Attachment 1.1 Non-Technical Summary

2019/2020

Integrated Resource Plan

VECTREN

A CenterPoint Energy Company

Non-Technical Summary

I. Introduction

Southern Indiana Gas and Electric Company d/b/a Vectren a CenterPoint Energy Company's ("Vectren") 2019/2020 Integrated Resource Plan is submitted in accordance with the requirements of the Indiana Utility Regulatory Commission (IURC or Commission) and the guidance provided in the Commission's recent orders related to the preferred portfolio described in Vectren's previous 2016 Integrated Resource Plan ("IRP"). The preferred portfolio in Vectren's previous 2016 IRP contemplated replacement of some of Vectren's coal fleet by the end of 2023 with a mix of renewable, energy efficiency and gas resources while retaining other coal resources. To implement this plan, Vectren filed two cases seeking Certificates of Public Convenience and Necessity ("CPCN") to (1) own and operate a 50 MW solar project located on its system (the "Troy Solar Project"), (2) install equipment designed to achieve compliance with environmental regulations in order to continue operation of its 270 MW Culley Unit 3 beyond 2023 and construct a 700-850 MW Combined Cycle Gas Turbine ("CCGT"). The Commission approved issuance of CPCNs authorizing the construction of the Troy Solar Project and Culley Unit 3 compliance projects. The Commission order denying a CPCN for the 700-850 MW CCGT urged Vectren to:

- Focus on outcomes that reasonably minimize the potential risk of an asset becoming uneconomic in an environment of rapid technological innovation;
- Fully consider options that provide a bridge to the future;
- Utilize a request for proposals ("RFP") to determine the price and availability of renewables; and
- Consider resource diversity and alternatives that provide off ramps that would allow Vectren to react to changing circumstances.

Vectren began its 2019/2020 IRP process in April 2019 with the objective of engaging in a generation planning process responsive to the Commission's guidance and seeking input from a variety of stakeholders. As part of its 2019/2020 IRP process, Vectren's evaluation has focused on exploring all new and existing supply-side and demand side resource options to reliably serve Vectren customers over the next 20 years. While the fundamentals of integrated resource planning were adhered to in developing the 2016 IRP, Vectren has enhanced its process and analysis in several ways. These enhancements include, but are not limited to the following:

- Issuance of an All-Source RFP to provide current market project pricing to be utilized in IRP modeling and potential projects to pursue, particularly for renewable resources such as wind and solar;
- An exhaustive review of reasonable options that leverage existing coal resources;
- increased participation and collaboration from stakeholders on all aspects of the analysis, inputs and resource evaluation criteria, with specific considerations and responses from Vectren;
- An encompassing analysis of wholesale market dynamics that accounts for MISO developments and market trends;
- The use of a more sophisticated IRP modeling tool, Aurora, which provided several benefits (simultaneous evaluation of many resources, evaluation of portfolios on an hourly basis and consistency in modeling, including least cost long-term capacity expansion planning optimization, simulated dispatch of resources and probabilistic modeling); and
- A more robust risk analysis, which encompasses a broad consideration of risks and an exploration of resource performance over a wide range of potential futures.

Based on this planning process and detailed analysis, Vectren has selected a preferred portfolio plan that significantly yet prudently diversifies the resource mix for its generation portfolio with the addition of significant solar and wind energy resources, the retirement or exit of four coal units, and continued investment in energy efficiency. These resources are complemented with dispatchable resources including continued operation of Culley Unit 3 and the addition of two flexible natural gas Combustion Turbines (CTs). The gas units represent a much smaller portion of Vectren's generation portfolio as compared to the 2016 IRP preferred portfolio while still providing reliable capacity and energy. The highly dispatchable and fast-ramping gas units are an important match with the significant renewable investment, enabling Vectren to maintain constant electric supply during potentially extended periods of low output from renewable energy sources. The units ramp quickly and provide load following capability, complimenting renewable energy production, which is expected to grow throughout the MISO footprint. Vectren's preferred portfolio reduces its cost of providing service to customers over the next 20 years by more than $320 million as compared to continuing with its existing generation fleet. Additionally, the preferred portfolio reduces carbon dioxide output by approximately 67% by 2025 and 75% by 2035 when compared to 2005 levels, which helps Vectren's parent company, CenterPoint Energy, achieve its commitments to environmental stewardship and sustainability, while meeting customer expectations for clean energy that is reliable and affordable.

Vectren's preferred resource plan reduces risk through diversification, reduces the cost to serve load over the next 20 years and provides the flexibility to continue to evaluate and respond to future needs through subsequent IRPs. The preferred portfolio has several advantages: including: 1) Energy supplied by this portfolio is generated primarily through a significant amount of near-term renewable solar and wind projects that take advantage of the Investment Tax Credit and the Production Tax Credit. This lowers portfolio costs and takes advantage of current tax-advantaged assets. 2) Two new, low-cost gas combustion turbines, continued use of Vectren's most efficient coal unit (Culley 3) and new battery storage resources, provide resilient, dispatchable power to Vectren's system that is complementary to significant investment in new intermittent renewable resources. This is very important, as coal plants, which have provided these attributes in the past, continue to retire in MISO Zone 6. 3) The portfolio provides flexibility to adapt to and perform well under a wide range of potential future legislative, regulatory, and market conditions. The preferred portfolio performed well under CO_2, methane constraints, and other related regulations such as a fracking ban. The cost position of this portfolio that is backed up by the two combustion turbine capacity resources does not change because the gas turbines predominantly run during peak load conditions. This provides a financial hedge against periodic instances of high market energy and capacity prices, while also providing reactive reserves and system reliability in times of extended renewable generation droughts, i.e., cloud cover and low wind. 4) It reasonably balances energy sales against purchases to remain poised to adapt to market shifts. 5) It includes new solar capacity when it is most economic to the portfolio. 6) Finally, it is timely. New combustion turbines can come online quickly to replace coal generation that retires by the end of 2023, minimizing in-service lag and reducing exposure to the market.

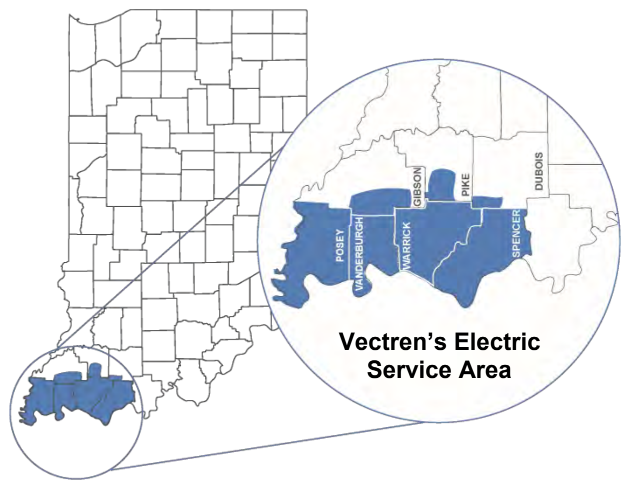
The resource options selected in this plan provide a bridge to the future. For example, CT's allow time for battery storage technology to continue to become more competitive in price and further develop longer duration storage capabilities. Further, should there be a need for new baseload generation in the future to accommodate a large load addition or to replace Warrick 4 and Culley 3, one or both CT's could be converted to a CCGT, a highly efficient gas energy resource. Even with the large commitment in the near term to renewable resources, additional renewable resources can be added over time.

The preferred portfolio also provides several off-ramps (future transitional inflection points) should they be needed. 1) Vectren continues to speak with Alcoa about a possible extension of Warrick 4 (W4) joint operations through 2026. This option could provide additional time and shield Vectren customers from capacity purchases at a time where the market is expected to be tight, causing much higher projected prices than today. Additionally, time may be needed to allow Vectren to secure the level of renewable resources identified in the preferred portfolio and to allow for contingency for permitting and construction of new combustion turbines. 2) While Culley 3 is not scheduled to be retired within the timeframe of this analysis, including thermal dispatchable generation in this portfolio will allow Vectren flexibility to evaluate this option in future IRPs. 3) Vectren will work to secure attractive renewables projects from the recent All-Source RFP but will likely require a second RFP to fully secure 700-1,000 MWs of solar on multiple sites and 300 MWs of wind constructed over a span of several years. Issuing a second RFP provides two main benefits. It allows more local renewable options to select from, as some offered proposals are no longer available. Second, it provides additional time to better understand how MISO intends to move forward with market adjustments, such as capacity accreditation and energy price formation. MISO's wholesale market is adapting to fleet transition that is moving toward intermittent renewable resources.

What follows is a summary of Vectren's process to identify this portfolio, focusing on Vectren's operations, an explanation of the planning process and a summary of the preferred portfolio.

II. Vectren Overview

Vectren provides energy delivery services to more than 146,000 electric customers located near Evansville in Southwestern Indiana. In 2018, approximately 44% of electric sales were made to large (primarily industrial) customers, 30% were made to residential customers and 26% were made to small commercial customers.



The table below shows Vectren generating units. Since the last IRP, Vectren has formally retired four, older small natural gas units[1] rather than investing significant capital dollars to ensure safety and reliability. Note that Vectren also offers customers energy efficiency programs to help lower customer energy usage and bills.

Unit	Installed Capacity ICAP (MW)	Primary Fuel	Year in Service	Unit Age	Coal Unit Environmental Controls[2]
A.B. Brown 1	245	Coal	1979	41	Yes
A.B. Brown 2	245	Coal	1986	34	Yes
F.B. Culley 2	90	Coal	1966	54	Yes
F.B. Culley 3	270	Coal	1973	47	Yes

[1] In 2018, Vectren retired BAGS 1 (50 MW). In 2019, Vectren retired Northeast 1&2 (20 MW) and BAGS2 (65 MW)

[2] All coal units are controlled for Sulfur Dioxide (SO_2), Nitrogen Oxide (NO_X), Particulate Matter (dust), and Mercury. All coal units are controlled for Sulfur Trioxide (SO_3) and Sulfuric Acid (H2S0$_4$) except F.B. Culley 2.

Unit	Installed Capacity ICAP (MW)	Primary Fuel	Year in Service	Unit Age	Coal Unit Environmental Controls[2]
Warrick 4	150	Coal	1970	50	Yes
A.B. Brown 3	80	Gas	1991	29	
A.B. Brown 4	80	Gas	2002	18	
Blackfoot[3]	3	Landfill Gas	2009	11	
Fowler Ridge	50	Wind PPA	2010	10	
Benton County	30	Wind PPA	2007	13	
Oak Hill[4]	2	Solar	2018	<2	
Volkman Rd[5]	2	Solar	2018	<2	
Troy	50	Solar	2021		

III. Integrated Resource Plan

Every three years Vectren submits an IRP to the IURC as required by IURC rules. The IRP describes the analysis process used to evaluate the best mix of generation and energy efficiency resources (resource portfolio) to meet customers' needs for reliable, low cost, environmentally sustainable power over the next 20 years. The IRP can be thought of as a compass setting the direction for future generation and energy efficiency options. Future analysis, filings and subsequent approvals from the IURC are needed to implement selection of new resources.

Vectren utilized direct feedback on analysis methodology, analysis inputs, and evaluation criteria from stakeholders, including but not limited to Vectren residential, commercial and industrial customers, regulators, elected officials, customer advocacy groups and environmental advocacy groups. Vectren continues to place an emphasis on reliability, customer cost, risk, resource diversity, and sustainability. The IRP process has become increasingly complex in nature as renewable resources have become more cost competitive, battery energy storage has become more viable, and existing coal resources are dispatched less and less.

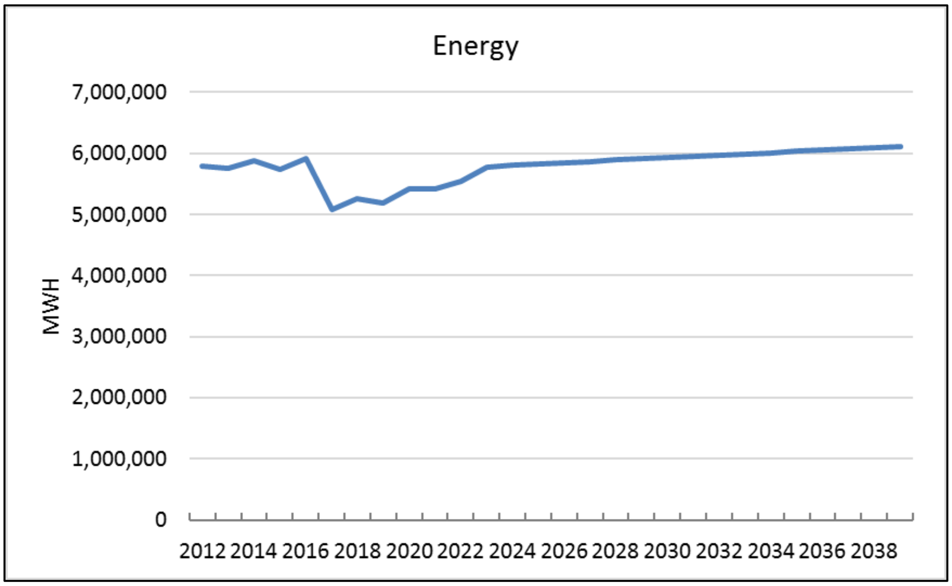
[3] The Blackfoot landfill gas generators are connected at the distribution level.
[4] Oak Hill Solar is connected at the distribution level.
[5] Volkman Rd. Solar is connected at the distribution level.

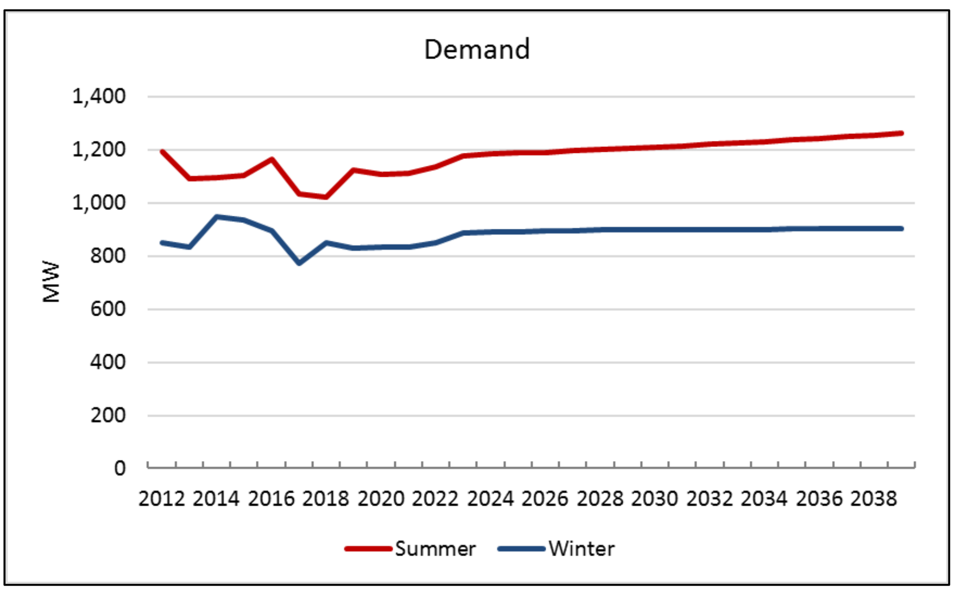
A. Customer Energy Needs

The IRP begins by evaluating customers' need for electricity over the 20-year planning horizon. Vectren worked with Itron, Inc., a leader in the energy forecasting industry, to develop a forecast of customer energy and demand requirements. Demand is the amount of power being consumed by customers at a given point in time, while energy is the amount of power being consumed over time. Energy is typically measured in Megawatt hours (MWh) and demand is typically measured in Megawatts (MW). Both are important considerations in the IRP. While Vectren purchases some power from the market, Vectren is required to have enough generation and energy efficiency resources available to meet expected customers' annual peak demand plus additional reserve resources to meet MISO's Planning Reserve Margin Requirement (PRMR) for reliability. Reserve resources are necessary to minimize the chance of rolling black outs; moreover, as a MISO (Midcontinent Independent System Operator) member, Vectren must comply with MISO's evolving rules to maintain reliability.

Historically, IRPs have focused on meeting customer demand in the summer, which is typically when reserve margins are at a minimum. As the regional resource mix changes towards intermittent (variable) renewable generation, it is important to ensure that resources are available to meet this demand in all hours of the year, particularly in the times of greatest need (summer and winter). MISO functions as the regional transmission operator for 15 Midwestern and Southern states, including Indiana (also parts of Canada). In recognition of MISO's ongoing evaluation of how changes in the future resource mix impact seasonal reliability, Vectren ensured that its preferred portfolio would have adequate reserve margins for meeting both the winter and summer peak demand. Later in this document it is further explained how MISO is evaluating measures to help ensure year-round reliability.

Vectren utilizes sophisticated models to help determine energy needs for residential, commercial and large customers. These models include projections for the major drivers of energy consumption, including but not limited to, the economy, appliance efficiency trends, population growth, price of electricity, weather, specific changes in existing large customer demand and customer adoption of solar and electric vehicles. Overall, customer energy and summer demand are expected to grow by 0.6% per year. Winter demand grows at a slightly slower pace of 0.5%.





B. Resource Options

The next step in an IRP is identifying resource options to satisfy customers' anticipated need. Many resources were evaluated to meet customer energy needs over the next 20 years. Vectren considered both new and existing resource options. Burns and McDonnell, a well-respected engineering firm, conducted an All-Source RFP which generated 110 unique proposals to provide energy and capacity from a wide range of technologies, including: solar, solar + short duration battery storage, standalone short duration battery storage, demand response, wind, gas and coal. These project bids provided up-to-date market-based information to inform the analysis and provide actionable projects to pursue to meet customer needs in the near to midterm. Additionally, Vectren utilized other information sources for long term costs and operating characteristics for these resources and others over the entire 20-year period. Other options include continuation of existing coal units, conversion of coal units to natural gas, various natural gas resources, hydro, landfill gas, and long-duration batteries, as well as partnering with other load-serving entities. Every IRP is a snapshot in time producing a direction based on the best information known at the time. It is helpful to provide some background into significant issues that help shape the IRP analysis, including but not limited to: projected low stable gas prices, low cost and projected high penetration of intermittent renewable resources, future of coal resources, new technology and projected changes in the MISO market to adapt and help ensure reliability.

Energy Efficiency/Demand Response

Natural Gas

Coal

Renewables, Wind & Solar

Battery Storage

i. Industry Transition

The cost of fuel used by generation facilities to produce electricity is also accounted for in evaluating the cost of various electric supply alternatives. Gas prices are near record low levels and are projected to remain stable over the long term. Shale gas has revolutionized the industry, driving these low gas prices and has fueled a surge in low-cost gas generation around the country. Vectren's IRP reflects the benefit low gas prices provide to the market, as gas units are on the margin and typically set market prices for energy.

Within the MISO footprint, energy from gas generation has increased from less than 10% of total electric generation, used primarily to meet the needs during peak demand conditions in 2005, to approximately 26% of total generation in 2018[6]. Meanwhile, the cost of renewable energy has declined dramatically over this time period due to improvements in technology and helped by government incentives in the forms of the Production Tax Credit for wind and the Investment Tax Credit (ITC) for solar, both of which are set to expire or ratchet down significantly over the next few years.

MISO Energy Mix Transition (GWH) from 2005 to 2018 to 2030
(Based on Utility Announcements and State Integrated Resource Plans)*

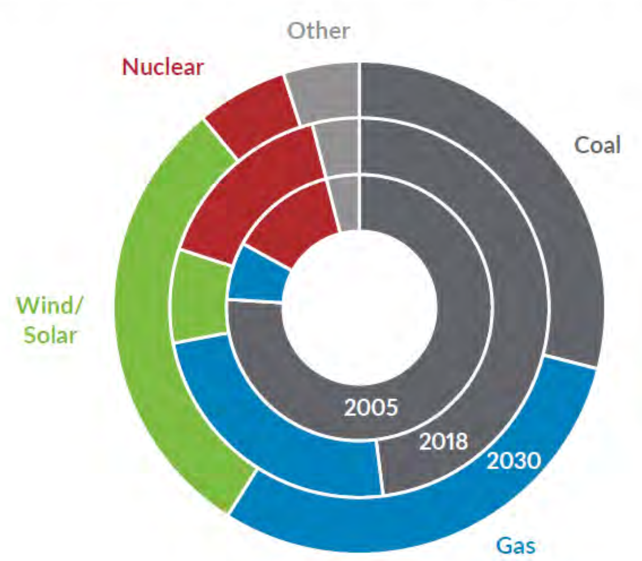


*Chart reflects ratios of generation.

The move toward low cost renewable and gas energy has come at the expense of coal generation, which has been rapidly retiring for several reasons. Coal plants have not been able to compete on price with low cost renewable and gas energy. Operationally, the move toward intermittent renewable energy requires coal plants to more frequently cycle on and off. These plants were not

[6] MISO Forward Report, March 2019, page 10. https://cdn.misoenergy.org/MISO%20FORWARD324749.pdf

designed to operate in this manner. The result is increased maintenance costs and more frequent outages. Additionally, older, inefficient coal plants are being retired to avoid spending significant dollars on necessary upgrades to achieve compliance with Environmental Protection Agency (EPA) regulations. Finally, public and investor pressure, coupled with future cost risk associated with the objective of decreasing carbon emissions, has driven unit retirements. Based on these and other major factors, MISO expects the generation mix in 2030 to be much more balanced than in the past with roughly one third renewables, one third gas and one third coal. Some large nuclear plants remain but have also found it challenging to compete on cost.

ii. Changing Market Rules to Help Ensure Reliability

MISO recognizes these major changes in the way energy is being produced. Traditionally, baseload coal plants produced energy at a constant level, while peaking gas plants were available to come online as needed to meet peak demand. Gradual increases and decreases in energy demand throughout the day and seasonally were easily managed with these traditional resources. As described above, the energy landscape is continuing its rapid change with increased adoption of more intermittent renewable generation which is available when the sun is shining, or the wind is blowing. This creates much more variability by hour in energy production. Some periods will have over production (more energy produced than is needed at the time) and other periods will have low to no renewable energy production, requiring dispatchable resources to meet real time demand for power. MISO is in the process of studying how this transition will affect the electrical grid and what is needed to maintain reliable service, as renewables penetrations reach 30-50%. Possible ramifications include challenges to the ability to maintain acceptable voltage and thermal limits on the grid.

To deal with these challenges, MISO has been working through a series of studies and has put forth guidance for how they intend to evaluate resources moving forward. One significant development is the recognition that all hours matter. In the past, MISO resource adequacy requirements focused on only the peak hour each year. Recent MISO emergencies in all seasons have demonstrated that the system can experience potential energy shortfalls in any hour due to changing resource conditions. As such, MISO is planning for new requirements to ensure resources are available for reliability in each of the 8,760 hours of the year. Each resource has different operating characteristics and different output levels, depending on the season. Vectren has accounted for these changes by validating that portfolios in this analysis provide sufficient resources to meets its MISO obligations[7] in the two heaviest demand periods (summer/winter). MISO has initiatives underway that include new testing requirements to ensure that Demand Response (DR) resources are available when needed. MISO's annual Market Road Map process has prioritized the development of mechanisms to more accurately account for resource availability. This includes an evaluation of how to best incent resources with the right kinds of critical attributes needed to keep the system operating reliably. Incentives are contemplated for resources that are available (dispatchable), flexible (ability to start quickly and meet changing load conditions when needed) and visible (have a better understanding of customer owned generation in addition to larger utility assets). MISO expects that traditional dispatchable coal and gas resources will continue to provide resilience to the grid.

iii. Battery Storage and Transmission Resources

Increasingly, utilities are considering the opportunity to add battery storage to resource portfolios to help provide the availability, flexibility and visibility needed to move to more reliance on intermittent renewable resources. Lithium-ion batteries have seen significant cost declines over the last several years as the technology begins to mature and as the auto industry creates economies of scale by increasing production to meet the anticipated demand for electric vehicles. Large scale batteries for utility applications have begun to emerge around the country, particularly where incentives

[7] Some portfolios have a heavy reliance on the market for both energy and capacity.

are available to lower the cost of this emerging technology or for special applications that improve the economics.

There are many applications for this resource, from shifting the use of renewable generation from time of generation to the time of need, to grid support for maintaining the reliability of the transmission system. Vectren has installed a 1 MW battery designed to capture energy from an adjacent solar project. This test project is providing information regarding the ability to store energy for use during the evening hours to meet customer energy demand. Along with the benefits provided by this technology, there are some limitations to keep in mind as utility scale battery storage is still evolving. Currently, commercially feasible batteries are short duration, typically four hours. There are some commercially available longer-duration batteries that show promise, but these are still very expensive. Additionally, safety standards are being developed and fire departments are being trained for the fire risk posed by L-ion batteries. Other chemistries are being developed to account for this issue but are not commercially imminent. Moreover, batteries today are a net energy draw on the system. They can produce about 90-95 percent of the energy that is stored in them. Part of this loss is due to the need to be well ventilated, cool and dry, which takes energy. Batteries are promising and have their place in current energy infrastructure, but they do not yet replace the need for other forms of dispatchable generation during extended periods without sun and wind. Vectren's All-Source RFP included bids for stand-alone batteries and batteries connected to solar resources.

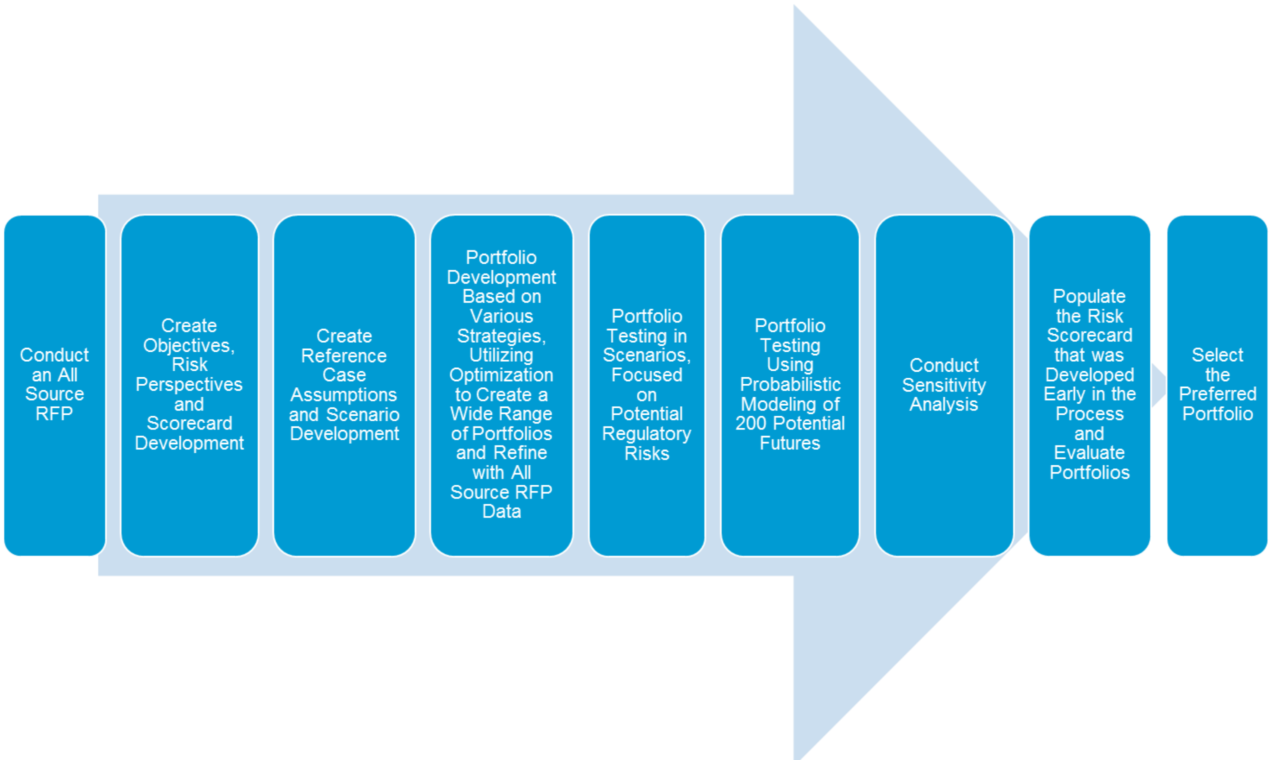
C. Uncertainty/Risk

The future is far from certain. Uncertainty creates a risk that a generation portfolio that is reasonable under an anticipated future fails to perform as expected if the future turns out differently. Vectren's IRP analysis was developed to identify the best resource mix of generation and energy efficiency to serve customer energy needs over a wide range of possible future states. Vectren performed two sets of risk analyses, one exposing a defined set of portfolios to a limited number of scenarios and another that exposed the same portfolios to 200 scenarios (stochastic or probabilistic risk assessment). To help better understand the wide range of possibilities for wholesale market dynamics, regulations, technological breakthroughs and shifts in the economy, complex models were utilized with varying assumptions for major inputs (commodity price forecasts, energy/demand forecasts, market power prices, etc.) to develop and test portfolios with diverse resource mixes.

IV. Analysis

Vectren's analysis included a step-by-step process to identify the preferred portfolio. The graphic below summarizes the major steps which included the following:

1. Conduct an All-Source RFP to better understand resource cost and availability.
2. Work with stakeholders to develop a scorecard as a tool in the full risk analysis to help highlight several tradeoffs among various portfolios of resources.
3. Work with stakeholders to develop a wide range of future states, called scenarios, to be used for testing of portfolios (mixes of various resource combinations to serve customer power and energy need).
4. Work with stakeholders to develop a wide range of portfolios for testing and evaluation within scenarios, sensitivity analysis and probabilistic analysis. Each of these analyses involves complex modeling.
5. Utilize the quantitative scorecard measures and judgement to select the preferred portfolio (the best mix of resources to reliably and affordably serve customer energy needs while minimizing known risks and maintaining flexibility).



V. Stakeholder Process

Vectren reevaluated how to conduct the stakeholder process based on comments in the Director's report, stakeholder feedback and the Commission order in Cause number 45052. Careful consideration was taken to ensure that the time spent was mutually beneficial.

Each of the first three stakeholder meetings began with stakeholder feedback. Vectren would review requests since the last stakeholder meeting and provide feedback. Suggestions were taken and in instances where suggestions were not acted upon, Vectren made a point to further discuss and explain why not. Per stakeholder feedback, notes for each meeting were included in question and answer format, summarizing the conversations. Additionally, feedback was received, and questions were answered via e-mail (irp@centerpointenergy.com) and with phone calls/meetings in between each session per request.

Three of four public stakeholder meetings were held at Vectren in Evansville, IN. The final stakeholder meeting on June 15, 2020 was held via webinar due to the COVID-19 situation. Dates and topics covered are listed below:

August 15, 2019

- 2019/2020 IRP Process
- Objectives and Measures
- All-Source RFP
- Environmental Update
- Draft Reference Case Market Inputs & Scenarios

October 10, 2019

- RFP Update
- Draft Resource Costs
- Sales and Demand Forecast
- DSM MPS/ Modeling Inputs
- Scenario Modeling Inputs
- Portfolio Development

December 13, 2019

- Draft Portfolios
- Draft Reference Case Modeling Results
- All-Source RFP Results and Final Modeling Inputs
- Scenario Testing and Probabilistic Modeling Approach and Assumptions

June 15, 2020*

- Final Reference Case and Scenario Modeling Results
- Probabilistic Modeling Results
- Risk Analysis Results
- Preview the Preferred Portfolio

- Moved final stakeholder meeting date per stakeholder request and the COVID-19 situation

Based on this stakeholder engagement, Vectren made fundamental changes to the analysis in real time to address concerns and strengthen the plan. IRP inputs and several of the evaluation measures used to help determine the preferred portfolio were updated through this process. Vectren utilized stakeholder information to create boundary conditions that were wide enough to produce plausible future conditions that would favor opposing resource portfolios (i.e. Indiana Coal Council (ICC) request to continue coal through 2029 or 2039 and environmental stakeholders' request to utilize all renewable resources by 2030). For example, the low regulatory future includes declining coal prices and higher gas prices, which was a request from the ICC. The High Regulatory scenario, which was heavily influenced by environmental stakeholders, is the other plausible future bookend with a natural gas fracking ban (sustained high price), a social cost of carbon fee starting at $50 per ton in 2022 and lower renewables cost trajectory than what is expected. Additionally, an evaluation measure was adjusted based on direct stakeholder input. Vectren included the life cycle of carbon emissions for all resources in response to the ICC and environmental stakeholders. The table below shows key stakeholder requests made during the process and Vectren's response.

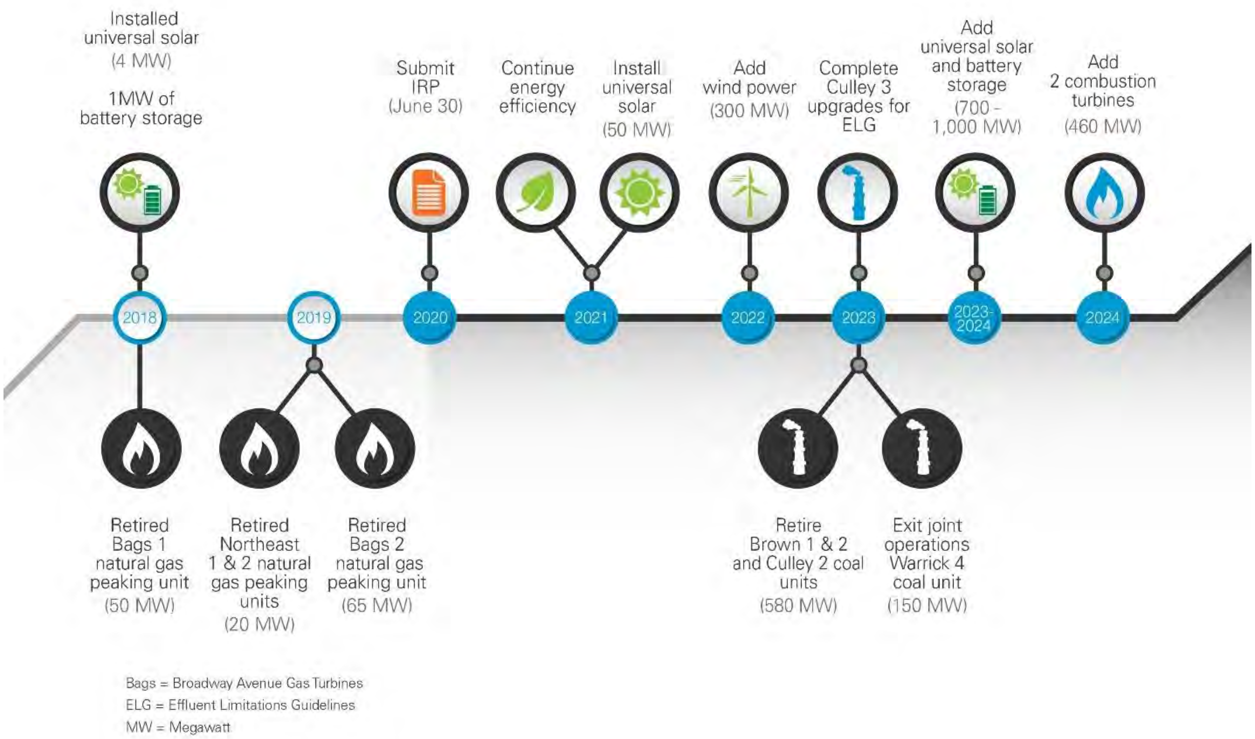
Request	Response
Update the High Regulatory scenario to include a carbon fee and dividend	Included a fee and dividend construct which assumed a balanced impact on the load (the economic drag from a carbon fee is neutralized by the economic stimulus of a dividend)
Lower renewables costs in the High Regulatory and 80% CO_2 Reduction scenarios	Updated scenario to include lower costs for renewables and storage than the Reference scenario
Consider life cycle emissions using CO_2 equivalent	Included a quantitative measure on the risk scorecard based on National Renewable Energy Lab (NREL) Life Cycle Greenhouse Gas Emissions (CO_2e) from Electricity Generation by Resource
Include a measure within the risk score card that considers the risk that assets become uneconomic	Included an uneconomic asset risk as a consideration in the overall evaluation. Not included in the scorecard.
Include a scenario with a carbon dividend modeled after HB 763 with a CO_2 price that was approximately $200 by the end of the forecast	Utilized a scenario with these prices to create an additional portfolio. Ultimately, this portfolio was not selected for the risk analysis, as the amount of generation built

Request	Response
	within modeling vastly exceeded Vectren's need and resulted in large energy sales
Reconsider the use of a seasonal construct for MISO resource accreditation	Reviewed calculation for solar accreditation in winter and utilized an alternate methodology, increasing accreditation in the winter
Include a CO_2 price in the reference case	Included mid-range CO_2 prices 8 years into the forecast. The Low Regulatory scenario did not include a CO_2 price, thus becoming a boundary condition

Meeting materials of each meeting can be found on www.vectren.com/irp and in Technical Appendix Attachment 3.1 Stakeholder Materials.

VI. The Preferred Portfolio

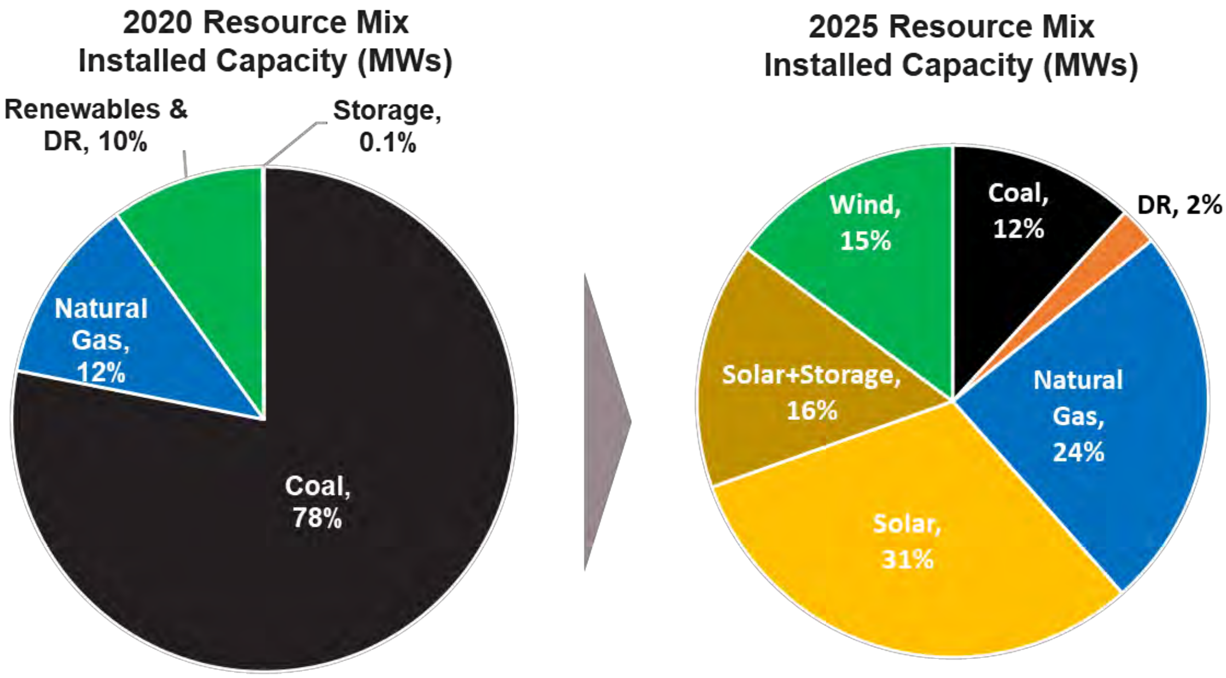
The Preferred Portfolio recommendation is to retire or exit 730 MWs of coal generation and replace with 700-1,000 MWs of solar generation (some connected to battery storage), add 300 MWs of wind backed by dispatchable generation that consists of 2 new Combustion Turbine (CT) gas units and maintaining Culley 3 (coal unit).



This preferred portfolio:

- Allows customers to enjoy the benefits of low-cost renewable energy, while ensuring continued reliable service as Vectren moves toward higher levels of intermittent renewable energy in the future.
- Saves customers over $320 million over the next 20 years when compared to continued operation of Vectren's coal fleet. The preferred portfolio is a low-cost portfolio in the near, mid and long term.
- Reduces lifecycle greenhouse gas emissions, which includes methane, by nearly 60% over the next 20 years. Direct carbon emissions are reduced 75% from 2005 levels by 2035.

- Includes a diverse mix of resources (renewables, gas and coal), mitigates the impacts of extended periods of limited renewable generation and protects against overreliance on the market for energy and capacity.
- Maintains future flexibility with several off ramps to accommodate a rapidly evolving industry, includes a multi-year build out of resources on several sites and maintains the option to extend the contract with Alcoa for Warrick 4 for a few years and maintains the option to consider the replacement of Culley 3 in the future when appropriate based on continual evaluation of changing conditions. These options will be revaluated in future IRPs.
- Provides the flexibility to adapt to future environmental regulations or upward shifts in fuel prices relative to Reference Case assumptions. The preferred portfolio performed consistently well across a wide range of potential future environmental regulations, including CO_2, methane and fracking.
- Adds some battery energy storage in the near term, paired with solar resources to provide clean renewable energy when solar is not available. Provides time for technological advances that will allow for high penetration of renewables across the system, further cost declines and further Vectren operational experience to meet Vectren's customers' energy needs.
- Continues Vectren's energy efficiency programs with near term energy savings of 1.25% of eligible sales and further long-term energy savings opportunities identified over the next 20 years. Vectren is committed to Energy Efficiency to help customers save money on their energy bills and will continue to evaluate this option in future IRPs.



VII. Next Steps

The preferred portfolio calls for Vectren to make changes to its generation fleet. Some of these changes require action in the near term. First, Vectren will finalize the selection process to secure renewable projects from the All-Source RFP and seek approval from the IURC for attractive projects. Second, the IRP calls for continuation of energy efficiency. Vectren filed a 2021-2023 plan with the IURC in June of 2020, consistent with the IRP. Third, Vectren intends to pursue two natural gas combustion turbines to provide dispatchable support to the large renewables based preferred portfolio. These filings will be consistent with the preferred portfolio. However, the assumptions included in any IRP can change over time, causing possible changes to resource planning. Changes in commodities, regulations, political policies, customer need and other assumptions could warrant deviations from the preferred plan.

Vectren's plan must be flexible; as several items are not certain at this time.

- The timing of exiting joint operations of the Warrick 4 coal plant could change. The plant is jointly owned with Alcoa. Without incremental investment, the plant does not comply with the ELG and other water discharge control requirements. Vectren therefore continues to talk to Alcoa about its plans.

- The availability of attractive renewable projects is currently being evaluated. Negotiations for resources must take place to finalize availability and cost of projects. The Coronavirus has put pressure on supply chains and put in jeopardy the ability of full utilization of the Production Tax Credit and Investment Tax Credit for some projects. Competition for these projects is steep, with multiple, on-going RFP processes in the state of Indiana.
- Finally, MISO continues to evaluate the accreditation of resources. Vectren will continue to follow developments to determine the right amount of renewable resources to pursue in the near term.

Attachment 1.2 Vectren Technology Assessment Summary Table

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
SIMPLE CYCLE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	**1x Aeroderivative SCGT - Natural Gas**		**1x Aeroderivative SCGT - Natural Gas**		**1x E Class Frame SCGT - Natural Gas**		**1x F Class Frame SCGT - Natural Gas**		**1x G/H Class Frame SCGT - Natural Gas**	
BASE PLANT DESCRIPTION	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit
Number of Gas Turbines/Engines/Units	1	1	1	1	1	1	1	1	1	1
Representative Class Gas Turbine	GE LM6000 PF		LMS100 PB		GE 7E.03		GE 7F.05		GE HA.01	
Capacity Factor, %	Peaking (10%)		Peaking (10%)		Peaking (10%)		Peaking (10%)		Peaking (10%)	
Startup Time to Base Load, min (Notes 1, 2)	5		10		10 fast start / 30 conventional		10 fast start / 30 conventional		10 fast start / 30 conventional	
Startup Time to MECL, min (Note 3)	4		8		8 fast start / 24 conventional		8 fast start / 24 conventional		8 fast start / 24 conventional	
Cold Startup Time to SCR Compliance, min (Note 3)	N/A		N/A		N/A		N/A		45	
Maximum Ramp Rate, MW/min (Online)	10		32		10		40		30	
Book Life, Years	30		30		30		30		30	
Equivalent Planned Outage Rate, % (Note 4, 15)	22.3%		22.3%		26.8%		26.8%		26.8%	
Equivalent Forced Outage Rate, % (Notes 4, 15)	25.9%		25.9%		5.8%		5.8%		5.8%	
Equivalent Availability Factor, % (Notes 4, 15)	90.6%		90.6%		93.8%		93.8%		93.8%	
Assumed Land Use, Acres	30	15	30	15	30	15	30	15	30	15
Fuel Design	Natural Gas Only		Natural Gas Only		Natural Gas Only		Natural Gas Only		Natural Gas Only	
Heat Rejection	Fin Fan Heat Exchanger		Fin Fan Heat Exchanger		Fin Fan Heat Exchanger		Fin Fan Heat Exchanger		Fin Fan Heat Exchanger	
NO_x Control	Dry Low NOx		Dry Low NOx		Dry Low NOx		Dry Low NOx		Dry Low NOx / SCR	
CO Control	Good Combustion Practice		Good Combustion Practice		Good Combustion Practice		Good Combustion Practice		CO Catalyst	
Particulate Control	Good Combustion Practice		Good Combustion Practice		Good Combustion Practice		Good Combustion Practice		Good Combustion Practice	
Technology Rating	Mature		Mature		Mature		Mature		Mature	
Permitting & Construction Schedule (Years from FNTP)	3		3		3		3		3	
ESTIMATED PERFORMANCE (All BASED ON NATURAL GAS OPERATION)										
Nominal Base Load Performance @59° F (ISO Conditions)										
Net Plant Output, kW	41,580	41,580	97,222	97,222	84,721	84,721	236,635	236,635	279,319	279,319
Net Plant Heat Rate, Btu/kWh (HHV)	9,280	9,280	8,895	8,895	11,527	11,527	9,928	9,928	9,311	9,311
Heat Input, MMBtu/h (HHV)	386	386	865	865	977	977	2,349	2,349	2,601	2,601
Nominal Min Load @ 59° F (ISO Conditions)										
Net Plant Output, kW	20,790	20,790	48,611	48,611	42,361	42,361	96,448	96,448	83,197	83,197
Net Plant Heat Rate, Btu/kWh (HHV)	12,170	12,170	10,431	10,431	15,158	15,158	13,240	13,240	13,527	13,527
Heat Input, MMBtu/h (HHV)	253	253	507	507	642	642	1,277	1,277	1,125	1,125
Base Load Performance @ 20° F (Winter Design)										
Net Plant Output, kW	48,100	48,100	98,709	98,709	95,908	95,908	234,585	234,585	287,269	287,269
Net Plant Heat Rate, Btu/kWh (HHV)	9,050	9,050	8,840	8,840	11,254	11,254	9,813	9,813	9,226	9,226
Heat Input, MMBtu/h (HHV)	435	435	873	873	1,079	1,079	2,302	2,302	2,650	2,650
Min Load Operational Status @ 20° F (Winter Design)										
Net Plant Output, kW	24,050	24,050	49,354	49,354	47,954	47,954	100,440	100,440	85,521	85,521
Net Plant Heat Rate, Btu/kWh (HHV)	11,650	11,650	10,407	10,407	14,608	14,608	13,240	13,240	13,653	13,653
Heat Input, MMBtu/h (HHV)	280	280	514	514	701	701	1,330	1,330	1,168	1,168
Base Load Performance @ 90° F (Summer Design)										
Net Plant Output, kW	32,610	32,610	86,225	86,225	75,072	75,072	216,502	216,502	256,829	256,829
Net Plant Heat Rate, Btu/kWh (HHV)	9,790	9,790	9,198	9,198	11,906	11,906	10,086	10,086	9,476	9,476
Heat Input, MMBtu/h (HHV)	319	319	793	793	894	894	2,184	2,184	2,434	2,434
Min Load Operational Status @ 90° F (Summer Design)										
Net Plant Output, kW	16,300	16,300	43,113	43,113	37,536	37,536	90,576	90,576	84,246	84,246
Net Plant Heat Rate, Btu/kWh (HHV)	13,830	13,830	11,040	11,040	15,866	15,866	13,645	13,645	13,327	13,327
Heat Input, MMBtu/h (HHV)	226	226	476	476	596	596	1,236	1,236	1,123	1,123

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
SIMPLE CYCLE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	1x Aeroderivative SCGT - Natural Gas		1x Aeroderivative SCGT - Natural Gas		1x E Class Frame SCGT - Natural Gas		1x F Class Frame SCGT - Natural Gas		1x G/H Class Frame SCGT - Natural Gas	
BASE PLANT DESCRIPTION	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit
ESTIMATED CAPITAL AND O&M COSTS										
EPC Project Capital Costs, 2019 MM$ (w/o Owner's Costs)	**$65**	**$46**	**$123**	**$86**	**$85**	**$60**	**$125**	**$93**	**$168**	**$134**
Owner's Costs, 2019 MM$	**$27**	**$13**	**$38**	**$20**	**$40**	**$21**	**$48**	**$27**	**$57**	**$36**
Owner's Project Development	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0
Owner's Operational Personnel Prior to COD	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0
Owner's Engineer	$0.8	$0.0	$0.8	$0.0	$0.8	$0.0	$0.8	$0.0	$0.8	$0.1
Owner's Project Management	$1.0	$0.0	$1.0	$0.0	$1.0	$0.0	$1.0	$0.0	$1.0	$0.2
Owner's Legal Costs	$0.5	$0.0	$0.5	$0.0	$0.5	$0.0	$0.5	$0.0	$0.5	$0.0
Owner's Start-up Engineering and Commissioning	$1.2	$0.6	$1.2	$0.6	$1.5	$0.8	$1.5	$0.8	$1.6	$0.8
Land	$0.2	$0.1	$0.2	$0.1	$0.2	$0.1	$0.2	$0.1	$0.2	$0.1
Construction Power and Water	$0.5	$0.1	$0.5	$0.1	$0.5	$0.1	$0.5	$0.1	$0.5	$0.1
Permitting and Licensing Fees	$0.5	$0.0	$0.5	$0.0	$0.5	$0.0	$0.5	$0.0	$0.5	$0.1
Switchyard	$5.3	$1.8	$5.3	$1.8	$5.3	$1.8	$5.3	$1.8	$5.2	$1.7
Political Concessions & Area Development Fees	$0.5	$0.0	$0.5	$0.0	$0.5	$0.0	$0.5	$0.0	$0.5	$0.0
Startup/Testing (Fuel & Consumables)	$0.5	$0.4	$0.5	$0.4	$2.0	$1.8	$2.0	$1.8	$2.3	$2.0
Initial Fuel Inventory	$0.6	$0.6	$0.6	$0.6	$3.1	$3.1	$3.1	$3.1	$3.6	$3.6
Site Security	$0.4	$0.0	$0.4	$0.0	$0.4	$0.0	$0.4	$0.0	$0.4	$0.0
Operating Spare Parts	$1.8	$0.5	$1.8	$0.5	$5.5	$1.4	$5.5	$1.4	$6.0	$1.5
Water Supply Infrastructure	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded
Natural Gas Supply Infrastructure	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded
Transmission Interconnect	$0.2	$0.2	$0.4	$0.4	$0.3	$0.3	$0.9	$0.9	$1.1	$1.1
Transmission Upgrade Costs	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded
Firm Gas Supply Reservation Charge	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner
Permanent Plant Equipment and Furnishings	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0	$0.3	$0.0
AFUDC (12.2% of EPC Project Capital Costs)	$7.9	$5.6	$15.0	$10.5	$10.3	$7.3	$15.3	$11.4	$20.5	$16.3
Builders Risk Insurance (0.45% of Construction Costs)	$0.3	$0.2	$0.6	$0.4	$0.4	$0.3	$0.6	$0.4	$0.8	$0.6
Owner's Contingency (5% for Screening Purposes)	$4.4	$2.8	$7.7	$5.1	$5.9	$3.8	$8.2	$5.7	$10.7	$8.1
Total Project Costs, 2019 MM$	**$93**	**$59**	**$161**	**$106**	**$124**	**$81**	**$173**	**$121**	**$225**	**$170**
EPC Cost Per kW, 2019 $/kW (Note 7)	**$1,570**	**$1,110**	**$1,270**	**$890**	**$1,000**	**$710**	**$530**	**$390**	**$600**	**$480**
Total Cost Per kW, 2019 $/kW (Note 7)	**$2,230**	**$1,420**	**$1,660**	**$1,090**	**$1,470**	**$950**	**$730**	**$510**	**$810**	**$610**
FIXED O&M COSTS (Note 8)										
Fixed O&M Cost - LABOR, 2019$MM/Yr	$0.8	$0.0	$0.9	$0.0	$0.9	$0.0	$0.9	$0.0	$0.8	$0.0
Fixed O&M Cost - OTHER, 2019$MM/Yr	$0.7	$0.3	$0.7	$0.3	$0.9	$0.5	$1.1	$0.4	$1.4	$0.4
LEVELIZED CAPITAL MAINTENANCE COSTS										
Major Maintenance Cost, 2019$/GT-hr or $/engine-hr (Notes 9, 10)	$190	$190	$190	$190	$370	$370	$350	$350	$600	$600
Major Maintenance Cost, 2019$/GT-start	N/A	N/A	N/A	N/A	$10,000	$10,000	$9,500	$9,500	$16,200	$16,200
Major Maintenance Cost, 2019$/MWh	$4.60	$4.60	$2.00	$2.00	$4.40	$4.40	$1.50	$1.50	$2.20	$2.20
Catalyst Replacement Cost, 2019$/MWh	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0.30	$0.30
NON-FUEL VARIABLE O&M COSTS (EXCLUDES MAJOR MAINTENANCE, Note 11)										
Total Variable O&M Cost, 2019$/MWh	$0.90	$0.90	$1.24	$1.24	$0.90	$0.90	$0.90	$0.90	$1.10	$1.10
Water Related O&M, $/MWh	$0.00	$0.00	$0.34	$0.34	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
SCR Reagent, $/MWh	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0.20	$0.20
Other Consumables and Variable O&M, $/MWh	$0.90	$0.90	$0.90	$0.90	$0.90	$0.90	$0.90	$0.90	$0.90	$0.90
ESTIMATED BASE LOAD OPERATING EMISSIONS: NATURAL GAS (See Note 13)										
Turbine Only (lb/MMBtu, HHV)										
NO_x	0.12	0.12	0.09	0.09	0.03	0.03	0.03	0.03	0.01	0.01
SO_2	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
CO	0.048	0.048	0.026	0.026	0.056	0.056	0.014	0.014	0.004	0.004
CO_2	120	120	120	120	120	120.00	120	120	120	120

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
SIMPLE CYCLE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
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PROJECT TYPE	1x Aeroderivative SCGT - Natural Gas		1x Aeroderivative SCGT - Natural Gas		1x E Class Frame SCGT - Natural Gas		1x F Class Frame SCGT - Natural Gas		1x G/H Class Frame SCGT - Natural Gas	
BASE PLANT DESCRIPTION	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit	First Unit	Next Unit

Notes

Note 1: Simple cycle GT starts are not affected by hot, warm or cold conditions. Simple cycle starts assume purge credits are available. Recip engine start times assume the engines are kept warm when not operational.
Note 2: Fast start package options allow 10 minute GT start.
Note 3: MECL start time assumes the min load at which the GT achieves the steady state NOx emissions ppm rate. The SCR compliance start time assumes a cold start, ending at the time when the catalysts are heated and the NOx levels meet the desired SCR emissions.
Note 4: Outage and availability statistics are collected using the NERC Generating Availability Data System. Simple cycle data is based on North American units that came online in 2006 or later. Reporting period is 2011-2016. Note that a unique gas reciprocating engine category does not exist in GADS. Diesel Engine data is used as a proxy.
Note 5: New and clean performance assumed for all scenarios. All performance ratings based on NATURAL GAS operation. Minimum loads are based on OEM information at requested ambient conditions.
Note 6: For the reciprocating engine option, it is assumed that six engines tie to one GSU.
Note 7: Capital and fixed O&M costs are presented in 2019 USD $MM.
Note 8: All Gas Turbine FOM costs assume 7 full time personnel for first unit. No additional personnel are included for the next unit(s). FOM costs do not include engine lease fees that may be available with LTSA, depending on OEM.
Note 9: Major maintenance $/hr holds for all aero gas turbines. Major maintenance $/hr holds for frame gas turbines where hours per start is >27.

Note 10: Recip engine FOM assumes 8 FTE for the first 200 MW plant. The NEXT plant adds 3 FTE. Major maintenance $/hr is per engine. LTSA costs are split in two categories: major overhauls and catalyst replacements are shown as capitalized maintenance, while scheduled minor maintenance supervision is shown in VOM.

Note 11: VOM assumes the use of temporarily trailers for demineralized water treatment, where applicable.
Note 12: This reflects startup when OEM fast start package is included. Fast start options are NOT reflected in base capital costs. Market trends suggest that O&M impacts from fast starts are negligible.
Note 13: Emissions estimates are shown for steady state operation at annual average conditions. Estimates account for the impacts of SCR and CO catalysts, as applicable.
Note 14: Performance ratings are based on elevation of 750 ft above msl.

Note 15: EFOR data from GADS may not accurately represent the benefits of a reciprocating plant, depending on how events are recorded. Typically, a maintenance event will not impact all engines simultaneously, so the plant would not be completely offline as it may be during an event at 1x gas turbine plant.

Note 16: Fuel Oil emissions based on ultra low sulfur diesel. Per the US EPA, this fuel must meet 15 ppm sulfur.
Note 17: Fuel oil performance conversion factors are included in a separate Fuel Oil Conversion tab in this workbook.
Note 18: Estimated Costs exclude decommissioning costs and salvage values.

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
RECIPROCATING ENGINE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
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PROJECT TYPE	Reciprocating Engine (9 MW Engines) Natural Gas		Reciprocating Engine (18 MW Engines) Natural Gas	
BASE PLANT DESCRIPTION	First Unit	Next Unit	First Unit	Next Unit
Number of Gas Turbines/Engines/Units	6	6	6	6
Representative Class Gas Turbine	Wartsila 20V34SG		Wartsila 18V50SG	
Capacity Factor, %	Peaking (10%)		Peaking (10%)	
Startup Time to Base Load, min (Notes 1)	5		5	
Startup Time to MECL, min	4		4	
Cold Startup Time to SCR Compliance, min	45		45	
Maximum Ramp Rate, MW/min (Online)	10		100	
Book Life, Years	35		35	
Equivalent Planned Outage Rate, % (Note 2, 10)	4.0%		4.0%	
Equivalent Forced Outage Rate, % (Notes 2, 10)	7.3%		7.3%	
Equivalent Availability Factor, % (Notes 2, 10)	94.3%		94.3%	
Assumed Land Use, Acres	30	10	30	10
Fuel Design	Natural Gas Only		Natural Gas Only	
Heat Rejection	Fin Fan Heat Exchanger		Fin Fan Heat Exchanger	
NO_x Control	SCR		SCR	
CO Control	Oxidation Catalyst		Oxidation Catalyst	
Particulate Control	Good Combustion Practice		Good Combustion Practice	
Technology Rating	Mature		Mature	
Permitting & Construction Schedule (Years from FNTP)	3		3	
ESTIMATED PERFORMANCE (All BASED ON NATURAL GAS OPERATION) (Note 9)				
Nominal Base Load Performance @59° F (ISO Conditions)				
Net Plant Output, kW	54,600	54,600	109,900	109,900
Net Plant Heat Rate, Btu/kWh (HHV)	8,480	8,480	8,290	8,290
Heat Input, MMBtu/h (HHV)	450	450	910	910
Nominal Min Load @ 59° F (ISO Conditions) - Single Engine				
Net Plant Output, kW	2,300	2,300	4,600	4,600
Net Plant Heat Rate, Btu/kWh (HHV)	12,150	12,150	11,040	11,040
Heat Input, MMBtu/h (HHV)	30	30	40	40
Base Load Performance @ 20° F (Winter Design)				
Net Plant Output, kW	54,600	54,600	109,900	109,900
Net Plant Heat Rate, Btu/kWh (HHV)	8,480	8,480	8,290	8,290
Heat Input, MMBtu/h (HHV)	450	450	910	910

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
RECIPROCATING ENGINE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	**Reciprocating Engine (9 MW Engines) Natural Gas**		**Reciprocating Engine (18 MW Engines) Natural Gas**	
BASE PLANT DESCRIPTION	First Unit	Next Unit	First Unit	Next Unit
Min Load Operational Status @ 20° F (Winter Design) - Single Engine				
Net Plant Output, kW	2,300	2,300	4,600	4,600
Net Plant Heat Rate, Btu/kWh (HHV)	12,150	12,150	11,040	11,040
Heat Input, MMBtu/h (HHV)	30	30	40	40
Base Load Performance @ 90° F (Summer Design)				
Net Plant Output, kW	54,600	54,600	109,900	109,900
Net Plant Heat Rate, Btu/kWh (HHV)	8,480	8,480	8,310	8,310
Heat Input, MMBtu/h (HHV)	450	450	910	910
Min Load Operational Status @ 90° F (Summer Design) - Single Engine				
Net Plant Output, kW	2,300	2,300	4,600	4,600
Net Plant Heat Rate, Btu/kWh (HHV)	12,150	12,150	11,040	11,040
Heat Input, MMBtu/h (HHV)	30	30	40	40
ESTIMATED CAPITAL AND O&M COSTS				
EPC Project Capital Costs, 2019 MM$ (w/o Owner's Costs)	**$81**	**$61**	**$120**	**$100**
Engineering	$3.3	$0.3	$5	$1
Gas Turbines/Engines	$10.3	$8.8	$112	$112
GSU (Note 6)	$0.4	$0.1	$2	$2
Environmental Equipment (SCR/CO)	Included with Engines	Included with Engines	Included with Engines	Included with Engines
BOP Equipment and Materials	$2.1	$1.4	$28	$21
Construction	$10.7	$10.4	$46	$28
Indirects and Fees	$4.1	$2.2	$15	$10
EPC Contingency	$1.0	$0.7	$10	$8

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
RECIPROCATING ENGINE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	Reciprocating Engine (9 MW Engines) Natural Gas		Reciprocating Engine (18 MW Engines) Natural Gas	
BASE PLANT DESCRIPTION	First Unit	Next Unit	First Unit	Next Unit
Owner's Costs, 2019 MM$	**$27**	**$14**	**$39**	**$24**
Owner's Project Development	$0.3	$0.0	$0.3	$0.0
Owner's Operational Personnel Prior to COD	$0.3	$0.0	$0.3	$0.0
Owner's Engineer	$0.8	$0.0	$0.5	$0.0
Owner's Project Management	$1.0	$0.0	$1.0	$0.0
Owner's Legal Costs	$0.5	$0.0	$0.5	$0.0
Owner's Start-up Engineering and Commissioning	$0.4	$0.2	$0.9	$0.5
Land	$0.2	$0.0	$0.2	$0.1
Construction Power and Water	$0.5	$0.1	$0.5	$0.1
Permitting and Licensing Fees	$0.5	$0.0	$0.5	$0.0
Switchyard	$5.3	$1.8	$7.1	$3.6
Political Concessions & Area Development Fees	$0.5	$0.0	$0.5	$0.0
Startup/Testing (Fuel & Consumables)	$0.1	$0.09	$0.5	$0.4
Initial Fuel Inventory	$0.0	$0.0	$0.0	$0.0
Site Security	$0.3	$0.0	$0.4	$0.0
Operating Spare Parts	$0.2	$0.1	$2.0	$0.5
Water Supply Infrastructure	Excluded	Excluded	Excluded	Excluded
Natural Gas Supply Infrastructure	Excluded	Excluded	Excluded	Excluded
Transmission Interconnect	$0.2	$0.2	$0.4	$0.4
Transmission Upgrade Costs	Excluded	Excluded	Excluded	Excluded
Firm Gas Supply Reservation Charge	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner
Permanent Plant Equipment and Furnishings	$0.3	$0.0	$0.3	$0.0
AFUDC (12.2% of EPC Project Capital Costs)	$9.9	$7.4	$14.6	$12.2
Builders Risk Insurance (0.45% of Construction Costs)	$0.4	$0.3	$0.5	$0.5
Owner's Contingency (5% for Screening Purposes)	$5.1	$3.5	$7.6	$5.9
Total Project Costs, 2019 MM$	**$108**	**$74**	**$159**	**$124**
EPC Cost Per kW, 2019 $/kW	**$1,480**	**$1,110**	**$1,090**	**$910**
Total Cost Per kW, 2019 $/kW	**$1,970**	**$1,360**	**$1,440**	**$1,130**
FIXED O&M COSTS				
Fixed O&M Cost - LABOR, 2019$MM/Yr	$1.0	$0.0	$1.0	$0.4
Fixed O&M Cost - OTHER, 2019$MM/Yr	$1.5	$0.20	$0.98	$0.35

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
RECIPROCATING ENGINE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	Reciprocating Engine (9 MW Engines) Natural Gas		Reciprocating Engine (18 MW Engines) Natural Gas	
BASE PLANT DESCRIPTION	First Unit	Next Unit	First Unit	Next Unit
LEVELIZED CAPITAL MAINTENANCE COSTS				
Major Maintenance Cost, 2019$/GT-hr or $/engine-hr (Notes 6, 11)	$0.07	$0.07	$0.00	$0.00
Major Maintenance Cost, 2019$/GT-start	N/A	N/A	N/A	N/A
Major Maintenance Cost, 2019$/MWh	$1.40	$1.40	$0.00	$0.00
Catalyst Replacement Cost, 2019$/MWh	$0.30	$0.30	$0.20	$0.20
NON-FUEL VARIABLE O&M COSTS (EXCLUDES MAJOR MAINTENANCE, Note 7)				
Total Variable O&M Cost, 2019$/MWh	$4.50	$4.50	$4.50	$4.50
Water Related O&M, $/MWh	$0.00	$0.00	$0.00	$0.00
SCR Reagent, $/MWh	$0.90	$0.90	$0.90	$0.90
Other Consumables and Variable O&M, $/MWh	$3.60	$3.60	$3.60	$3.60
ESTIMATED BASE LOAD OPERATING EMISSIONS: NATURAL GAS (See Note 8)				
Engine Only (lb/MMBtu, HHV)				
NO_X	0.33	0.33	0.32	0.32
SO_2	< 0.002	< 0.002	< 0.002	< 0.002
CO	0.52	0.52	0.51	0.51
CO_2	120	120	120	120
Engine with SCR and CO Catalyst (lb/MMBtu, HHV)				
NO_X	0.017	0.017	0.016	0.016
SO_2	< 0.002	< 0.002	< 0.002	< 0.002
CO	0.03	0.03	0.031	0.031
CO_2	120	120	120	120

Notes
Note 1: Recip engine start times assume the engines are kept warm when not operational.
Note 2: Outage and availability statistics are collected using the NERC Generating Availability Data System. Note that a unique gas reciprocating engine category does not exist in GADS. Diesel Engine data is used as a proxy.
Note 3: New and clean performance assumed for all scenarios. All performance ratings based on NATURAL GAS operation. Minimum loads are based on OEM information at requested ambient conditions.
Note 4: It is assumed that a maximum of six reciprocating engines tie to one GSU.
Note 5: Capital and fixed O&M costs are presented in 2019 USD $MM.
Note 6: Recip engine FOM assumes 8 FTE for the first 200 MW plant. Major maintenance $/hr is per engine. LTSA costs are split in two categories: major overhauls and catalyst replacements are shown as

Note 7: VOM assumes the use of temporarily trailers for demineralized water treatment, if required.

Note 8: Emissions estimates are shown for steady state operation at annual average conditions. Estimates account for the impacts of SCR and CO catalysts, as applicable.
Note 9: Performance ratings are based on elevation of 750 ft above msl.

Note 10: EFOR data from GADS may not accurately represent the benefits of a reciprocating plant, depending on how events are recorded. Typically, a maintenance event will not impact all engines simultaneously, so the plant would not be completely offline as it may be during an event at 1x gas turbine plant.

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT RECIPROCATING ENGINE TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019				
PROJECT TYPE	**Reciprocating Engine (9 MW Engines) Natural Gas**		**Reciprocating Engine (18 MW Engines) Natural Gas**	
BASE PLANT DESCRIPTION	First Unit	Next Unit	First Unit	Next Unit
Note: 11: If major maintenance is $0.00 - the units have will not reach a major overhaul even per manufacturer's recommendations of hours of operation based on the life of the plant and the capacity factor.				

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
COMBINED CYCLE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	**1x1 F Class CCGT - Unfired**	**1x1 F Class CCGT - Fired**	**1x1 G/H Class CCGT - Unfired**	**1x1 G/H Class CCGT - Fired**
BASE PLANT DESCRIPTION	Unfired	Fired	Unfired	Fired
Number of Gas Turbines	1	1	1	1
Number of Steam Turbines	1	1	1	1
Representative Class Gas Turbine	GE 7F.05		GE 7HA.01	
Steam Conditions (Main Steam / Reheat)	1,050°F / 1,050°F		1,050°F / 1,050°F	
Main Steam Pressure	2,330		2,330	
Steam Cycle Type	Subcritical		Subcritical	
Capacity Factor (%)	70%		70%	
Startup Time, Minutes (Cold Start to Unfired Base Load) (Note 7, 8)	180		180	
Startup Time, Minutes (Warm Start to Unfired Base Load) (Note 7, 8)	120		120	
Startup Time, Minutes (Hot Start to Unfired Base Load) (Note 7, 8)	80		80	
Startup Time, Minutes (Cold Start to Stack Emissions Compliance) (See note 4)	60		60	
Maximum Ramp Rate, MW/min (Online)	36		41	
Book Life (Years)	30		30	
Equivalent Planned Outage Rate (%)	10.1%		10.1%	
Equivalent Forced Outage Rate (%)	3.6%		3.6%	
Equivalent Availability Factor (%)	86.5%		86.5%	
Assumed Land Use (Acres)	70	30	70	30
Fuel Design	Natural Gas		Natural Gas	
Heat Rejection	Wet Cooling Towers		Wet Cooling Towers	
NO_x Control	DLN/SCR		DLN/SCR	
CO Control	Oxidation Catalyst		Oxidation Catalyst	
Particulate Control	Good Combustion Practice		Good Combustion Practice	
Technology Rating	Mature		Mature	
Permitting & Construction Schedule (Years from FNTP)	4		4	
ESTIMATED PERFORMANCE (See note 2)				
Base Load Performance @59 °F (Nominal)				
Net Plant Output, kW	357,200	359,900	410,600	412,100
Net Plant Heat Rate, Btu/kWh (HHV)	6,490	6,440	6,280	6,260
Heat Input, MMBtu/h (HHV)	2,320	2,320	2,580	2,580
Incremental Duct Fired Performance @ 59 °F (Nominal)				
Incremental Duct Fired Output, kW	N/A	82,600	N/A	98,600
Incremental Heat Rate, Btu/kWh (HHV)	N/A	8,370	N/A	8,420
Incremental Heat Input, MMBtu/h (HHV)	N/A	690	N/A	830
Minimum Load (Single Turbine at MECL) @ 59 °F (Nominal)				
Net Plant Output, kW	168,400	170,900	129,500	128,800
Net Plant Heat Rate, Btu/kWh (HHV)	7,740	7,630	7,970	8,010
Heat Input, MMBtu/h (HHV)	1,300	1,300	1,030	1,030

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT COMBINED CYCLE TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019				
PROJECT TYPE	**1x1 F Class CCGT - Unfired**	**1x1 F Class CCGT - Fired**	**1x1 G/H Class CCGT - Unfired**	**1x1 G/H Class CCGT - Fired**
BASE PLANT DESCRIPTION	Unfired	Fired	Unfired	Fired
Base Load Performance @ 20 °F (Winter)				
Net Plant Output, kW	357,100	360,900	415,100	417,400
Net Plant Heat Rate, Btu/kWh (HHV)	6,610	6,540	6,350	6,320
Heat Input, MMBtu/h (HHV)	2,360	2,360	2,640	2,640
Incremental Duct Fired Performance @ 20 °F (Winter)				
Incremental Duct Fired Output, kW	N/A	88,500	N/A	102,000
Incremental Heat Rate, Btu/kWh (HHV)	N/A	8,380	N/A	8,540
Incremental Heat Input, MMBtu/h (HHV)	N/A	740	N/A	870
Minimum Load (Single Turbine at MECL) @ 20 °F (Winter)				
Net Plant Output, kW	182,200	180,700	137,000	124,100
Net Plant Heat Rate, Btu/kWh (HHV)	7,610	7,670	7,850	8,660
Heat Input, MMBtu/h (HHV)	1,390	1,390	1,080	1,070
Base Load Performance @ 90 °F (Summer)				
Net Plant Output, kW	335,100	335,300	381,100	379,700
Net Plant Heat Rate, Btu/kWh (HHV)	6,540	6,540	6,340	6,370
Heat Input, MMBtu/h (HHV)	2,190	2,190	2,420	2,420
Incremental Duct Fired Performance @ 90 °F (Summer)				
Incremental Duct Fired Output, kW	N/A	80,600	N/A	95,000
Incremental Heat Rate, Btu/kWh (HHV)	N/A	8,220	N/A	8,200
Incremental Heat Input, MMBtu/h (HHV)	N/A	660	N/A	780
Minimum Load (Single Turbine at MECL) @ 90 °F (Summer)				
Net Plant Output, kW	164,900	161,800	147,000	142,100
Net Plant Heat Rate, Btu/kWh (HHV)	7,690	7,840	7,570	7,830
Heat Input, MMBtu/h (HHV)	1,270	1,270	1,110	1,110

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT COMBINED CYCLE TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019				
PROJECT TYPE	**1x1 F Class CCGT - Unfired**	**1x1 F Class CCGT - Fired**	**1x1 G/H Class CCGT - Unfired**	**1x1 G/H Class CCGT - Fired**
BASE PLANT DESCRIPTION	Unfired	Fired	Unfired	Fired
ESTIMATED CAPITAL AND O&M COSTS				
EPC Project Capital Costs, 2019 MM$ (w/o Owner's Costs)	**$351**	**$369**	**$400**	**$420**
Owner's Costs, 2019 MM$	**$125**	**$129**	**$136**	**$139**
Owner's Project Development	$3.5	$3.5	$3.5	$3.5
Owner's Operational Personnel Prior to COD	$1.7	$1.7	$1.7	$1.7
Owner's Engineer	$2.3	$2.3	$2.4	$2.4
Owner's Project Management	$5.9	$5.9	$6.1	$6.1
Owner's Legal Costs	$1.0	$1.0	$1.0	$1.0
Owner's Start-up Engineering and Commissioning	$5.7	$5.7	$5.6	$5.6
Land	$0.4	$0.4	$0.4	$0.4
Temporary Utilities	$1.6	$1.6	$1.7	$1.7
Permitting and Licensing Fees	$0.5	$0.5	$0.5	$0.5
Switchyard	$9.9	$9.9	$9.9	$9.9
Political Concessions & Area Development Fees	$0.5	$0.5	$0.5	$0.5
Startup/Testing (Fuel & Consumables)	$0.9	$0.9	$1.0	$1.0
Initial Fuel Inventory	$0.0	$0.0	$0.0	$0.0
Site Security	$0.8	$0.8	$0.8	$0.8
Operating Spare Parts	$6.0	$6.0	$6.5	$6.5
Water Supply Infrastructure (5 Mile Pipeline) (Note 13)	$15.0	$15.0	$15.0	$15.0
Natural Gas Supply Infrastructure	Excluded	Excluded	Excluded	Excluded
Transmission Interconnect	$1.4	$1.4	$1.6	$1.6
Transmission Upgrade Costs	Excluded	Excluded	Excluded	Excluded
Firm Gas Supply Reservation Charge	Provided by Owner	Provided by Owner	Provided by Owner	Provided by Owner
Permanent Plant Equipment and Furnishings	$1.3	$1.3	$1.3	$1.3
AFUDC (12.2% of EPC Project Capital Costs)	$42.8	$45.0	$48.8	$51.2
Builders Risk Insurance (0.45% of Construction Costs)	$1.6	$1.7	$1.8	$1.9
Owner's Contingency	$22.7	$23.7	$25.5	$26.6
Total Project Costs, 2019 MM$	**$476**	**$498**	**$536**	**$559**
EPC Cost Per UNFIRED kW, 2019 $/kW	**$982**	**$1,026**	**$974**	**$1,019**
Total Cost Per UNFIRED kW, 2019 $/kW	**$1,333**	**$1,384**	**$1,305**	**$1,357**
EPC Cost Per FIRED kW, 2019 $/kW	**N/A**	**$834**	**N/A**	**$822**
Total Cost Per FIRED kW, 2019 $/kW	**N/A**	**$1,125**	**N/A**	**$1,095**
FIXED O&M COSTS (See note 9)				
Fixed O&M Cost - LABOR, 2019 $MM/Yr	$2.8	$2.8	$2.8	$2.8
Fixed O&M Cost - OTHER, 2019 $MM/Yr	$1.8	$1.8	$2.1	$2.1

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
COMBINED CYCLE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	1x1 F Class CCGT - Unfired	1x1 F Class CCGT - Fired	1x1 G/H Class CCGT - Unfired	1x1 G/H Class CCGT - Fired
BASE PLANT DESCRIPTION	Unfired	Fired	Unfired	Fired
LEVELIZED CAPITAL MAINTENANCE COSTS				
Major Maintenance Cost, 2019 $/GT-hr	$350	$350	$580	$580
Major Maintenance Cost, 2019 $/MWh	$0.98	$0.97	$1.41	$1.41
Catalyst Replacement Cost, 2019 $/MWh	$0.19	$0.19	$0.17	$0.17
NON-FUEL VARIABLE O&M COSTS (EXCLUDES MAJOR MAINTENANCE)				
Total Variable O&M Cost, Unfired 2019 $/MWh	$1.80	$1.74	$1.80	$1.68
Water Related O&M ($/MWh)	$0.39	$0.40	$0.36	$0.36
SCR Reagent, $/MWh	$0.20	$0.20	$0.20	$0.20
Other Consumables and Variable O&M ($/MWh)	$1.20	$1.10	$1.20	$1.10
Incremental Duct Fired Variable O&M, 2019 $/MWh (For Incremental Output Only)	N/A	$1.39	N/A	$1.40
ESTIMATED BASE LOAD OPERATING EMISSIONS: NATURAL GAS, lb/MMBtu (HHV)				
NO_X	0.01	0.01	0.007	0.007
SO_2	< 0.002	< 0.002	< 0.002	< 0.002
CO	0.00	0.00	0.004	0.004
CO_2	120.00	120.00	120	120

Notes

Note 1: New and clean performance assumed. All performance is based on NATURAL GAS operation. Min load ratings are based on OEM performance information at specified ambient conditions. Fuel oil conversion factors are included in the "Fuel Oil Conversion" tab in this workbook.
Note 2: Base O&M costs are based on performance at annual average conditions.
Note 3: Major maintenance $/hr holds for frame gas turbines where hours per start is >27.
Note 4: Startup time to stack emissions compliance is not the same as the start time for gas turbine MECL. Stack emissions compliance is expected to be limited by the temperature of the CO catalyst, which impacts VOC emissions.
Note 5: Capital costs include duct firing to 1,600°F.
Note 6: Outage and availability statistics are collected using the NERC Generating Availability Data System. Combined cycle data is based on North American units that came online in 2006 or later. Reporting period is 2011-2016.
Note 7: Cold start is >72 hours after shutdown. Hot start is <8 hours after shutdown.
Note 8: Startup times reflect unrestricted, conventional starts for all gas turbines. These start times assume the inclusion of terminal point desuperheaters, full bypass, and associated controls. Fast start packages are not included in CCGT plants.
Note 9: Fixed O&M assumes 22 FTE for 1x1 configurations.
Note 10: Variable O&M costs assume onsite demin treatment system.
Note 11: Emissions estimates are shown for steady state operation at annual average conditions. Estimates account for the impacts of SCR and CO catalysts.
Note 12: Estimated costs exclude decommissioning costs and salvage values.

VECTREN ENERGY 2019 GENERIC UNIT ASSESSMENT SUMMARY TABLE
COMBINED HEAT AND POWER TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	Combined Heat and Power	Combined Heat and Power
BASE PLANT DESCRIPTION	2x 9MW Reciprocating Engine (Wartsila 20V34SG)	1 x Titan 250 CTG w/ unfired HRSG
Number of Gas Turbines / Engines / Reactors	2	1
Number of HRSGs	1	1
Number of Steam Turbines	0	0
Steam Conditions (Main Steam / Reheat)	150 psig/366F (saturated)	150 psig/366F (saturated)
Main Steam Pressure	150 psig	150 psig
Steam Cycle Type	Topping Cycle	Topping Cycle
Capacity Factor (%)	85%	85%
Startup Time (Cold Start), hours	0.5	< 1.5 Hrs to Full Plant Load
Startup Time (Warm Start), hours	0.5	< 45 min to Full Plant Load
Startup Time (Hot Start), hours	0.5	< 45 min to Full Plant Load
Startup Time to MECL	0.5	< 45 min to Full Plant Load
Maximum Ramp Rate (Online), MW/min	4	2
Book Life, years	35	35
Equivalent Planned Outage Rate (%)	4%	6%
Equivalent Forced Outage Rate (%)	7%	8%
Equivalent Availability Factor (%)	94%	88%
Assumed Land Use (Acres)	1	1
Fuel Design	Natural Gas	Natural Gas
Heat Rejection	Remote Radiator	Remote Radiator
NO_x Control	SCR	Low NOx Combustion / SCR
SO_2 Control	N/A	N/A
CO_2 Control	N/A	N/A
Particulate Control	Good Combustion Practice	Good Combustion Practice
Technology Rating	Mature	Mature
Permitting & Construction Schedule (Years from FNTP)	3	3
ESTIMATED PERFORMANCE		
Base Load Performance @ (Annual Average)		
Net Plant Output, kW	N/A - See Below	N/A - See Below
Net Plant Heat Rate, Btu/kWh (HHV)	N/A - See Below	N/A - See Below
Heat Input, MMBtu/h (HHV)	N/A - See Below	N/A - See Below

VECTREN ENERGY 2019 GENERIC UNIT ASSESSMENT SUMMARY TABLE
COMBINED HEAT AND POWER TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	**Combined Heat and Power**	**Combined Heat and Power**
BASE PLANT DESCRIPTION	2x 9MW Reciprocating Engine (Wartsila 20V34SG)	1 x Titan 250 CTG w/ unfired HRSG
Minimum Load Operational Status @ (Annual Average)		
Net Plant Output, kW	N/A - See Below	N/A - See Below
Net Plant Heat Rate, Btu/kWh (HHV)	N/A - See Below	N/A - See Below
Heat Input, MMBtu/h (HHV)	N/A - See Below	N/A - See Below
CHP Base Load Performance @ (Winter)		
Net Plant Output, kW	17,940	21,670
Simple Cycle Heat Rate, Btu/kWh (HHV)	8,180	10,120
Plant Heat Rate, Btu/kWh (HHV)	6,830	6,420
Heat Input, MMBtu/h (HHV)	152	219
Plant Steam Output, pph	25,800	68,100
Plant Steam Output, MMBtu/h (HHV)	26	68
CHP Minimum Load Operational Status @ (Winter) (Single Unit)		
Net Plant Output, kW	4,530	10,860
Simple Cycle Heat Rate, Btu/kWh (HHV)	8,990	13,920
Plant Heat Rate, Btu/kWh (HHV)	7,010	7,410
Heat Input, MMBtu/h (HHV)	42	151
Plant Steam Output, pph	9,000	60,100
Plant Steam Output, MMBtu/h (HHV)	9	60
CHP Base Load Performance @ (Annual Average)		
Net Plant Output, kW	17,940	19,910
Simple Cycle Heat Rate, Btu/kWh (HHV)	8,180	10,390
Plant Heat Rate, Btu/kWh (HHV)	6,830	6,120
Heat Input, MMBtu/h (HHV)	152	207
Plant Steam Output, pph	25,800	72,300
Plant Steam Output, MMBtu/h (HHV)	26	72
CHP Minimum Load Operational Status @ (Annual Average) (Single Unit)		
Net Plant Output, kW	4,530	9,980
Simple Cycle Heat Rate, Btu/kWh (HHV)	8,990	14,220
Plant Heat Rate, Btu/kWh (HHV)	7,010	7,060
Heat Input, MMBtu/h (HHV)	42	142
Plant Steam Output, pph	9,000	60,700
Plant Steam Output, MMBtu/h (HHV)	9	61

VECTREN ENERGY 2019 GENERIC UNIT ASSESSMENT SUMMARY TABLE COMBINED HEAT AND POWER TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019		
PROJECT TYPE	**Combined Heat and Power**	**Combined Heat and Power**
BASE PLANT DESCRIPTION	2x 9MW Reciprocating Engine (Wartsila 20V34SG)	1 x Titan 250 CTG w/ unfired HRSG
CHP Base Load Performance @ (Summer)		
Net Plant Output, kW	17,940	15,860
Simple Cycle Heat Rate, Btu/kWh (HHV)	8,180	11,260
Plant Heat Rate, Btu/kWh (HHV)	6,830	6,030
Heat Input, MMBtu/h (HHV)	152	179
Plant Steam Output, pph	25,800	70,600
Plant Steam Output, MMBtu/h (HHV)	26	71
CHP Minimum Load Operational Status @ (Summer) (Single Unit)		
Net Plant Output, kW	4,530	7,950
Simple Cycle Heat Rate, Btu/kWh (HHV)	8,990	16,170
Plant Heat Rate, Btu/kWh (HHV)	7,010	6,910
Heat Input, MMBtu/h (HHV)	42	128
Plant Steam Output, pph	9,000	62,500
Plant Steam Output, MMBtu/h (HHV)	9	63

VECTREN ENERGY 2019 GENERIC UNIT ASSESSMENT SUMMARY TABLE COMBINED HEAT AND POWER TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019		
PROJECT TYPE	**Combined Heat and Power**	**Combined Heat and Power**
BASE PLANT DESCRIPTION	2x 9MW Reciprocating Engine (Wartsila 20V34SG)	1 x Titan 250 CTG w/ unfired HRSG
ESTIMATED CAPITAL AND O&M COSTS		
EPC Project Capital Costs, 2019 MM$ (w/o Owner's Costs)	**$54**	**$48**
Owner's Costs, 2019 MM$	**$22**	**$22**
Owner's Project Development	$0.3	$0.3
Owner's Operational Personnel Prior to COD	$0.3	$0.3
Owner's Engineer	$0.4	$0.4
Owner's Project Management	$0.8	$0.8
Owner's Legal Costs	$0.5	$0.5
Owner's Start-up Engineering and Commissioning	$0.2	$0.2
Land	$0.01	$0.01
Construction Power and Water	$0.5	$0.5
Permitting and Licensing Fees	$0.5	$0.5
Switchyard	N/A	N/A
Political Concessions & Area Development Fees	$0.3	$0.3
Startup/Testing (Fuel & Consumables)	$0.1	$0.3
Initial Fuel Inventory	$0.0	$0.0
Site Security	$0.2	$0.2
Operating Spare Parts	$0.3	$0.5
Water Supply Infrastructure (5 Mile Pipeline) (Note 6)	$7.5	$7.5
Natural Gas Supply Infrastructure	Excluded	Excluded
Transmission Interconnect	$0.1	$0.1
Transmission Upgrade Costs	Excluded	Excluded
Firm Gas Supply Reservation Charge	Provided by Owner	Provided by Owner
Permanent Plant Equipment and Furnishings	$0.0	$0.0
AFUDC (12.2% of EPC Project Capital Costs)	$6.6	$5.8
Builders Risk Insurance (0.45% of Construction Costs)	$0.3	$0.3
Owner's Contingency (5% for Screening Purposes)	$3.7	$3.3

VECTREN ENERGY 2019 GENERIC UNIT ASSESSMENT SUMMARY TABLE
COMBINED HEAT AND POWER TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	**Combined Heat and Power**	**Combined Heat and Power**
BASE PLANT DESCRIPTION	2x 9MW Reciprocating Engine (Wartsila 20V34SG)	1 x Titan 250 CTG w/ unfired HRSG
Total Project Costs, 2019 MM$	**$77**	**$69**
EPC Cost Per kW, 2019 $/kW	**$3,040**	**$3,010**
Total Cost Per kW, 2019 $/kW	**$4,290**	**$4,370**
FIXED O&M COSTS		
Fixed O&M Cost - LABOR, 2019$MM/Yr	$0.60	$0.60
Fixed O&M Cost - Other, 2019$MM/Yr	$0.15	$0.15
MAJOR MAINTENANCE COSTS		
Major Maintenance Cost, 2019$/MWh	$2.40	$8.70
NON-FUEL VARIABLE O&M COSTS (EXCLUDES MAJOR MAINTENANCE)		
Total Variable O&M Cost, 2019$/MWh	$5.93	$1.22
Water Related O&M ($/MWh)	$0.00	$0.00
SCR Related O&M ($/MWh)	$0.93	$0.32
Other Variable O&M ($/MWh)	$5.00	$0.90
ESTIMATED BASE LOAD OPERATING EMISSIONS, lb/MMBtu (HHV)		
NO_X	0.018	0.01
SO_2	< 0.002	< 0.002
CO	0.03	0.01
CO_2	120	120

Notes
Note 1: Combined heat and power (CHP) options assume that water treatment costs are the responsibility of the host and are not included in the O&M costs above.
Note 2: CHP start time shown is total system startup time. CTG or engine is capable of full load operation within ~10 minutes. Overall length of startup is primarily dependent upon startup rates recommended by HRSG manufacturer.

Note 3: CHP make-up water costs for the steam system will be dependent on Host condensate return percentage. DI water cost for water wash is negligible.

Note 4: LFG engine start times account for time required to heat engine jacket water appropriately to accommodate startup.
Note 5: Decommissioning costs and salvage values are excluded from analysis.

VECTREN ENERGY 2019 GENERIC UNIT ASSESSMENT SUMMARY TABLE
WASTE-TO-ENERGY TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	Bubbling Fluidized Bed	Landfill Gas Engine
BASE PLANT DESCRIPTION		3x Reciprocating Engine
Number of Gas Turbines / Engines / Reactors	N/A	3
Number of HRSGs	N/A	N/A
Number of Steam Turbines	1	N/A
Main Steam Pressure	1,400 psi-a	N/A
Steam Cycle Type	950°F / 950°F	N/A
Capacity Factor (%)	85%	10%
Startup Time (Cold Start), hours	12 Hours	6+ Hours
Startup Time (Warm Start), hours	Not Provided	1-2 Hours
Startup Time (Hot Start), hours	Not Provided	7 Minutes
Startup Time to MECL	Not Provided	5 Minutes
Maximum Ramp Rate (Online), MW/min	Not Provided	1
Book Life, years	30	30
Equivalent Planned Outage Rate (%)	2%	2%
Equivalent Forced Outage Rate (%)	10%	10%
Equivalent Availability Factor (%)	83%	83%
Fuel Design	Chipped Wood Biomass	Landfill Gas
Heat Rejection	Wet Cooling Tower	Fin Fan Heat Exchanger
NO_x Control	SNCR	Good Combustion Practice
SO_2 Control	Dry Sorbent Injection	N/A
CO_2 Control	Good Combustion Practice	N/A
Particulate Control	Baghouse	N/A
Technology Rating	Mature	Mature
Permitting & Construction Schedule (Years from FNTP)	4	2
ESTIMATED PERFORMANCE		
Base Load Performance @ (Annual Average)		
Net Plant Output, kW	50,000	4,500
Net Plant Heat Rate, Btu/kWh (HHV)	13,000	10,740
Heat Input, MMBtu/h (HHV)	650	48
Minimum Load Operational Status @ (Annual Average)		
Net Plant Output, kW	17,500	2,200
Net Plant Heat Rate, Btu/kWh (HHV)	15,500	11,910
Heat Input, MMBtu/h (HHV)	270	26

VECTREN ENERGY 2019 GENERIC UNIT ASSESSMENT SUMMARY TABLE WASTE-TO-ENERGY TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019		
PROJECT TYPE	**Bubbling Fluidized Bed**	**Landfill Gas Engine**
BASE PLANT DESCRIPTION		3x Reciprocating Engine
ESTIMATED CAPITAL AND O&M COSTS		
EPC Project Capital Costs, 2019 MM$ (w/o Owner's Costs)	**$224**	**$14**
Owner's Costs, 2019 MM$	**$58**	**$5**
Owner's Project Development	$3.0	$0.3
Owner's Operational Personnel Prior to COD	$1.6	$0.0
Owner's Engineer	$1.0	$0.1
Owner's Project Management	$2.0	$0.1
Owner's Legal Costs	$1.0	$0.1
Owner's Start-up Engineering and Commissioning	$0.2	$0.1
Land	$1.0	$0.0
Construction Power and Water	$1.3	$0.2
Permitting and Licensing Fees	$1.0	$0.1
Switchyard	$6.0	$2.0
Political Concessions & Area Development Fees	$0.5	$0.1
Startup/Testing (Fuel & Consumables)	$1.5	$0.0
Initial Fuel Inventory	$4.3	$0.0
Site Security	$0.8	$0.1
Operating Spare Parts	$0.6	$0.0
Water Supply Infrastructure	Excluded	Excluded
Natural Gas Supply Infrastructure	Excluded (On-site)	Excluded (On-site)
Transmission Interconnect	$0.2	$0.0
Transmission Upgrade Costs	Excluded	Excluded
Firm Gas Supply Reservation Charge	Provided by Owner	Provided by Owner
Permanent Plant Equipment and Furnishings	$0.6	$0.0
AFUDC (12.2% of EPC Project Capital Costs)	$27.4	$1.8
Builders Risk Insurance (0.45% of Construction Costs)	$1.0	$0.1
Owner's Contingency (5% for Screening Purposes)	$2.8	$0.2
Total Project Costs, 2019 MM$	**$282**	**$20**
EPC Cost Per kW, 2019 $/kW	**$4,490**	**$3,190**
Total Cost Per kW, 2019 $/kW	**$5,640**	**$4,110**

VECTREN ENERGY 2019 GENERIC UNIT ASSESSMENT SUMMARY TABLE WASTE-TO-ENERGY TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019		
PROJECT TYPE	**Bubbling Fluidized Bed**	**Landfill Gas Engine**
BASE PLANT DESCRIPTION		3x Reciprocating Engine
FIXED O&M COSTS		
Fixed O&M Cost - LABOR, 2019$MM/Yr	$3.60	$0.40
Fixed O&M Cost - Other, 2019$MM/Yr	$2.60	$0.10
MAJOR MAINTENANCE COSTS		
Major Maintenance Cost, 2019$/MWh	$4.28	$9.50
NON-FUEL VARIABLE O&M COSTS (EXCLUDES MAJOR MAINTENANCE)		
Total Variable O&M Cost, 2019$/MWh	$2.85	$7.62
Water Related O&M ($/MWh)	Included	$0.00
SCR Related O&M ($/MWh)	Included	$0.00
Other Variable O&M ($/MWh)	Included	$7.62
ESTIMATED BASE LOAD OPERATING EMISSIONS, lb/MMBtu (HHV)		
NO_X	0.10	0.15
SO_2	0.01	0.01
CO	0.08	1.27
CO_2	205	170

Notes

Note 1: Combined heat and power (CHP) options assume that water treatment costs are the responsibility of the host and are not included in the O&M costs above.

Note 2: CHP start time shown is total system startup time. CTG or engine is capable of full load operation within ~10 minutes. Overall length of startup is primarily dependent upon startup rates recommended by HRSG manufacturer.

Note 3: CHP make-up water costs for the steam system will be dependent on Host condensate return percentage. DI water cost for water wash is negligible.

Note 4: LFG engine start times account for time required to heat engine jacket water appropriately to accommodate startup.

Note 5: Decommissioning costs and salvage values are excluded from analysis.

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
RENEWABLE AND STORAGE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
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PROJECT TYPE	**Hydroelectric**	**Wind Energy**	**Wind Energy**	**Wind Energy**	**Wind Plus Storage**	**Solar Photovoltaic**	**Solar Photovoltaic**	**Solar Photovoltaic**
BASE PLANT DESCRIPTION	Low Head Hydroelectric	Southern IN	Northern IN	North Dakota	Indiana	Single Axis Tracking	Single Axis Tracking	Single Axis Tracking
Nominal Output, MW	50	200	200	200	50 MW Wind & 10 MW / 40 MWh Storage	10	50	100
Number of Turbines	1	58 x 3.45 MW	58 x 3.45 MW	58 x 3.45 MW	15 x 3.45 MW	N/A	N/A	N/A
Capacity Factor (%) (Notes 1,2)	40%	28%	38%	41%	38%	24.3%	24.2%	24.2%
Startup Time (Cold Start)		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Book Life (Years)	40	30	30	30	30	30	30	30
Equivalent Planned Outage Rate (%)	11%	< 5%	< 5%	< 5%	< 5%	< 1%	< 1%	< 1%
Equivalent Forced Outage Rate (%)	< 5%	< 5%	< 5%	< 5%	< 5%	< 1%	< 1%	< 1%
Equivalent Availability Factor (%) (Note 6)	84%	95%	95%	95%	95%	99%	99%	99%
Assumed Land Use (Acres)	N/A	44	44	44	44	80	400	800
Fuel Design	Elevated Water	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Heat Rejection	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total System Cycles	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Interconnection Voltage Assumption	230 kV	230 kV	230 kV	230 kV	230 kV	34.5kV	230 kV	230 kV
PV Inverter Loading Ratio (DC/AC)	N/A	N/A	N/A	N/A	N/A	1.40	1.40	1.40
PV Degradation (%/yr) (Note 7)	N/A	N/A	N/A	N/A	N/A	First year: 2% After 1st Year: 0.5% per year	First year: 2% After 1st Year: 0.5% per year	First year: 2% After 1st Year: 0.5% per year
Storage System Initial Overbuild (%)	N/A	N/A	N/A	N/A	18%	N/A	N/A	N/A
Storage System Augmentation (%/yr)	N/A	N/A	N/A	N/A	2.5%	N/A	N/A	N/A
Storage System AC Roundtrip Efficiency (%)	N/A	N/A	N/A	N/A	85%	N/A	N/A	N/A
Technology Rating	Mature	Mature	Mature	Mature	Mature	Mature	Mature	Mature
Permitting & Construction Schedule (Years from FNTP)	7	2.5	2.5	2.5	2.5	2	2	2
ESTIMATED PERFORMANCE								
Base Load Performance @ (Annual Average)								
Net Plant Output, kW	50,000	200,000	200,000	200,000	50,000	10,000	50,000	100,000
Net Plant Heat Rate, Btu/kWh (HHV)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Heat Input, MMBtu/h (HHV)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ESTIMATED CAPITAL AND O&M COSTS								
Project Capital Costs, 2019 MM$ (w/o Owner's Costs)	**$210**	**$230**	**$230**	**$230**	**$73**	**$16**	**$73**	**$145.9**
Wind Capital Cost Breakdown								
Engineering	N/A	$1.05	$1.05	$1.05	$0.26	N/A	N/A	N/A
Equipment and Materials	N/A	$160	$160	$160	$40	N/A	N/A	N/A
Turbine Towers	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
Turbine Blades	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
Turbine Hubs	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
Nacelle and nacelle components	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
SCADA Equipment	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
Construction	N/A	$69	$69	$69	$17	N/A	N/A	N/A
Turbine Foundation and Erection	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
BOP Costs	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
Collector Bus	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
Indirects and Fees	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
EPC Contingency	N/A	Incl	Incl	Incl	Incl	N/A	N/A	N/A
PV Capital Cost Breakdown								
Engineering	N/A	N/A	N/A	N/A	N/A	$1.2	$1.2	$1.5
Equipment and Materials	N/A	N/A	N/A	N/A	N/A			
Modules	N/A	N/A	N/A	N/A	N/A	$5.2	$25.8	$51.6
Inverters	N/A	N/A	N/A	N/A	N/A	$0.6	$3.1	$6.2
Racking	N/A	N/A	N/A	N/A	N/A	$1.7	$8.4	$16.8
Construction (Note 16)	N/A	N/A	N/A	N/A	N/A	$5.1	$25.7	$51.4
Indirects and Fees	N/A	N/A	N/A	N/A	N/A	$1.5	$7.1	$14.0
EPC Contingency	N/A	N/A	N/A	N/A	N/A	$0.5	$2.1	$4.2
	N/A							
Battery Storage Capital Cost Breakdown								
Batteries	N/A	N/A	N/A	N/A	$8	N/A	N/A	N/A
Inverters	N/A	N/A	N/A	N/A	$1	N/A	N/A	N/A
BOP	N/A	N/A	N/A	N/A	$1	N/A	N/A	N/A
Construction and Indirects	N/A	N/A	N/A	N/A	$6	N/A	N/A	N/A
Owner's Costs, 2019 MM$	**$93**	**$66**	**$66**	**$66**	**$18.9**	**$9**	**$17**	**$27**
Owner's Project Development	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Owner's Engineer	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Owner's Project Management	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Startup / Testing / Warranties	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Included in EPC	Included in EPC
Land (Note 11)	Excluded - Assumes Existing Dam	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease
Transmission Upgrade Costs	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded
Permitting and Licensing Fees	Included	Included	Included	Included	Included	Included in EPC	Included in EPC	Included in EPC
Switchyard / Substation (Notes 8,9,12)	$2.0 M Allowance Included	$5.3 M Allowance Included	$5.3 M Allowance Included	$5.3 M Allowance Included	$5.3 M Allowance Included	$5.3M Allowance Included	$5.3M Allowance Included	$1.0M Allowance Included
AFUDC (Note 17)	$25.6	$23.2	$23.2	$23.2	$7.4	$1.3	$5.9	$11.7
Builder's Risk Insurance	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Owner's Contingency	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Total Project Costs, 2019 MM$	**$303**	**$296**	**$296**	**$296**	**$92**	**$25**	**$90**	**$173**
EPC Cost Per kW, 2019 $/kW (plus $/kWh for Storage)	**$4,200**	**$1,150**	**$1,150**	**$1,150**	**$1460 / $390**	**$1,580**	**$1,470**	**$1,460**
Total Cost Per kW, 2019 $/kW (plus $/kWh for Storage)	**$6,050**	**$1,480**	**$1,480**	**$1,480**	**$1840 / $650**	**$2,500**	**$1,810**	**$1,730**

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
RENEWABLE AND STORAGE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
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PROJECT TYPE	Hydroelectric	Wind Energy	Wind Energy	Wind Energy	Wind Plus Storage	Solar Photovoltaic	Solar Photovoltaic	Solar Photovoltaic
BASE PLANT DESCRIPTION	Low Head Hydroelectric	Southern IN	Northern IN	North Dakota	Indiana	Single Axis Tracking	Single Axis Tracking	Single Axis Tracking
Nominal Output, MW	50	200	200	200	50 MW Wind & 10 MW / 40 MWh Storage	10	50	100
Fixed O&M Cost - TOTAL, 2019$MM/Yr (Notes 3-5)	**$4.6**	**$8.0**	**$8.0**	**$8.0**	**$2.2**	**$0.3**	**$1.3**	**$2.44**
Annual Fixed Labor Cost, 2019$MM/Yr	Included in FOM	$0.6	$0.6	$0.6	$0.2	$0.0	$0.0	$0.00
Equipment Maintenance Cost, 2019$MM/Yr	Included in FOM	$4.8	$4.8	$4.8	$1.4	$0.1	$0.4	$0.70
BOP and Other Cost, 2019$MM/Yr	Included in FOM	$1.8	$1.8	$1.8	$0.5	$0.1	$0.4	$0.85
Land Lease Allowance, 2019$MM/Yr (Notes 10,11,14)	Included in FOM	$0.8	$0.8	$0.8	$0.2	$0.0	$0.2	$0.48
Property Tax Allowance, 2019$MM/Yr (Note 14)	Included in FOM	$0.0	$0.0	$0.0	$0.0	0	$0.0	$0.00
Capital Replacement Allowance, 2019$/MWh (Notes 3-5)	Included in FOM	% of OPEX; See Table	% of OPEX; See Table	% of OPEX; See Table	% of OPEX; See Table	$0.0	$0.2	$0.42
Variable O&M Cost, 2019$/MWh (excl. major maint.) (Note 4)	Included in FOM	Included in FOM	Included in FOM	Included in FOM	$14.5 (Storage MWh Only)	Included in FOM	Included in FOM	Included in FOM
ESTIMATED BASE LOAD OPERATING EMISSIONS, lb/MMBtu (HHV)								
NO_X	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO_2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes
1. Wind capacity factor represents Net Capacity Factor (NCF), which accounts for typical system losses. Capacity factor is based on Vestas V125-3.45 MW turbines with 87 meter hub height and 7.0 m/s average wind speed. Offshore capacity factor is based on estimates from publicly available studies.
2. Solar capacity factor accounts for typical losses. Fixed tilt systems assumes 20 degree tilt.
3. Capital maintenance allowances for onshore wind options are not included in the annual FOM above. A supplemental table in the report shows capital allowances estimated as percentages of annual operating expenses for a 30 year life. Offshore wind O&M estimates, based on publicly available documents, include levelized capital maintenance.
4. Battery FOM assumes the site is remotely controlled. Capital costs assume the system is oversized to accommodate normal degradation, so no battery replacement fund is included. Variable O&M accounts for the parasitic power draw of the system, including HVAC and efficiency losses.
5. PV O&M estimates assume fixed contracts for all maintenance activities. It is assumed the system is remotely controlled. Capital maintenance assumes an inverter replacement allowance levelized over the first 15 years. Inverter replacement is not included in the Solar + Storage option because of 15 year project life.
6. NERC GADS performance statistics are not available for PV, battery storage, and wind technologies. Availability estimates are based on vendor correspondence and industry publications.
7. PV degradation based on typical warranty information for polycrystalline products. Assuming factory recommended maintenance is performed, PV performance is estimated to degrade ~2% in the first year and 0.5% each remaining year.
8. Battery system assumes interconnection at distribution voltage and therefore excludes GSU and switchyard.
9. EPC costs for wind include 34.5 kV collection system and GSU to 230 kV. Owner's costs include 3 position ring bus switchyard for interconnection at 230kV. EPC cost for offshore wind include HVDC line and onshore converter. Owner's costs include 3 position ring bus switchyard for interconnection at 230kV.
10. Offshore wind project assumes cost for BOEM ocean lease is included in fixed O&M.
11. Onshore wind and PV projects assume that land is leased and therefore land costs are included in O&M, not capital costs. Onshore wind assumes one acre per turbine. PV assumes seven acres per MW for fixed tilt and eight acres per MW for tracking options.
12. PV scope for EPC includes 34.5 kV collector bus and circuit breaker. Owner costs include allowance for interconnection at 34.5 kV. PV costs updated in March 2019 to reflect potential impacts of tariffs on PV panels and steel.
13. Battery storage costs are shown as $/kW and as $/kWh per industry norms.
14: Land lease and property estimates are assumed allowances.
15: Estimated Costs exclude decommissioning costs and salvage values.
16. Construction line item for PV includes Labor, Construction Materials, and miscellaneous BOP Equipment
17. AFUDC of 12.2% used for the hydro option, 10.1% for the wind options, and 8% for the solar and storage options. AFUDC percentage is based on project schedule.

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PROJECT TYPE	Solar Plus Storage	Battery Storage	Battery Storage	Battery Storage	Battery Storage	Battery Storage	Battery Storage
BASE PLANT DESCRIPTION	Single Axis Tracking	Lithium Ion	Lithium Ion	Flow Battery	Flow Battery	Flow Battery	Flow Battery
Nominal Output, MW	50 MW PV & 10 MW / 40 MWh Storage	10 MW / 40 MWh	50 MW / 200 MWh	10 MW / 60 MWh	10 MW / 80 MWh	50 MW / 300 MWh	50 MW / 400 MWh
Number of Turbines	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Capacity Factor (%) (Notes 1,2)	24.2%	17%	17%	25%	33%	25%	33%
Startup Time (Cold Start)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Book Life (Years)	15	15	15	20	20	20	20
Equivalent Planned Outage Rate (%)	< 3%	< 3%	< 3%	< 3%	< 3%	< 3%	< 3%
Equivalent Forced Outage Rate (%)	< 3%	< 3%	< 3%	< 3%	< 3%	< 3%	< 3%
Equivalent Availability Factor (%) (Note 6)	97%	97%	97%	97%	97%	97%	97%
Assumed Land Use (Acres)	402	5	8	20	20	20	20
Fuel Design	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Heat Rejection	N/A	Air-cooled HVAC	Air-cooled HVAC	Air-cooled chiller	Air-cooled chiller	Air-cooled chiller	Air-cooled chiller
Total System Cycles	N/A	5,500	5,500	7,200	7,200	7,200	7,200
Interconnection Voltage Assumption	230 kV	230 kV	230 kV	230 kV	230 kV	230 kV	230 kV
PV Inverter Loading Ratio (DC/AC)	1.40	N/A	N/A	N/A	N/A	N/A	N/A
PV Degradation (%/yr) (Note 7)	First year: 2% After 1st Year: 0.5% per year	N/A	N/A	N/A	N/A	N/A	N/A
Storage System Initial Overbuild (%)	18%	18%	18%	0%	0%	0%	0%
Storage System Augmentation (%/yr)	2.5%	2.5%	2.5%	0%	0%	0%	0%
Storage System AC Roundtrip Efficiency (%)	85%	85%	85%	68%	68%	68%	68%
Technology Rating	Mature	Mature	Mature	Developing	Developing	Developing	Developing
Permitting & Construction Schedule (Years from FNTP)	2	2	2	2	2	2	2
ESTIMATED PERFORMANCE							
Base Load Performance @ (Annual Average)							
Net Plant Output, kW	50,000	10,000 kW / 40,000 kWh	50,000 kW / 200,000 kWh	10,000 kW / 60,000 kWh	10,000 kW / 80,000 kWh	50,000 kW / 300,000 kWh	50,000 kW / 400,000 kWh
Net Plant Heat Rate, Btu/kWh (HHV)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Heat Input, MMBtu/h (HHV)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ESTIMATED CAPITAL AND O&M COSTS							
Project Capital Costs, 2019 MM$ (w/o Owner's Costs)	**$88.8**	**$16.5**	**$63.1**	**$35.8**	**$44.6**	**$162.8**	**$205.5**
Wind Capital Cost Breakdown							
Engineering	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Equipment and Materials	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Turbine Towers	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Turbine Blades	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Turbine Hubs	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nacelle and nacelle components	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SCADA Equipment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Construction	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Turbine Foundation and Erection	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BOP Costs	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Collector Bus	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indirects and Fees	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EPC Contingency	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PV Capital Cost Breakdown							
Engineering	$1.2	N/A	N/A	N/A	N/A	N/A	N/A
Equipment and Materials		N/A	N/A	N/A	N/A	N/A	N/A
Modules	$25.8	N/A	N/A	N/A	N/A	N/A	N/A
Inverters	$3.1	N/A	N/A	N/A	N/A	N/A	N/A
Racking	$8.4	N/A	N/A	N/A	N/A	N/A	N/A
Construction (Note 16)	$25.7	N/A	N/A	N/A	N/A	N/A	N/A
Indirects and Fees	$7.1	N/A	N/A	N/A	N/A	N/A	N/A
EPC Contingency	$2.1	N/A	N/A	N/A	N/A	N/A	N/A
Battery Storage Capital Cost Breakdown							
Batteries	$8	$8	$40	$26	$34	$128	$170
Inverters	$1	$1	$3	$1	$1	$3	$3
BOP	$1	$2	$2	$1	$1	$5	$5
Construction and Indirects	$6	$6	$17	$9	$9	$27	$27
Owner's Costs, 2019 MM$	**$19**	**$9.6**	**$16**	**$16**	**$17**	**$33**	**$36**
Owner's Project Development	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Owner's Engineer	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Owner's Project Management	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Startup / Testing / Warranties	Included in EPC	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Land (Note 11)	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease	Excluded - Assumes Lease
Transmission Upgrade Costs	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded
Permitting and Licensing Fees	Included in EPC	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Switchyard / Substation (Notes 8,9,12)	$1.0M Allowance Included	$5.3M Allowance Included	$5.3M Allowance Included	$5.3M Allowance Included	$5.3M Allowance Included	$5.3M Allowance Included	$5.3M Allowance Included

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
RENEWABLE AND STORAGE TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	Solar Plus Storage	Battery Storage	Battery Storage	Battery Storage	Battery Storage	Battery Storage	Battery Storage
BASE PLANT DESCRIPTION	Single Axis Tracking	Lithium Ion	Lithium Ion	Flow Battery	Flow Battery	Flow Battery	Flow Battery
Nominal Output, MW	50 MW PV & 10 MW / 40 MWh Storage	10 MW / 40 MWh	50 MW / 200 MWh	10 MW / 60 MWh	10 MW / 80 MWh	50 MW / 300 MWh	50 MW / 400 MWh
AFUDC (Note 17)	$7.1	$1.3	$5.0	$2.9	$3.6	$13.0	$16.4
Builder's Risk Insurance	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Owner's Contingency	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included	Allowance Included
Total Project Costs, 2019 MM$	**$108**	**$26**	**$79**	**$51**	**$61**	**$195**	**$242**
EPC Cost Per kW, 2019 $/kW (plus $/kWh for Storage)	**$1,780**	**$1650 / $410**	**$1260 / $320**	**$3580 / $600**	**$4460 / $560**	**$3260 / $540**	**$4110 / $510**
Total Cost Per kW, 2019 $/kW (plus $/kWh for Storage)	**$2,160**	**$2610 / $650**	**$1580 / $390**	**$5150 / $860**	**$6140 / $770**	**$3910 / $650**	**$4830 / $600**
Fixed O&M Cost - TOTAL, 2019$MM/Yr (Notes 3-5)	**$1.5**	**$0.3**	**$0.7**	**$1.9**	**$1.9**	**$2.1**	**$2.1**
Annual Fixed Labor Cost, 2019$MM/Yr	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Equipment Maintenance Cost, 2019$MM/Yr	$0.6	$0.2	$0.5	$1.9	$1.9	$1.9	$1.9
BOP and Other Cost, 2019$MM/Yr	$0.4	Included	Included	Included	Included	Included	Included
Land Lease Allowance, 2019$MM/Yr (Notes 10,11,14)	$0.2	$0.003	$0.005	$0.01	$0.01	$0.01	$0.01
Property Tax Allowance, 2019$MM/Yr (Note 14)	$0.0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Capital Replacement Allowance, 2019$/MWh (Notes 3-5)	$0.3	$0.04	$0.20	$0.1	$0.1	$0.2	$0.2
Variable O&M Cost, 2019$/MWh (excl. major maint.) (Note 4)	$14.5 (Storage MWh Only)	$14.50	$14.50	Included in FOM	Included in FOM	Included in FOM	Included in FOM
ESTIMATED BASE LOAD OPERATING EMISSIONS, lb/MMBtu (HHV)							
NO_X	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO_2	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes

1. Wind capacity factor represents Net Capacity Factor (NCF), which accounts for typical system losses. Capacity factor is based on Vestas V125-3.45 MW turbines with 87 meter hub height and 7.0 m/s average wind speed. Offshore capacity factor is based on estimates from publicly available studies.
2. Solar capacity factor accounts for typical losses. Fixed tilt systems assumes 20 degree tilt.
3. Capital maintenance allowances for onshore wind options are not included in the annual FOM above. A supplemental table in the report shows capital allowances estimated as percentages of annual operating expenses for a 30 year life. Offshore wind O&M estimates, based on publicly available documents, include levelized capital maintenance.
4. Battery FOM assumes the site is remotely controlled. Capital costs assume the system is oversized to accommodate normal degradation, so no battery replacement fund is included. Variable O&M accounts for the parasitic power draw of the system, including HVAC and efficiency losses.
5. PV O&M estimates assume fixed contracts for all maintenance activities. It is assumed the system is remotely controlled. Capital maintenance assumes an inverter replacement allowance levelized over the first 15 years. Inverter replacement is not included in the Solar + Storage option because of 15 year project life.

6. NERC GADS performance statistics are not available for PV, battery storage, and wind technologies. Availability estimates are based on vendor correspondence and industry publications.
7. PV degradation based on typical warranty information for polycrystalline products. Assuming factory recommended maintenance is performed, PV performance is estimated to degrade ~2% in the first year and 0.5% each remaining year.
8. Battery system assumes interconnection at distribution voltage and therefore excludes GSU and switchyard.
9. EPC costs for wind include 34.5 kV collection system and GSU to 230 kV. Owner's costs include 3 position ring bus switchyard for interconnection at 230kV. EPC cost for offshore wind include HVDC line and onshore converter. Owner's costs include 3 position ring bus switchyard for interconnection at 230kV.

10. Offshore wind project assumes cost for BOEM ocean lease is included in fixed O&M.
11. Onshore wind and PV projects assume that land is leased and therefore land costs are included in O&M, not capital costs. Onshore wind assumes one acre per turbine. PV assumes seven acres per MW for fixed tilt and eight acres per MW for tracking options.
12. PV scope for EPC includes 34.5 kV collector bus and circuit breaker. Owner costs include allowance for interconnection at 34.5 kV. PV costs updated in March 2019 to reflect potential impacts of tariffs on PV panels and steel.
13. Battery storage costs are shown as $/kW and as $/kWh per industry norms.
14: Land lease and property estimates are assumed allowances.
15: Estimated Costs exclude decommissioning costs and salvage values.
16. Construction line item for PV includes Labor, Construction Materials, and miscellaneous BOP Equipment
17. AFUDC of 12.2% used for the hydro option, 10.1% for the wind options, and 8% for the solar and storage options. AFUDC percentage is based on project schedule.

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT
COAL TECHNOLOGY ASSESSMENT PROJECT OPTIONS
PRELIMINARY - NOT FOR CONSTRUCTION
December 2019

PROJECT TYPE	Supercritical Pulverized Coal with Carbon Capture	Ultra-Supercritical Pulverized Coal with Carbon Capture
BASE PLANT DESCRIPTION		
Nominal Output	500 MW Net with CCS	750 MW Net with CCS
Number of Gas Turbines	N/A	N/A
Number of Boilers/Reactors	1	1
Number of Steam Turbines	1	1
Steam Conditions (Main Steam / Reheat)	1050 F/1050F	1100 F/1100F
Main Steam Pressure	3675 psia	3694 psia
Steam Cycle Type	Supercritical	Ultra-Supercritical
Capacity Factor (%)	70%	70%
Startup Time (Cold Start)	10 Hours	10 Hours
Startup Time (Warm Start)	6 Hours	6 Hours
Startup Time (Hot Start)	4 Hours	4 Hours
Book Life (Years)	33	33
Equivalent Planned Outage Rate (%)	9.0%	8.8%
Equivalent Forced Outage Rate (%)	10.9%	8.8%
Equivalent Availability Factor (%)	79.5%	80.8%
Fuel Design	Bituminous Coal	Bituminous Coal
Heat Rejection	Wet Cooling Tower	Wet Cooling Tower
NO_x Control	Low NOx burners / SCR	Low NOx burners / SCR
SO_2 Control	Integrated WFGD and DFGD	Integrated WFGD and DFGD
Acid Gas Control	Integrated WFGD and DFGD	Integrated WFGD and DFGD
CO_2 Control	Advanced Amine	Advanced Amine
Particulate Control	Baghouse	Baghouse
Ash Disposal	Landfill	Landfill
Technology Rating	Mature	Mature
Permitting & Construction Schedule (Years from FNTP)	6.5 Years	6.5 Years
ESTIMATED PERFORMANCE		
Base Load Performance @ (Annual Average) w/ Carbon Capture		
Net Plant Output, kW	505,750	747,100
Net Plant Heat Rate, Btu/kWh (HHV)	11,290	10,480
Heat Input, MMBtu/h (HHV)	5,710	7,830
Minimum Load Operational Status @ (Annual Average)		
Net Plant Output, kW	177,010	298,840
Net Plant Heat Rate, Btu/kWh (HHV)	13,410	12,240
Heat Input, MMBtu/h (HHV)	2,370	3,660

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT COAL TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019		
PROJECT TYPE	**Supercritical Pulverized Coal with Carbon Capture**	**Ultra-Supercritical Pulverized Coal with Carbon Capture**
ESTIMATED CAPITAL AND O&M COSTS		
EPC Project Capital Costs, 2019 MM$ (w/o Owner's Costs)	**$2,609**	**$3,523**
Owner's Costs, 2019 MM$	**$612**	**$780**
Owner's Project Development	$7.5	$7.5
Owner's Operational Personnel Prior to COD	$7.7	$7.7
Owner's Engineer	$11.5	$11.5
Owner's Project Management	$10.0	$10.0
Owner's Legal Costs	$3.0	$3.0
Owner's Start-up Engineering	$0.4	$0.4
Land	$5.0	$5.0
Operator Training	$0.6	$0.6
Construction Power and Water	$3.6	$3.6
Permitting and Licensing Fees	$4.0	$4.0
Switchyard	$10.1	$10.1
Political Concessions & Area Development Fees	$2.5	$2.5
Startup/Testing (Fuel & Consumables)	$30.1	$30.1
Initial Fuel Inventory	$16.8	$16.8
Site Security	$0.6	$0.6
Operating Spare Parts	$8.2	$8.2
Water Supply Infrastructure	Included in Project Capital	Included in Project Capital
Natural Gas Supply Infrastructure	N/A	N/A
Transmission Interconnect	$2.0	$3.0
Transmission Upgrade Costs	Excluded	Excluded
Firm Gas Supply Reservation Charge	Provided by Owner	Provided by Owner
Permanent Plant Equipment and Furnishings	$4.6	$4.6
AFUDC (12.2% of EPC Project Capital Costs)	$318.3	$429.8
Builders Risk Insurance (0.45% of Construction Costs)	$11.7	$15.9
Owner's Contingency (5% for Screening Purposes)	$153	$205
Total Project Costs, 2019 MM$	**$3,220**	**$4,302**
EPC Cost Per kW, 2019 $/kW	**$5,158**	**$4,715**
Total Cost Per kW, 2019 $/kW	**$6,370**	**$5,760**

VECTREN 2019 IRP TECHNOLOGY ASSESSMENT COAL TECHNOLOGY ASSESSMENT PROJECT OPTIONS PRELIMINARY - NOT FOR CONSTRUCTION December 2019		
PROJECT TYPE	**Supercritical Pulverized Coal with Carbon Capture**	**Ultra-Supercritical Pulverized Coal with Carbon Capture**
CO_2 Transportation and Geologic Sequestration (See note 4)		
50 Mile Pipeline Cost, 2019 MM$	$122	$122
CO_2 Pipeline Maintenance ($/MWh)	$3.52	$3.52
CO_2 Storage Cost ($/MWh)	$9.14	$9.14
Fixed O&M Cost, 2019$/kW-Yr	$29.10	$29.10
Fixed O&M Cost, 2019 $MM/Yr	$14.70	$21.70
Major Maintenance Cost, 2019$/MWh	$5.20	$5.20
Variable O&M Cost, 2019$/MWh (excl. major maint.)	$11.20	$11.20
ESTIMATED BASE LOAD OPERATING EMISSIONS (NO CCS), lb/MMBtu (HHV)		
NO_X	0.02	0.02
SO_2	0.02	0.02
CO	0.15	0.15
CO_2	100	100

Notes
Note 1: PC cost and performance are based on net performance inclusive of carbon capture.
Note 2: The PC unit assumes that cooler tower blowdown is recycled in the wet FGD.
Note 3: The PC unit assumes a spray dry absorber will be used to control acid gases. FGD purge will be recycled in the SDA.
Note 4: Carbon transportation and sequestration assumes 50 mile pipeline to a suitable subterranean reservoir.
Note 5: Outage and availability statistics are collected using the NERC Generating Availability Data System. Reporting period is those units that reported evenings between 2013-2017.

Attachment 3.1 Stakeholder Materials

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VECTREN PUBLIC STAKEHOLDER MEETING

AUGUST 15, 2019

WELCOME, INTRODUCTION TO CENTERPOINT, AND SAFETY SHARE

LYNNAE WILSON

INDIANA ELECTRIC CHIEF BUSINESS OFFICER

SAFETY SHARE

Know your exits

- Whenever you are entering a public area or a guest in a facility such as this, always know your exits. Take note of the signs
- There are two emergency exits, immediately behind me, Additionally, there are exit doors directly behind you – once through the door, to the left is the main entrance into the building. Should the main entrance be blocked there is an exit to the right of this room through a set of doors leading to the loading dock area

Visualize for safety

- When you enter a new space, visualize that an emergency – like a fire, bad weather, or an earthquake – could happen there and consider how you can respond
- The best way is to prepare to respond to an emergency before it happens. Few people can think clearly and logically in a crisis, so it is important to do so in advance, when you have time to be thorough

  Fire

  - Evacuate the building and move to the back of the Vectren parking lot, near the YWCA

  Bad Weather

  - During a tornado warning, stay away from windows, glass doors, and outside walls
  - Move in an orderly fashion to the stairwell, just outside of the lobby in the main entrance way

  Earthquake

  - Move under the desk where you are sitting, facing away from glass, and cover your head and face
  - Once shaking has subsided, move in an orderly fashion towards the nearest exit and move to the back of the Vectren parking lot, near the YWCA

OUR BUSINESSES

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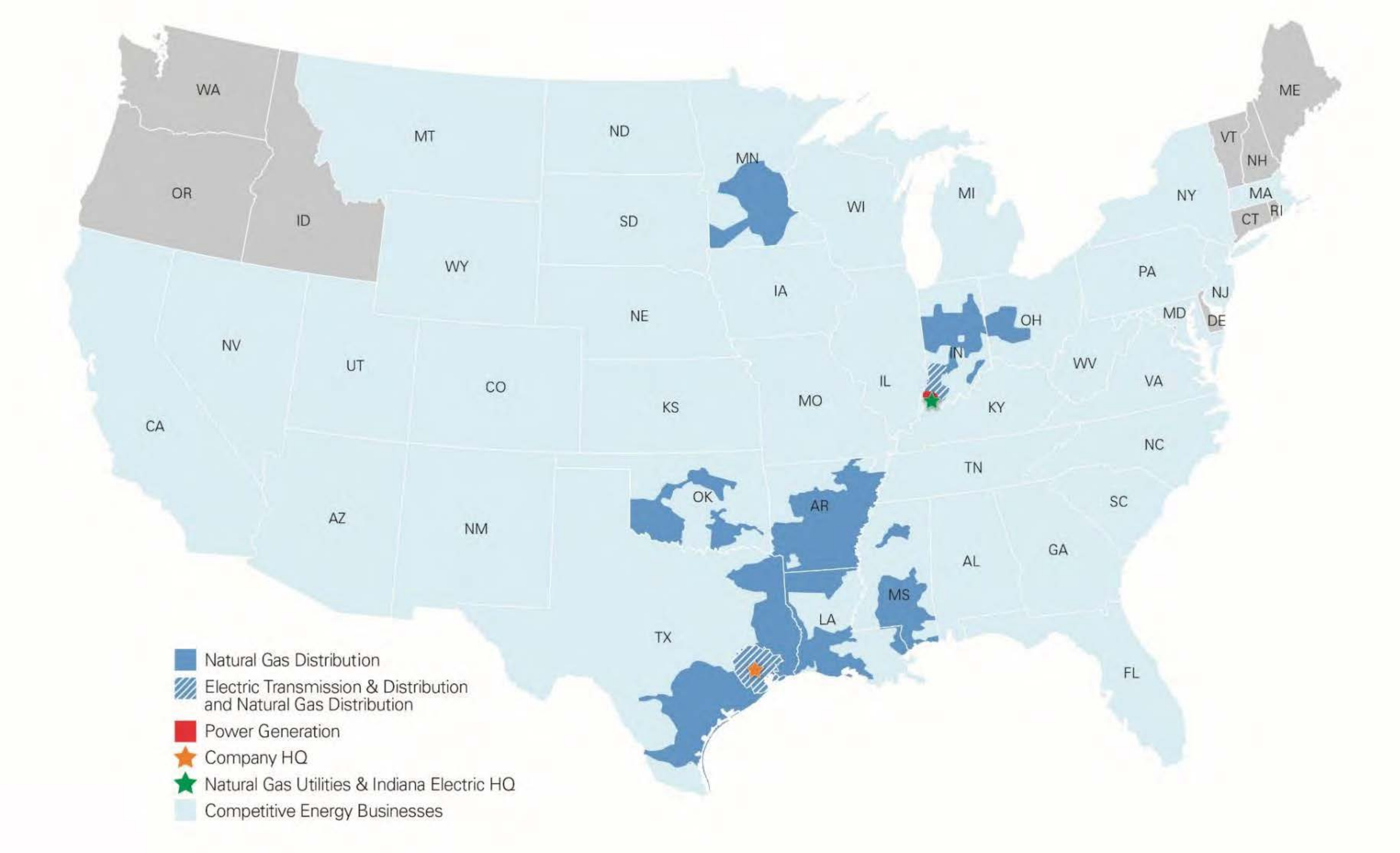

AGENDA

Time		
9:00 a.m.	Sign-in/Refreshments	
9:30 a.m.	Welcome, Safety Message	Lynnae Wilson, CenterPoint Energy Indiana Electric Chief Business Officer
9:45 a.m.	2019/2020 IRP Process	Matt Rice, Vectren Manager of Resource Planning and Gary Vicinus, Managing Director for Utilities, Pace Global
10:35 a.m.	Break	
10:45 a.m.	Objectives & Measures Workshop	Gary Vicinus, Managing Director for Utilities, Pace Global
11:30 a.m.	Lunch	
12:15 p.m.	All-Source RFP	Matt Lind, Resource Planning & Market Assessments Business Lead, Burns and McDonnell
1:00 p.m.	Environmental Compliance Update	Angila Retherford, CenterPoint Energy, Vice President Environmental Affairs and Corporate Responsibility
1:35 p.m.	Break	
1:45 p.m.	Draft Base Case Market Inputs and Scenarios Workshop	Gary Vicinus, Managing Director for Utilities, Pace Global
2:30 p.m.	Stakeholder Questions and Feedback	Moderated by Gary Vicinus, Managing Director for Utilities, Pace Global
3:00 p.m.	Adjourn	

MEETING GUIDELINES

1. Please hold most questions until the end of each presentation. Time will be allotted for questions following each presentation. (Clarifying questions about the slides are fine throughout)
2. For those on the webinar, we will open the (currently muted) phone lines for questions within the allotted time frame. You may also type in questions via the chat feature. Only questions sent to 'All-Entire Audience' will be seen and answered during the session.
3. At the end of the presentation, we will open up the floor for "clarifying questions," thoughts, ideas, and suggestions.
4. There will be a parking lot for items to be addressed at a later time.
5. Vectren does not authorize the use of cameras or video recording devices of any kind during this meeting.
6. Questions asked at this meeting will be answered here or later.
7. We will do our best to capture notes but request that you provide written feedback (concepts, inputs, methodology, etc.) at IRP@CenterPointEnergy.com following the meeting. Additional questions can also be sent to this e-mail address.

2019/2020 IRP PROCESS

MATT RICE

VECTREN MANAGER OF RESOURCE PLANNING

DIRECTOR'S REPORT FEEDBACK

Improvement Opportunities	Positive Comments
Include lower and higher boundary scenarios to create a wider range of portfolios	Significant improvements in all aspects of the IRP
Model a wide range of portfolios	Use of state-of-the art models
Strategist model did not consider enough options simultaneously	A collegial stakeholder process with a concerted efforts to broaden stakeholder participation
Update risk analysis methodology to be less qualitative and more encompassing of known risks	Appropriate use of short, mid, and long term breaks in forecasts
Explore other options for modeling EE cost options and make greater use of a Market Potential Study (MPS)	Being credible and well-reasoned, with narratives that were clear
More consideration given to Warrick unit 4 in scenario development	Maintaining optionality in the plan
Clearly define risk analysis methodology	Commendable use of multiple fuel prices
Clearly define Energy Efficiency Methodology	Top management participation

ADDITIONAL DIRECTOR'S REPORT GUIDANCE

The director had five specific requests of all utilities that should be incorporated into IRPs

- Greater use of tables
- Easier comparisons for scenario assumptions
- List of technical modeling constraints
- Expanded use of graphics
- Solicit stakeholder inputs and improve the exploratory nature of IRPs

IURC ORDER 45052

- Vectren selected a Combined Cycle Gas Turbine (CCGT) that was too large for a small utility
  - Did not adequately consider flexibility to change paths, adding stranded asset risks
  - Did not consider fuel or geographic diversity
- Risk analysis did not consider the full range of portfolios
  - Did not fully explore options at the Brown plant (conversion or scrubber alternatives)
  - Need to more fully consider customer-generator opportunities
  - Did not fully consider energy and capacity purchases
  - Did not consider smaller gas plant options in the risk analysis
- Vectren's analysis disadvantaged renewable resources
  - Vectren did not make a serious effort to determine the price and availability of renewables
  - The RFP was too restrictive
- Vectren did not fully respond to the Director's report critiques in updated CPCN analysis
  - Did not update the risk modeling
  - Did not consider the full range of gas prices (including methane regulation)

Other Items to Note

- Acknowledged that Vectren needs to act swiftly to develop our 2019 IRP to meet the 2023 constraints
- DSM was compared on a consistent and comparable basis with supply side alternatives

VECTREN COMMITMENTS FOR 2019/2020 IRP

- Will strive to make every encounter meaningful for stakeholders and for us
- Will provide a data release schedule and provide modeling data ahead of filing for evaluation
- The IRP process informs the selection of the preferred portfolio
- Utilize an All-Source RFP to gather market pricing & availability data
- Use one model for consistency in optimization, simulated dispatch, and probabilistic functions
- Attempt to model more resources simultaneously
- Will include a balanced, less qualitative risk score card. Draft to be shared at the first public stakeholder meeting
- Work with stakeholders on portfolio development
- Will test a wide range of portfolios in scenario modeling and ultimately in the risk analysis
- Will conduct a sensitivity analysis
- Exhaustive look at existing resource options
- The IRP will include information presented for multiple audiences (technical and non-technical)

KEY DIFFERENCES FROM 2016 APPROACH

2016	2019/2020
Utilized technology assessment information	All-Source RFP, supplemented with technology assessment information
Discussed objectives, risks, and provided example of potential metrics. Showed scorecard and final metrics in the last stakeholder meeting	Will show objectives, metrics, and gather feedback on scorecard early in the process
Built 15 portfolios for the risk analysis, including continuing use of coal plants, least cost portfolios, diversified portfolios, and stakeholder portfolios	Work with stakeholders to build a wide range of portfolios to be tested in the risk analysis. Utilize models to develop least cost portfolios for various portfolio strategies
Other than the continue coal portfolio, alternatives such as gas conversion or repower options did not ultimately make it into the risk analysis	More exhaustive look at viability of existing units, and include in the risk analysis
Utilized scenario modeling to create computer generated portfolios. Essentially used as a screening tool for the risk analysis	Utilize scenarios to evaluate regulatory risk, with simulated dispatch for a wide range of portfolios
No sensitivity analysis	Will include a sensitivity analysis on various risks, utilizing data from probabilistic modeling. EE Sensitivity.
Modeled 8 blocks of EE up to 2% of sales. Costs based on EIA penetration model. EE selection was binary (selected for full period or not)	Will model EE bins of varying sizes and timeframes. Ties directly to MPS with costs based in empirical data and historical experience
Did not provide modeling data until after IRP was filed	Will provide modeling data throughout the process
Utilized two IRP models (Strategist & Aurora)	Moving to Aurora for all IRP modeling

PROPOSED 2019/2020 IRP PROCESS

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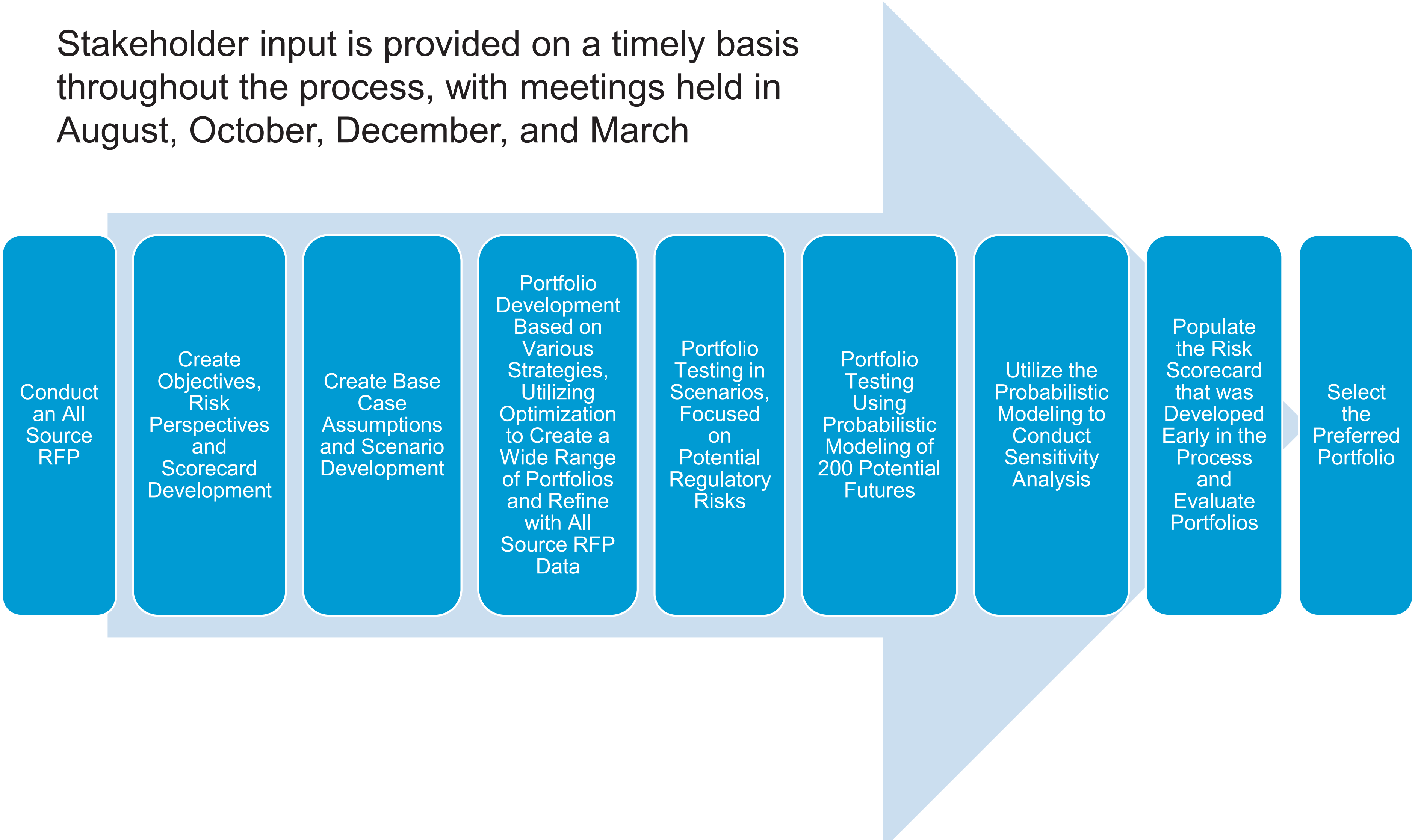
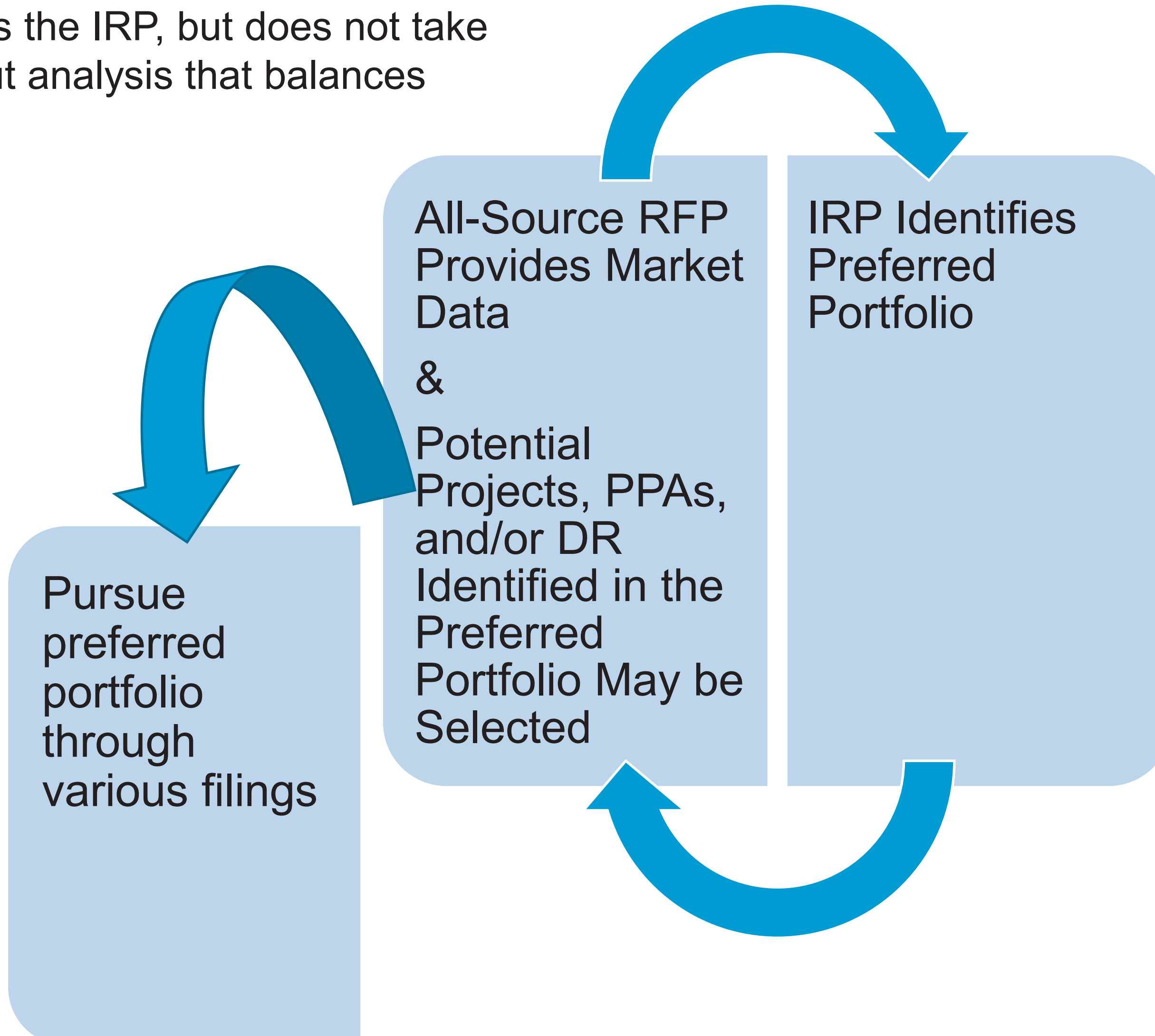
Stakeholder input is provided on a timely basis throughout the process, with meetings held in August, October, December, and March



ROLE OF THE ALL-SOURCE RFP

The All-Source RFP informs the IRP, but does not take the place of well thought out analysis that balances multiple objectives

- Average delivered cost by resource will inform modeling
- Resources to be modeled on a tiered basis
- The full IRP analysis, including risk analysis, will test a diverse set of resource mixes and will ultimately identify a preferred portfolio
- Vectren will pursue resources consistent with those identified in the preferred portfolio



KEY VENDORS

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RFP

- Burns and McDonnell
  - Draft RFP
  - Post
  - Interpret and align bids
  - Bid risk assessment
  - Convert into modeling inputs
  - Further evaluation on viable projects
  - Transmission analysis where needed

IRP

- Pace
  - Moderation of stakeholder meetings
  - Strategy (assist with stakeholder engagement, scenario, portfolio, objectives, & metrics development)
  - Deterministic modeling (determined scenarios)
  - Probabilistic modeling
  - Sensitivity analysis
  - Risk assessment and scorecard

File May 1, 2020

2019/2020 STAKEHOLDER PROCESS

August 15, 2019	October 10, 2019	December 12, 2019	March 19, 2020
• 2019/2020 IRP Process • Objectives and Measures • All-Source RFP • Environmental Update • Draft Base Case Market Inputs & Scenarios	• RFP Update • Draft Resource costs • Sales and Demand Forecast • DSM MPS/ Modeling Inputs • Scenario Modeling Inputs • Portfolio Development	• Draft Portfolios • Draft Base Case Modeling Results • All-Source RFP Results and Final Modeling Inputs • Probabilistic Modeling Approach and Assumptions	• Final Base Case Modeling • Probabilistic Modeling Results • Risk Analysis Results • Preview the Preferred Portfolio

FEEDBACK AND DISCUSSION

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OBJECTIVES & MEASURES

GARY VICINUS

MANAGING DIRECTOR FOR UTILITIES, PACE GLOBAL

IRP OBJECTIVES & MEASURES

The purpose of the IRP is to evaluate Vectren's current energy resource portfolio and a range of alternative future portfolios to meet customers' electrical energy needs in an affordable, system-wide manner

In addition, the IRP process evaluates portfolios in terms of environmental stewardship, market and price risk, and future flexibility, system flexibility to provide backup resources, reliability, and resource diversity

Each objective is important and worthy of balanced consideration in the IRP process, taking into account uncertainty. Some objectives are better captured in portfolio construction than as a portfolio measure

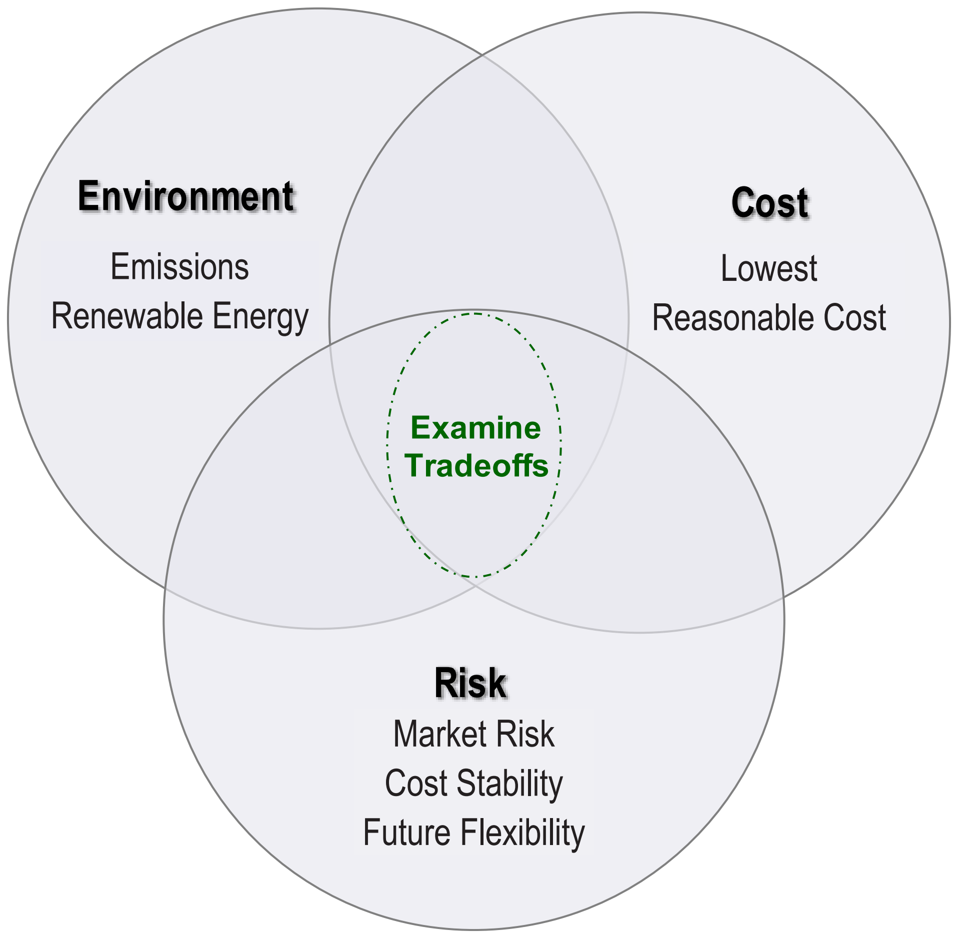
The measures allow the analysis to compare portfolio performance and potential risk on an equal basis

Quantitative IRP Objectives
Affordability
Environmental Risk Minimization
Price Risk Minimization
Market Risk Minimization
Future Flexibility

Qualitative IRP Objectives
Resource Diversity
System Flexibility

EACH PORTFOLIO WILL HAVE TRADEOFFS

Customer Perspective



IRP OBJECTIVES & MEASURES

For each resource portfolio, the objectives are tracked and measured to evaluate portfolio performance in the base case, in four alternative scenarios, and across a wide range of possible future market conditions. All measures of portfolio performance are based on probabilistic modeling of 200 futures

Objective	Measure	Unit
Affordability	20-Year NPVRR	$
Price Risk Minimization	95th percentile value of NPVRR	$
Environmental Risk Minimization	CO_2 Emissions	tons
Market Risk Minimization	Energy Market Purchases or Sales outside of a +/- 15% Band	%
	Capacity Market Purchases or Sales outside of a +/- 15% Band	%
Future Flexibility	MWh of impairment by asset	MWh

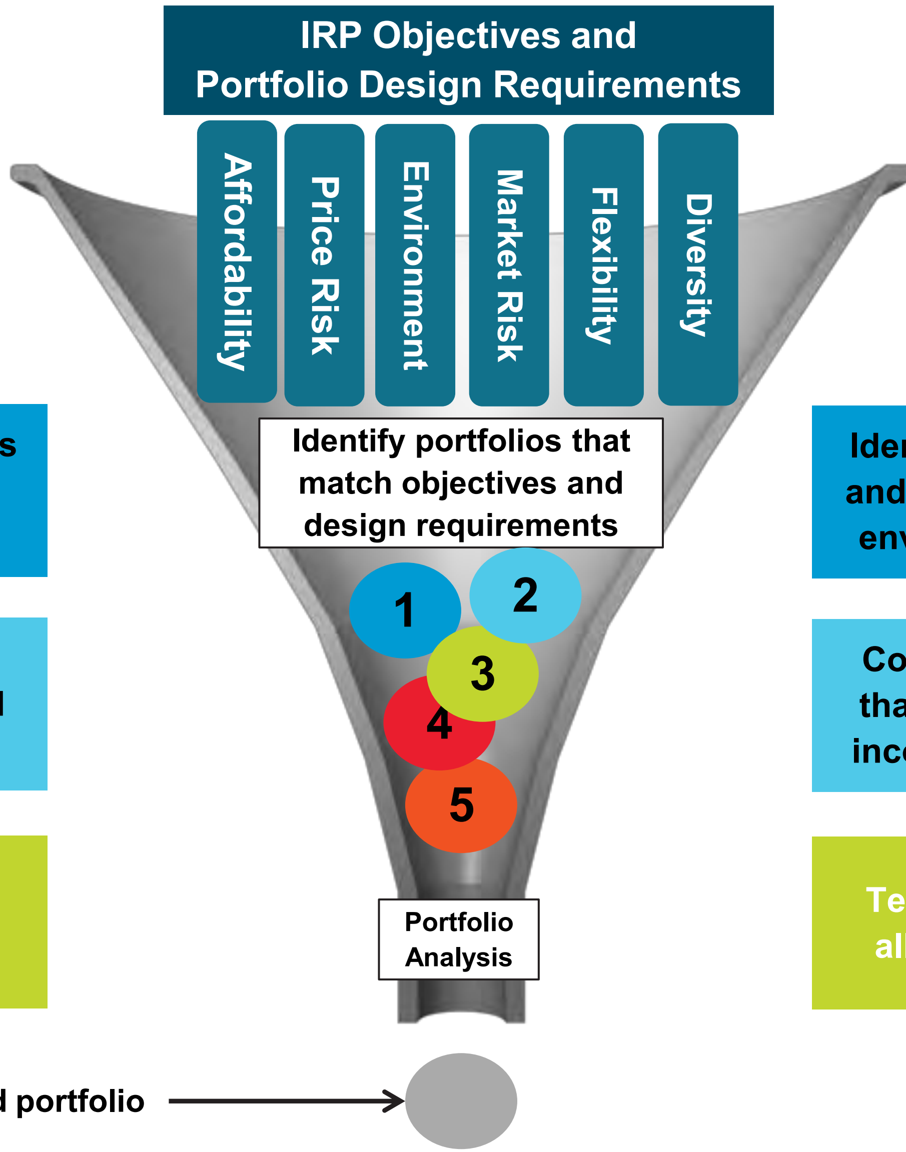
SCREENING PORTFOLIO PERFORMANCE

Task

Screen portfolio options for objectives and design requirements

Combine individual options into integrated portfolios

Perform risk analysis



Select preferred portfolio

Approach

Identify design requirements and rank options by cost and environmental performance

Construct portfolio options that meet requirements and incorporate strategy options

Test each portfolio against all objectives & measures

FEEDBACK AND DISCUSSION

ALL-SOURCE RFP UPDATE

MATT LIND,

RESOURCE PLANNING & MARKET ASSESSMENTS BUSINESS LEAD, BURNS AND MCDONNELL

OVERVIEW

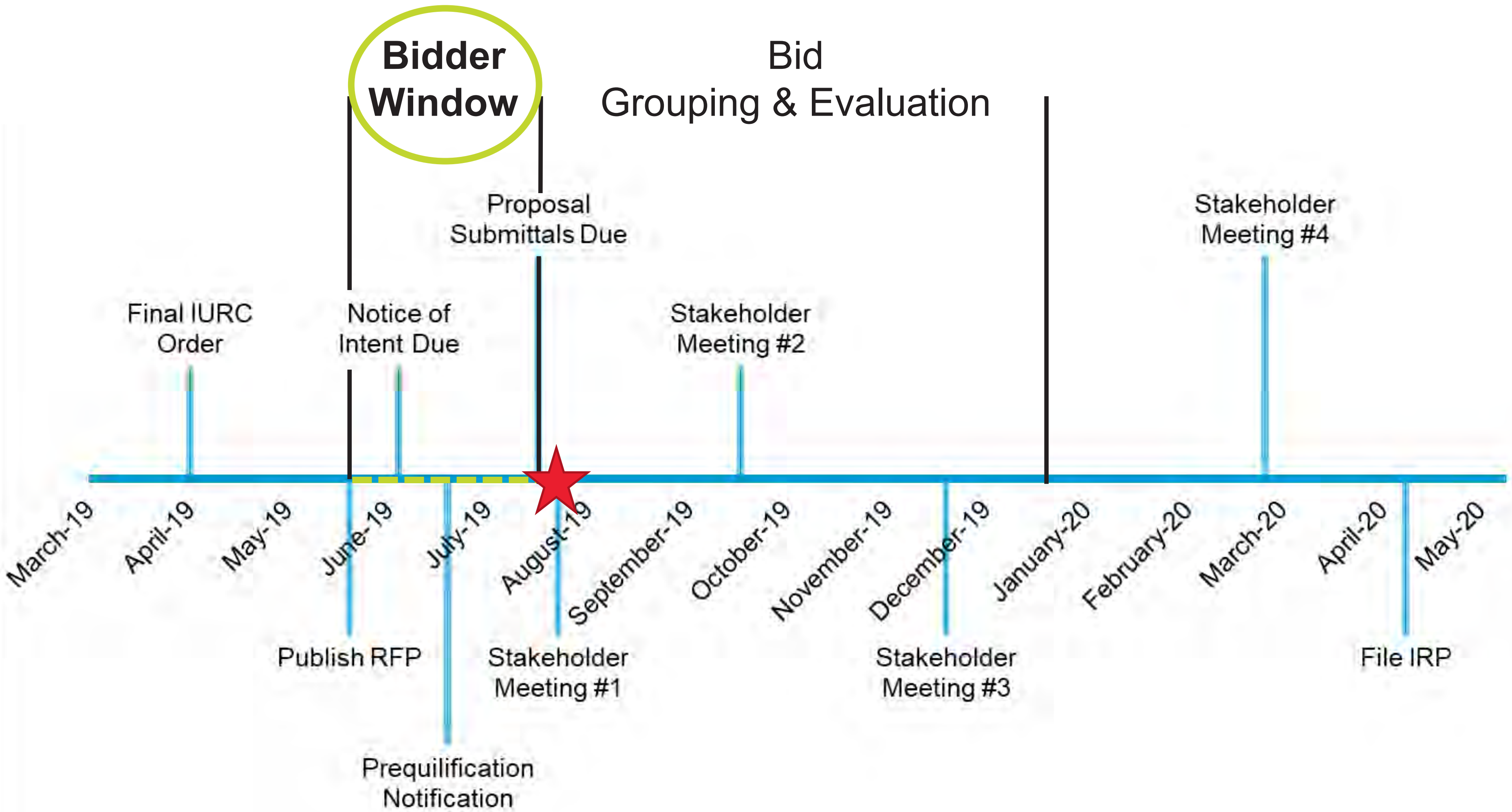
- 2016 IRP:
  - Identified capacity and energy shortfall beginning in 2023
  - Potential need of ~700 MW accredited capacity
- 2019/2020 IRP:
  - Must examine existing resources alongside alternatives
  - Potentially a similar need
- 2019 All-Source RFP:
  - Feed IRP inputs
  - Identify potential cost effective resources

ALL-SOURCE RFP KEY DATES

Event	Anticipated Date*
All-Source RFP Issued	Wednesday, June 12, 2019
Notice of Intent (NOI), All-Source RFP NDA, and Respondent Pre-Qualification Application Due	5:00 p.m. CDT Thursday, June 27, 2019
Respondents Notified of Results of Pre-Qualification Application Review	5:00 p.m. CDT ~~Wednesday, July 3, 2019~~ Friday, July 12, 2019
Proposal Submittal Due Date	**5:00 p.m. CDT** ~~**Wednesday, July 31, 2019**~~ **Friday, August 9, 2019**
Initial Proposal Review and Evaluation Period	August - September 2019
Interconnection Evaluation	August - October 2019
Congestion Evaluation	4^{th} Quarter, 2019
Inputs to IRP	4^{th} Quarter, 2019

*Negotiation schedule for smaller projects can be expedited at Vectren's discretion

TIMELINE


Bidder Window
Bid Grouping & Evaluation
Proposal Submittals Due
Stakeholder Meeting #4
Final IURC Order
Notice of Intent Due
Stakeholder Meeting #2
March-19
April-19
May-19
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August-19
September-19
October-19
November-19
December-19
January-20
February-20
March-20
April-20
May-20
Publish RFP
Stakeholder Meeting #1
Stakeholder Meeting #3
File IRP
Prequilification Notification

ALL-SOURCE RFP PUBLICATION & DISTRIBUTION

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- Ad published in Megawatt Daily (~20,000 recipients)
- North American Energy Markets Association (NAEMA) distribution (150 members)
- Published in June 2019 Midwest Energy Efficiency Alliance (MEEA) Minute (161 members)
- Included on Vectren.com
- Sent to participants in Vectren's 2017 RFP
- BMcD RFP contact list (>450 industry contacts)
- Vectren stakeholders & industry contacts
- Interviews with Evansville Courier & Press

REQUEST FOR PROPOSALS

Vectren Energy Delivery (Vectren), a subsidiary of CenterPoint Energy, is issuing this

All-Source

Request for Proposals (RFP) targeting

10 to 700 MW

of capacity and unit-contingent energy to meet the needs of its customers.

Bids are due by Wednesday, July 31, 2019. The RFP documents, schedule, and other RFP information can be found at: http://VectrenRFP.rfpmanager.biz/

Vectren has retained Burns & McDonnell to act as its agent in managing the RFP process. All RFP inquiries and communications are to be made via e-mail: VectrenRFP@burnsmcd.com

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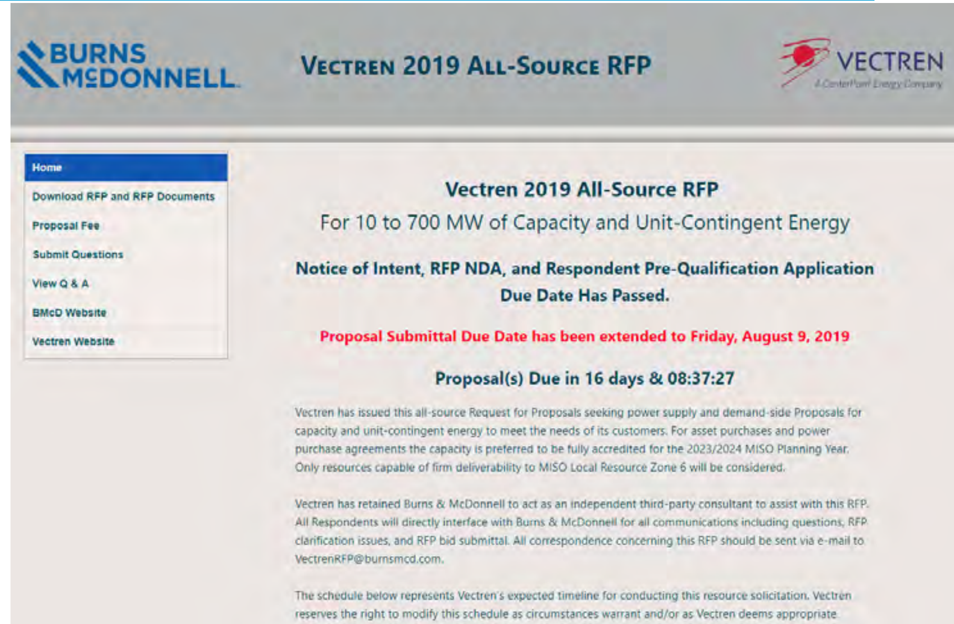
BURNS & McDONNELL

WEBSITE: HTTP://VECTRENRFP.RFPMANAGER.BIZ/

VECTREN
A CenterPoint Energy Company

- RFP document downloads
  - 142 unique people
  - 107 companies
- Website visits (June 12th-July 31st)
  - ~800 users
  - ~3,000 pageviews
- Question & Answers posted


BURNS McDONNELL

VECTREN 2019 ALL-SOURCE RFP

VECTREN
A CenterPoint Energy Company

- Home
- Download RFP and RFP Documents
- Proposal Fee
- Submit Questions
- View Q & A
- BMcD Website
- Vectren Website

Vectren 2019 All-Source RFP

For 10 to 700 MW of Capacity and Unit-Contingent Energy

Notice of Intent, RFP NDA, and Respondent Pre-Qualification Application Due Date Has Passed.

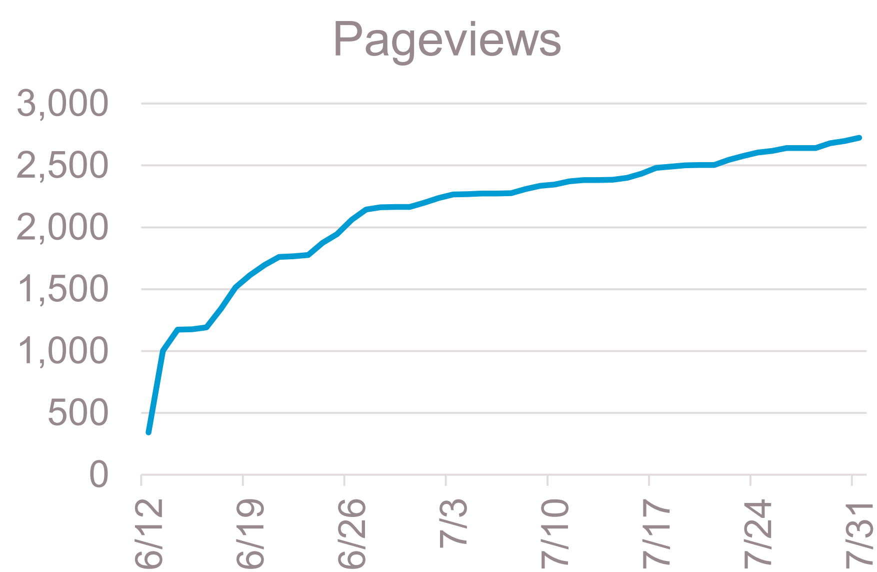
Proposal Submittal Due Date has been extended to Friday, August 9, 2019

Proposal(s) Due in 16 days & 08:37:27

Vectren has issued this all-source Request for Proposals seeking power supply and demand-side Proposals for capacity and unit-contingent energy to meet the needs of its customers. For asset purchases and power purchase agreements the capacity is preferred to be fully accredited for the 2023/2024 MISO Planning Year. Only resources capable of firm deliverability to MISO Local Resource Zone 6 will be considered.

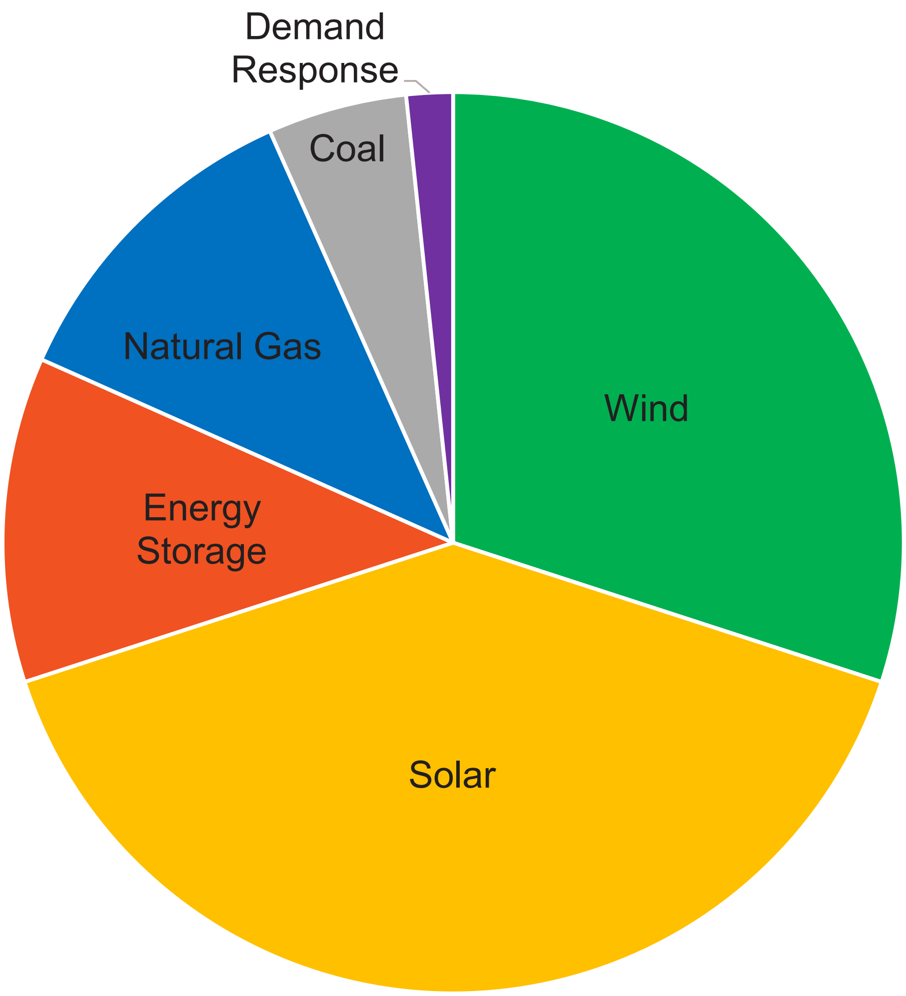
Vectren has retained Burns & McDonnell to act as an independent third-party consultant to assist with this RFP. All Respondents will directly interface with Burns & McDonnell for all communications including questions, RFP clarification issues, and RFP bid submittal. All correspondence concerning this RFP should be sent via e-mail to VectrenRFP@burnsmcd.com.

The schedule below represents Vectren's expected timeline for conducting this resource solicitation. Vectren reserves the right to modify this schedule as circumstances warrant and/or as Vectren deems appropriate.



ALL-SOURCE RFP PARTICIPATION

- 32 companies submitted Notice of Intent (NOI)



TYPES OF RESOURCES CONSIDERED

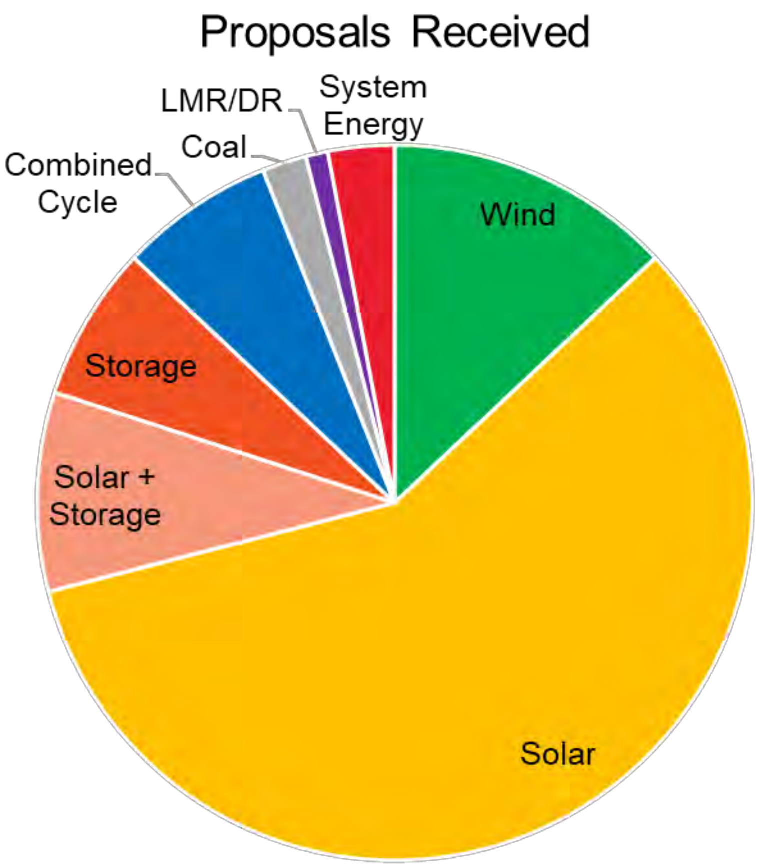
- Open, non-limiting All-Source RFP
  - Asset purchase or power purchase agreement (PPA)
    - Existing or planned dispatchable generation
    - Existing or planned utility scale renewable resources
    - Existing or planned utility scale storage facilities, either stand-alone or paired with renewables
  - Load modifying resource (LMR)/Demand Resource (DR)
    - In Local Resource Zone 6 (LRZ6)
    - Proposals outside of Vectren's service territory are only eligible for capacity

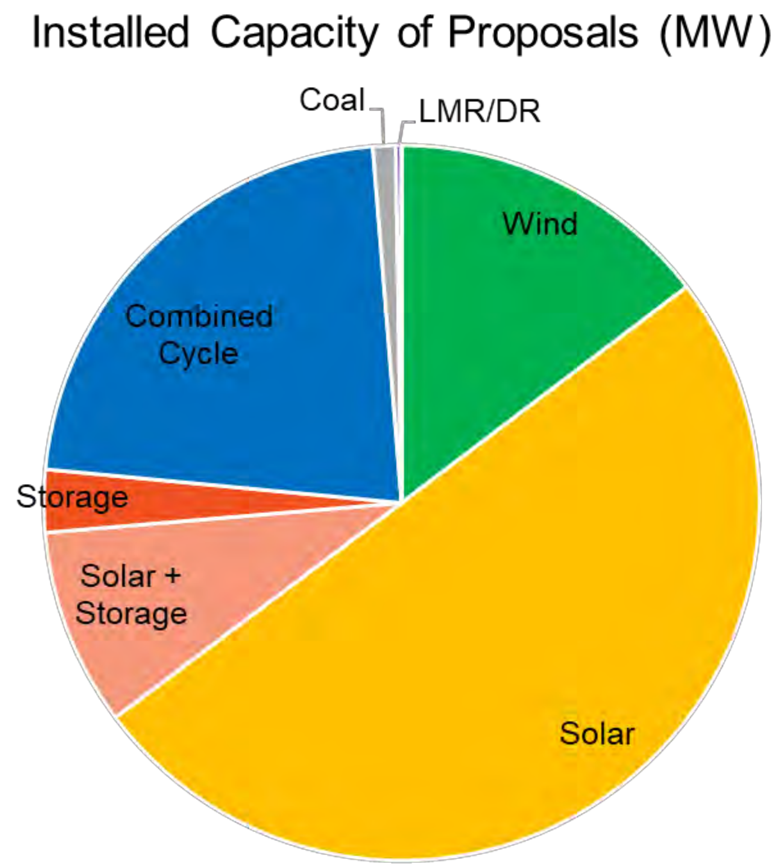
PROPOSAL REQUIREMENTS

- MISO accredited or accreditable capacity (including Zonal Resource Credits) of no less than 10 MW to MISO LRZ 6
- Submittal forms (NOI, NDA, Pre-Qualification Application)
- 1-year pricing guarantee (from Proposal Submittal Due Date)
- Credit worthy bidders
- Respondent information and experience
- Facility information (Appendix D)
- Remaining life of at least 5 years from acquisition date for asset purchase

PRELIMINARY* RFP STATISTICS

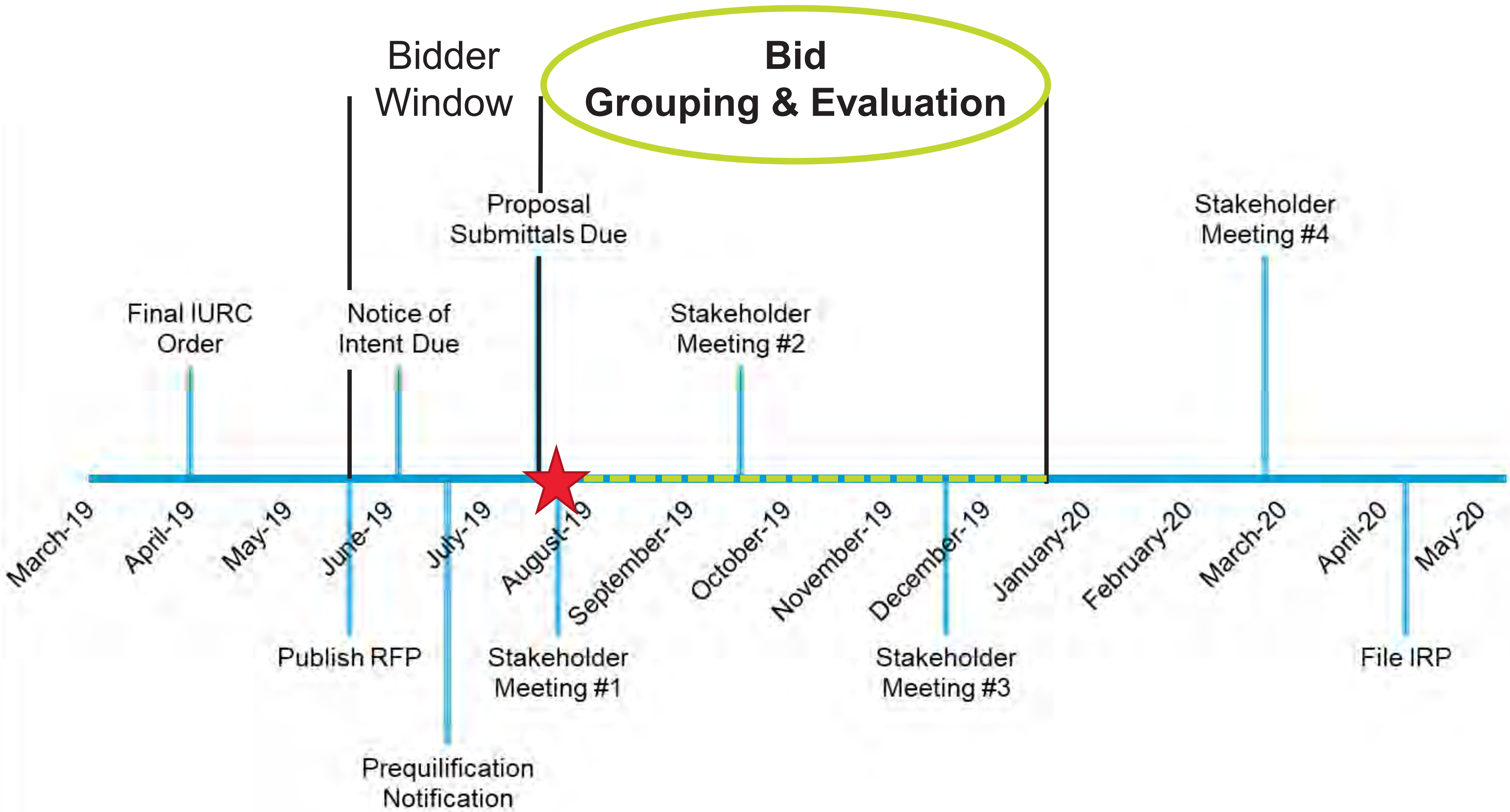
- 100 Proposals from 22 Respondents (4/5 in Indiana, 2/3 are PPA)





*Proposals received 4 business days ago. Follow-up and clarification process with respondents is ongoing.

TIMELINE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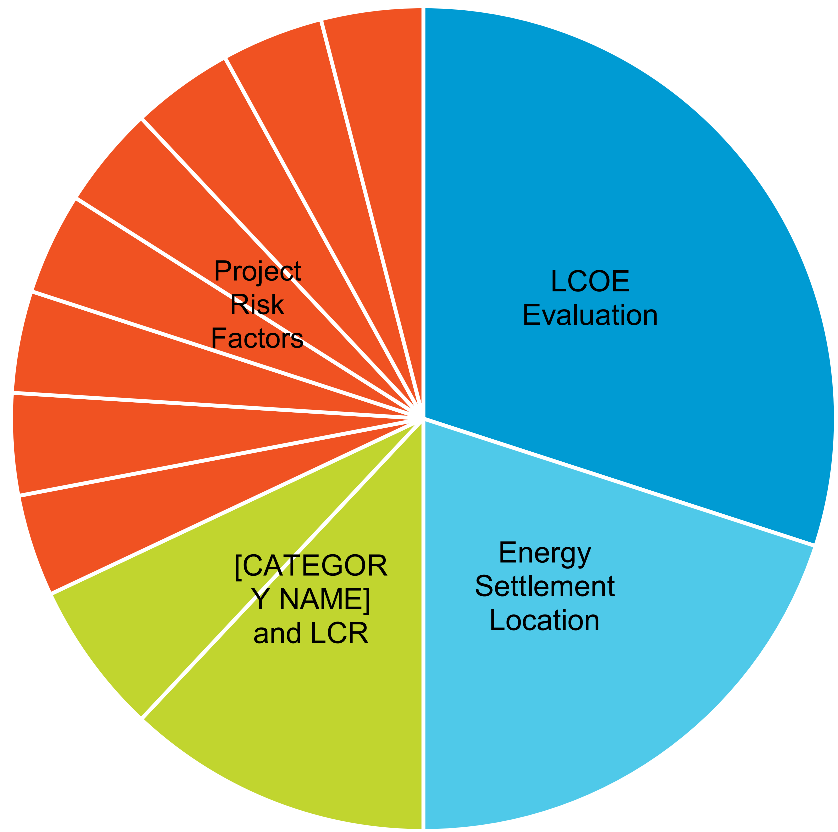
PROPOSAL EVALUATION

- Proposals will be grouped with similar proposals and scored relative to other bids within the same grouping
  - The preferred resource mix will be identified by the IRP analysis
  - All-Source RFP evaluation will rank order available resources within each grouping

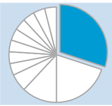
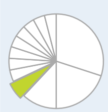
Rank	Illustrative Resource Groupings						
1	Solar	Wind	Storage	Coal	Gas	Demand Response	etc.
2							
3							
4							
5							
6							
7							
8							

500 Total Points*

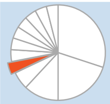
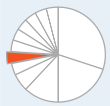
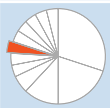
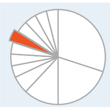
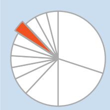
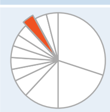
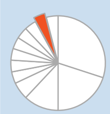
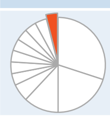


*Vectren reserves the right to add up to 100 points to Proposals located in Southern Indiana (generally defined as the following counties within Vectren's service territory; Dubois, Gibson, Pike, Posey, Spencer, Vanderburgh, and Warrick), as local resources provide multiple benefits: VAR support, economic development, less future congestion risk, etc.

EVALUATION SUMMARY

Scoring Criteria Name	Points		Scoring Method	Definition	Importance
LCOE Evaluation	150		Curve	$/MWh calculation within asset class	An LCOE evaluation comparing similar resource groups will help to show which Project(s) may provide lower cost energy to Vectren's customers.
Energy Settlement Location	100		Binary	Proposals that include all costs to have energy financially settled or directly delivered to Vectren's load node (SIGE.SIGW)	Having financial settlement or direct delivery to Vectren's load node provides Project's true resource cost to Vectren's customers, eliminating risks/costs associated with the delivery of energy.
Interconnection and Development Status	60		Binary	Executed a pro-forma MISO Service Agreement and Interconnection Construction Services Agreement (12 points) Completed a MISO Facilities Study (12 points) Completed a MISO System Impact Study (12 points) Achieved site control and completed zoning requirements (12 points) EPC Contract awarded (12 points)	These points are for completion of various critical milestones in the interconnection and development process. Projects which are further through the interconnection and development process will receive more points as cost certainty improves.
Local Clearing Area Requirement	30		Binary	Physically and electrically located in LRZ 6	Being located in LRZ 6 provides greater certainty that asset capacity can be deliverable to Vectren and fall within LCR requirements through entire life or contract term.

EVALUATION SUMMARY

Scoring Criteria Name	Points		Scoring Method	Definition	Importance
Credit and Financial Plan	20		Curve	Vectren will be reviewing the credit rating and financing capabilities in relation to a Bidder's Project	Projects which lack the financial wherewithal to ensure development pose a significant risk to Vectren and their customers.
Development Experience	20		Curve	Scored based on 1,500 MW of relevant development experience	Relevant technology experience is important when looking at asset purchases or PPA's for facilities which are not in service. A Bidder's track record of project completion is a benefit to the Project's scoring.
Sole Ownership/ Partial Owner	20		Binary	Being a sole owner would allow full site and dispatch rights/preferences	Being able to solely own, operate, and maintain a Project lowers risks for Vectren and their customers.
Ownership Structure (Purchase/PPA)	20		Binary	Vectren has a preference for ownership	Owning an asset and having control with regards to dispatch, maintenance, and operation of the facility lowers risks for Vectren and their customers.
Operational Control	20		Binary	Dispatch parameters used for the scheduling of energy into MISO and approval for maintenance outage periods	Operational control provides the ability to make prudent operational decisions when it makes economic sense for Vectren's customers.
Fuel Risk	20		Binary	Sites having firm and reliable fuel supply	Having fuel restrictions or a lack of reliable fuel could effect the operation of the Project and be a risk to the owner/off taker.
Delivery Date	20		Curve	For each year prior or after MISO PY 2023/2024, 25% of the points will be deducted	To the extent resources are brought on-line before potential Vectren unit retirements, Vectren customers could pay for duplicative capacity and/or energy; while there may be reasons to proceed with such projects, in recognition of their incremental costs, it is appropriate for such projects to not score as well in terms of timing.
Site Control	20		Binary	Proper rights to the site in which the facility will be located	Without proper permitting and permissions from the owner, there is a risk that the project may not move forward or could experience significant delays.

LMR/DR - PROPOSAL EVALUATION

- Proposals will be grouped with similar proposals and scored relative to other bids within the same grouping
  - The preferred resource mix will be identified by the IRP analysis
  - All-Source RFP evaluation will rank order available resources within each grouping

Rank	Illustrative Resource Groupings						
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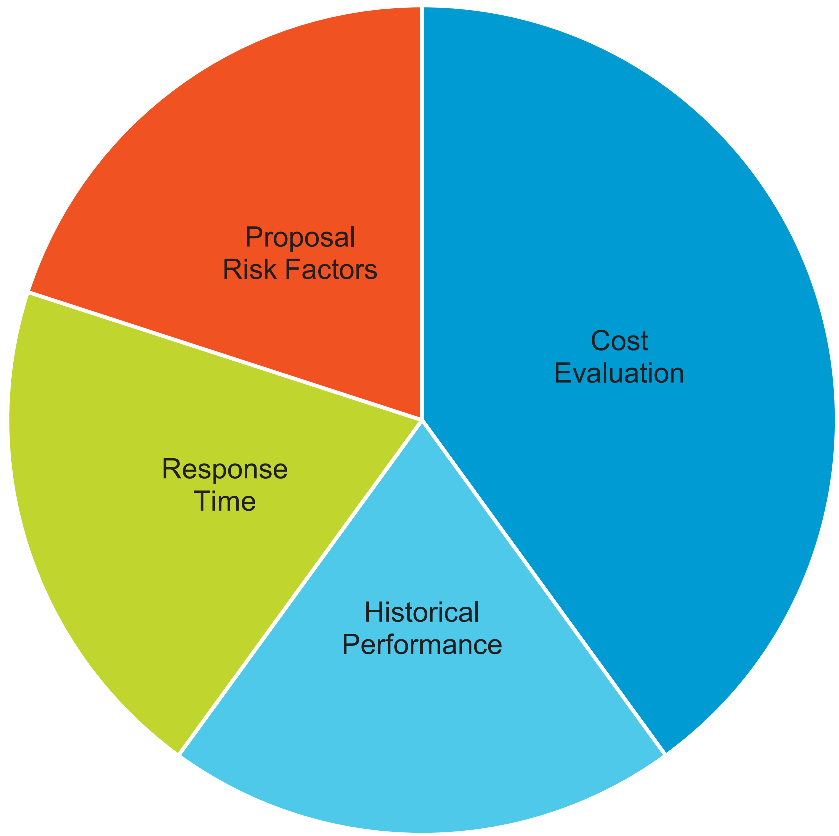
500 Total Points*



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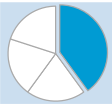
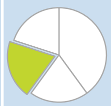
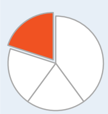
LMR/DR - EVALUATION SUMMARY

Scoring Criteria Name	Points		Scoring Method	Definition	Importance
Cost Evaluation	200		Curve	$/MW calculation to determine scoring based on rank order	The cost of the Project will have the most impact on Vectren's ability to provide low cost energy to its customers.
Historical Performance	100		Range	Scored based on the length of time the Project has provided demand response services without receiving a non-performance penalty	Historical data can show a track record of performance which can be a benefit to the Project's scoring.
Response Time	100		Range	Scored based on the time it takes the LMR/DR to reach load reduction target after receiving notification	Fast response time allows the LMR/DR to take advantage of specific control signals
Proposal Risk Factors	100		Binary	Scored based on the amount of material risk identified	Risk factors may cause concern for the reliability or cost of delivery. Risks associated with a specific Proposal will be considered during the evaluation process.

FEEDBACK AND DISCUSSION

ENVIRONMENTAL COMPLIANCE UPDATE

ANGILA RETHERFORD

VICE-PRESIDENT ENVIRONMENTAL AFFAIRS AND CORPORATE RESPONSIBILITY

REVIEW ENVIRONMENTAL CONTROLS

Unit	In Service Date	Installed Generating Capacity	SO_2 Control	NO_x Control	Soot Control	Hg Control	H_2SO_4 Control
Culley 2*	1966	90 MW	Scrubber (1995)	Low NO_x (1995)	ESP (1972)	Organosulfide Injection (2015)	
Culley 3	1973	270 MW	Scrubber (1995)	SCR (2003)	Fabric Filter (2006)	Organosulfide Injection (2015)	Sorbent Injection System (2016)
Brown 1	1979	250 MW	Scrubber (1979)	SCR (2005)	Fabric Filter (2004)	Organosulfide Injection (2015)	Sorbent Injection System (2015)
Brown 2	1986	250 MW	Scrubber (1986)	SCR (2004)	ESP (1986)	Organosulfide Injection (2015)	Sorbent Injection System (2016)
Warrick 4	1970	150 MW	Scrubber (2009)	SCR (2004)	ESP (1970)	Organosulfide Injection	Lime Injection

COAL COMBUSTION RESIDUALS RULE

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- Final Rule issued April 2015
- Allows continued beneficial reuse of coal combustion residuals
  - Majority of Vectren's fly ash beneficially reused in cement application
  - Scrubber by-product at Culley and Warrick beneficially reused in synthetic gypsum application
- Rule established operating criteria and assessments as well as closure and post-closure care standards
- Groundwater monitoring requirements are underway
- "Phase 1, Part 1" rule was published on July 30, 2018
  - Requires closure of surface impoundments effective October 2020 for impoundments that fail uppermost aquifer location restriction or groundwater protection standard

COAL COMBUSTION RESIDUALS RULE

- D.C. Circuit Court decision on August 2018 declared all unlined impoundments an unacceptable risk under CERCLA
  - IDEM interprets D.C. Circuit Court as requiring enhanced focus on mitigating and/or eliminating horizontal infiltration of groundwater through impounded ash
- Evaluating closure-by-removal for Culley East Ash Pond and planning for a closure-by-removal with beneficial reuse for Brown Ash Pond
- Timing for commencement of closure activities based upon results of groundwater monitoring, alternative disposal capacity, and construction of new impoundment or other water storage and treatment system
- Same closure strategy assumed under all scenarios

EFFLUENT LIMITATION GUIDELINES

- On September 30, 2015, the EPA finalized its new Effluent Limitation Guidelines (ELGs) for power plant wastewaters, including ash handling and scrubber wastewaters
- The ELGs prohibit discharge of water used to handle fly ash and bottom ash, thereby mandating dry handling of fly ash and bottom ash
  - Vectren has previously converted its generating units to dry fly ash handling, however we currently anticipate additional modifications to the existing dry fly ash handling system at Brown to comply with the ELGs
- ELG Postponement Rule published September 2017
  - Delayed initial compliance deadline for Bottom Ash Transport Water by two years, to November 2020
  - Compliance deadline for Fly Ash Transport Water remains November 2018, however the rule provides that utilities can seek an alternative compliance schedule through the water discharge permit renewal process

EFFLUENT LIMITATION GUIDELINES CONT.

- The ELG rules provide an alternative compliance date of December 2023 for generating units that agree to a more stringent set of discharge limits, which could include retirement
- While we continue to work on engineering solutions to reduce potential compliance costs, the following technologies are in process or being evaluated for ELG compliance for Vectren plants:
  - Culley
    - Includes dry bottom ash conversion, scrubber wastewater treatment and ash landfill construction
    - Converting to dry bottom ash Fall 2020
    - FGD Wastewater conversion to Zero Liquid Discharge (ZLD) estimated late 2022
  - Brown
    - Includes dry fly ash system upgrades, dry bottom ash conversion, an ash landfill and a new lined process pond or tank system
    - The existing Brown scrubbers are closed loop, and are not required to meet ELG wastewater discharge limits for scrubber wastewater discharges; Any new scrubber retrofits would be required to comply with applicable scrubber wastewater discharges

CLEAN WATER ACT 316B

- In May 2014 EPA finalized its Clean Water Act §316(b) rule which requires that power plants use the best technology available to prevent and/or mitigate adverse environmental impacts to fish and aquatic species
- The final rule did not mandate cooling water tower retrofits
- The Brown plant currently uses closed loop technology
- Vectren submitted the multi-year studies for F.B. Culley as required under the rule and the NPDES permit
- For purposes of IRP modeling, Vectren has assumed intake screen modifications for the Culley plant and assumed a 2024 deadline for compliance

AFFORDABLE CLEAN ENERGY (ACE) RULE

- Rule finalized in June 2019. Repealed & replaced the Clean Power Plan (CPP)
- Rule establishes standards for states to use when developing plans to limit CO_2 at coal-fired power plants
- Establishes heat rate improvement, or efficiency improvement, targets as the best system of emissions reductions for CO_2
  - These heat rate targets to be set on a unit by unit basis; Averaging not allowed
  - Vectren currently reviewing technology alternatives available for each unit
- State Implementation Plans are due September 2022 with compliance planned to begin within 24 months of submission
- For purposes of base case assumptions, Vectren assumed that ACE will be upheld upon judicial review

FEEDBACK AND DISCUSSION

DRAFT BASE CASE MARKET INPUTS AND SCENARIOS WORKSHOP

GARY VICINUS

MANAGING DIRECTOR FOR UTILITIES, PACE GLOBAL

BASE CASE INPUTS

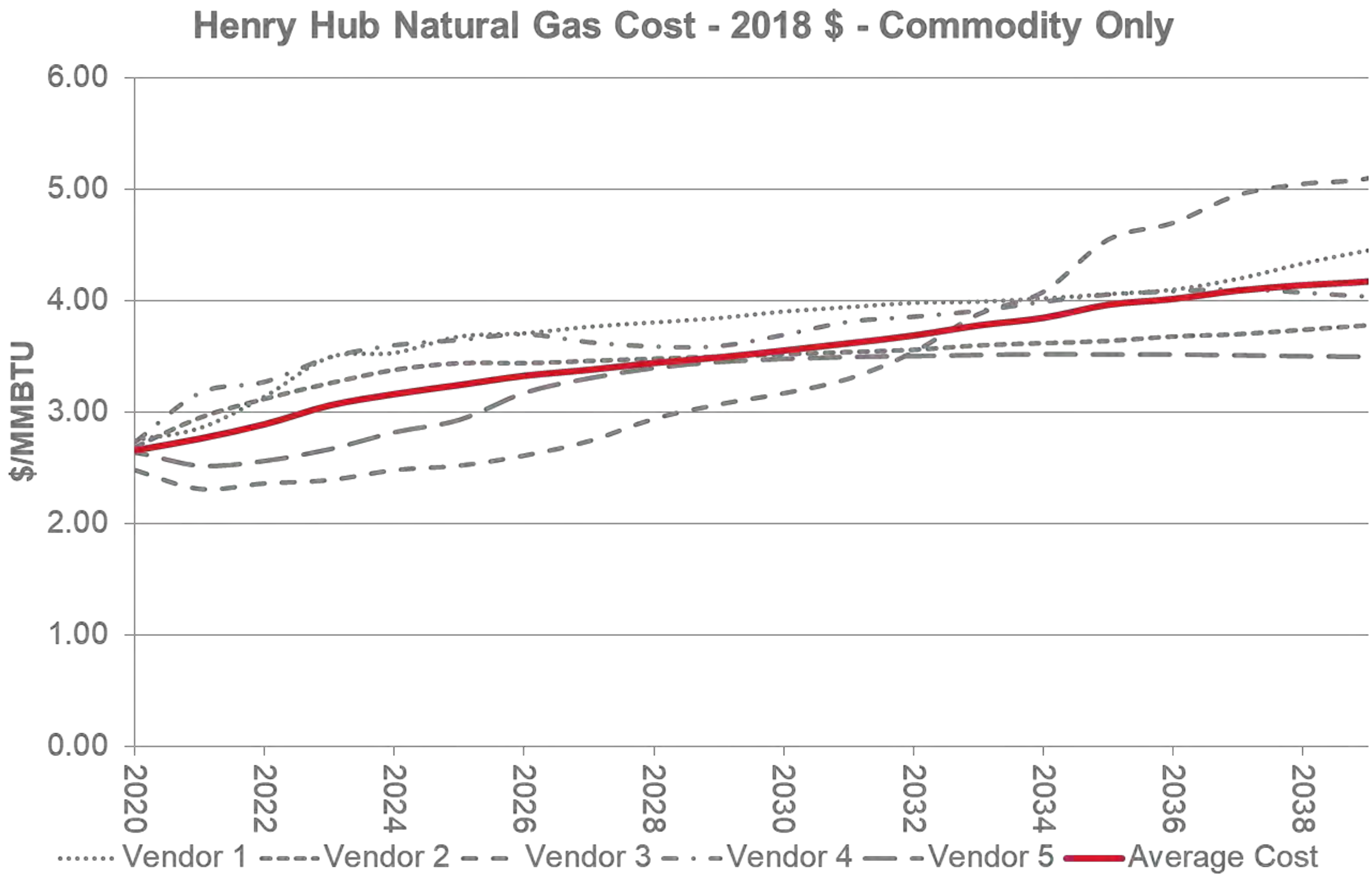
Vectren surveyed and incorporated a wide array of sources in developing its base case assumptions, which reflect a current consensus view of key drivers in power and fuel markets

- Base case assumptions include forecasts of the following key drivers:
  – Vectren and MISO energy and demand (load)
  – Henry Hub and delivered natural gas prices
  – Illinois Basin minemouth and delivered coal prices
  – Capital costs for various generation technologies

- On- and off-peak power prices are an output of scenario assumptions

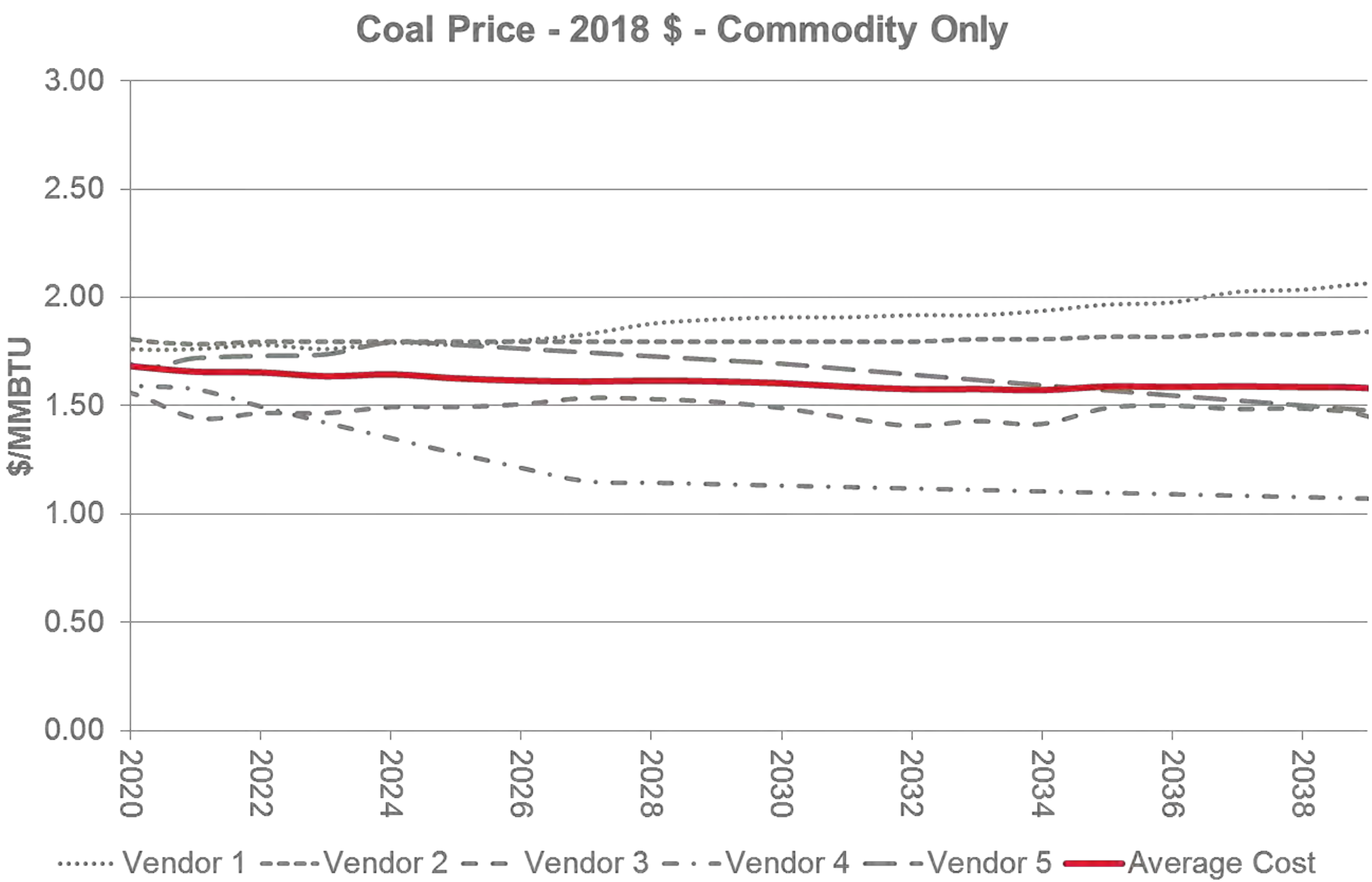
- Vectren uses a consensus base case view, by averaging forecasts from several sources where applicable

BASE CASE CONSENSUS FUEL FORECASTS



Note: Vendors used were PIRA, Wood Mackenzie, Pace, ABB, & EVA

BASE CASE CONSENSUS FUEL FORECASTS



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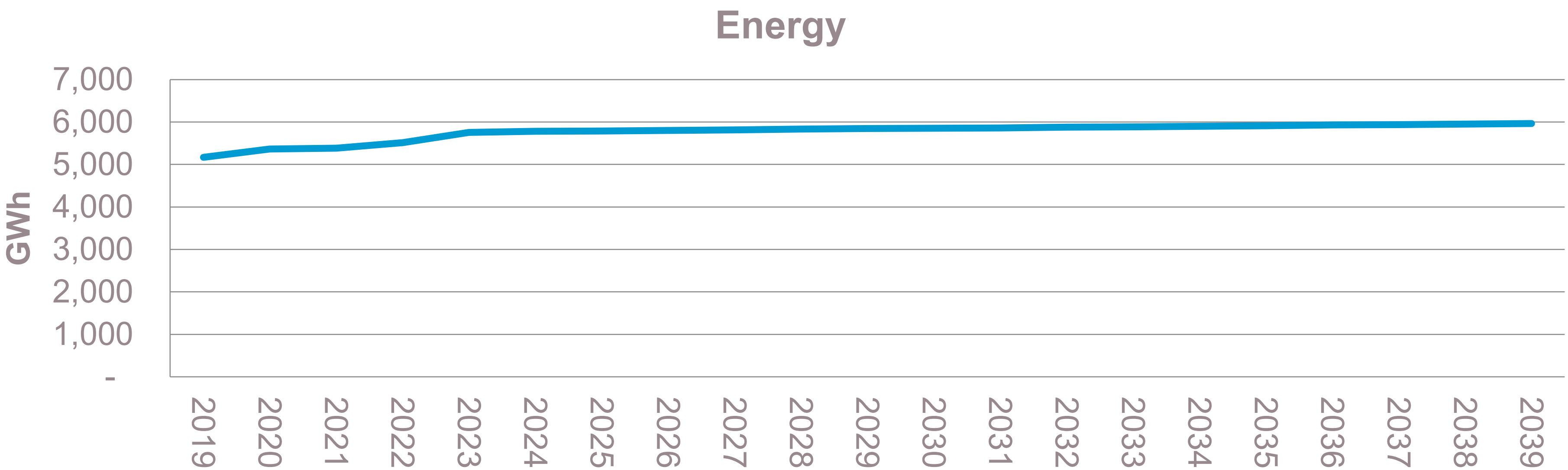
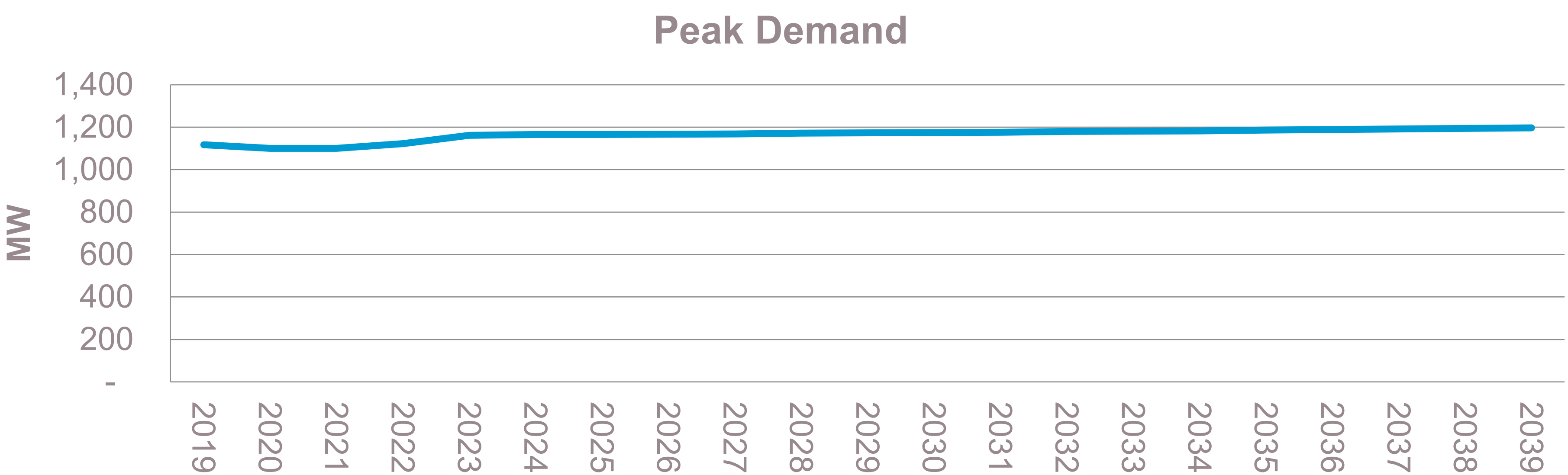
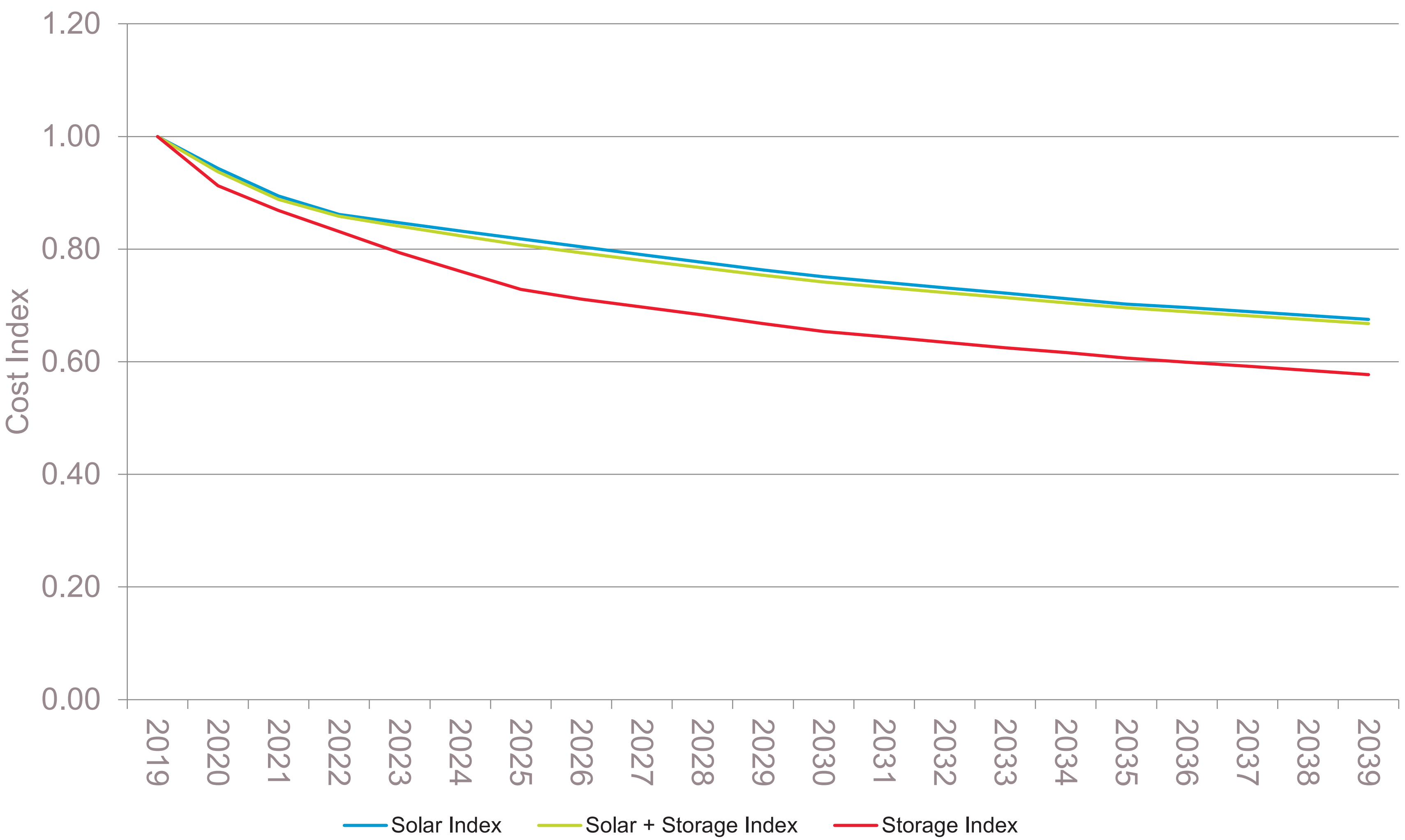
BASE CASE LOAD (PRELIMINARY – FORECAST IS CURRENTLY BEING UPDATED)





BASE CASE RENEWABLES AND STORAGE LONG TERM COST CURVES

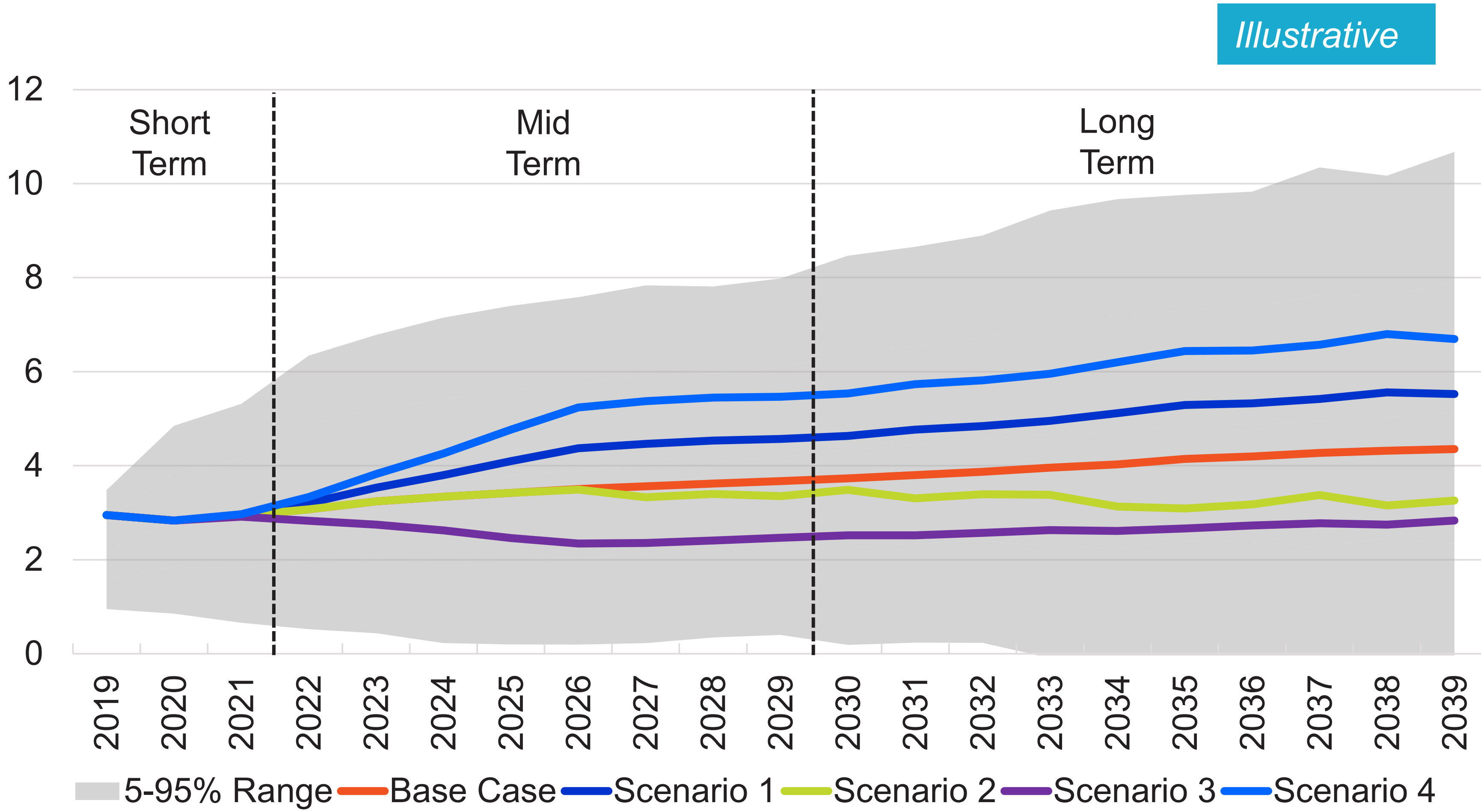


SCENARIO DEVELOPMENT

Vectren worked with Pace to develop a base case and four alternative, internally consistent scenarios (potential futures), to test which portfolios are optimal over a wide range of future market and regulatory conditions.

- Subjecting portfolios to a range of deterministic scenarios can test portfolio performance in key risk areas important to management and stakeholders alike
- Portfolios would still be run through a stochastic risk analysis to measure performance across a large number of future scenarios
- Scenarios include a low regulatory case, a high technology case, an 80% CO_2 reduction by 2050 case, and high regulatory case. Each is described in the following pages with narratives of the major drivers that characterize the scenario
- The framework was developed to ensure internal consistency with the scenario by first developing directional changes for each variable (load, gas prices, coal prices, carbon prices, and capital costs) relative to the base case forecast in the near, mid and long term

RANGE OF BOUNDARY CONDITIONS



DRAFT SCENARIOS

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Vectren will utilize scenario based modeling to evaluate various regulatory constructs. The base case is considered the most likely future. The alternative scenarios are shown as higher than, lower than, or the same as the base case.

Increasing Regulation

	CO_2	Gas Reg.	Water Reg.	Economy	Load	Gas Price	Coal Price	Renewables and Storage Cost	EE Cost
Base Case	ACE		ELG	Base	Base	Base	Base	Base	Base
Low Reg.	ACE Delay**		ELG Light*	Higher	Higher	Higher	Base	Base	Base
High Tech	Low CO_2 Tax		ELG	Higher	Higher	Lower	Lower	Lower	Lower
80% CO_2 Reduction by 2050	Cap and Trade	Methane	ELG	Lower	Lower	Base	Lower	Higher	Higher
High Reg.	High CO_2 Tax	Fracking Ban	ELG	Lower	Lower	Higher	Lower	Higher	Higher

*No bottom ash conversion required based on size of the unit and delay requirement for 2 years
**ACE Delayed for 3 years

SCENARIO NARRATIVES

Base Case

- The base case is the "most likely" case, built with commodity forecasts based on industry expert averages
- Load forecast is being developed by Itron and will be submitted to MISO this fall
- The ACE (Affordable Clean Energy) rule, which was finalized as the replacement of the Clean Power Plan, has been promulgated and is included in the base case
- All other scenarios reference the base case (individual uncertainties are at the same levels or are higher or lower than the base case)
- In the base case:
  - Coal prices remain relatively flat over the 20 year forecast horizon in constant dollars
  - Natural gas prices move upward in real dollars to 2039
  - Energy and Demand increase moderately through 2039
  - Capital costs generally decline slightly for fossil resources and decline more for wind and approximately 35% or more for solar and storage resources

SCENARIO NARRATIVES

Low Regulatory

- In the low regulatory scenario, there is a delay of the ACE rule for three years due to legal challenges, but ultimately remains in place. Indiana implements a lenient interpretation of the rule. ELG is partially repealed with bottom ash conversations not required for some smaller units and is delayed for two years (this does not apply to FB Culley 3)
- Fewer regulations lead to a better economy and higher load
- Gas prices edge up slightly with increased demand
- Coal prices continue to remain at base levels as demand for coal continues to decline nationally due to investor pressure and demand for cleaner alternatives
- Technology costs continue to decline at base case levels
- EE costs net to the base level. There is downward pressure with fewer codes and standards being implemented, leaving some low hanging fruit, but upward pressure with increasing load, netting to no change from the base level

SCENARIO NARRATIVES

High Technology

- This scenario assumes that technology costs decline faster than in the base case, allowing renewables and battery storage to be more competitive
- A low CO_2 tax is implemented. The economic outlook is better than in the base case as lower technology costs and lower energy prices offset the impact of the CO_2 tax
- Increased demand for natural gas is more than met with advances in key technologies that unlock more shale gas, increasing supply and lowering gas prices relative to the base case
- Less demand for coal results in lower prices relative to the base case
- Utility-sponsored energy efficiency costs rise early in the forecast but ultimately fall back to below base levels due to technology advances, allowing for new and innovative ways to partner with customers to save energy
- As technology costs fall, customers begin to move towards electrification, driving more electric vehicles and higher adoption of rooftop solar/energy storage and trend towards highly efficient electric heat pumps in new homes

SCENARIO NARRATIVES

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80% CO_2 Reduction by 2050 (aka 2 degrees scenario)

- This scenario assumes a carbon regulation mandating 80% reduction of CO_2 from 2005 levels by 2050 is implemented. A glide path would be set using a cap and trade system similar to the CPP, gradually ratcheting down CO_2 emissions and driving CO_2 allowance costs up
- Load decreases as the costs for energy and backup power increase and as the energy mix transitions
- In this scenario, regulations on methane emissions initially drive up gas prices, but are partially offset by increased supply. The price of natural gas is slightly higher in the mid term, then decreases back to base levels by the end of the forecast
- There is less demand for coal, driving prices lower than the base case; however, some large and efficient coal plants remain as large fleets are able to comply with the regulation on a fleet wide basis
- Renewables and battery storage technology are widely implemented to help meet the mandated CO_2 reductions, increasing prices relative to the base case
- Market based solutions are implemented to lower CO_2. Innovation occurs, but is offset by more codes and standards with no incentives, energy efficiency costs rise as a result

SCENARIO NARRATIVES

High Regulatory

- The social cost of carbon is implemented via a high CO_2 tax early in the scenario
- A fracking ban is imposed, driving up the cost of natural gas as supply dramatically shrinks
- Tighter regulations are implemented in all aspects coal production and use. As these costs are imposed, prices for coal decrease
- High regulation costs are a drag on the economy and load decreases relative to the base case
- As renewables and battery storage are widely implemented to avoid paying high CO_2 prices, prices are driven up
- Utility-sponsored energy efficiency costs are higher as more codes and standards are implemented, leaving less low hanging fruit

FEEDBACK AND DISCUSSION

STAKEHOLDER PROCESS RECAP AND Q&A

STAKEHOLDER PROCESS RECAP

August 15, 2019

- 2019/2020 IRP Process
- Objectives and Measures
- All-Source RFP
- Environmental Update
- Draft Base Case Market Inputs & Scenarios

October 10, 2019

- All-Source RFP Update
- Draft Tech Assessment Forecasts
- Sales and Demand Forecast
- DSM MPS/ Modeling Inputs
- Scenario Modeling Inputs
- Portfolio Development

December 12, 2019

- Draft Portfolios
- Draft Base Case Modeling Results
- All-Source RFP Results and Final Modeling Inputs
- Probabilistic Modeling Approach and Assumptions

March 19, 2020

- Final Base Case Modeling
- Probabilistic Modeling Results
- Risk Analysis Results
- Preview the Preferred Portfolio

Q&A

VECTREN
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APPENDIX

DEFINITIONS

Term	Definition
ACE	Affordable Clean Energy (ACE) Rule, establishes emission guidelines for states to develop plans to address greenhouse gas emissions from existing coal-fired power plants
All-Source RFP	Request for proposals, regardless of source (renewable, thermal, storage, demand response)
Aurora	Electric modeling forecasting and analysis software. Allows for model consistency in capacity expansion, chronological dispatch, and stochastic functions
Base Case	The most expected future scenario that is designed to include a current consensus view of key drivers in power and fuel markets
Baseload	The minimum level of demand on an electrical grid over a span of time
Cap and Trade	Emissions trading program aimed at reducing pollution
Capacity	The maximum output of electricity that a generator can produce under ideal conditions (megawatts)
CCGT	A combined-cycle power plant uses both a gas and a steam turbine together to produce up to 50 percent more electricity from the same fuel than a traditional simple-cycle plant. The waste heat from the gas turbine is routed to the nearby steam turbine, which generates extra power
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act (Commonly known as Superfund)
CO2	Carbon dioxide
CPCN	A Certificate of Public Convenience and Necessity is required to be granted by the Commission for significant generation projects
CPP	Clean Power Plan
Deterministic Modeling	Simulated dispatch of a portfolio in a determined future. Often computer generated portfolios are created by optimizing on cost to the customer

DEFINITIONS CONT.

Term	Definition
DSM	Demand side management includes both Energy Efficiency and Demand Response programs to reduce customer demand for electricity
EE	Energy Efficiency
ELG	Effluent Limitation Guidelines are U.S. national standards for wastewater discharges to surface waters and publicly owned treatment works
Energy	Amount of electricity (megawatt-hours) produced over a specific time period
EPA	Environmental Protection Agency
GW	Giga watt (1,000 million watt), unit of electric power
Henry Hub	Point of interconnection of interstate and intrastate natural gas pipelines as well as other related infrastructure in Erath, Louisiana
Installed Capacity (ICAP)	Refers to generating capacity after ambient weather adjustments and before forced outages adjustments
Intermittent	An intermittent energy source is any source of energy that is not continuously available for conversion into electricity and outside direct control
IRP	Integrated Resource Plan is a comprehensive plan to meet customer load expectations
IURC	The Indiana Utility Regulatory Commission is the public utilities commission of the State of Indiana. The commission regulates electric, natural gas, telecommunications, steam, water and sewer utilities
LCOE	Levelized Cost of Energy, A measure that looks at cost and energy production over the life of an asset so different resources can be compared. Does not account for capacity value.

DEFINITIONS CONT.

Term	Definition
LMR	Load Modifying Resource
Local Clearing Requirement (LCR)	Capacity needs to be fulfilled by local resource zone
LRZ6	MISO Local Resource Zone 6
Mine Mouth	At the mine location
MISO	Midcontinent Independent System Operator, an Independent System Operator (ISO) and Regional Transmission Organization(RTO) providing open-access transmission service and monitoring the high-voltage transmission system in the Midwest United States and Manitoba, Canada and a southern United States region which includes much of Arkansas, Mississippi, and Louisiana. MISO also operates one of the world's largest real-time energy markets
MPS	Market potential study - Determines the total market size (value/volume) for a DSM at a give period of time
MW	Mega watt (million watt), unit of electric power
Name Plate Capacity	The intended full-load sustained output of a generation facility
NDA	Non-Disclosure Agreement
NOI	Notice of Intent

DEFINITIONS CONT.

Term	Definition
NPDES	National Pollutant Discharge Elimination System
OMS	Organization of MISO States, was established to represent the collective interests of state and local utility regulators in the Midcontinent Independent System Operator (MISO) region and facilitate informed and efficient participation in related issues.
Peaking	Power plants that generally run only when there is a high demand, known as peak demand, for electricity
Planning Reserve Margin Requirement	Total capacity obligation each load serving entity needs to meet
Portfolio	A group of resources to meet customer load
PPA	Purchase power agreement
Preferred Portfolio	The IRP rule requires that utilities select the portfolio that performs the best, with consideration for cost, risk, reliability, and sustainability
Probabilistic modeling	Simulate dispatch of portfolios for a number of randomly generated potential future states, capturing performance measures
RA (Resource Adequacy)	RA is a regulatory construct developed to ensure that there will be sufficient resources available to serve electric demand under all but the most extreme conditions
Resource	Supply side (generation) or demand side (Energy Efficiency, Demand Response, Load Shifting programs) to meet planning reserve margin requirements

DEFINITIONS CONT.

Term	Definition
Scenario	Potential future State-of-the-World designed to test portfolio performance in key risk areas important to management and stakeholders alike
Sensitivity Analysis	Analysis to determine what risk factors portfolios are most sensitive to
Strategist	Strategic planning software application typically used for IRP analyses
Technology Assessment	An analysis that provides overnight and all-in costs and technical specifications for generation and storage resources
Unforced Capacity (UCAP)	A unit's generating capacity adjusted down for forced outage rates (thermal resources) or expected output during peak load (intermittent resources)
VAR Support	Unit by which reactive power is expressed in an AC electric power system
ZLD	Zero Liquid Discharge

Vectren 2019 IRP
1st Stakeholder Meeting Minutes Q&A
August 15, 2019, 9 am – 3 pm CDT

Lynnae Wilson (CenterPoint Energy Indiana Electric Chief Business Officer) – Welcome, Safety Message, Introduction to CenterPoint Energy/ Vectren, Personal background and Vectren team introductions, Updates and Goals for this 2019 IRP

> Subject matter experts in the room: Natalie Hedde, Angie Casbon-Scheller, Justin Joiner, Christine Keck, Bob Heidorn, Wayne Games, Matt Rice, Ryan Wilhelmus, Rina Harris, Nick Kessler, Laurie Thornton, Jason Stephenson, Cas Swiz, Steve Rawlinson, Tom Bailey, Roland Rosario.

Gary Vicinus (Moderator, Managing Director for Utilities, Pace Global) – General Introduction to this IRP Process, Introductions for approximately 40 stakeholders in the room, List of affiliations include:

Country Mark
Deaconess Health Systems
EQ Research
Hallador Energy/Sunrise Coal
IBEW Local 702
IURC
NIPSCO
Orion Renewable Energy Group LLC
OUCC
Sierra Club
SUFG
Tr-State Creation Care
Valley Watch
Whole Sun Designs Inc.

More than 30 stakeholders attended on the phone. Those registered included representatives from:

Advanced Energy Economy
AECOM
AEMA
AEP
Applied Economics Clinic
Boardwalk Pipeline
CAC
Development Partners Group
Energy Futures Group
Enerwise Global Technologies, LLC d/b/a CPower; and Advanced Energy Management Alliance
Hoosier Energy
Indiana Distributed Energy Alliance

IPL
IURC
Lewis Kappes
MEEA
Morton Solar & Electric
Orion Renewable Energy Group LLC
OUCC
Sierra Club
St. Joe
Vote Solar

Matt Rice (Vectren Manager of Resource Planning) – Discussed the feedback received since the 2016 IRP, the 2019/2020 IRP process, and the role of the all source request for proposals.

- Slide 8 Director's Report Feedback:
  - Question: What was the suggestion given consideration for Warrick 4, and what does it mean to maintain optionality?
    - Response: In the 2016 IRP, we hard coded an assumption in for Warrick 4 shutdown. With respect to Warrick 4 the Director's report comment referred to evaluating running the unit longer or shutting it down sooner. While not addressed in the meeting, in 2016 the Director provided praise for building scenario inputs in the short, mid, and long term, thus maintaining optionality.
  - Follow-up: After the smelter shutdown, there was higher risk to Warrick 4. So why was there an extension to the Warrick 4 agreement?
    - Response: The agreement was extended through 2023. Please see Wayne Games for more questions. While not stated in the meeting, the extension supported ALCOA's decision to reopen its smelter.
- Slide 13 Proposed 2019/2020 IRP Process:
  - Question: Will you provide preparatory material, list of potential strategies, etc. ahead of the next meeting?
    - Response: Yes, we will post the presentation and potential strategies one week ahead of next meeting. Below is a list of potential strategies for you to think about it in advance.
      - Minimize CO2
      - Minimize cost
      - Continue to run existing plants
      - Maximize Energy Efficiency (EE) and renewables
      - Balanced/Diverse mix of resources (don't put all of your eggs in one basket),
  - Question: Regarding Slide 8 (Director's Report Feedback), how will scoring be done this time?
    - Response: We will cover details in the Objectives and Measures section today.
  - Statement: Please differentiate among stakeholders. Additionally, I have a concern about the loss of industrial load and support for the community, particularly low income customers.
    - Response: There are many different stakeholders, and we try to make this IRP process relevant to all stakeholders. Tom Bailey can speak to economic development, and we have scenarios with higher load. We hear your concern on

price impact, and we'll address those concerns during Objectives & Measures discussion.

- Slide 14 Role of the All-Source RFP:
    - Question: Please explain how resources will be modeled on a tiered basis?
        - Response: We will group resources by cost and by like-resources.
    - Question: How much modeling of RFP responses has Pace and Vectren done to-date?
        - Response: None, as we are still gathering inputs. RFP bids just came in last week so there's been very little analysis to-date.
    - Question: CenterPoint has a vested interest in using natural gas. How do you not bias toward natural gas in this plan?
        - Response: Portfolios will be evaluated based on tradeoffs presented in the scorecard, which we will talk about today. Vectren has no preconceived notion of what the portfolio will be. We are taking an unbiased approach to selecting resources.
- Slide 15 Key Vendors:
    - Question: Since bids are done, doesn't that limit us?
        - Response: No, we will use the RFP as an input into the IRP. We are looking for your input on how we evaluate portfolios of resources.
    - Question: Will RFP data be made available to all stakeholders, and can we learn the total number and type of bids?
        - Response: We will summarize data. We must protect confidential information, but we will work with some groups to try and find a way to show certain groups, like the OUCC, bid information. We will provide some summary data later today, and we will continue to provide more detailed information as analysis is completed.
- Slide 16 2019/2020 Stakeholder Process:
    - Question: We have an ongoing concern with use of Aurora for IRP purposes. It is not possible to export input/output files according to Energy Exemplar, and costs are large even for a read-only model. Additionally, we cannot see the manual without having a license.
        - Response: We will provide all of the inputs, outputs, and talk about the constraints. We have also determined that the cost for a read only license is $5k. For those who obtain the license, we will provide modeling files for review. We will follow up about the owner's manual.
    - Follow-up: Still concerned about costs and would like to know if stakeholders can log-in using existing license.
        - Response: We can have a follow-up conversation and can discuss options. We chose Aurora based on capabilities, feedback, internal consistency, and run-times on the cloud.
    - Follow-up statement: We appreciate working with Vectren on how to gain access to data within Aurora, which will allow for a meaningful stakeholder process, no further questions here but we want to comment that this is critical.
        - Response: Vectren will work hard to provide useful information.
    - Statement: I am responding to the gentleman that said he has a concern about the loss of industrial load and support for the community, particularly low income customers. I have a concern that you will only try to encourage industrial growth. There are many businesses that we should be attracting.
        - Response: Vectren works to attract all types of customers.

Gary Vicinus – Discussed Objectives & Measures and gathered stakeholder feedback:

- Slide 23 Feedback and Discussion:

- Question: The concept of affordability is inclusive of all costs over time, including externalities. Clarify the concept of affordability.
    - Response: Cost is inclusive of relevant costs associated with portfolios. In the scenarios, we'll talk about costs of regulation (e.g., social cost of carbon in one scenario) where some of the costs considered go beyond direct cost of generation.
- Follow-up: Do we account for environmental and health impacts?
    - Response: In the high regulatory scenario, health impacts are one of the considerations that go into the social cost of carbon.
- Question: Where does the 15% band come from [for the Market Risk Minimization metric]?
    - Response: It was selected as a placeholder but we will continue to review to determine if it is reasonable, including looking at historical data.
- Question: How are you measuring impairment; how would it be calculated?
    - Response: We will run 200 iterations and track plant-level economics. We can determine how many scenarios would have shut down a unit for economics and track the number of MWhs over time that unit would have produced. The methodology for assessing potential asset impairment remains under review.
- Question: By only looking at CO_2 emissions at a plant level, aren't we missing local impacts (ground level ozone, PM) and upstream impacts (methane fugitive emissions, flaring, etc.)?
    - Response: Would you have a suggestion for a better metric?
        - Response: You could use CO_2-equivalent instead of CO_2.
- Statement: It seems like MWh impairment is more of a price risk. Maybe this measure should be capital exposed rather than MWh.
- Question: I echo his questions and am also concerned that Market Risk measures. Would that bias toward excess sales/purchases?
    - Response: Just the opposite is the case. Excess sales and purchases above or below a band would be detrimental to portfolio performance.
- Statement: You should track other emissions within the modeling.
    - Response: CO_2 isn't the only thing we'll track in the model. It is important to get the big picture, beyond the scorecard. We are going to be capturing a wide range of outputs from future scenarios going forward, including the implications of methane.
- Statement: It will be hard to quantify costs to methane emissions.
    - Response: It will be a challenge, and we'll bring our estimates to the next meeting and you will have a chance to comment if our inputs seem reasonable or not.
- Statement: CO_2 emitted now is worse than CO_2 emitted 20 years from now (as demonstrated by CCL models), so consider a NPV of CO_2.
- Question: How do we incorporate feedback from initial steps to optimize the preferred portfolio? Are you considering feedback loops in determining the best or optimal portfolio?
    - Response: Can you clarify what you mean in "best" vs "optimal" portfolio?
    - Question: Yes, let's say we have 150 portfolios. How do you use something like Artificial Intelligence to improve the portfolio selection?
    - Response: IRPs are done every 3 years, which is in a way a feedback loop. We'd be interested in how to implement this within an IRP. If you have comments that you would like to send to us, we would be happy to look at it.
- Question: Are you measuring environmental harm from mining/ fracking? Also, if renewables costs are expensive, why does Vectren have the highest rates in the state despite using fossil generation?

- Response: Renewables costs may be more or less expensive. The RFP process provide inputs that will provide useful information regarding the cost of renewables. Also, fracking will be captured in the scenario analysis.
  - Question: Are you looking at measuring other GHGs (methane) and water pollution on a lifecycle basis? If so, where does that fit?
    - Response: We'll take into consideration CO2-equivalent and also will measure the impact of methane emissions regulations. If we don't answer your question within the scenario discussion, you will have a chance to ask again at the end of the day.
  - Question: Where is the optimal nexus of the Venn diagram on Slide 20 (Each Portfolio Will have Tradeoffs) to explore tradeoffs vs synergies?
    - Response: We are not just exploring tradeoffs but also synergies, which should point towards the optimal solution.
  - Statement: I have a concern with weighting metrics.
    - Response: We have presented the metrics, and we will talk about how we plan to evaluate the metrics over time.
  - Statement: On slide 72 (Definitions Cont.) the definition of optimal portfolio includes consideration for sustainability. My comment is that fossil fuel is inherently unsustainable.
  - Question: Why did Vectren not do an open source RFP last IRP (2016)?
    - Response: The traditional approach for an IRP is to utilize a technology assessment. There is a very large cost difference between a technology assessment [a study of costs and operating characteristics of various resources] and a RFP. Also, it's only recently that IRPs have begun to incorporate the use of RFPs.
  - Question: Is 15% on slide 21 (IRP Objectives and Measures) based on expected load or expected purchases and sales?
    - Response: It's based on a range around expected purchases/ sales with +/- 15% from those levels.

Matt Lind – Discussed the Request For Proposals (RFP) methodology, scoring, role, and provided high level statistics for Vectren's RFP.

- Slide 25 [RFP] Overview:
  - Question: Are you considering existing resources with alternatives? Does that include the OVEC contract? I'm concerned about ratepayers being impacted by extra cost now that FirstEnergy has pulled out of that contract. Also, is Vectren involved in the decision on coal ash ponds?
    - Response: FirstEnergy is not out of the contract yet.
  - Question: Is it covered in the IRP?
    - Response: To the extent all resources are considered, yes.
- Slide 32 Proposal Requirements:
  - Question: Why set the limit at 10 MW when you already have two 2 MW projects.
    - Response: Those two 2 MW projects are pilot projects.
  - Question: Will you share the bidder list, and will there be an opportunity to bid in again later on?
    - Response: We will share a list with bidder names. We do not plan to obtain bids again for this IRP.
  - Question: Were there any bidders that came too late or any that were rejected because they were unacceptable?
    - Response: At this point no bids have been rejected because they were deemed unacceptable. We accepted bids from all that provided bids on time with an NOI and NDA.
  - Question: Were bidders allowed to offer in existing resources in the RFP?
    - Response: Yes.

- Question: Did you provide information on your existing situation?
  - Response: No.
- Question: Why was the RFP deadline extended?
  - Response: We did not get responses back regarding credit review to bidders within our stated timeframe on the RFP, so we extended the due date proportionately.
- Question: Can you tell us how many respondents NIPSCO had to its RFP?
  - Response: We believe somewhere close to 90 proposals.

- Slide 33 Preliminary RFP Statistics:
  - Question: How big is the solar portion of the pie to the right?
    - Response: Solar is about 19,500 MW, but there is double counting here (multiple PPA vs build options).
  - Question: Is this nameplate capacity or accredited capacity?
    - Response: This is ICAP (nameplate), not UCAP (accredited).
  - Question: Did Vectren or its related companies submit proposals to the RFP.
    - Response: No.
- Slide 37 [RFP] Evaluation Summary:
  - Question: I'm afraid that the way you are conducting this RFP process won't allow the most affordable options to rise to the top.
    - Response: The RFP at this point is providing information about the cost of each resource and will feed IRP modeling. The IRP will be the process that picks the preferred portfolio mix. Gas is not competing with solar and wind within the RFP scoring. Like groups of resources will be grouped so that solar resources are competing with solar within the RFP and gas is competing with gas.
- Slide 40 Feedback and Discussion:
  - Question: Why do projects within your service territory get 100 points? I would like to get more clarity about how this may hamper projects not within this area.
    - Response: Potential local points are additive to the 500 points. It is not a given that they will be applied. It is an option to apply 100 additional points based on a preference for local resources and the benefits that local resources provide to transmission reliability, lower congestion risk, and economic development. In terms of the local preference, we will provide the criteria at a later date. If we apply it, we will give rational.
  - Question: I have a concern over delivery date, why penalize based on early delivery (before 2023/24 date)?
    - Response: To the extent capacity is needed early, we'll capture that in the IRP process.
  - Question: Fuel sources have to compete with one another in this process. Is that what is being done in the IRP?
    - Response: Yes. The resources compete with one another within the IRP.
  - Question: You mentioned that there is an Import/Export limit on resources, who sets the value and what is the limit?
    - Response MISO does an annual (public) LOLE study that determines I/E limits for Local Resource Zone-6. Currently about 70% of Vectren resources need to be located within MISO zone 6.
  - Question: Will point scoring be an input in any way or via weighting in the Aurora Model?
    - Response: No.
  - Follow-up: How are local vs. non-local resources going to be evaluated?
    - Response: Cost information from bids will be evaluated in Aurora based on the cost to deliver energy to Vectren's load node. Burns and McDonnel will also do an evaluation of congestion costs for RFP scoring.
  - Follow-up: I'm still unclear on RFP scoring and how it relates to the IRP.

        - Response: The IRP will identify a preferred resource mix [portfolio] and then we may go back to the RFP proposals for best offers within each resource category.
    - Question: I'm concerned about options from the RFP. Two nearby dams can provide approximately 700 MWs of hydroelectric power. So why is hydro not in bids?
        - Response: No hydro bids were received. Within IRP modeling, we will supplement bid information with technology assessment information for resources where we did not receive a bid, including hydro.

Angila Retherford – Discussed the current regulatory environment as it pertains to generation, including, but not limited to, CCR, ELG, the Clean Water Act 316B, and ACE.

- Slide 48 Affordable Clean Energy (ACE) Rule:
    - Question: What is the conversion rate that you are using for CO2?
        - Response: We will have to verify, but it is around 26x. We will clarify at the next meeting.
    - Question: Are you talking about CO2-equivalence as a measured life-cycle or at the stack?
        - Response: At the stack, but we will get closer to life-cycle with one of our scenarios.
    - Question: How do you justify the ACE rule will stand for 20 years?
        - Response: The ACE is the current regulation for CO2 and is therefore included as the base case. Your question is focused around a base case. We're going to construct scenarios around more stringent regulations. This is a business as usual scenario.
    - Question: Have you evaluated compliance costs for 100% solar?
        - Response: No, but we would need to also consider upstream environmental costs of renewable energy the same as we consider them for fossil.
    - Question: Are you accounting for methane leaks in Vectren's system?
        - Response: Not in terms of the distribution system, but the high reg scenario will capture higher methane costs for regulations.

Gary Vicinus – Discussed base case inputs and draft scenarios and asked for feedback.

- Slide 53 Base Case Consensus Fuel Forecasts [Coal]:
    - Question: Can you provide delivered coal prices to compare to these forecasts?
        - Response: Yes. We will provide delivered historic prices compared to these projections. Note that delivered prices are included in modeling.
    - Question: Some coal plants are designated as "must-run" due to take-or-pay coal contracts. Do you designate your plants under must run status? Is that how any of your coal contracts are set up?
        - Response: No, we do not designate our plants as must run unless there is a reliability issue and our system operator tells us we need to run a plant. It is not a function of coal supply contracts.
    - Question: Gary mentioned both coal and gas have a $1/MMBtu difference [between the high and low inputs], but in absolute terms these are very different. Comment?
        - Response: These consensus forecasts are showing a difference of about a $1/MMBtu. The distinction though is that one is off of a three dollar base and the other is off of about a dollar and a half base.
    - Question: Is Vectren's gas price similar to Henry Hub?
        - Response: We're showing commodity only, but we'll factor in transportation costs.
    - Question: 4/5 vendors gas forecasts were close. One was quite different. Do you know why?

        - Response: One of the benefits of a consensus forecast is that it is a best guess, but the drawback is you can't always look at underlying assumptions. Vectren's view is that these are all credible vendor forecasts.
- Slide 55 Base Case Renewables and Storage Long Term Cost Curves:
    - Question: Am I interpreting this chart correctly, that solar cost will decline ~30% and storage ~40%?
        - Response: Yes.
    - Question: Are capital cost decline indices a combo of NREL, B&M, and Pace?
        - Response: Yes.
    - Comment: At some point technology advances are less important to cost because of other costs, like land, become larger.
        - Response: Absolutely correct.
    - Question: We've historically underestimated solar costs. How do you account for that? Will you consider a steeper decline curve.
        - Response: We will evaluate bid costs and assess if these curves still make sense. Additionally, a steeper decline curve will be assessed in the high technology scenario.
- Slide 58 Draft Scenarios:
    - Question: How did you determine Economy? What is higher and lower and how did you determine?
        - Response: These are all in relation to the Base Case.
    - Follow-up: Please look at the Economy again. It may not be valid that a High Regulation case leads to Lower-than-Base-Case economy.
        - Response: Perfectly valid concerns. That is why we want your input.
    - Question: What are the ACE rule implications?
        - Response: ACE means there is greater investment to increase efficiency to meet targets in the rule.
    - Comment: I want to echo the concern that correlates High Reg with Low Economy. I think that it is a false assumption. There is a bipartisan bill in congress that has been analyzed using REMI analysis that says High Reg (carbon dividend, specifically) would in fact *improve* the economy.
        - Response: That is the kind of input that we are looking for. We will look into the study/bill that you suggest.
    - Question: Where is the 100% clean energy scenario? NIPSCO, Xcel, others have committed to 100% renewable.
        - Response: There is a distinction between scenario and strategy. You described a strategy. Here, we're looking at scenarios, but portfolio construction can be designed to achieve 100% renewable energy. You could construct a scenario with a high 80-100% renewable portfolio standard.
- Slide 62 Scenario Narratives [80% CO2 Reduction by 2050 (aka 2 degrees scenario)]:
    - Comment: I disagree in the 80% scenario that you'd see that battery storage prices would increase with more demand, just like computer prices didn't increase with greater demand.
        - Response: We will consider, but we need to make sure to capture boundary conditions within scenarios. These are not cast in stone. We appreciate your input.
- Slide 63 Scenario Narratives:
    - Comment: Please don't set boundaries to disadvantage renewables.
        - Response: Remember that we'll also expose the portfolios not only to these scenarios but also 200 iterations.
    - Question: The base case is supposed to be most likely, so the idea that in the Base Case that the ACE rule will last 20 years is not realistic. Also, I don't think we would

raise solar prices due to higher regulatory restrictions, particularly over 30 years to 2050.
    - Response: Fair point, that feedback is valuable. Keep in mind that when you see higher, this is higher relative to the base case. In other words, the costs will decline more slowly.
- Comment: Again, Base Case assumption of ACE rule is unrealistic.
    - Response: The most likely future is probably a misnomer, but it is the rule on the books. Don't focus too much on this since we are modeling lots of other scenarios. Ignoring the CO2 law on the books that exists now is problematic from a process standpoint.

Open Q&A Session

- Question: I have a question on the October 10th meeting on what portfolios are vs. strategies.
    - Response: We will be looking for your input on strategies for portfolio development.
- Question: How reliable are your coal plants?
    - Response: There are a couple of ways to measure reliability. Capacity factor is around 60-65% over last 4-5 years. Our forced outage rate is around 4.5%.
- Question: Can you confirm that each tiered resource modeled in Aurora will consist of the average price of the prices from each tier, and will each tier consist of the sum of MWs within that tier, and will all tiers compete with one other simultaneously? Will the price of each tier simply be the average or will there be adders of any kind from congestion layered on top of them.
    - Response: Within each category there will be tiers to the extent that there are multiple proposals represented within that tier. Not in every case (e.g., DR, which had one response), but yes - we'll capture in the tiers various cost levels that may include congestion. We'll revisit in next meeting. To add with our own experience, we have a wind PPA that sits in the northern part of the state. So when the transmission system is loaded, we have to pay MISO to get that energy. The congestion component based on where these plants are is a big deal. We will do the best we can to capture the costs that our customers are going to see.
- Question: How are you using stakeholder input in IRP process; will it be tangibly used?
    - Response: We will be transparent in how we use or not use stakeholder inputs. If we chose not to use a suggestion, we will tell you why.
- Question: How do Objectives & Measures work, and will they be weighted?
    - Response: At this point nothing is weighted. We are looking at tradeoffs for portfolios. The balanced scorecard is a tool to understand tradeoffs. At the end of the day, the scorecard is not going to produce a score and rank order portfolios. It is a tool to understand where the differences lie and how each portfolio meets these multiple objectives. We can place an emphasis on certain measures but that is in the realm of judgement. We can't take ultimate decision-making out of management's hands and reduce it down to a formula. The tradeoffs have to be considered fully by management, with transparency of the body of evidence of performance and implications among tradeoffs.
- Comment: We received a serious warning one year ago from the IPCC. I appreciate your expertise, and we need your knowledge and skills. But I also want you to inject a morale urgency into your decision-making to ensure we're creating a pathway to respond to the warnings of climate experts. We would like to see you indicate which portfolios meet the IPCC standards.

VECTREN PUBLIC STAKEHOLDER MEETING

OCTOBER 10, 2019

WELCOME AND SAFETY SHARE

LYNNAE WILSON

INDIANA ELECTRIC CHIEF BUSINESS OFFICER

SAFETY SHARE

Tips to Avoid Distractions While Driving

- Make adjustments before your get underway. Address vehicle systems like your GPS, seats, mirrors, climate controls and sound systems before hitting the road. Decide on your route and check traffic conditions ahead of time.
- Snack smart. If possible, eat meals or snacks before or after your trip, not while driving. On the road, avoid messy foods that can be difficult to manage.
- Secure children and pets before getting underway. If they need your attention, pull off the road safely to care for them. Reaching into the backseat can cause you to lose control of the vehicle.
- Put aside your electronic distractions. Don't use cell phones while driving – handheld or hands-free – except in absolute emergencies. Never use text messaging, email functions, video games or the internet with a wireless device, including those built into the vehicle, while driving.
- If another activity demands your attention, instead of trying to attempt it while driving, pull off the road and stop your vehicle in a safe place. To avoid temptation, power down or stow devices before heading out.
- As a general rule, if you cannot devote your full attention to driving because of some other activity, it's a distraction. Take care of it before or after your trip, not while behind the wheel.

2019/2020 STAKEHOLDER PROCESS

August 15, 2019	October 10, 2019	December 13, 2019[1]	March 19, 2020
• 2019/2020 IRP Process • Objectives and Measures • All-Source RFP • Environmental Update • Draft Base Case Market Inputs & Scenarios	• RFP Update • Draft Resource Costs • Sales and Demand Forecast • DSM MPS/ Modeling Inputs • Scenario Modeling Inputs • Portfolio Development	• Draft Portfolios • Draft Base Case Modeling Results • All-Source RFP Results and Final Modeling Inputs • Probabilistic Modeling Approach and Assumptions	• Final Base Case Modeling • Probabilistic Modeling Results • Risk Analysis Results • Preview the Preferred Portfolio

1 Snow date is December 19, 2019

AGENDA

Time		
9:00 a.m.	Sign-in/Refreshments	
9:30 a.m.	Welcome, Safety Message	Lynnae Wilson, CenterPoint Energy Indiana Electric Chief Business Officer
9:40 a.m.	Follow-up Information Since Our Last Stakeholder Meeting	Matt Rice, Vectren Manager of Resource Planning and Gary Vicinus, Managing Director for Utilities, Pace Global
10:10 a.m.	MISO Considerations	Justin Joiner, Vectren Director Power Supply Services
10:40 a.m.	Break	
10:50 a.m.	Scenario Modeling Inputs	Gary Vicinus, Managing Director for Utilities, Pace Global
11:30 a.m.	Lunch	
12:00 p.m.	Long-term Base Energy and Demand Forecast	Mike Russo, Senior Forecasting Analyst, Itron
12:30 p.m.	Existing Resource Overview	Wayne Games, Vectren Vice President Power Generation Operations
1:00 p.m.	Potential New Resources and MISO Accreditation	Matt Lind, Resource Planning & Market Assessments Business Lead, Burns and McDonnell
1:40 p.m.	Break	
1:50 p.m.	DSM Modeling in the IRP	Jeffrey Huber, Managing Director, GDS Associates
2:20 p.m.	Portfolio Development Workshop	Moderated by Gary Vicinus, Managing Director for Utilities, Pace Global
3: 00 p.m.	Adjourn	

MEETING GUIDELINES

1. Please hold most questions until the end of each presentation. Time will be allotted for questions following each presentation. (Clarifying questions about the slides are fine throughout)
2. For those on the webinar, please place your phone and computer on mute. We will open the phone lines for questions within the allotted time frame. You may also type in questions via the chat feature. Only questions sent to 'All-Entire Audience' will be seen and answered during the session.
3. There will be a parking lot for items to be addressed at a later time.
4. Vectren does not authorize the use of cameras or video recording devices of any kind during this meeting.
5. Questions asked at this meeting will be answered here or later.
6. We will do our best to capture notes but request that you provide written feedback (concepts, inputs, methodology, etc.) at IRP@CenterPointEnergy.com following the meeting. Additional questions can also be sent to this e-mail address.

FOLLOW-UP INFORMATION SINCE OUR LAST STAKEHOLDER MEETING

MATT RICE

VECTREN MANAGER OF RESOURCE PLANNING

GARY VICINUS

MANAGING DIRECTOR FOR UTILITIES, PACE GLOBAL

VECTREN COMMITMENTS FOR 2019/2020 IRP

VECTREN
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By the end of the second stakeholder meeting Vectren will have made significant progress towards the following commitments

- ✓ Utilizing an All-Source RFP to gather market pricing & availability data
- ✓ Including a balanced, less qualitative risk score card; draft was shared at the first public stakeholder meeting
- ✓ Performing an exhaustive look at existing resource options
- ✓ Using one model for consistency in optimization, simulated dispatch, and probabilistic functions
- ✓ Working with stakeholders on portfolio development

Vectren will continue to work towards the remaining commitments over the next several months

- Providing a data release schedule and provide modeling data ahead of filing for evaluation
- Striving to make every encounter meaningful for stakeholders and for us
- Ensuring the IRP process informs the selection of the preferred portfolio
- Modeling more resources simultaneously
- Testing a wide range of portfolios in scenario modeling and ultimately in the risk analysis
- Conducting a sensitivity analysis
- Including information presented for multiple audiences (technical and non-technical)

PROPOSED 2019/2020 IRP PROCESS

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Conduct an All Source RFP

Create Objectives, Risk Perspectives and Scorecard Development

Create Base Case Assumptions and Scenario Development

Portfolio Development Based on Various Strategies, Utilizing Optimization to Create a Wide Range of Portfolios and Refine with All Source RFP Data

Portfolio Testing in Scenarios, Focused on Potential Regulatory Risks

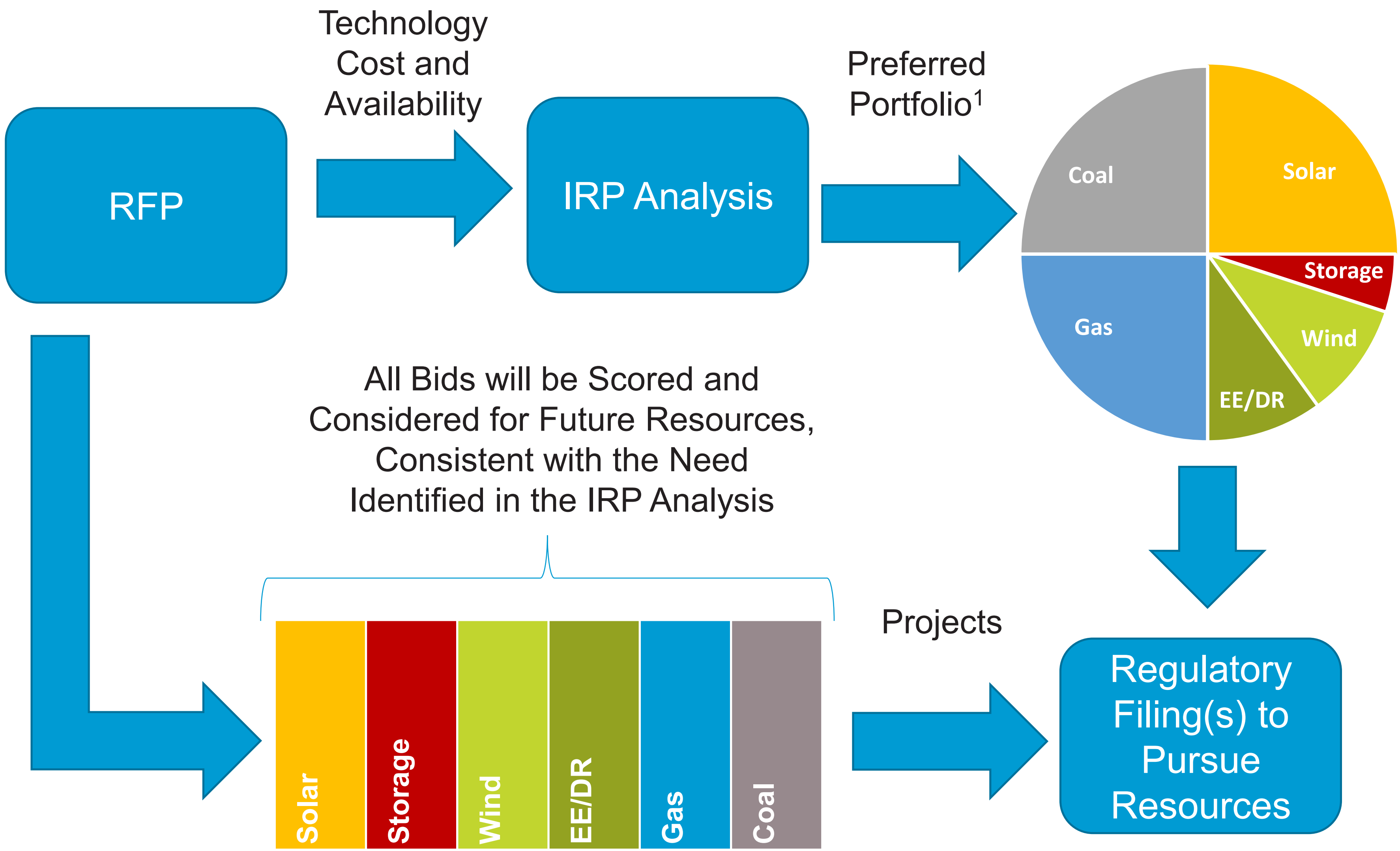
Portfolio Testing Using Probabilistic Modeling of 200 Potential Futures

Utilize the Probabilistic Modeling to Conduct Sensitivity Analysis

Populate the Risk Scorecard that was Developed Early in the Process and Evaluate Portfolios

Select the Preferred Portfolio

REVIEW ROLE OF THE ALL SOURCE RFP



1 Illustrative example

STAKEHOLDER FEEDBACK

Request	Response
Scenario: Update the High Regulatory scenario to include a carbon dividend. Concern was expressed that the economic outlook would not necessarily grow worse under a high CO2 tax scenario.	Economic outlook is correlated with the load forecast. We have updated the High Regulatory scenario load forecast direction from lower than the base case forecast to equal with the base. The High Regulatory scenario includes other regulations, which we assume will net out any positive impact created from a carbon dividend.
Scenario: Update a scenario to have renewables costs lower than the base due to innovation and removal of waste from the value chain. The example provided was that the price of laptops declined as demand went up.	We have updated the 80% CO_2 Reduction and the High Regulatory scenarios to be lower cost than base.
Modeling: Options to view Aurora modeling files. Additionally, provide an understanding of "industry-supplied data" Include these modeling assumptions.	Read only copy of Aurora costs $5k and includes a help function and basic self learning slides. Additionally, we will provide Aurora release notes to those that request and sign an NDA.
Portfolio development: Fully explore the use of hydro resources, given Vectren's proximity to the Ohio River.	Vectren reviewed available materials provided to better understand/compare to our technology assessment provided by Burns and McDonnell. While we did not receive a bid and costs are high, hydro could be included within portfolio development.

STAKEHOLDER FEEDBACK CONT.

Request	Response
Scorecard: Update Environmental Risk Minimization measure to report CO_2 equivalent and consider utilizing life cycle emissions by electric generation technology	Utilize NREL Life Cycle Greenhouse Gas Emissions (upstream and downstream) from Electricity Generation by resource analysis. NREL CO_2e rates per MWh will be applied to both retail sales covered by Vectren portfolios, as well as a CO_2e emissions estimate when relying on the market.
Scorecard: Consider sunk costs in Future Flexibility measure. Change basis from MWhs of impairment by asset to $ to better reflect uneconomic asset risk	Will update this measure to reflect dollars. Will measure when costs to run an asset do not cover energy and capacity revenues in three consecutive years. Methodology will be described later in this presentation.
Scorecard: Market Risk Minimization metric bounds of 15% rational needs to be described.	We reviewed the +/-15% deadband for energy and capacity market purchases for reasonableness and feel this is a reasonable assumption. We will discuss again today.
RFP/IRP costs: Concern was expressed that we could lose opportunities to include low cost resources within Integrated Resource Plan (IRP) modeling if we only include Request for Proposals bids with a delivered cost.	For modeling, we will include firm bids on our system and those with a delivered cost. Additionally, Burns and McDonnell will review other bids and assess potential congestion costs. Such evaluated resources (including congestion estimate) may also be included within IRP modeling.

STAKEHOLDER FEEDBACK CONT.

Request	Response
Scenarios: Include an RPS standard scenario.	There are several mandates that could be imposed in the future, from renewables interests to coal interests. The primary purpose of scenarios in this IRP will be to help determine how portfolios perform in various future states. We would like your feedback on portfolio development. We can develop various portfolios utilizing an RPS, coal portfolio mandate, etc. within the model. The performance of these portfolios will be assessed within the scenarios and probabilistic modeling.
Scorecard: Include a health benefits measure.	We reviewed a recent EPA report titled "Public Health Benefits per kWh of Energy Efficiency and Renewable Energy in the United States: A Technical Report[1]," which included a screening level estimate of Benefits-per-KWh value for EE, wind, and solar projects. The report noted that there are no comprehensive national studies available with data of this kind. Values from this report cannot be used for this analysis as estimates are explicitly only good through 2022.

1 Source: https://www.epa.gov/sites/production/files/2019-07/documents/bpk-report-final-508.pdf

AURORAxmp TOOL

- AURORAxmp (Aurora) is an industry standard model for electricity production costing and market simulations
- Aurora is licensed by approximately 100 clients in North America, ranging from consultants to full-scale utilities to traders to Indiana's State Utility Forecasting Group (SUFG)
- Aurora is accepted in many regulatory jurisdictions
- Vectren will use the Aurora model in the IRP to provide the following analysis:
  - Least cost optimization of different portfolios, including decisions to build, purchase, or retire plants
  - Simulation of the performance of different portfolios under a variety of market conditions
  - Production cost modeling to provide market prices for energy
  - Emissions tracking based on unit dispatch
  - A comparative analysis of various regulatory structures
- A primary output is portfolio cost performance in terms of Net Present Value

For more information: https://energyexemplar.com/solutions/aurora/

ACCESSING THE AURORA MODEL

- A one year, read-only End User License Agreement for AURORAxmp is available for $5k from Energy Exemplar; this purchase entitles access the library of modeling presentations via the web login
- The model's Help menu features material similar to a user manual
- IRP databases would include input and output tables used in the modeling and will require an NDA with Siemens
- The model database will be available for review but Siemens will not provide any review support beyond clearly-defined naming conventions (data key)

DRAFT SCENARIOS UPDATE

VECTREN
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Vectren has updated scenarios based on stakeholder feedback. Scenario modeling will evaluate various regulatory constructs. As a reminder, the Base Case serves as a benchmark. Alternative scenarios are shown as higher than, lower than, or the same as the Base Case

	CO_2	Gas Reg.	Water Reg.	Economy	Load	Gas Price	Coal Price	Renewables and Storage Cost	EE Cost
Base Case	ACE	none	ELG	Base	Base	Base	Base	Base	Base
Low Reg.	ACE Delay**	none	ELG Light*	Higher	Higher	Higher	Base	Base	Base
High Tech	Low CO2 Tax	none	ELG	Higher	Higher	Lower	Lower	Lower	Lower
80% CO_2 Reduction by 2050	Cap and Trade	Methane	ELG	Lower	Lower	Base	Lower	Lower	Higher
High Reg.	High CO_2 Tax w/ Dividend	Fracking Ban	ELG	Base	Base	Highest (+2 SD)	Lower	Lower	Higher

Increasing Environmental Regulation

*No bottom ash conversion required based on size of the unit and delay requirement for 2 years
**ACE Delayed for 3 years

Revised from last meeting

SCENARIO NARRATIVES

80% CO_2 Reduction by 2050 (aka 2 degrees scenario)

- This scenario assumes a carbon regulation mandating 80% reduction of CO_2 from 2005 levels by 2050 is implemented. A glide path would be set using a cap and trade system similar to the CPP, gradually ratcheting down CO_2 emissions and driving CO_2 allowance costs up.
- Load decreases as the costs for energy and backup power increase and as the energy mix transitions.
- In this scenario, regulations on methane emissions initially drive up gas prices, but are partially offset by increased supply. The price of natural gas remains on par with the Base Case.
- There is less demand for coal, driving prices lower than the Base Case; however, some large and efficient coal plants remain as large fleets are able to comply with the regulation on a fleet wide basis.
- Renewables and battery storage technology are widely implemented to help meet the mandated CO_2 reductions. Despite this demand, costs are lower than the Base Case due to subsidies or similar public support to address climate change.
- Market based solutions are implemented to lower CO_2. Innovation occurs, but is offset by more codes and standards with no incentives, energy efficiency costs rise as a result.

Revised from last meeting

SCENARIO NARRATIVES

High Regulatory (Revised)

- The social cost of carbon is implemented via a high CO_2 tax early in the scenario. Monthly rebate checks (dividend) redistribute revenues from the tax to American households based on number of people in the household.
- A fracking ban is imposed, driving up the cost of natural gas to +2 standard deviations in the long-term as supply dramatically shrinks.
- A strong decline in demand puts downward pressure on coal prices.
- The economic outlook remains at the Base Case level as any potential benefit of the CO2 dividend is offset by the drag on the economy imposed by additional regulations, including the fracking ban.
- Innovation occurs as renewables and battery storage are widely implemented to avoid paying high CO_2 prices, allowing costs to fall even as demand for these technologies increases.
- Utility-sponsored energy efficiency costs rise over time as the cost for regulatory compliance rises

Revised from last meeting

IRP OBJECTIVES & MEASURES UPDATE

VECTREN
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For each resource portfolio, the objectives are tracked and measured to evaluate portfolio performance in the Base Case, in four alternative scenarios, and across a wide range of possible future market conditions. All measures of portfolio performance are based on probabilistic modeling of 200 futures.

Objective	Measure	Unit
Affordability	20-Year NPVRR	$
Price Risk Minimization	95th percentile value of NPVRR	$
Environmental Risk Minimization	~~CO_2 Emissions~~ Life Cycle Greenhouse Gas Emissions	Tons CO_2e
Market Risk Minimization	Energy Market Purchases or Sales outside of a +/- 15% Band	%
	Capacity Market Purchases or Sales outside of a +/- 15% Band	%
Future Flexibility	~~MWh of impairment by asset~~ Uneconomic Asset Risk	~~MWh~~ $

Revised from last meeting

ENVIRONMENTAL RISK MINIMIZATION
LIFE CYCLE GREENHOUSE GAS EMISSIONS

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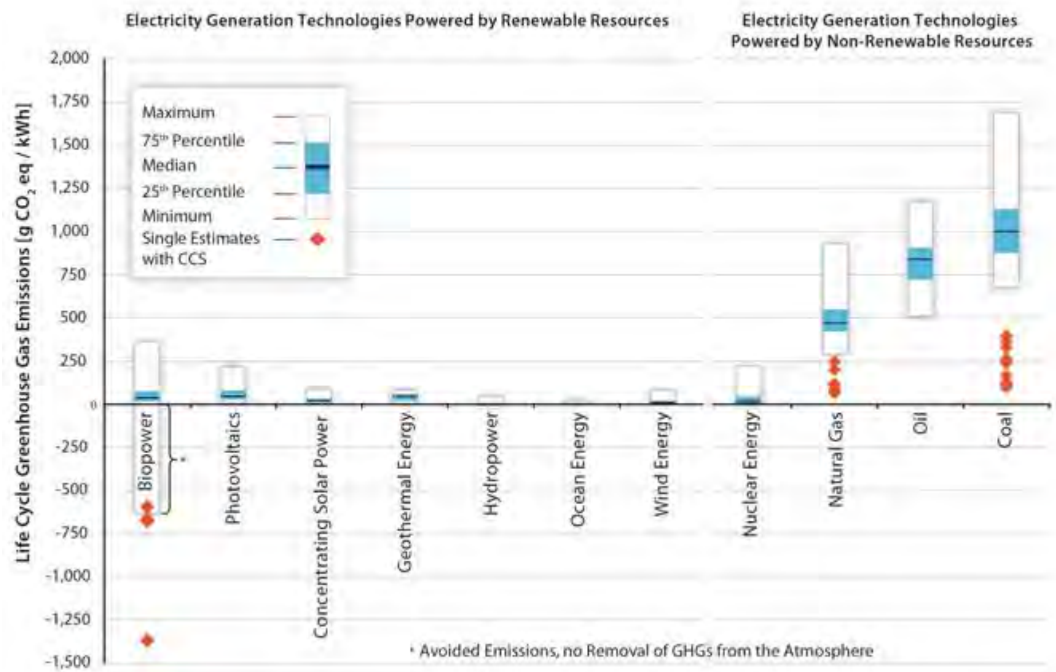
- Stakeholders requested a Life Cycle Analysis (LCA) and CO_2 equivalent on the scorecard
- LCA can help determine environmental burdens from “cradle to grave” and facilitate more consistent comparisons of energy technologies, including upstream, fuel cycle, operation, and downstream emissions
- NREL conducted a systematic review[1] of 2,100 life cycle greenhouse gas emissions studies for electricity generating technologies and screened down the list to about 300 credible references

Life Cycle GHG Emissions



	Biopower	Photovoltaics	Concentrating Solar Power	Geothermal Energy	Hydropower	Ocean Energy	Wind Energy	Nuclear Energy	Natural Gas	Oil	Coal
Count of Estimates	222(+4)	124	36	8	28	10	126	125	83(+7)	24	169(+12)
Count of References	52(+0)	26	10	6	11	5	49	32	36(+4)	10	50(+10)

NREL

ipcc INTERGOVERNMENTAL PANEL ON climate change

1 Source: https://www.nrel.gov/analysis/life-cycle-assessment.html

ENVIRONMENTAL RISK MINIMIZATION LIFE CYCLE GHG EMISSIONS CONTINUED…

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- NREL utilizes median values[2] listed in the table to the right for life cycle analyses
- We plan to apply NREL rates (g CO_2e/kWh) to simulated portfolio generation emissions to serve retail load using specific technology rates
- In order to obtain a full picture of emissions, we must also estimate total emissions when customer load is being served by the market using the market rates and an average buildout of resources based on the MISO Transmission Expansion Plan (MTEP)
- Total CO_2 equivalent will be calculated for each portfolio based on emissions it generates and emissions generated from reliance on the market

Life Cycle GHG Emissions[1]
(grams of CO_2e per kWh)

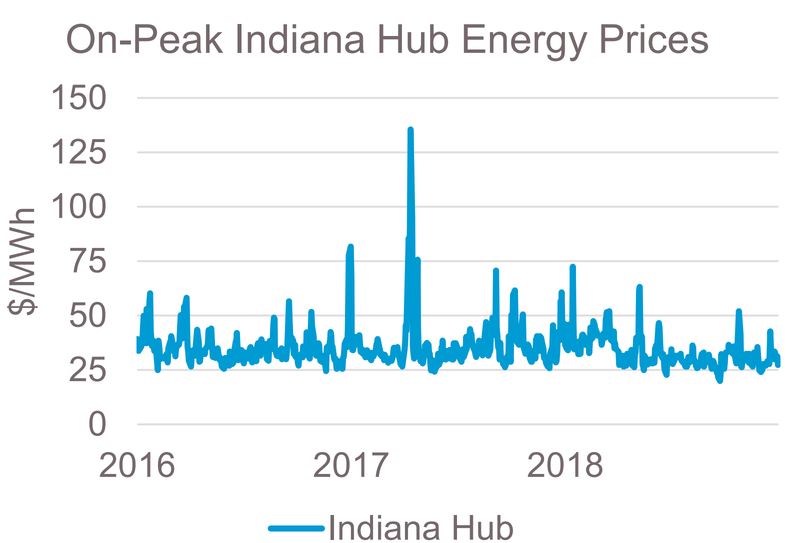
	Specific Technology	Market
All Coal		1,002
Sub Critical	1,062	
Super Critical	863	
All Gas		474
Gas CT	599	
Gas CC[3]	481	
All Nuclear		16
Onshore Wind	12	12
All PV		54
Thin Film	35	
Crystalline	57	
All hydropower	7	7
Bio Power	43	43

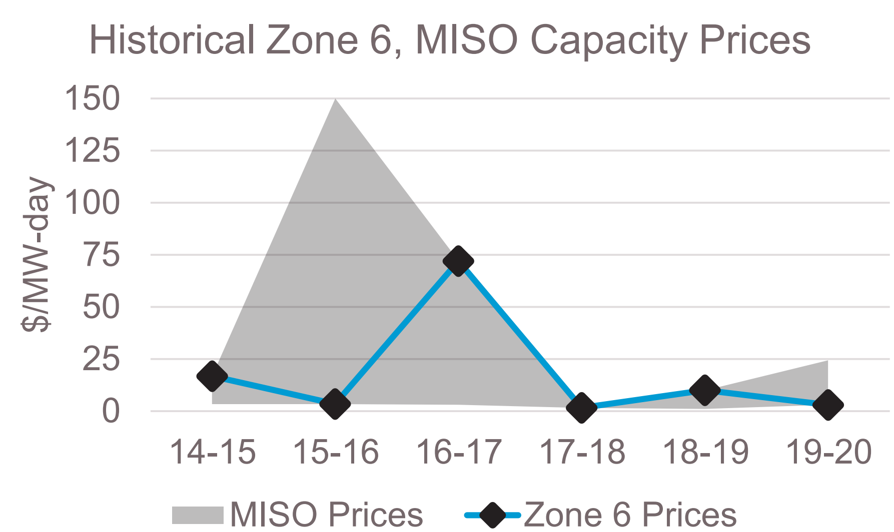
1 Battery storage was not included in the NREL report. Evaluating options for this resource.
Source: https://www.nrel.gov/analysis/life-cycle-assessment.html
2 Values derived from graphs included for each resource type.
3 Assumes 70% shale gas, 30% conventional

+/-15% ENERGY AND CAPACITY PURCHASES AND SALES BAND JUSTIFICATION

- Market transactions carry the risk for Vectren of buying when prices are high and selling when price are low.
- Vectren energy purchases are 1-2% of regional volumes* and 10-30% below regional prices for similar long-term transactions. On-peak power prices demonstrate ongoing volatility. To reduce exposure to this risk, we seek to minimize net energy sales and purchases to +/-15% of annual total sales.
- Capacity prices also fluctuate broadly in MISO and Zone 6 (Indiana). Exposure to price swings should be minimized to a range of +/-15% around forecasted demand.

Reliability First Corporation 2018 Energy Purchases by Contract Type (GWh)	
Short-Term	23,700
Intermediate-Term	14,500
Long-Term	53,100
of which Vectren	750
Other	298,000
Total	389,300





* 2016-2018; Reliability First Corporation NERC Subregion

UNECONOMIC ASSET RISK ANALYSIS

VECTREN
A CenterPoint Energy Company

- Following from stakeholder feedback, we changed the uneconomic asset risk objective measure from a MWh basis to a dollar cost basis
- Definition of an uneconomic asset: when going forward costs of the asset, which include annual variable costs (fuel + variable operations & maintenance or VOM + emissions) plus annual fixed operations & maintenance or FOM costs, are collectively greater than the total annual revenues (including both energy revenues and capacity revenues) in three successive years. By equation:

$$Going\ Forward\ Costs\ \left(\frac{\$}{kW-yr}\right) = \frac{[VOM+Fuel+Emissions+FOM]\left(\frac{\$}{yr}\right)}{Nameplate\ Capacity\ (kW)}$$

- We then identify in each stochastic model run:
  - Year when asset is deemed uneconomic
  - Undepreciated book value as of first uneconomic year
  - Revenues less going forward costs as of first uneconomic year for each year it is negative
- The resulting cost is weighted by frequency of occurrence across the iterations

FEEDBACK AND DISCUSSION

MISO CONSIDERATIONS

JUSTIN JOINER

VECTREN DIRECTOR OF POWER SUPPLY SERVICES

MISO SUMMARY

- Based on feedback from the last stakeholder meeting we felt it necessary to go over some of the MISO principles and considerations Vectren must take into account during the IRP process.
- This section is aimed at conveying four main points:
  - 1) MISO ensures low cost and reliable energy by enforcing market and planning rules that its members must adhere to; specifically:
    - Sufficient capacity to meet peak load
    - Adequate transmission to deliver the energy
  - 2) These rules focus on generator cost and ability to reach needed load; if the generation is not cost efficient or it can not be safely delivered on the MISO transmission system, MISO will not dispatch it
  - 3) MISO is undergoing a changing resource mix that has led to an increase in emergency events and a review of accrediting resources
  - 4) Because of these principles Vectren must fully evaluate the transmission components of a project and the expected output and accreditation it will receive in order to accurately evaluate the cost and efficiency of a project

WHAT IS MISO?

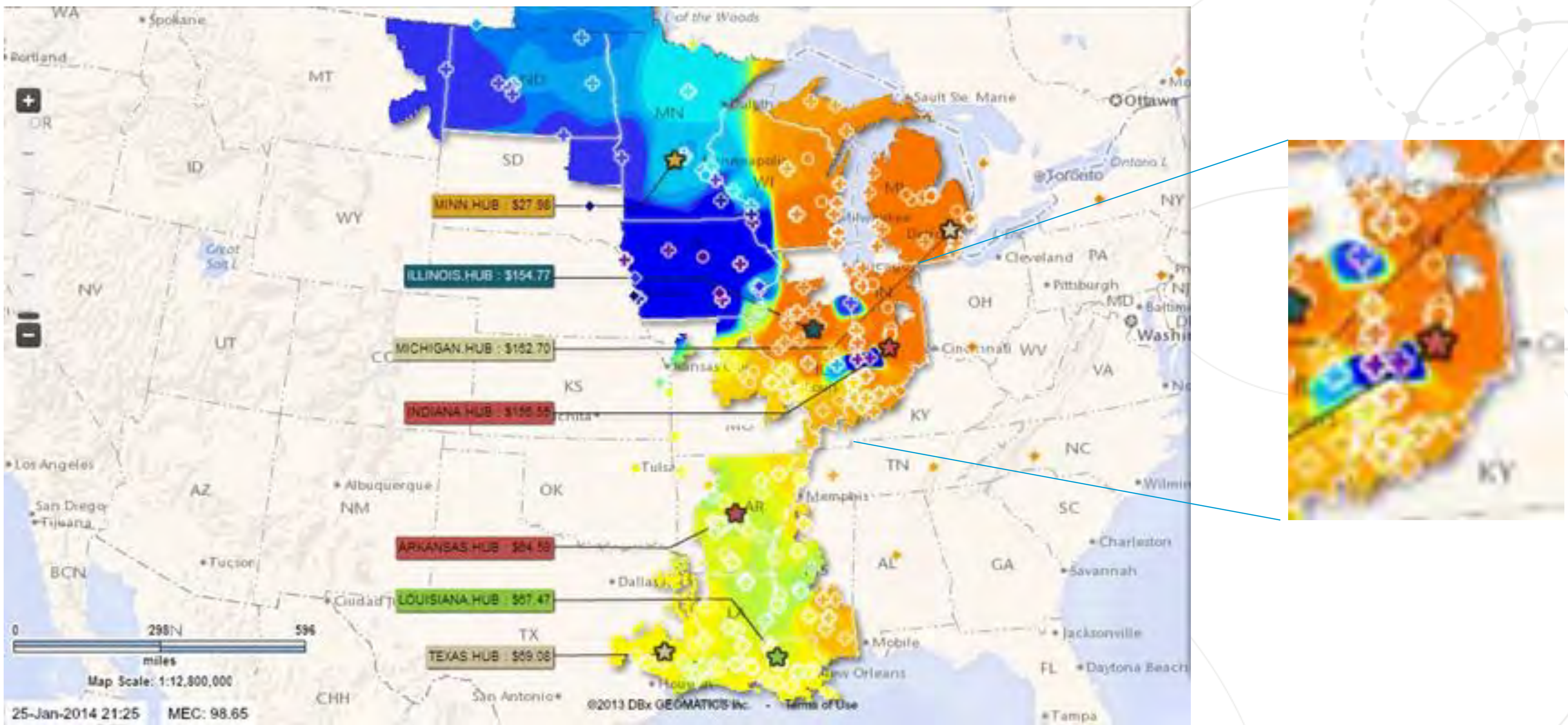
Midcontinent **I**ndependent Transmission **S**ystem **O**perator

- In 2001, MISO was approved as the first Regional Transmission Organization (RTO)
  - MISO has operational authority: the authority to control transmission facilities and coordinate security for its region to ensure reliability
  - MISO is responsible for dispatch of lowest cost generation units: MISO's energy market dispatches the most cost effective generation to meet load needs
- MISO is divided into 11 Local Resources Zones (LRZ), Indiana is part of Zone 6, which includes northwest Kentucky (Big Rivers Electric Cooperative)
- Each LRZ has its own planning requirements in regards to energy and capacity
- Each Zone's ability to rely on neighboring Zones depends largely on transmission infrastructure. Based on MISO's Local Clearing Requirement (LCR), approximately 70% of Vectren's generation must be physically located within MISO Zone 6

Source: MISO

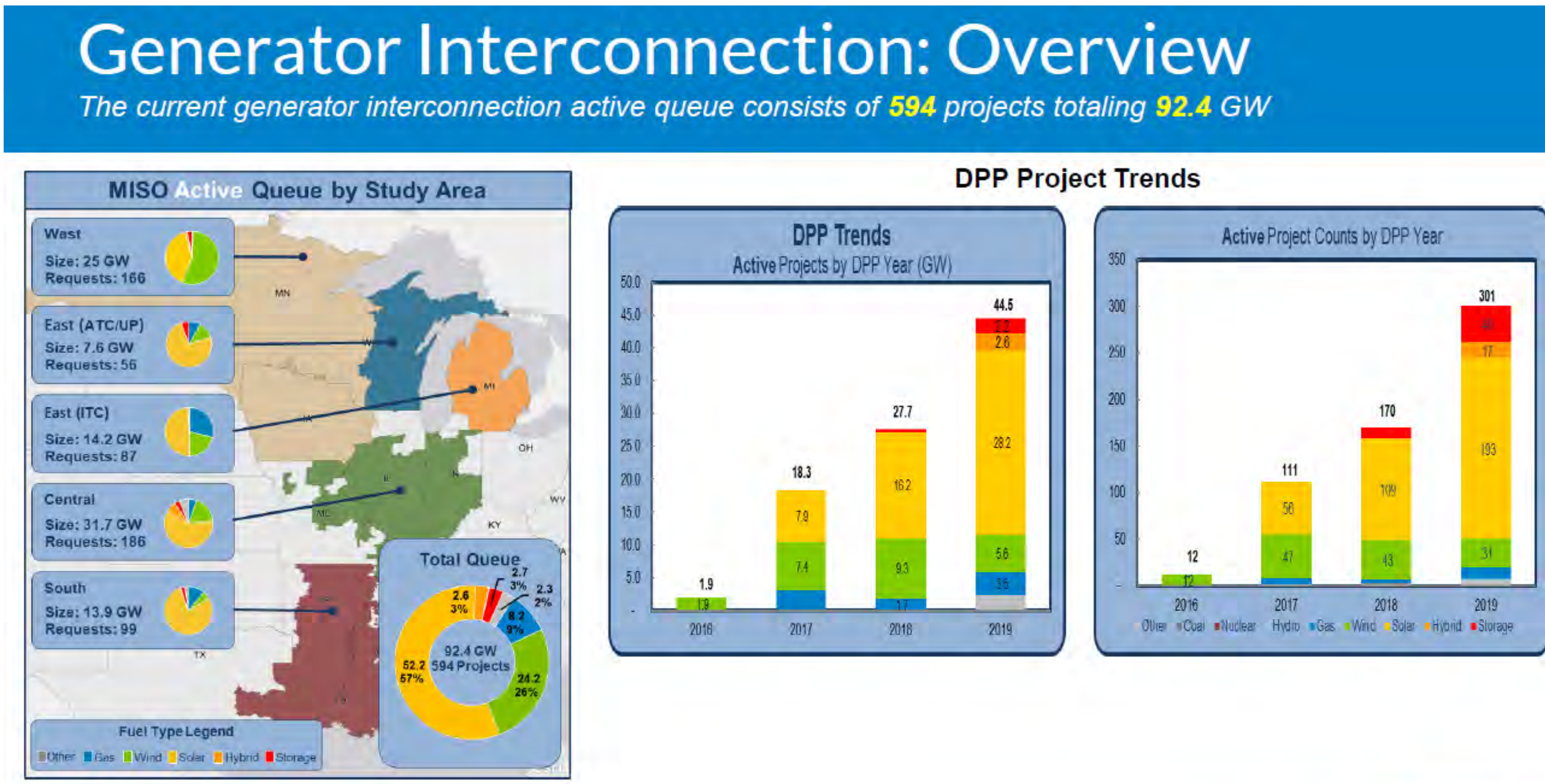
CONGESTION

- Congestion on the MISO system during a period when energy in MN was $27.98 while at that same time energy in IN was $156.55; thereby, generators in MN received $128.57 less than load was paying in IN
  - Vectren experiences price separation for wind resource power purchase agreements within IN zone 6
  - Throughout the year there is a $5 price spread that magnifies over night during periods of low load
- Important consideration for long-term energy supplies as over time and depending on transmission build-out, generation retirements and additions and congestion could change the economics and reliability of a project



MISO INTERCONNECTION SNAPSHOT

- Lengthy process that involves studies that are susceptible to many variables and cost allocation based on position in queue
- MISO Interconnection is predominantly composed of renewables (76%), followed by natural gas
- MISO's Renewable Integration Impact Assessment[1] is studying system impacts as renewables penetrate the grid and has determined that significant transmission upgrades will be necessary to reach 30% to 40% renewable penetration levels; this could lead to additional and substantial transmission investment



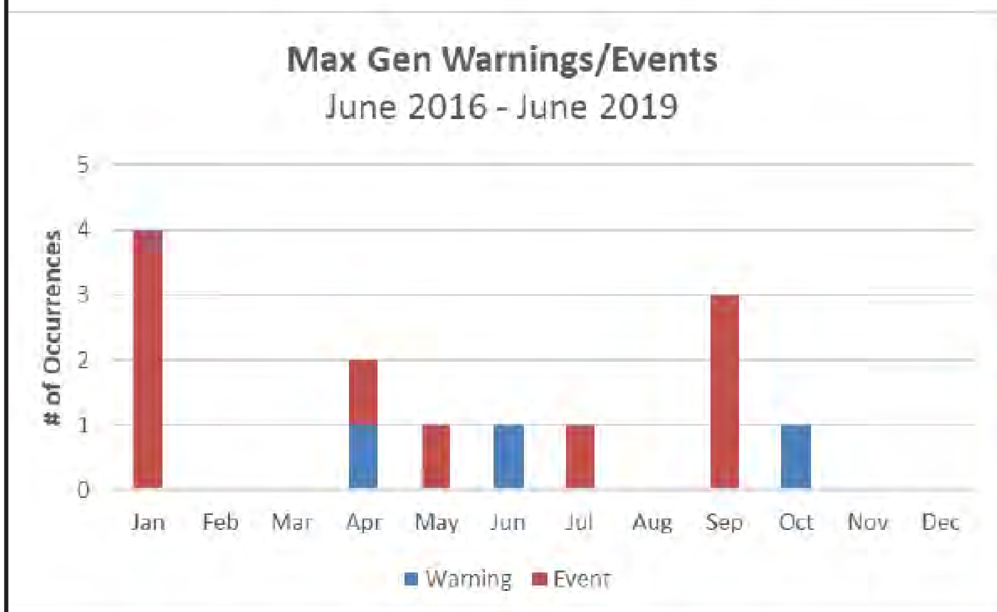
Updated: 9/1/2019

[1] https://www.misoenergy.org/planning/policy-studies/Renewable-integration-impact-assessment

MISO RESOURCE AVAILABILITY AND NEED (RAN) INITIATIVE

VECTREN
A CenterPoint Energy Company

- Less capacity and lower generator availability have led to tighter operating conditions in all four seasons
- MISO has experienced 10 Max Generation Events in the last 4 years; a Max Gen Event used to occur once every couple years
- As such, the RAN Initiative is to ensure resource accreditation aligns with actual available generation throughout the year



Year	Warnings*	Events	Total
2009	0	0	0
2010	0	0	0
2011	0	1	1
2012	2	1	3
2013	0	0	0
2014	1	1	2
2015	0	0	0
2016	1	1	2
2017	1	3	4
2018	0	3	3
2019	1	3	4
Total	6	13	19

4

*Warnings occurring on the same day as an Event are not included

MISO

https://www.misoenergy.org/stakeholder-engagement/issue-tracking/resource-availability-and-need-ran/

ALL MISO CONSIDERATIONS NEED TO BE ACCOUNTED FOR DURING THE IRP

VECTREN
A CenterPoint Energy Company

- Due to MISO planning requirements being based on NERC reliability standards, generator location is an important consideration
- Location is also an important consideration from a financial perspective as congestion can add or reduce considerable costs to delivered energy costs
- Furthermore, a changing resource mix in MISO has led to an increase in emergency events and a review of accrediting resources
- The IRP must review and consider actual energy sources and not simply financial representations or obligations
  - Energy must be deliverable from a congestion standpoint and must be interconnected to the MISO transmission system
  - Energy credits from projects not connected to MISO will not provide needed low-cost energy to meet our customer needs during peak conditions
  - A seasonal construct will change the expected capacity credit for generating resources and the benefit Vectren customers can receive from a project
- Due to these multiple and complex considerations, we must carefully review all RFP responses and resource mixes in order to meet MISO requirements and appropriately value the costs and benefits of projects

FEEDBACK AND DISCUSSION

SCENARIO MODELING INPUTS

GARY VICINUS

MANAGING DIRECTOR FOR UTILITIES, PACE GLOBAL

SUMMARY

- Pace Global utilized the qualitative draft scenarios discussed in the first stakeholder meeting to develop quantitative forecasts of key inputs
- Probabilistic modeling was utilized to develop higher and lower forecasts, relative to the base case for gas, CO_2, coal, load, and renewables/storage capital cost trajectories
- Coal and gas price forecasts have much wider ranges than the 2019 Energy Information Administration (EIA) Annual Energy Outlook (AEO)
- Note that capital cost forecasts will be adjusted to reflect RFP results. Final capital cost forecasts will be shared in the third public stakeholder meeting

SCENARIO MODELING

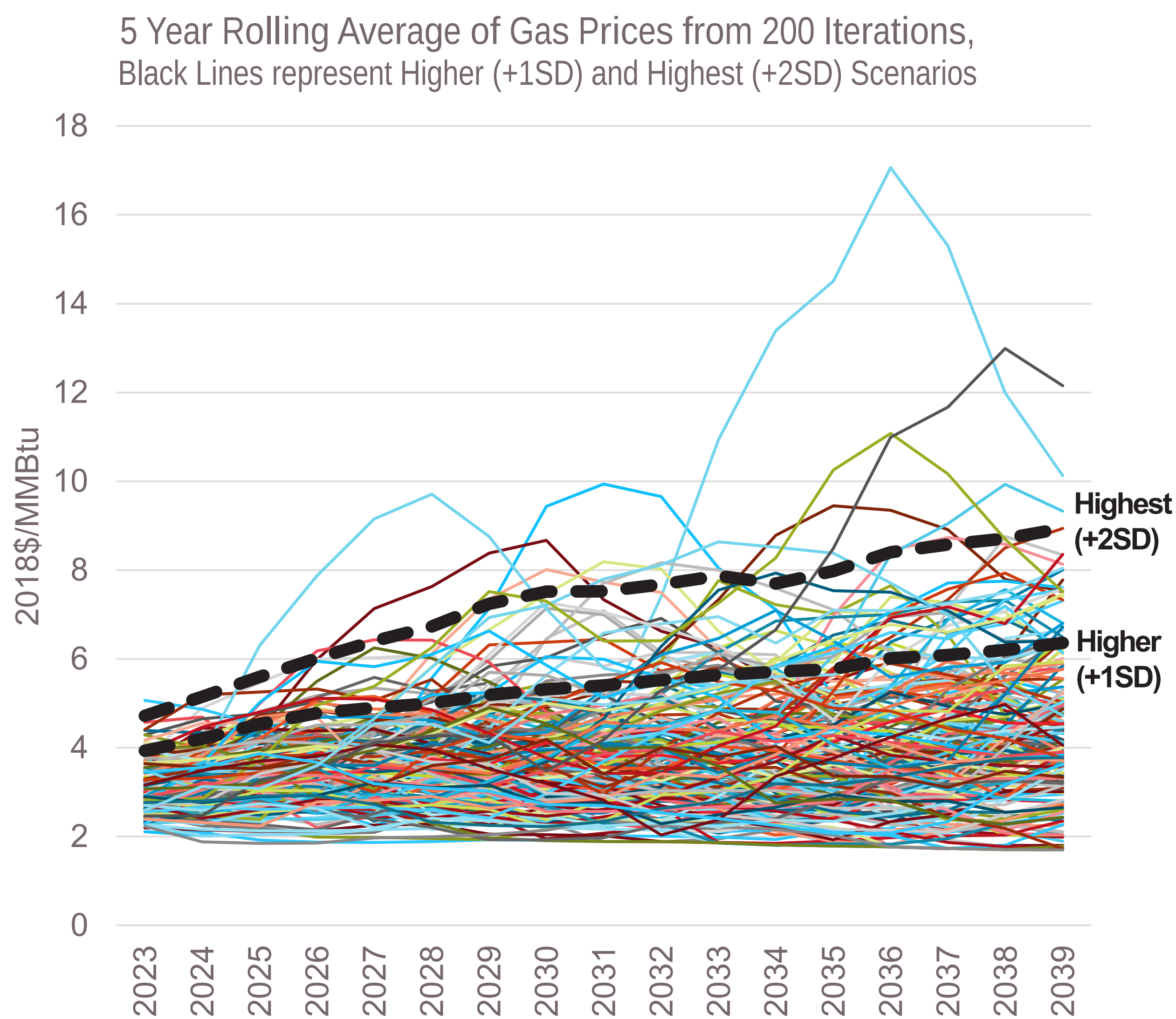
- In addition to the Base Case, four scenarios are being modeled. This will result in a least cost portfolio for each of the five cases. Additional portfolios will be developed beginning with today's stakeholder breakout session
- The Base Case inputs were shown in the first stakeholder presentation. To develop the scenario inputs, we begin with Base Case inputs and then shift into base, higher and lower ranges
- The higher and lower ranges are developed using a Monte Carlo (referred to as probabilistic or stochastic) simulation that creates 200 future paths for each variable
- A Base Case and Scenarios Assumptions Book in Excel format will be made available to intervenors
- Scenario data sheets included in the Appendix

PROBABILISTIC MODELING

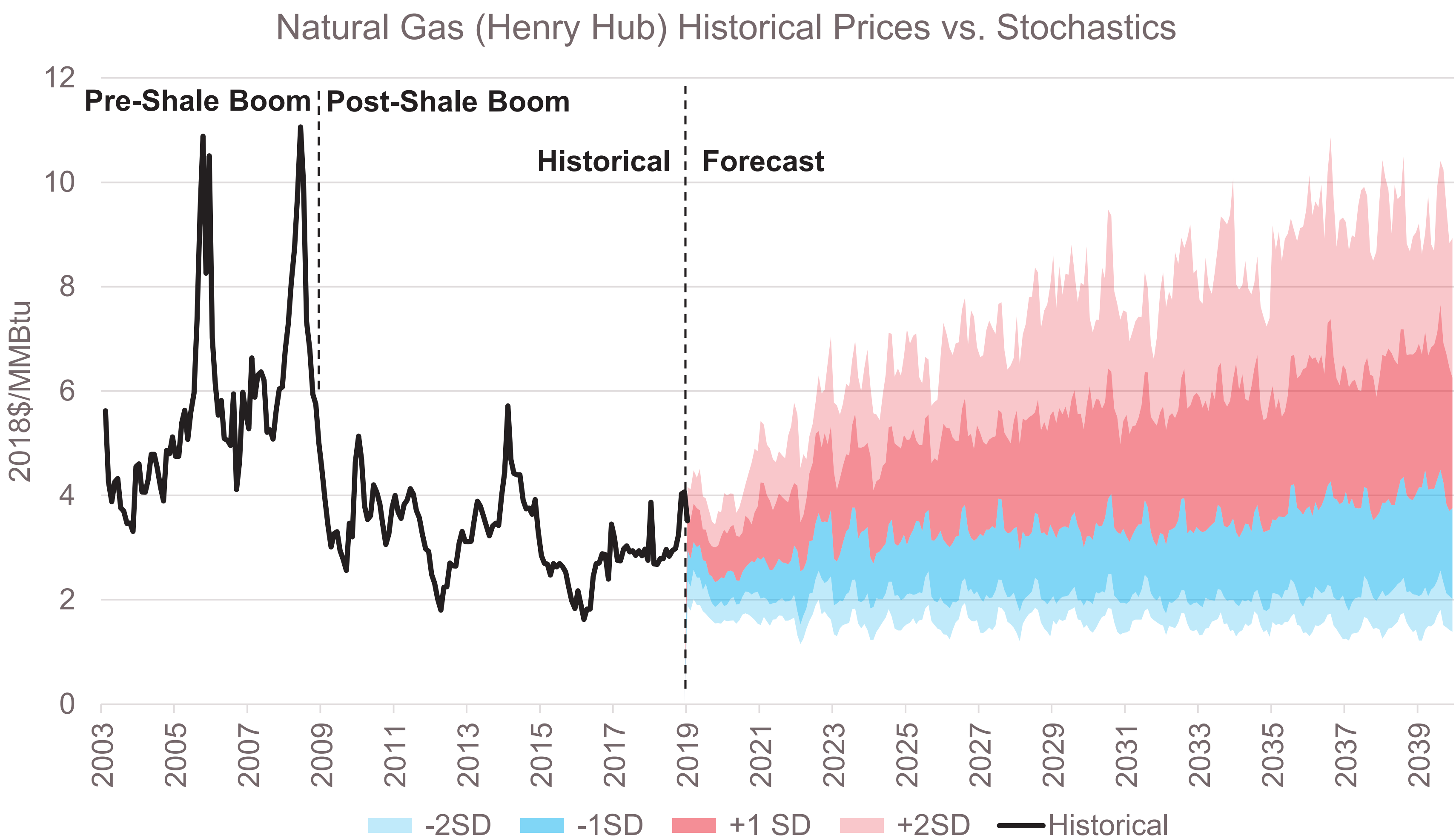
- Probabilistic modeling helps to measure risk from two hundred potential future paths for each stochastic variable
- These iterations provide percentile bands that can be used to measure the probability that a variable will be above (or below) a given percentile in a given time period and relative to the Base Case
  - For +1 Standard Deviation (+1SD) in a normal distribution, it is 84.2%
  - For -1 Standard Deviation (-1SD) in a normal distribution, it is 15.8%
  - For +2 or -2 SD, it is 97.8% and 2.2%, respectively
- Scenarios are assumed to remain the same as the Base Case in the short-term (2019-2021). In the medium-term (2022-2028), they grow or decline to +/-1SD or (+/-2SD) by 2025 (midpoint of medium-term). After 2025, the variable stays at +/-1SD (or +/-2SD) into the long-term to 2039
- Because our price path remains at the one (or two) standard deviation(s) path for the entire planning horizon, these levels have a low probability and are very conservative

PROBABILISTIC MODELING CONT.

- This spaghetti diagram shows a 5-year rolling average of all 200 gas price iterations against the Higher and Highest gas price scenarios.
- In any given year, about 16% of prices are above the Higher line and about 2% are above the Highest line.
- Looking at the 20 year price average, about 7% of the 200 iterations were above the Higher line and none were above the Highest line.

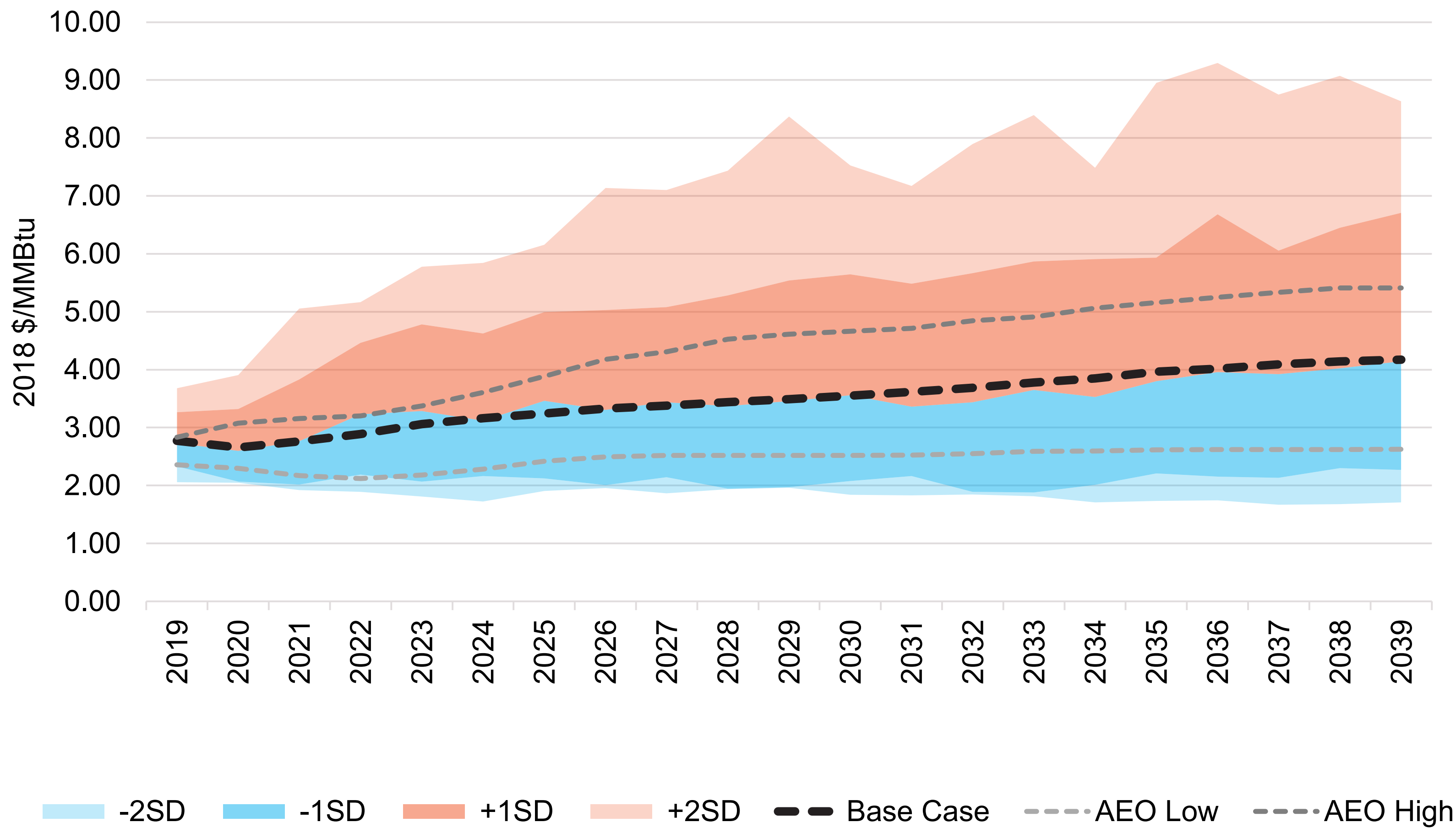


HISTORICAL PRICES VS. STOCHASTICS



HENRY HUB GAS PRICE DISTRIBUTIONS AND: COMPARISON TO EIA AEO[1] 2019

VECTREN
A CenterPoint Energy Company

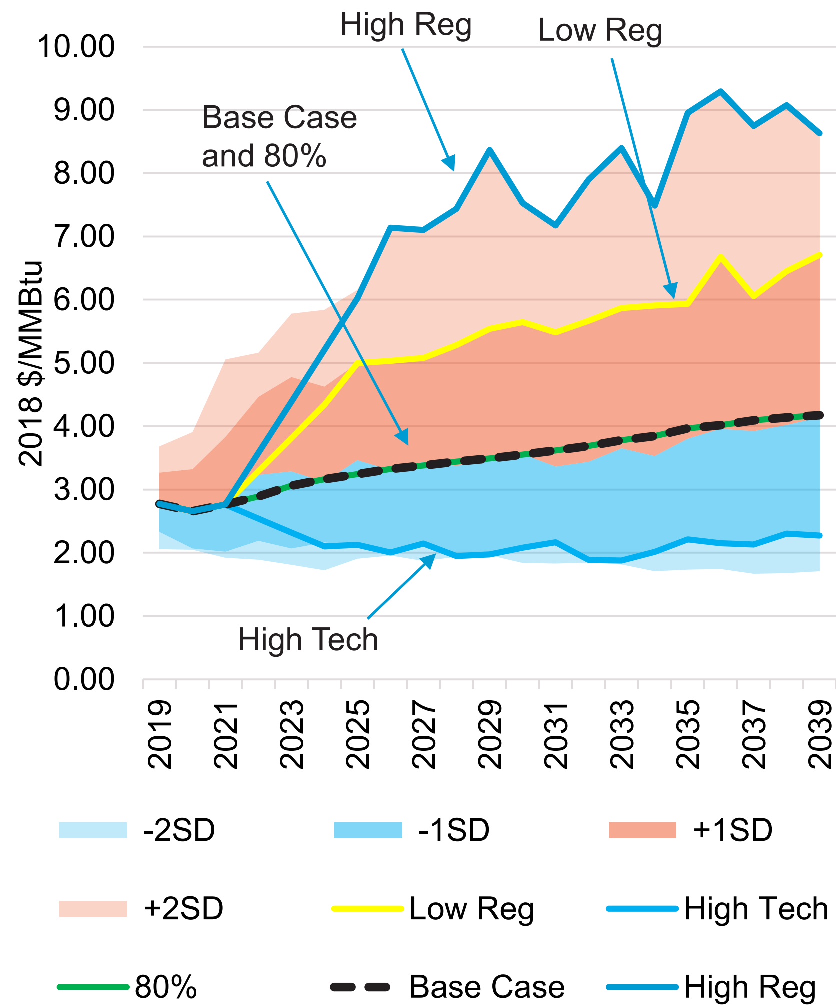


1Source:Energy Information Administration (EIA) Annual Energy Outlook (AEO) https://www.eia.gov/outlooks/aeo/
EIA Low = AEO 2019: High Oil & Gas Resource and Technology scenario
EIA High = AEO 2019: Low Oil & Gas Resource and Technology scenario

SCENARIO INPUTS: NATURAL GAS HENRY HUB (2018$/MMBTU)[1]

VECTREN
A CenterPoint Energy Company

	Base Case	Low Reg	High Tech	80% Reduction	High Reg
2019	2.77	2.77	2.77	2.77	2.77
2020	2.66	2.66	2.66	2.66	2.66
2021	2.76	2.76	2.76	2.76	2.76
2022	2.89	3.46	3.01	2.89	3.58
2023	3.06	4.10	2.82	3.06	4.39
2024	3.16	4.75	2.64	3.16	5.21
2025	3.24	5.12	2.33	3.24	6.03
2026	3.33	5.27	2.08	3.33	7.14
2027	3.38	5.20	2.13	3.38	7.10
2028	3.44	5.45	2.06	3.44	7.43
2029	3.49	5.62	2.04	3.49	8.37
2030	3.55	5.77	2.12	3.55	7.53
2031	3.62	5.60	2.13	3.62	7.17
2032	3.69	5.76	1.97	3.69	7.89
2033	3.78	5.95	2.02	3.78	8.40
2034	3.85	6.02	1.95	3.85	7.49
2035	3.96	6.12	2.12	3.96	8.95
2036	4.02	6.64	2.12	4.02	9.29
2037	4.09	6.23	2.07	4.09	8.75
2038	4.14	6.77	2.19	4.14	9.07
2039	4.17	6.85	2.20	4.17	8.63

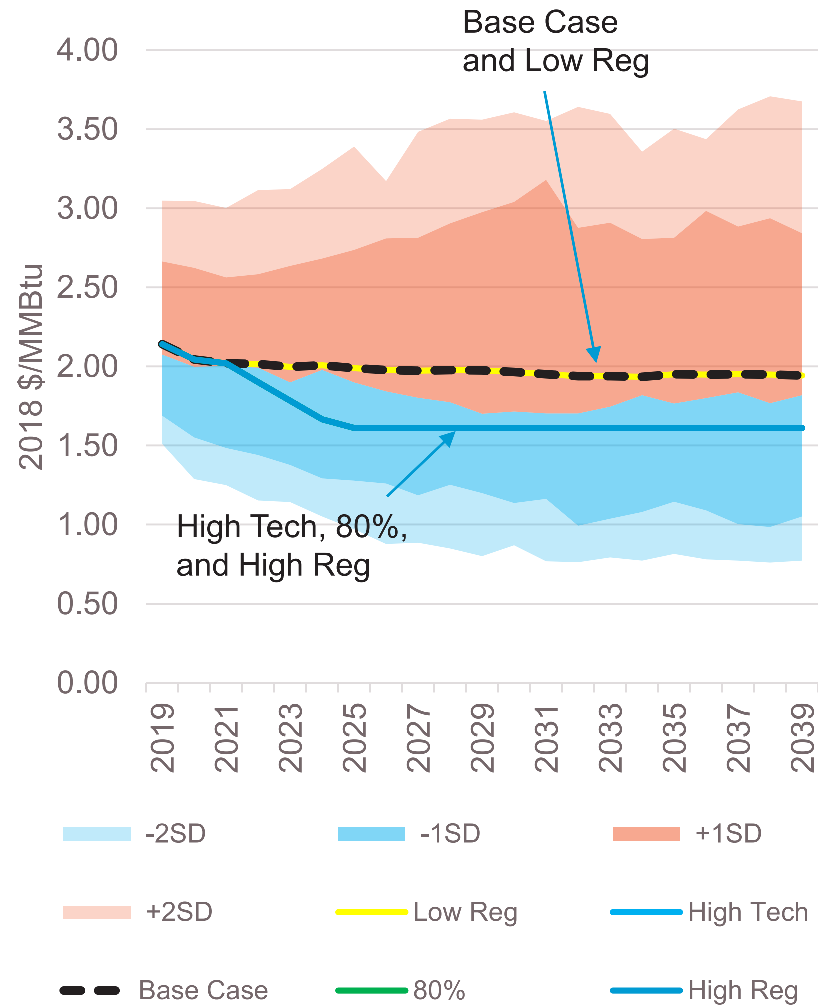


1 Modeling will include estimated inflation of 2.2% per year

SCENARIO INPUTS: ILLINOIS BASIN COAL DELIVERED TO BROWN (2018$/MMBTU) [1]

VECTREN
A CenterPoint Energy Company

	Base Case	Low Reg	High Tech	80% Reduction	High Reg
2019	2.14	2.14	2.14	2.14	2.14
2020	2.04	2.04	2.04	2.04	2.04
2021	2.02	2.02	2.02	2.02	2.02
2022	2.02	2.02	1.90	1.90	1.90
2023	2.00	2.00	1.78	1.78	1.78
2024	2.01	2.01	1.67	1.67	1.67
2025	1.99	1.99	1.61	1.61	1.61
2026	1.98	1.98	1.61	1.61	1.61
2027	1.97	1.97	1.61	1.61	1.61
2028	1.98	1.98	1.61	1.61	1.61
2029	1.97	1.97	1.61	1.61	1.61
2030	1.97	1.97	1.61	1.61	1.61
2031	1.95	1.95	1.61	1.61	1.61
2032	1.94	1.94	1.61	1.61	1.61
2033	1.94	1.94	1.61	1.61	1.61
2034	1.93	1.93	1.61	1.61	1.61
2035	1.95	1.95	1.61	1.61	1.61
2036	1.95	1.95	1.61	1.61	1.61
2037	1.95	1.95	1.61	1.61	1.61
2038	1.95	1.95	1.61	1.61	1.61
2039	1.94	1.94	1.61	1.61	1.61

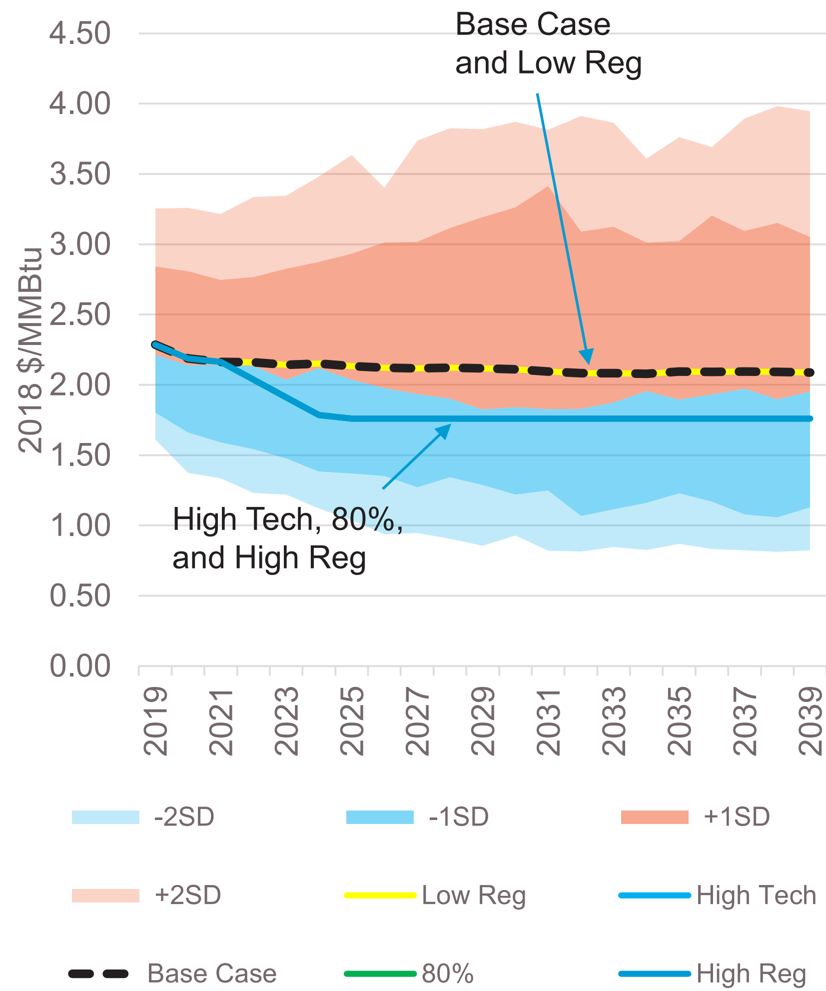


A price floor is set at $1.61/MMBtu

1 Modeling will include estimated inflation of 2.2% per year

SCENARIO INPUTS: ILLINOIS BASIN COAL DELIVERED TO CULLEY (2018$/MMBTU) [1]

	Base Case	Low Reg	High Tech	80% Reduction	High Reg
2019	2.29	2.29	2.29	2.29	2.29
2020	2.19	2.19	2.19	2.19	2.19
2021	2.16	2.16	2.16	2.16	2.16
2022	2.16	2.16	2.04	2.04	2.04
2023	2.14	2.14	1.91	1.91	1.91
2024	2.15	2.15	1.78	1.78	1.78
2025	2.13	2.13	1.76	1.76	1.76
2026	2.12	2.12	1.76	1.76	1.76
2027	2.12	2.12	1.76	1.76	1.76
2028	2.12	2.12	1.76	1.76	1.76
2029	2.12	2.12	1.76	1.76	1.76
2030	2.11	2.11	1.76	1.76	1.76
2031	2.09	2.09	1.76	1.76	1.76
2032	2.08	2.08	1.76	1.76	1.76
2033	2.08	2.08	1.76	1.76	1.76
2034	2.08	2.08	1.76	1.76	1.76
2035	2.09	2.09	1.76	1.76	1.76
2036	2.09	2.09	1.76	1.76	1.76
2037	2.10	2.10	1.76	1.76	1.76
2038	2.09	2.09	1.76	1.76	1.76
2039	2.09	2.09	1.76	1.76	1.76

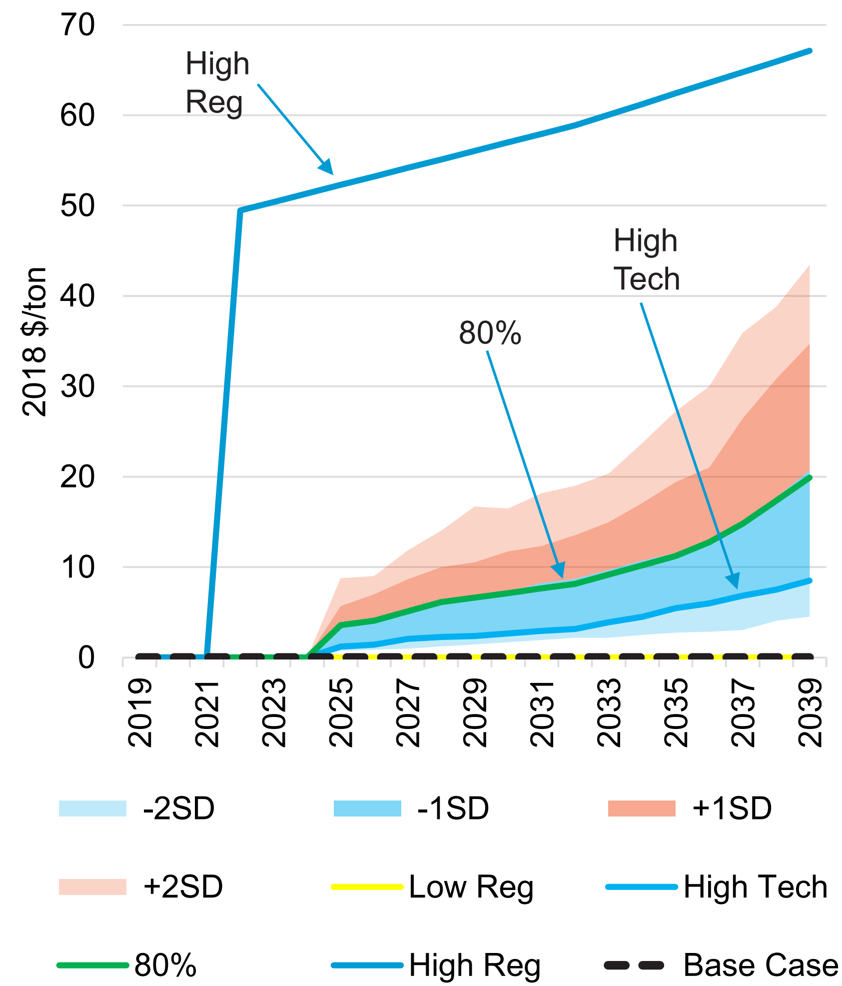


A price floor is set at $1.76/MMBtu

1 Modeling will include estimated inflation of 2.2% per year

SCENARIO INPUTS: CO2 PRICE (2018$/TON) [1]

	Base Case	Low Reg	High Tech	80% Reduction	High Reg
2019	0	0	0	0	0
2020	0	0	0	0	0
2021	0	0	0	0	0
2022	0	0	0	0	49.46
2023	0	0	0	0	50.40
2024	0	0	0	0	51.34
2025	0	0	1.20	3.57	52.28
2026	0	0	1.44	4.08	53.23
2027	0	0	2.06	5.10	54.17
2028	0	0	2.28	6.12	55.11
2029	0	0	2.38	6.63	56.05
2030	0	0	2.68	7.14	56.99
2031	0	0	2.94	7.65	57.94
2032	0	0	3.17	8.16	58.88
2033	0	0	3.89	9.18	60.06
2034	0	0	4.49	10.20	61.23
2035	0	0	5.46	11.22	62.41
2036	0	0	6.01	12.75	63.59
2037	0	0	6.85	14.79	64.77
2038	0	0	7.52	17.34	65.94
2039	0	0	8.50	19.89	67.12

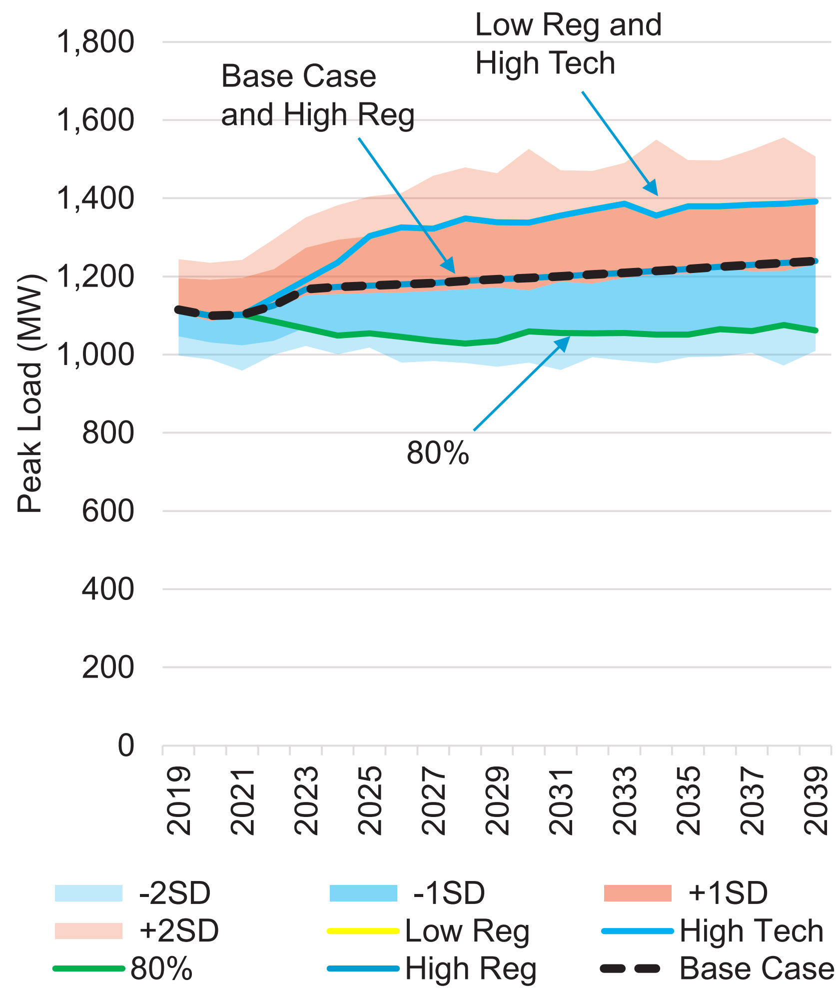


1 Modeling will include estimated inflation of 2.2% per year

SCENARIO INPUTS: VECTREN PEAK LOAD (MW)

VECTREN
A CenterPoint Energy Company

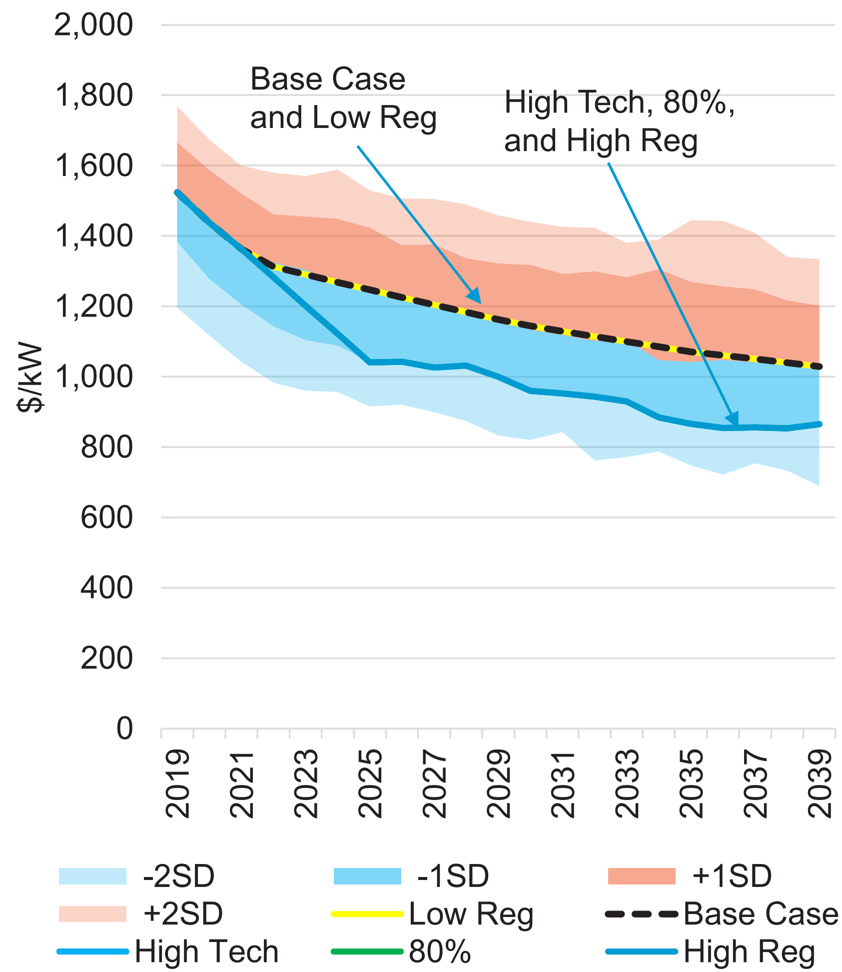
	Base Case	Low Reg	High Tech	80% Reduction	High Reg
2019	1,115	1,115	1,115	1,115	1,115
2020	1,100	1,100	1,100	1,100	1,100
2021	1,102	1,102	1,102	1,102	1,102
2022	1,126	1,146	1,146	1,084	1,126
2023	1,168	1,191	1,191	1,066	1,168
2024	1,173	1,235	1,235	1,049	1,173
2025	1,176	1,303	1,303	1,055	1,176
2026	1,179	1,325	1,325	1,045	1,179
2027	1,183	1,322	1,322	1,036	1,183
2028	1,189	1,348	1,348	1,028	1,189
2029	1,192	1,338	1,338	1,035	1,192
2030	1,196	1,337	1,337	1,059	1,196
2031	1,200	1,356	1,356	1,055	1,200
2032	1,205	1,371	1,371	1,055	1,205
2033	1,209	1,386	1,386	1,056	1,209
2034	1,214	1,356	1,356	1,051	1,214
2035	1,219	1,379	1,379	1,051	1,219
2036	1,225	1,379	1,379	1,065	1,225
2037	1,229	1,383	1,383	1,060	1,229
2038	1,234	1,386	1,386	1,076	1,234
2039	1,239	1,391	1,391	1,062	1,239



SCENARIO INPUTS: CAPITAL COST SOLAR (100 MW) (2018$/KW) [1]

VECTREN
A CenterPoint Energy Company

	Base Case	Low Reg	High Tech	80% Reduction	High Reg
2019	1,524	1,524	1,524	1,524	1,524
2020	1,438	1,438	1,438	1,438	1,438
2021	1,362	1,362	1,362	1,362	1,362
2022	1,313	1,313	1,282	1,282	1,282
2023	1,290	1,290	1,202	1,202	1,202
2024	1,268	1,268	1,121	1,121	1,121
2025	1,247	1,247	1,041	1,041	1,041
2026	1,225	1,225	1,042	1,042	1,042
2027	1,204	1,204	1,026	1,026	1,026
2028	1,183	1,183	1,031	1,031	1,031
2029	1,162	1,162	999	999	999
2030	1,144	1,144	960	960	960
2031	1,129	1,129	952	952	952
2032	1,114	1,114	944	944	944
2033	1,100	1,100	929	929	929
2034	1,085	1,085	884	884	884
2035	1,070	1,070	866	866	866
2036	1,061	1,061	854	854	854
2037	1,050	1,050	856	856	856
2038	1,040	1,040	853	853	853
2039	1,029	1,029	865	865	865

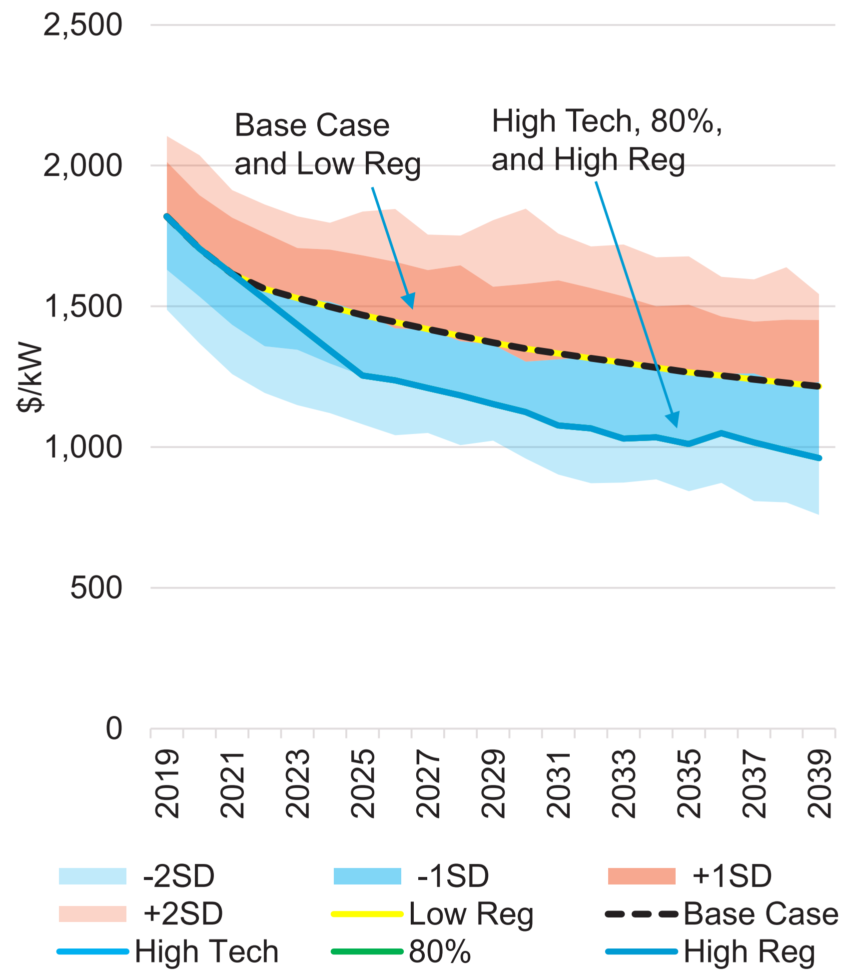


1 Modeling will include estimated inflation of 2.2% per year

SCENARIO INPUTS: CAPITAL COST

SOLAR+STORAGE (50 MW PV + 10 MW/ 40 MWH STORAGE) [1]

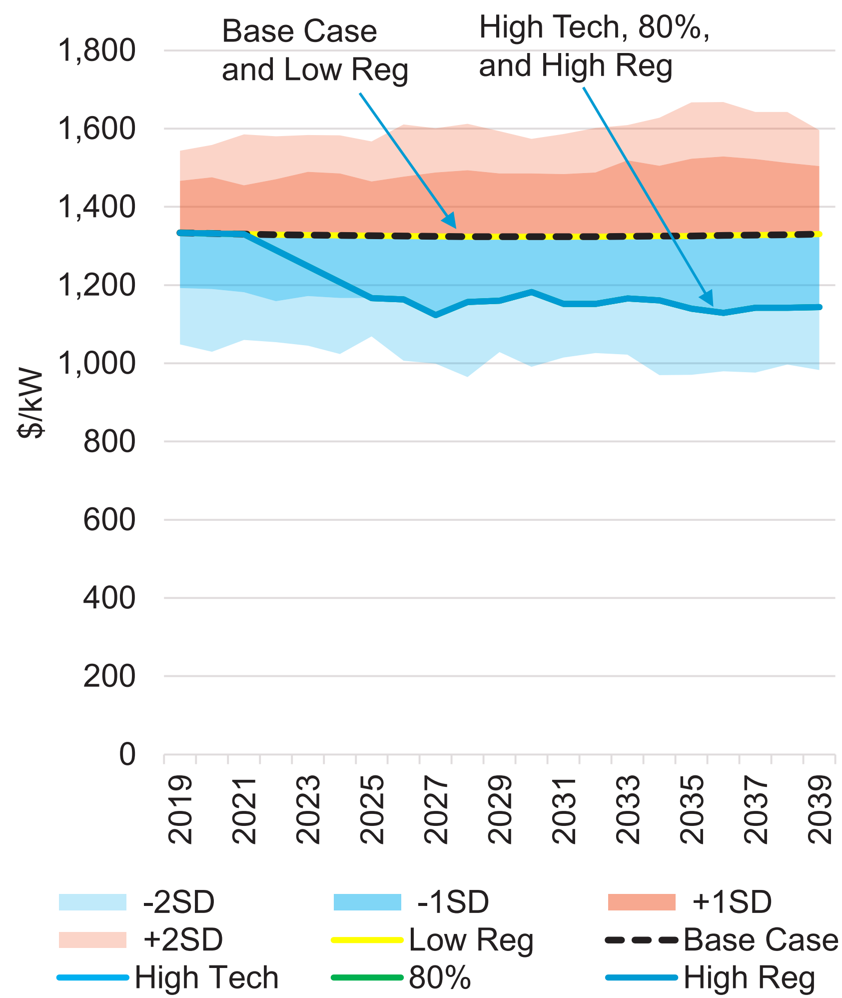
	Base Case	Low Reg	High Tech	80% Reduction	High Reg
2019	1,820	1,820	1,820	1,820	1,820
2020	1,705	1,705	1,705	1,705	1,705
2021	1,616	1,616	1,616	1,616	1,616
2022	1,562	1,562	1,526	1,526	1,526
2023	1,529	1,529	1,435	1,435	1,435
2024	1,499	1,499	1,344	1,344	1,344
2025	1,469	1,469	1,254	1,254	1,254
2026	1,443	1,443	1,237	1,237	1,237
2027	1,419	1,419	1,210	1,210	1,210
2028	1,395	1,395	1,183	1,183	1,183
2029	1,371	1,371	1,153	1,153	1,153
2030	1,349	1,349	1,124	1,124	1,124
2031	1,332	1,332	1,077	1,077	1,077
2032	1,316	1,316	1,066	1,066	1,066
2033	1,299	1,299	1,031	1,031	1,031
2034	1,282	1,282	1,034	1,034	1,034
2035	1,266	1,266	1,011	1,011	1,011
2036	1,254	1,254	1,049	1,049	1,049
2037	1,241	1,241	1,016	1,016	1,016
2038	1,228	1,228	988	988	988
2039	1,215	1,215	961	961	961



1 Modeling will include estimated inflation of 2.2% per year

SCENARIO INPUTS: CAPITAL COST WIND (200 MW) (2018$/KW) [1]

	Base Case	Low Reg	High Tech	80% Reduction	High Reg
2019	1,334	1,334	1,334	1,334	1,334
2020	1,332	1,332	1,332	1,332	1,332
2021	1,330	1,330	1,330	1,330	1,330
2022	1,329	1,329	1,289	1,289	1,289
2023	1,328	1,328	1,249	1,249	1,249
2024	1,327	1,327	1,208	1,208	1,208
2025	1,326	1,326	1,167	1,167	1,167
2026	1,325	1,325	1,163	1,163	1,163
2027	1,324	1,324	1,123	1,123	1,123
2028	1,324	1,324	1,157	1,157	1,157
2029	1,324	1,324	1,160	1,160	1,160
2030	1,324	1,324	1,182	1,182	1,182
2031	1,324	1,324	1,152	1,152	1,152
2032	1,324	1,324	1,152	1,152	1,152
2033	1,324	1,324	1,166	1,166	1,166
2034	1,325	1,325	1,161	1,161	1,161
2035	1,326	1,326	1,139	1,139	1,139
2036	1,327	1,327	1,129	1,129	1,129
2037	1,328	1,328	1,142	1,142	1,142
2038	1,329	1,329	1,142	1,142	1,142
2039	1,330	1,330	1,143	1,143	1,143



1 Modeling will include estimated inflation of 2.2% per year

FEEDBACK AND DISCUSSION

LONG-TERM BASE ENERGY AND DEMAND FORECAST

Michael Russo, Sr. Forecast Consultant

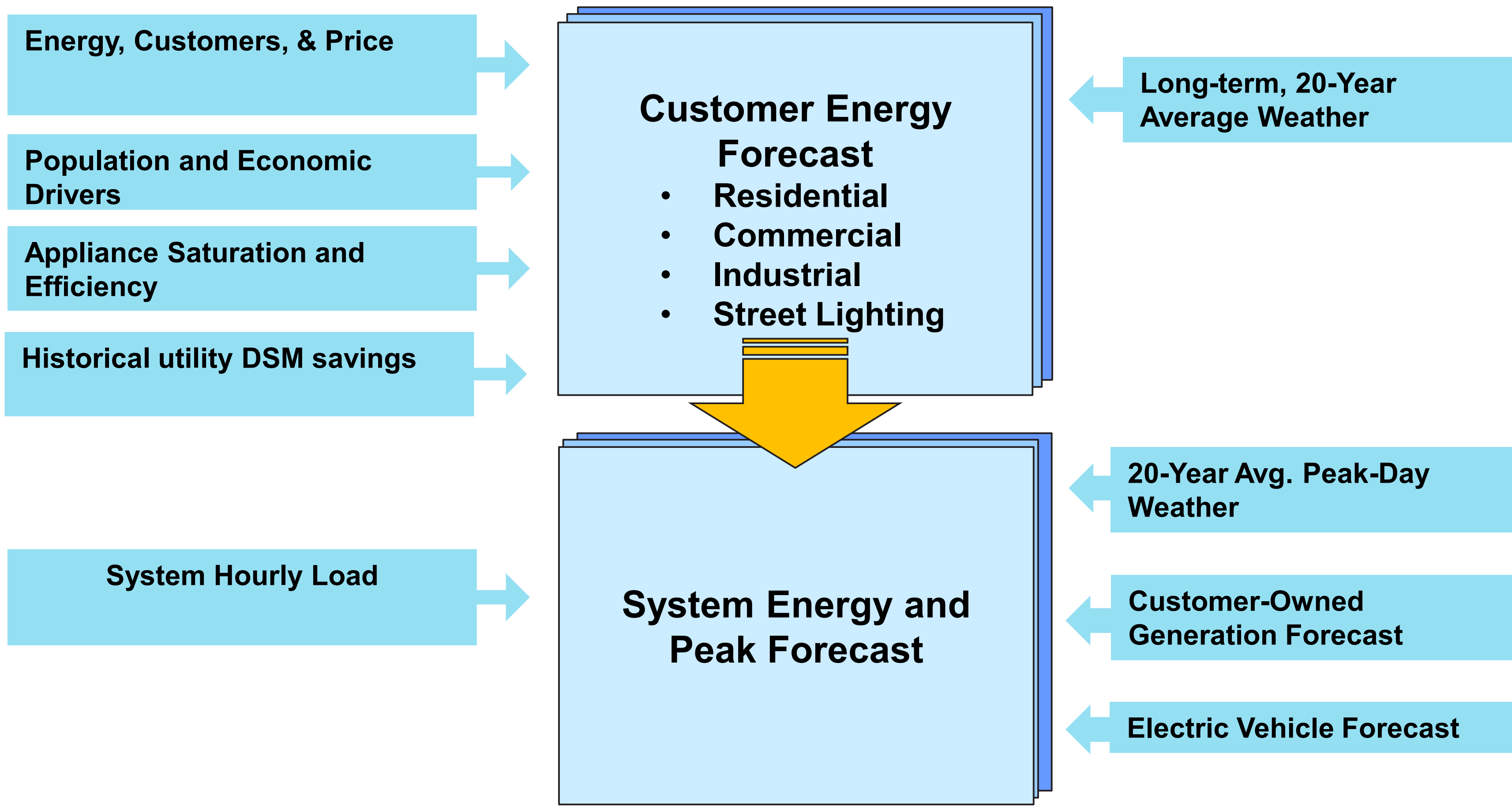
Itron

FORECAST SUMMARY

- Moderate energy growth
  - Annual energy and demand growth of 0.6%[1]
  - Slow long-term population growth (0.2% annual growth) & moderate output growth (1.7% annual growth)
  - Strong end-use efficiency gains reflecting new and existing Federal codes and standards
    - Air conditioning, heating, lighting, refrigeration, cooking, etc. are becoming more efficient over time
  - Market-driven solar adoption
  - Electric vehicle projections based on EIA 2019 Annual Energy Outlook

[1] Future energy efficiency programs are not included in the sales and demand forecast and will be considered a resource option

BOTTOM-UP FORECAST APPROACH



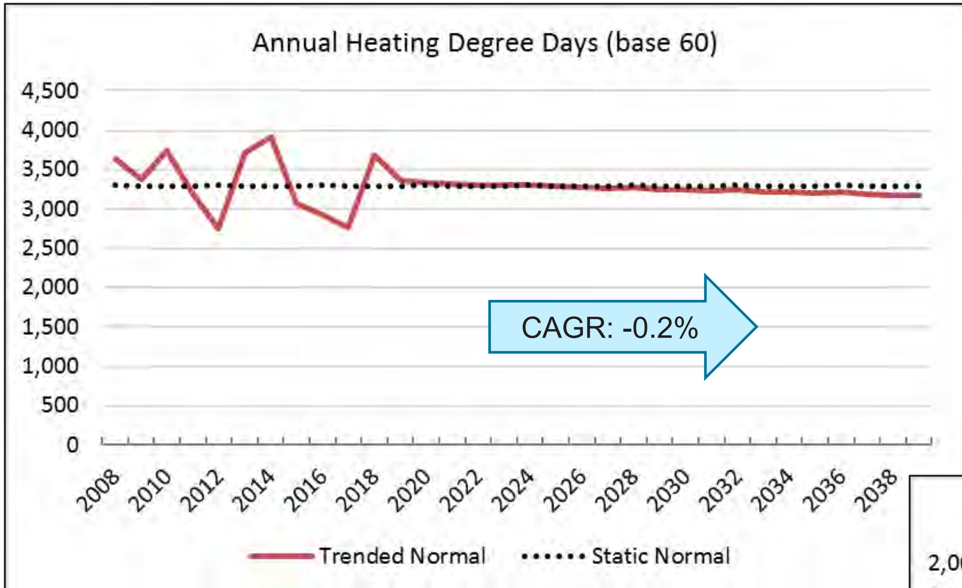
ECONOMIC DRIVERS

Moody's Analytic forecast for the Evansville MSA

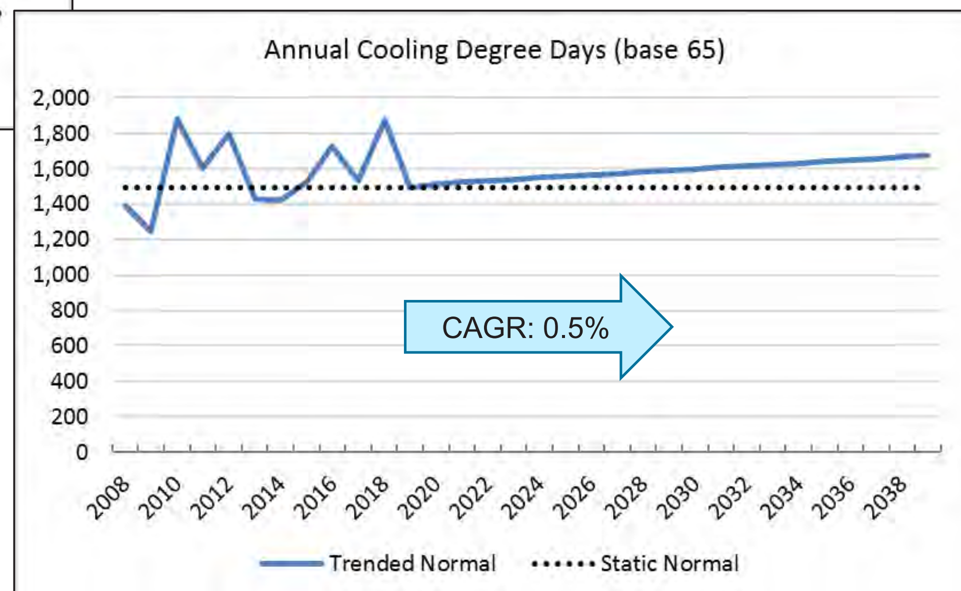
- Residential Sector
  - Households: 0.4% CAGR
  - Real Household Income: 1.6% CAGR
  - Household Size -0.3% CAGR
- Commercial Sector
  - Non-Manufacturing Output: 1.7% CAGR
  - Non-Manufacturing Employment : 0.6% CAGR
  - Population 0.2% CAGR
- Industrial Sector
  - Manufacturing Output: 1.8% CAGR
  - Manufacturing Employment: -0.5% CAGR

TRENDED NORMAL WEATHER

VECTREN
A CenterPoint Energy Company

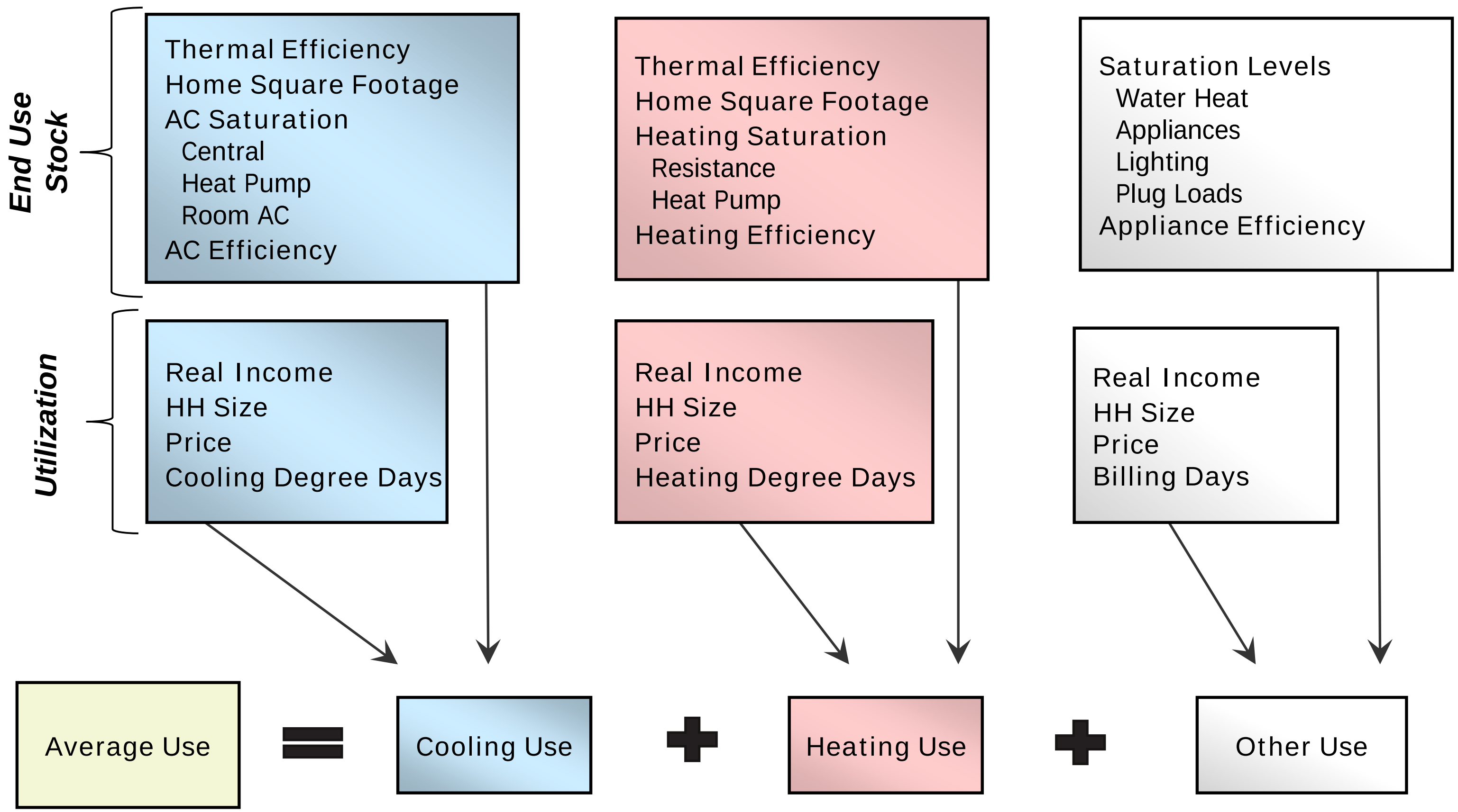


- Average temperature is increasing
  - Decline in HDD (warmer winters)
  - Increase in CDD (hotter summers)

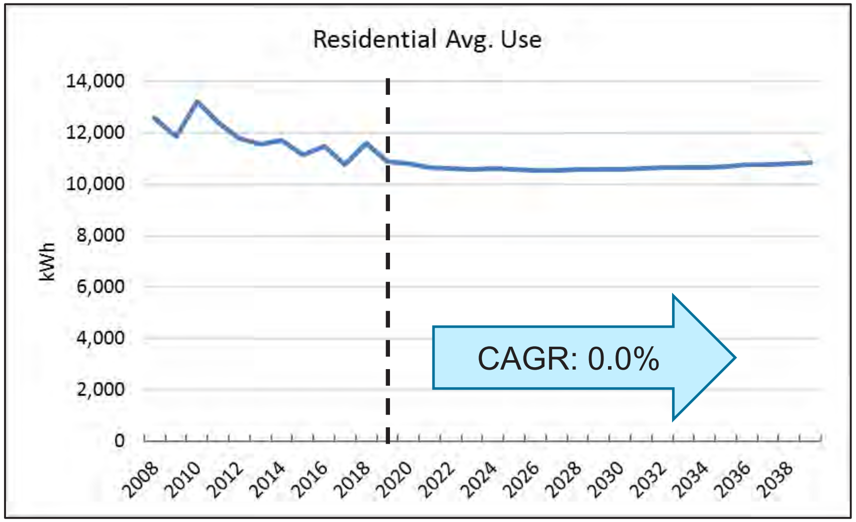


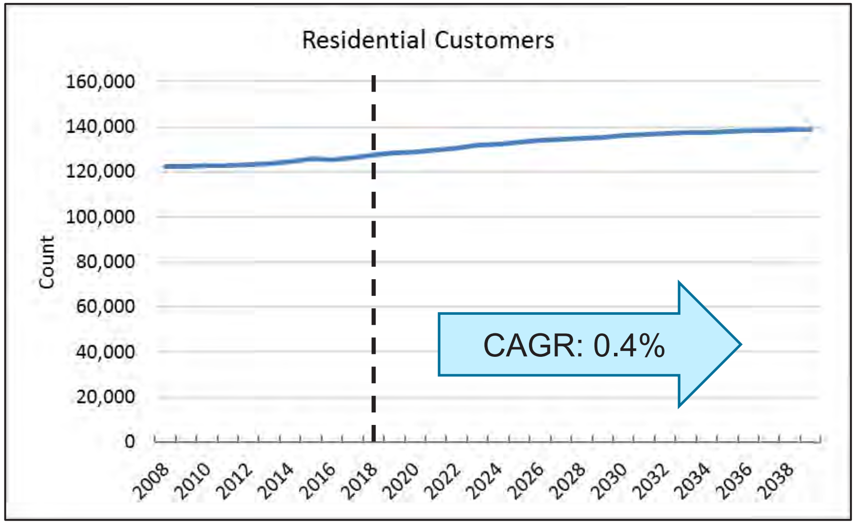
- Temperature trend based on statistical analysis of historical temperature data (1988 to 2018)

RESIDENTIAL AVERAGE USE MODEL

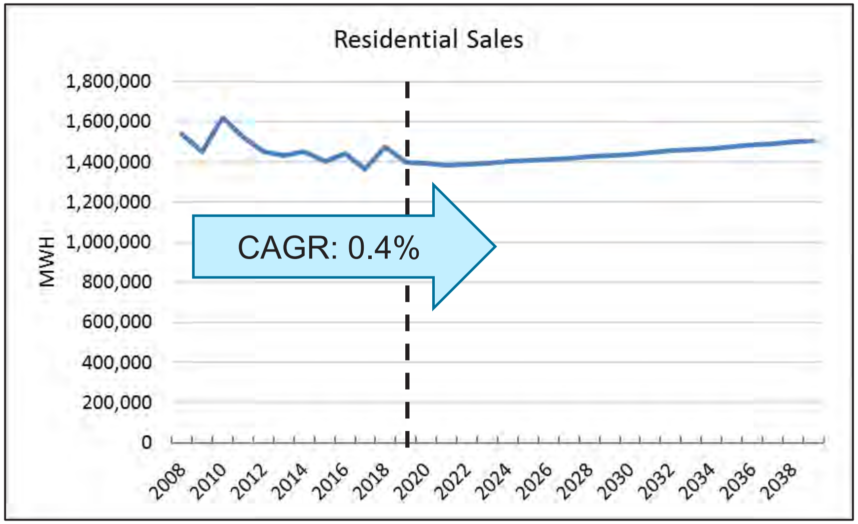


RESIDENTIAL FORECAST

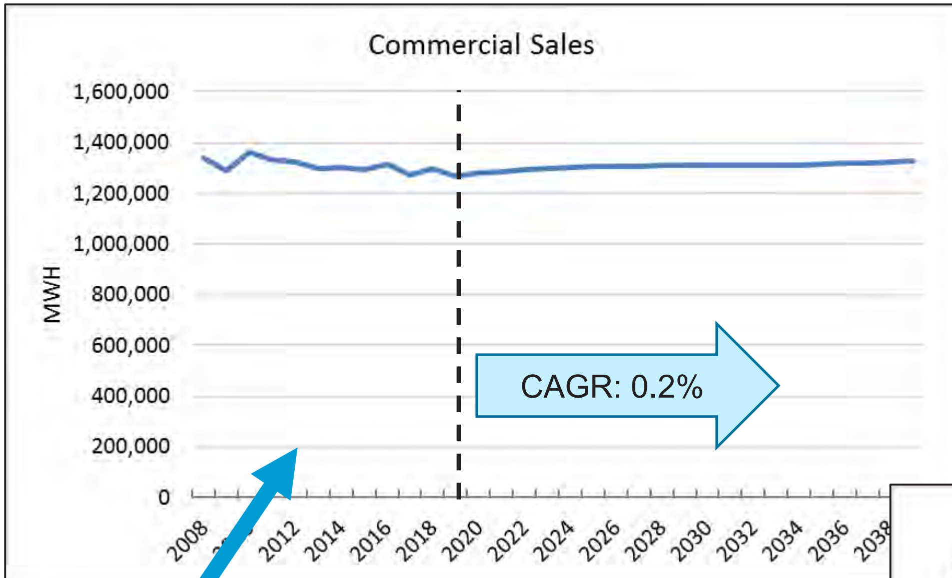


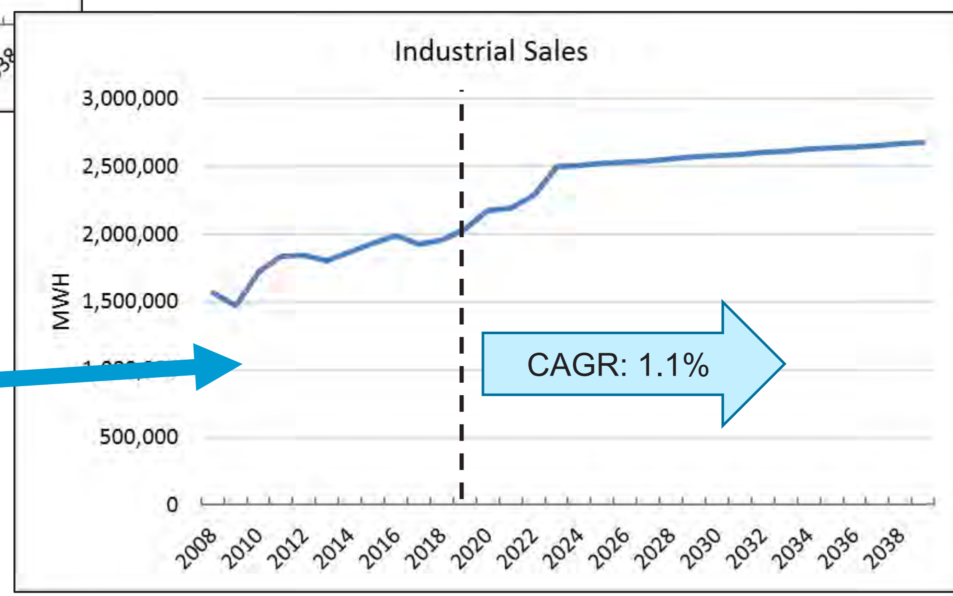


- Flat average use forecast, does not include the impact of future DSM program activity



C&I SALES FORECAST

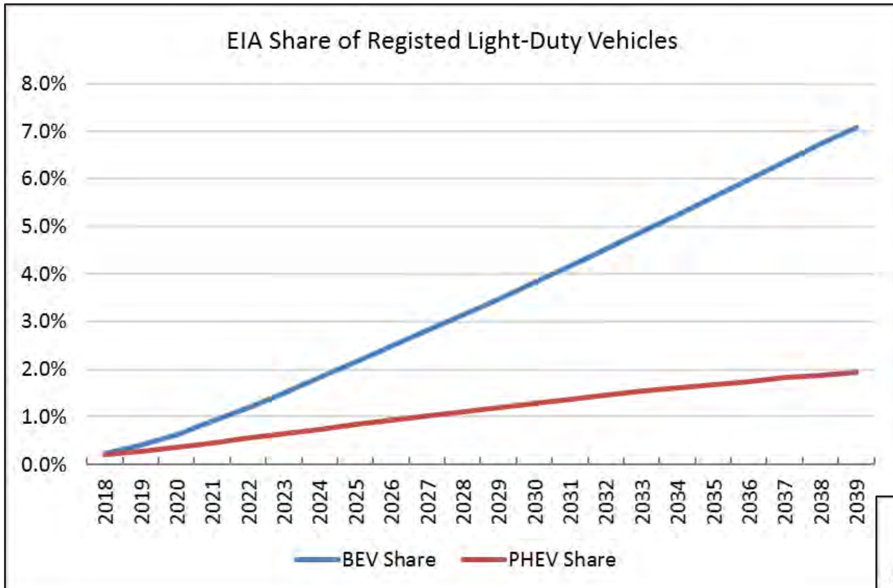




- Increase in commercial business activity countered by end-use efficiency gains
- Strong industrial sales growth related to near-term expected industrial expansion

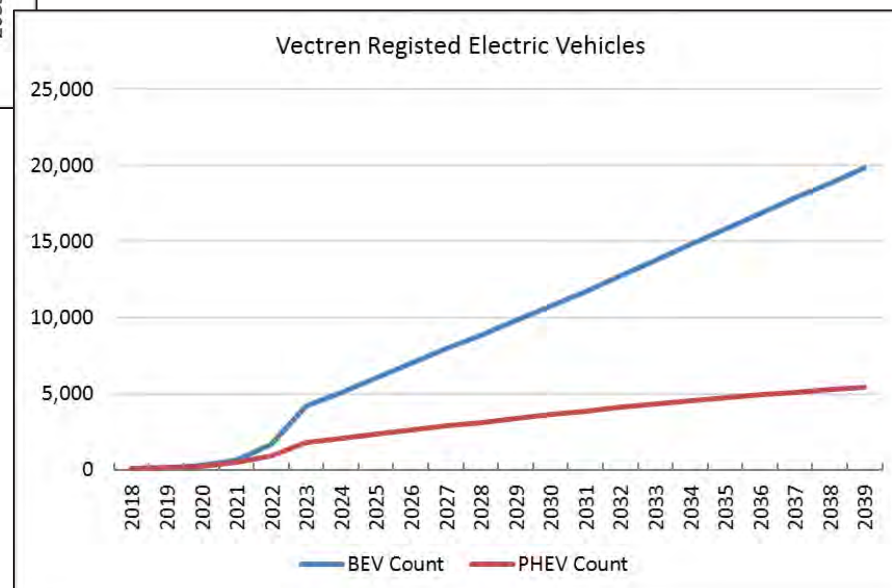
* Excludes future energy efficiency program impacts and customer-owned DG

ELECTRIC VEHICLES

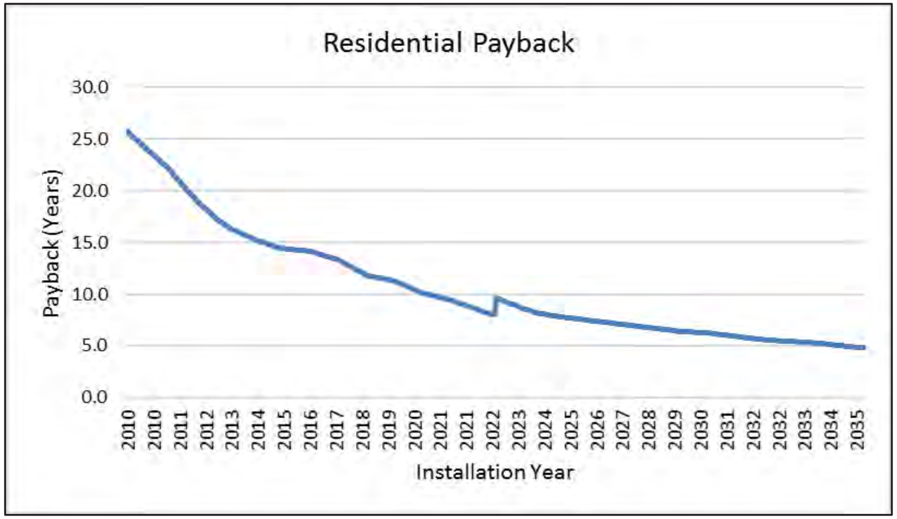


- Energy Information Administration (EIA) forecast based on share of total registered vehicles; differentiating between all electric (BEV) and plug-in hybrid electric (PHEV)

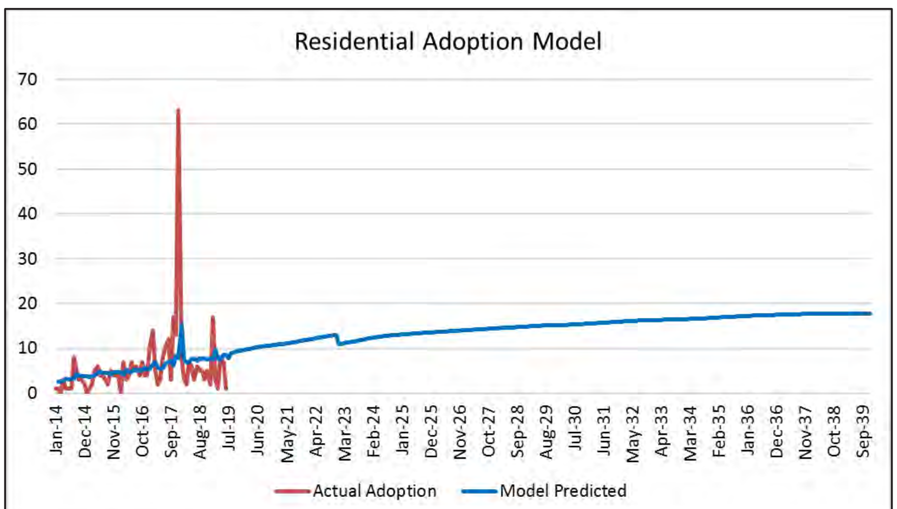
- Average annual kWh per vehicle based on weighted average of current registered BEV/PHEV
  - 3,752 kWh per BEV
  - 2,180 kWh per PHEV



CUSTOMER OWNED PV

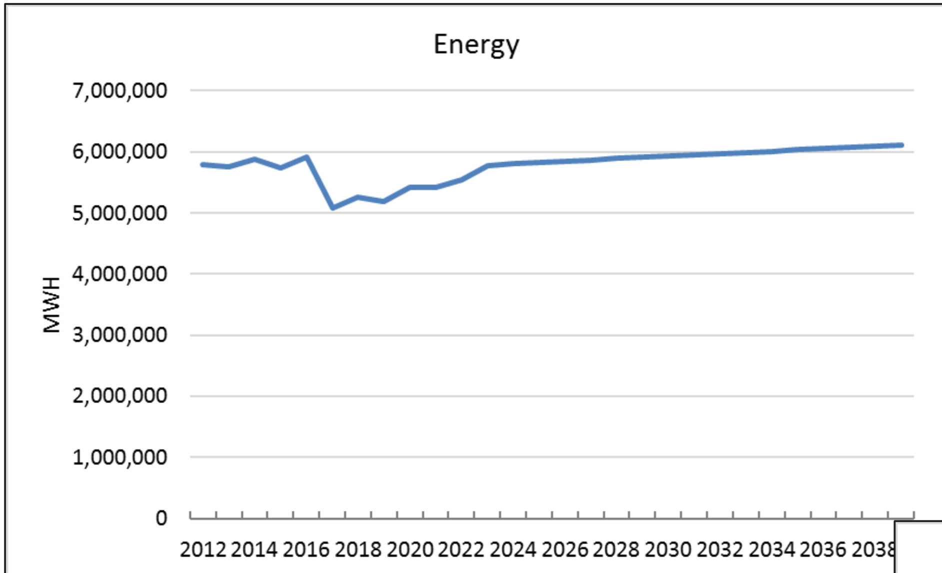


- Customer economics defined using simple payback
  - incorporates declining solar system costs, electric price projections, changes in net metering laws, and federal incentives

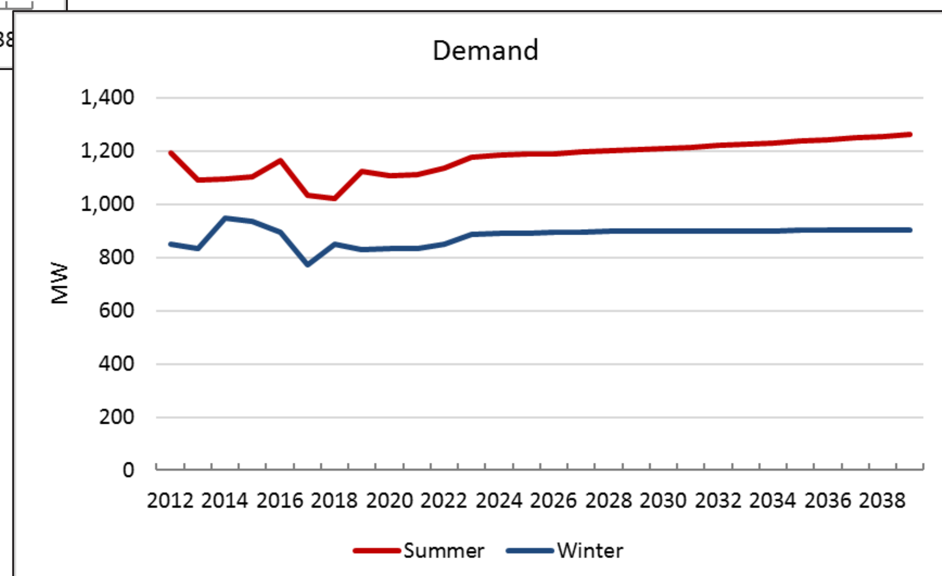


- Monthly adoption based on simple payback

ENERGY & DEMAND FORECAST



- Combining economic growth, end-use efficiency, and adoption of new technologies, and trended weather results in 0.6% long-term energy and summer demand CAGR (2020-2039)*



* Excludes future energy efficiency programs. Includes a forecast of customer owned solar generation and forecast for electric vehicle penetration. Excludes company owned generation on the distribution system

FEEDBACK AND DISCUSSION

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EXISTING RESOURCE OVERVIEW

WAYNE GAMES

VECTREN VICE PRESIDENT POWER GENERATION OPERATIONS

EXISTING RESOURCE SUMMARY

- Vectren is doing an exhaustive look at options for existing coal resources, including continued operation, retirement and coal to gas conversion of units
- Vectren must comply with EPA regulations; as such we are performing several studies to determine compliance options
- There is risk for Vectren in continued joint operation or sole ownership options as it pertains to Warrick 4

DEFINITIONS

- ACE – Affordable Clean Energy Rule; Carbon rule that establishes emission guidelines for states to use when developing plans to limit CO_2 (improve heat rate) at their coal fired power plants
  - Heat rate improvements can be achieved through equipment upgrades or operation & maintenance practices
  - State of Indiana expected to issue requirement to comply in 2021
- Capacity Factor – The amount of energy a resource produces in a given period of time divided by the maximum amount of energy the resource is capable of producing during the same period of time
- CCR – Coal Combustion Residuals
- $EFOR_d$ – Equivalent Forced Outage Rate Demand; reliability measure used by MISO in the calculation of capacity accreditation for thermal resources
- Heat Rate – Measure of efficiency of a thermal generating resource; lower values represent better efficiency
- ICAP – Installed capacity of a resource
- MW – Megawatt
- PPA – Purchase Power Agreement
- UCAP – Unforced capacity; capacity credit a market participant receives from MISO for their resources
  - Thermal resources are based on tested unit output and 3 year historical $EFOR_d$ (Takes into account forced outages and forced derates)
  - Intermittent resources are based on historical output during peak summer hours
    - Solar resources without operating data default to a credit of 50% of installed capacity
    - Wind resources without operating default to the MISO system wide wind capacity credit from the effective load carrying capability (ELCC) study
      - Received 8% and 9.2% capacity credit for current wind PPA's in 2019-2020 planning year
- FGD – Flue gas desulfurization

SUMMARY OF CURRENT RESOURCE UCAP ACCREDITATION FOR SUMMER PEAK

Resource	Fuel \ Technology	Installed Net Capacity (MW)	2019-2020 MISO Planning Year UCAP[2] (MW)	2020-2021 MISO Planning Year UCAP[2] Projection (MW)	ICAP Conversion to UCAP (%) – 2020-2021 Planning Year Projection
A.B. Brown 1	Coal (24x7 Power)	245	209	232	Coal Fleet 92%
A.B. Brown 2	Coal (24x7 Power)	245	225	234	
F.B. Culley 2	Coal (24x7 Power)	90	86	86	
F.B. Culley 3	Coal (24x7 Power)	270	251	247	
Warrick 4	Coal (24x7 Power)	150[1]	127	118	
OVEC	Coal (24x7 Power)	32	30	30	
A.B. Brown 3	Natural Gas (Peaking)	85	71	73	Natural Gas (Peaking) 85%
A.B. Brown 4	Natural Gas (Peaking)	85	71	72	
Demand Response	N/A	62	62	62	Demand Response 100%
Benton County	Wind (Intermittent)	30	2	2	Wind 9%
Fowler Ridge	Wind (Intermittent)	50	5	5	
50 MW Solar	Solar (Intermittent)	50	0	0[3]	N/A
Total		**1,344**	**1,139**	**1,161**	

1 – Vectren Share
2 – Unforced capacity
3 – 25MW of UCAP projected for 2021-2022 MISO planning year

IRP OPTIONS FOR EXISTING COAL RESOURCES

- Continued operation of existing solely owned coal units –
  - Brown 1 & 2 and Culley 2
    - Cost to comply with CCR/ELG environmental requirements
    - Cost to comply with ACE requirements
    - AB Brown FGD replacement (Study performed to estimate cost for different technologies to identify best path forward)
  - Culley 3
    - IURC approval to install technologies to comply with CCR/ELG
    - Cost to comply with ACE requirement
- Retirement of Brown 1 & Brown 2 in 2029
    - Cost to comply with CCR/ELG environmental requirements
    - Cost to comply with ACE requirements[1]
    - Continue existing FGD operation
- Natural gas conversion for Brown 1, Brown 2, and Culley 2
- Retirement of Brown 1, Brown 2, and Culley 2 in 2023
- Extend or exit Warrick Unit 4 partnership; (agreement currently set to expire at the end of 2023)

1 - Costs are estimates pending the final IDEM implementation plan for Indiana.

RENEWABLES

- Solar (54 MW installed capacity)
  - Two 2 MW solar fields (behind the meter generation)
    - Both fields went in service late in 2018
    - 1 MW/4 MWH energy storage system connected at Volkman Road site
  - 50 MW solar field
    - Finalizing engineering & design and preparing to order materials
    - Currently scheduled for commercial operation in late 2020 to early 2021
- Wind PPA contracts (80 MW installed capacity)
  - Benton County
    - Contract for 30 MW of installed capacity expires in 2028
  - Fowler Ridge
    - Contract for 50 MW of installed capacity expires in 2030
- Blackfoot Landfill Gas (behind the meter generation)
  - Units are capable of producing 3 MW combined

COMBUSTION TURBINES (NATURAL GAS PEAKING UNITS)

- Broadway Avenue Generating Station 1; 53 MW installed capacity
  – Retired in 2018
- Northeast units 1 and 2 (10 MW installed capacity each)
  – Retired in early 2019
- Broadway Avenue Generating Station 2; 65 MW installed capacity
  – Currently in process of retirement through MISO process
    - Typical life is 30-40 years; Unit has been in service for 38 years
    - Highest heat rate (least efficient) of current generating fleet
    - Recent five year capacity factor just over 1%
    - Several millions dollars needed for known repairs
    - High probability of additional expenses in the near future given current age and condition
- Brown 3; 85 MW installed capacity
  – Black start capabilities (able to burn fuel oil)
  – No upgrades required for continued operation
- Brown 4; 85 MW installed capacity
  – No upgrades required for continued operation

F.B. CULLEY OPTIONS

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- Culley 2; 90 MW installed coal capacity
  - Business as usual (continue beyond 2023)
    - Requires CCR (Coal Combustion Residuals) and Effluent Limit Guidelines (ELG) compliance
    - Compliance with ACE (Affordable Clean Energy) rule; unit upgrades & improvements
  - Natural Gas Conversion
    - Preserve existing capacity
    - High cost energy
    - Anticipate low capacity factor with high reliance on market
  - Retirement in 2023 to avoid environmental investments

Business As Usual

Regulation	Upgrade	Estimated Cost	Potential Efficiency Improvement
CCR/ELG	Dry Bottom Ash Conversion	$6 million	N/A

Business As Usual

Regulation	Potential Upgrade/Projects	Estimated Cost	Potential Efficiency Improvement
ACE	• Turbine Upgrade • Air heater • Variable Frequency Drives • Boiler program • Condenser work • O&M Practices	$30 million[1]	~4-4.5%

Natural Gas Conversion

Item	Estimated Cost
Modifications to convert unit to natural gas firing	$46 million
Gas pipeline construction	$11 million
Total	**$57 million**

1 – Costs are estimates pending the final IDEM implementation plan for Indiana

F.B. CULLEY OPTIONS (CONT.)

- Culley 3; 270 MW installed coal capacity
  - Moving forward with upgrades approved in cause 45052 to comply with CCR (Coal Combustion Residuals) and ELG (Effluent Limitations Guidelines)[1]
  - Compliance with ACE (Affordable Clean Energy) rule; requires unit upgrades to improve efficiency

Business As Usual

Regulation	Potential Upgrade/Projects	Estimated Cost	Potential Efficiency Improvement
ACE	• Turbine upgrades • Air heater Upgrade • Variable Frequency Drives • Boiler Program • Condenser Upgrade • O&M Practices	$35 million[1]	~3%

1 - Costs are estimates pending the final IDEM implementation plan for Indiana

WARRICK GENERATING STATION UNIT 4

- Warrick 4; 150 MW installed capacity (Vectren share of a 300 MW jointly owned coal fired unit)
  - Current operating agreement expires in 2023
  - Either party can exit earlier with sufficient notice
  - Alcoa currently evaluating future options. Committed to respond in 4th quarter
- Risks of continued joint operation
  - Lack of operational control
  - Environmental upgrades (cost and liability)
  - Alcoa can exit agreement after giving notice
    - Smelter future reliant on global aluminum market
- Ramifications of Alcoa exiting the operation agreement
  - Vectren takes ownership
    - 100% of environmental upgrade costs (lose benefit of industrial classification for water discharge and CCR)
    - 100% capital and O&M investment responsibility
    - Operational challenges of taking over facility
    - Future decommissioning costs
    - Increase percentage of coal capacity
  - Retire the unit
    - Procure replacement capacity

A.B. BROWN

- Brown 1 & 2; 245 MW installed coal capacity (each)
  - Natural Gas Conversion
    - Preserve existing capacity
    - High cost energy
    - Anticipate low capacity factor with high reliance on market

Item	Brown 1 Estimated Cost ($)	Brown 2 Estimated Cost ($)	Total
Modification to convert unit to gas	$89 million	$97 million	$186 million
Gas pipeline construction[1]	$50 million	$50 million	$100 million
Total	$139 million	$147 million	$286 million

1- Values shown assume both units are converted. Single unit conversion is approximately $77 million

A.B. BROWN (CONT.)

- Brown 1 & 2; 245 MW (each)
  - Business as usual
    - Requires dry bottom ash conversion and dry flyash system upgrades for CCR (Coal Combustion Residuals) and ELG (Effluent Limitations Guidelines) compliance
    - A new landfill would be needed for disposal of FGD (Flue Gas Desulphurization) by-products and fly ash
    - FGD replacement is included in continued operation plan
    - Compliance with ACE (Affordable Clean Energy) rule; requires unit upgrades & improvements based on IDEM ruling

Business As Usual

Regulation	Upgrade Projects	Brown Unit 1 Estimated Cost	Brown Unit 2 Estimated Cost	Total Estimated Cost
CCR\ELG	• Dry bottom ash conversion • Dry Fly Ash Conversion • Water treatment	$53 million	$53 million	$106 million[2]

Regulation	Potential Upgrade/Projects	Brown Unit 1 Estimated Cost	Brown Unit 2 Estimated Cost	Total Estimated Cost	Potential Efficiency Improvement	Potential Efficiency Improvement
ACE	• Air heater • Variable Frequency Drives • Boiler program • Condenser work • O&M Practices	$13 million[1]	$13 million[1]	$26 million[1]	~2.2%	~2.6%

1 - ACE costs are estimates pending the final IDEM implementation plan for Indiana
2 – Does not include landfill cost for FGD by-products and ash. New landfill required to operate beyond 2023. Size and cost to be determined based on future FGD technology

NEW FGD OPTIONS

Eight FGD technologies reviewed; four chosen for further analysis

- Market analysis being conducted for potential by-products sales
- Will perform Net Present Value (NPV) screening analysis in modeling to determine low cost option
- NPV results along with operating considerations will help determine the preferred FGD replacement technology

FGD Technology	Primary Reagent	Estimated Initial Capital Investment[1]	Estimated Landfill Capital and O&M	Estimated Variable O&M Cost/MWHr (2019$)	Marketable Fly Ash	Community Right-To-Know Emergency Action Plan	Marketable By-Product
Limestone Forced Oxidation (LSFO)	**Limestone**	**$596 million[2,4]**	**TBD Based on Gypsum and Ash Market**	**$4.44/MWHr**	**Yes**	**No**	**Gypsum**
Lime Inhibited Oxidation (LSIO)	**Lime Quicklime**	**$450 million[2,4]**	**$119 million**	**$9.39/MWHr**	**Yes (Limited)**	**No**	**No**
Ammonia Based (JET)	**Anhydrous Ammonia**	**$411 million[2,3,4,5]**	**TBD Based on Ammonium Sulfate Market**	**$11.67/MWHr**	**Yes**	**Yes**	**Ammonium Sulfate Fertilizer[6]**
Circulating Dry Scrubber (CDS)	**Lime**	**$387 million[2,3,5]**	**$125 million**	**$14.92/MWHr**	**Yes**	**No**	**No**

1 – Values represent estimated total cost for both A.B. Brown units
2 – Includes new wastewater treatment system
3 - Includes new mercury mitigation system
4 – Includes new SO_3 mitigation system
5 – Includes new particulate matter collection system
6 – Also produces unmarketable by-product (brominated powder activated carbon and mercury)

A.B. BROWN FGD OPTIONS (CONT.)

- Replacement of existing FGD's (cont.)
  - Spray Dryer FGD and Flash Dryer FGD
    - Neither option can meet emission criteria based on 1 hour SO2 limit for Posey County and Illinois Basin Coal supply
- Conversion of existing FGD's to limestone based technologies
  - Lime Inhibited Oxidation (LSIO) or Limestone Forced Oxidation (LSFO)
    - Neither option can meet emissions criteria based on 1 hour SO2 limit for Posey County
- Continued operation of current Brown dual alkali FGD's through 2029

FGD Technology	Estimated 10 Year Capital	Estimated 10 Year O&M	Estimated Landfill Capital and O&M	Estimated Variable O&M Cost/MWHr (2019$)	Marketable Fly Ash	Community Right-To-Know Emergency Action Plan	Marketable By-Product
Dual Alkali	**$137 million**	**$58 million**	**$49 million**	**5.72**	**Yes**	**No**	**No**

FEEDBACK AND DISCUSSION

POTENTIAL NEW RESOURCES AND MISO ACCREDITATION

MATT LIND,

RESOURCE PLANNING & MARKET ASSESSMENTS BUSINESS LEAD, BURNS & MCDONNELL

NEW RESOURCE AND MISO ACCREDITATION SUMMARY

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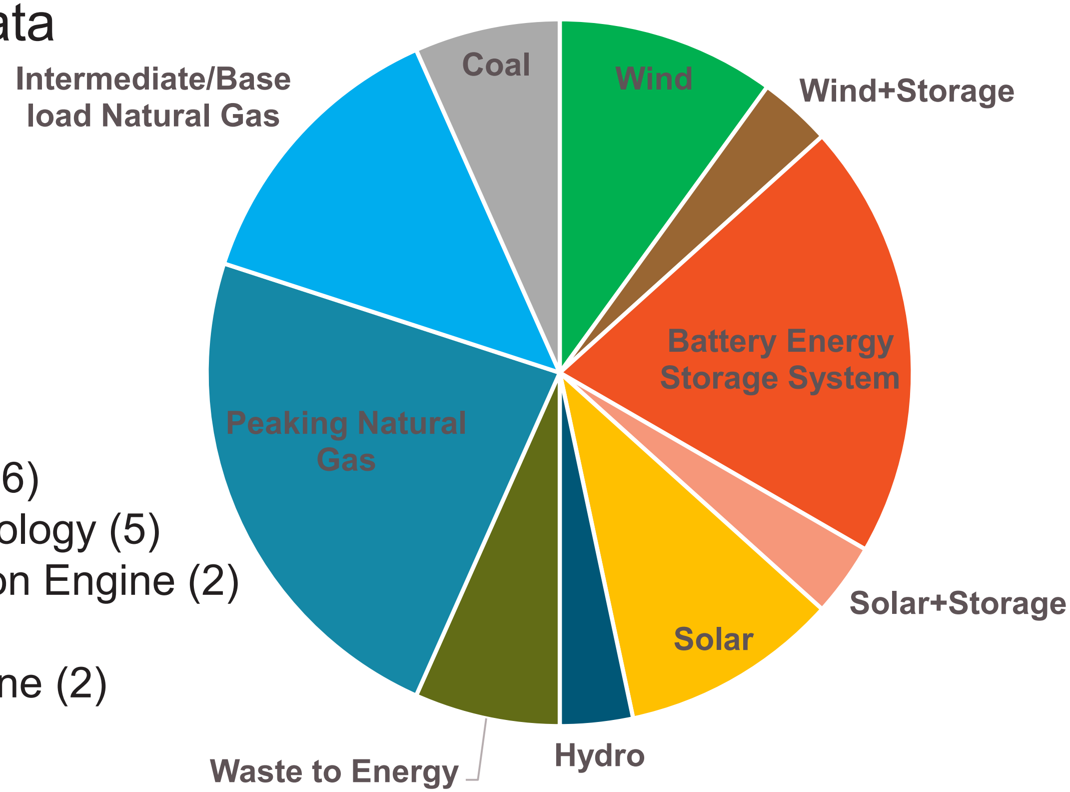
- Vectren initially plans to model new potential resources with draft technology assessment information as RFP modeling inputs are being completed
- Technology costs will be updated with bid information, where applicable; final modeling inputs will be shared in December
- Intermittent resources lack dispatch flexibility, as penetration increases, MISO projects lower capacity accreditation
- MISO is planning for seasonal capacity accreditation (summer/winter), some resources will receive varying levels of capacity credit depending on differences in seasonal availability

BACKGROUND

- Base Case Inputs for new power supply options
- Consensus estimates from Burns & McDonnell, Pace Global, and NREL for solar and storage resources
- Supplemental to RFP Bid data
- Resource Options (30):
  - Wind (3)
  - Wind + Storage (1)
  - Solar Photovoltaic (3)
  - Solar + Storage (1)
  - Hydro (1)
  - Landfill Gas (2)
  - Battery Energy Storage System (6)
  - Simple Cycle Gas Turbine Technology (5)
  - Reciprocating Internal Combustion Engine (2)
  - Combined Cycle Gas Turbine (2)
  - Combined Heat and Power Turbine (2)
  - Coal (2)



TECHNOLOGY DETAILS

Examples of candidates for natural gas peaking generation:

Gas Simple Cycle (Peaking Units)	Example 1	Example 2	Example 3	Example 4
Combustion Turbine Type	LM6000	LMS100	E-Class	F-Class
Size (MW)	41.6 MW	97.2 MW	84.7 MW	236.6 MW
Fixed O&M (2019 $/kW-yr)	$36	$16	$21	$8
Total Project Costs (2019 $/kW)	~$2,400	~$1,700	~$1,500	~$800

Examples of candidates for natural gas combined cycle generation:

Gas Combined Cycle (Base / Intermediate Load Units)	Example 1	Example 2
Combustion Turbine Type	1x1 F-Class[1]	1x1 G/H-Class[1]
Size (MW)	357.2 MW	410.6 MW
Fixed O&M (2019 $/kW-yr)	$13	$12
Total Project Costs (2019 $/kW)	~$1,400	~$1,300

[1] 1x1 Combined Cycle Plant is one combustion turbine with heat recovery steam generator and one steam turbine utilizing the unused exhaust heat from the combustion turbine.

TECHNOLOGY DETAILS

Examples of candidate combined heat and power gas generation:

Gas Combined Heat and Power[1]	2 x 10 MW Recip Engines	20 MW Combustion Turbine
Net Plant Electrical Output (MW)	17.9 MW	21.7 MW
Fixed O&M (2019 $/kW-yr)	$42	$35
Total Project Costs (2019 $/kW)	~$2,800	~$4,600

[1] Utility owned and sited at a customer facility

Examples of candidates for renewable energy and energy storage:

Renewable Generation & Storage Technologies	Solar Photovoltaic	Solar + Storage	Indiana Wind Energy	Lithium Ion Battery Storage
Base Load Net Output (kW)	100 MW (Scalable Option)	50 MW + 10MW/40 MWh	200 MW	10 MW/40 MWh (Scalable Option)
Fixed O&M (2019 $/kW-yr)	$20	$27	$44	$19
Total Project Costs (2019 $/kW)[1]	~$1,600	~$1,900	~$1,700	~$2,000

[1]Total Project Costs (2019 $/kW) may change based on economies of scale. The Technology Assessment contains unique costs for the different scales of the projects.

TECHNOLOGY DETAILS

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Example of candidates for hydroelectric generation:

	Low Head Hydroelectric Generation
Base Load Net Output (kW)	50 MW
Fixed O&M (2019 $/kW-yr)	$92
Total Project Costs (2019 $/kW)	~$5,900

Potential local resources:

Dam	2012 DOE[1] Estimated Potential Capacity (MW)	2013 U.S. Army Corps of Engineers Estimated Feasible Potential Capacity (MW)	2013 U.S. Army Corps of Engineers Estimated Optimal Potential Capacity (MW)
John T. Myers (Uniontown)	395	24-115	36
Newburgh	319	15-97	22

Notes:
In 2019 dollars, the Cannelton hydro project (~84 MW) total cost was approximately $5,500/kW (US Army Corps of Engineers press release)
Transmission upgrades required for the Uniontown dam are estimated at $14 million
Transmission upgrades required for the Newburgh dam are estimated at $10 million

TECHNOLOGY DETAILS

Examples of candidates for coal generation:

Coal Fired	Example 1	Example 2
Combustion Turbine Type	Supercritical Pulverized Coal with Carbon Capture	Ultra-Supercritical Pulverized Coal with Carbon Capture
Size (MW)	506 MW	747 MW
Fixed O&M (2019 $/kW-yr)	$29	$29
Total Project Costs (2019 $/kW)	~$6,100	~$5,500

FORWARD COST ESTIMATES

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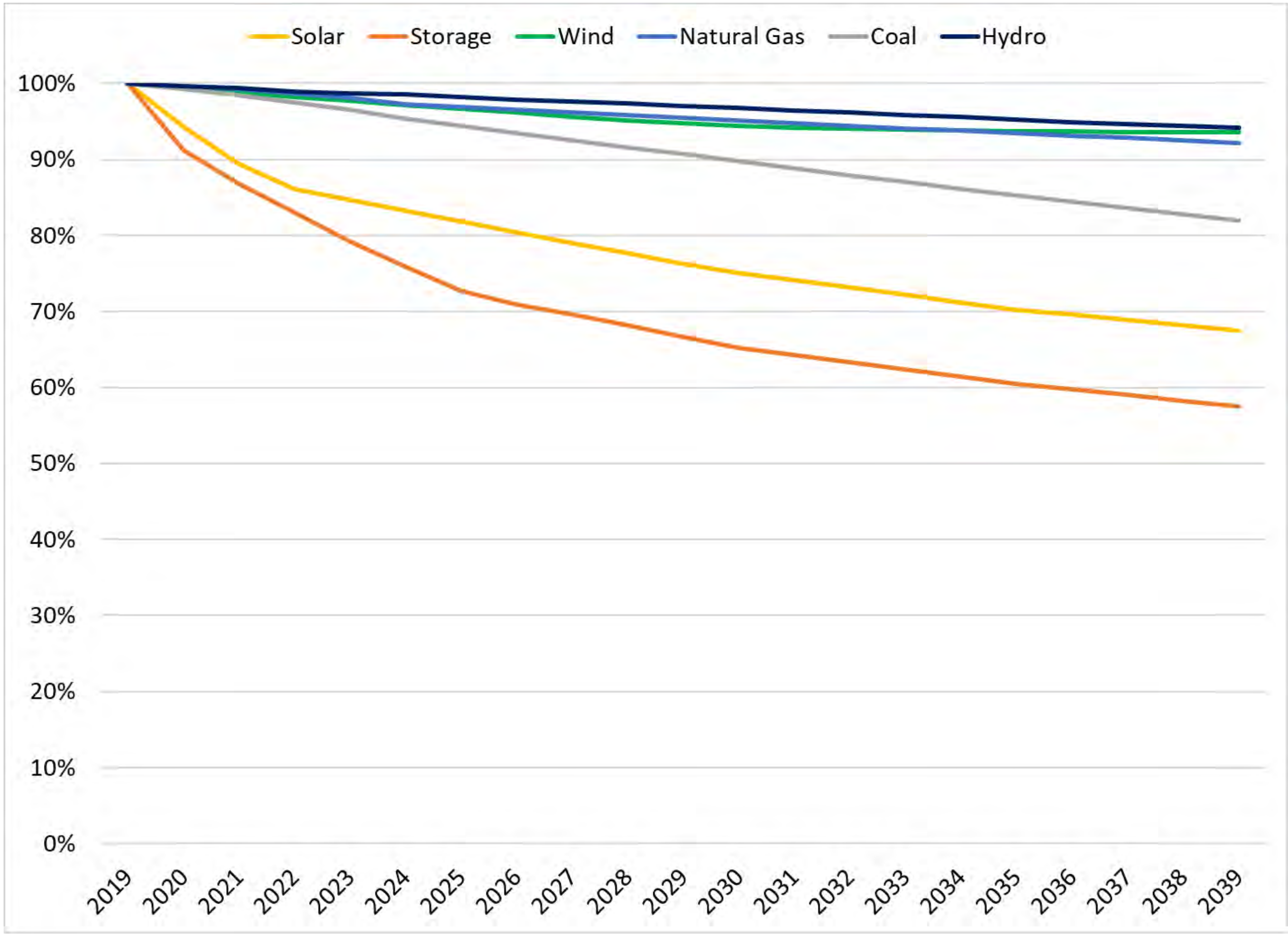
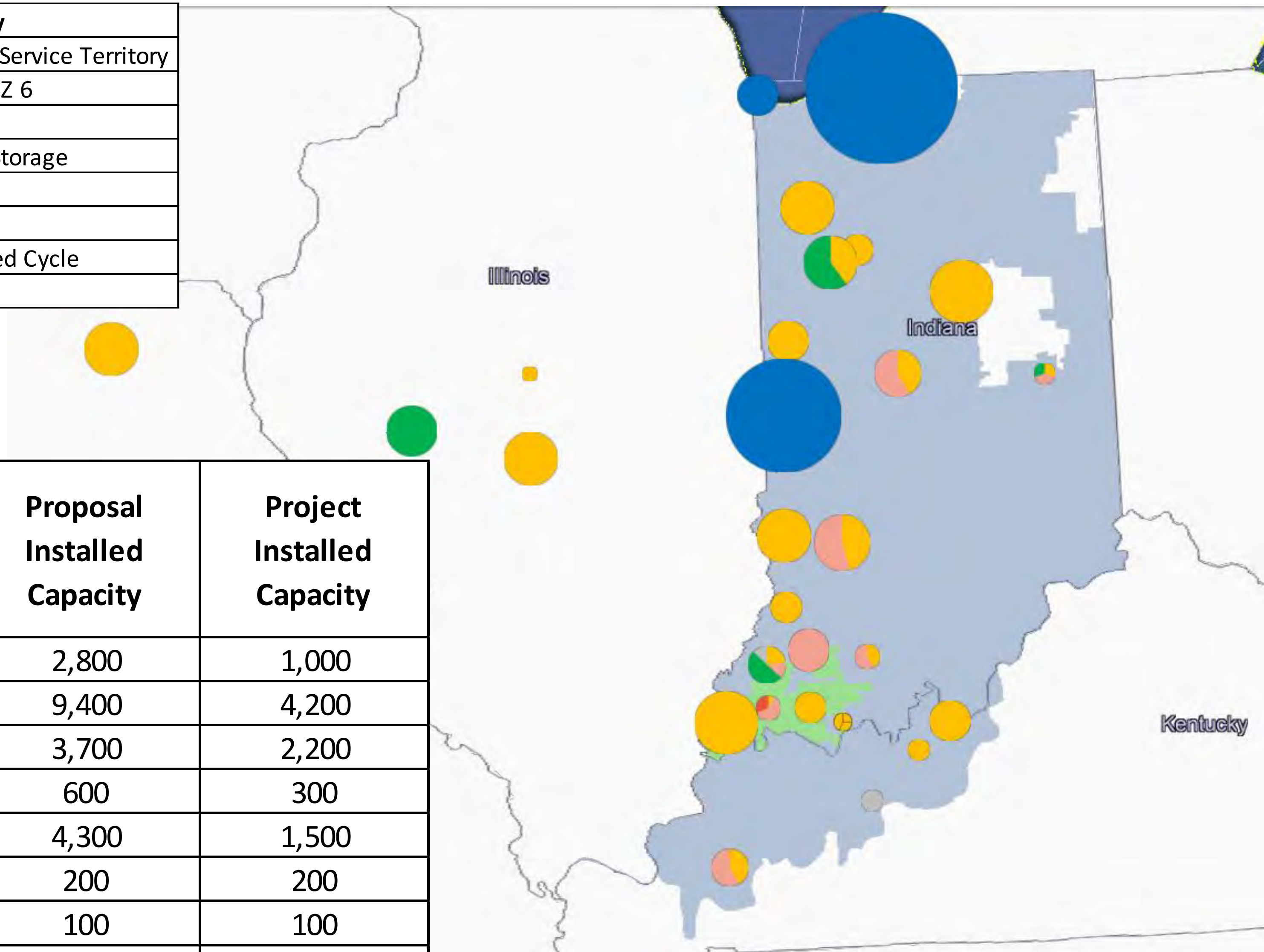


Technology Maturity

PROPOSAL LOCATION REVIEW

Key	
	Vectren Service Territory
	MISO LRZ 6
	Solar
	Solar + Storage
	Storage
	Wind
	Combined Cycle
	Coal



2019 RFP Responses (MW)	Proposal Installed Capacity	Project Installed Capacity
Wind	2,800	1,000
Solar	9,400	4,200
Solar + Storage	3,700	2,200
Storage	600	300
Combined Cycle	4,300	1,500
Coal	200	200
LMR/DR	100	100
System Energy	300	100
Total	**21,400**	**9,600**

PARTICIPATING COMPANIES

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bp

ST. JOSEPH energy center

Origis Energy
POWERING THE SOLAR REVOLUTION

S·POWER
An AES and AIMCo Company

EmberClear

RANGER POWER

Constellation
An Exelon Company

APEX
CLEAN ENERGY

NEXTera ENERGY RESOURCES

Clēnera

edp renewables

e·on

CALPINE

lightsource bp

DUKE ENERGY

enel x

ORION
RENEWABLE ENERGY GROUP LLC

engie

Big Rivers
ELECTRIC CORPORATION

res

Invenergy

Capital Dynamics
TRULY INVESTED.

TENASKA

PROPOSAL GROUPING

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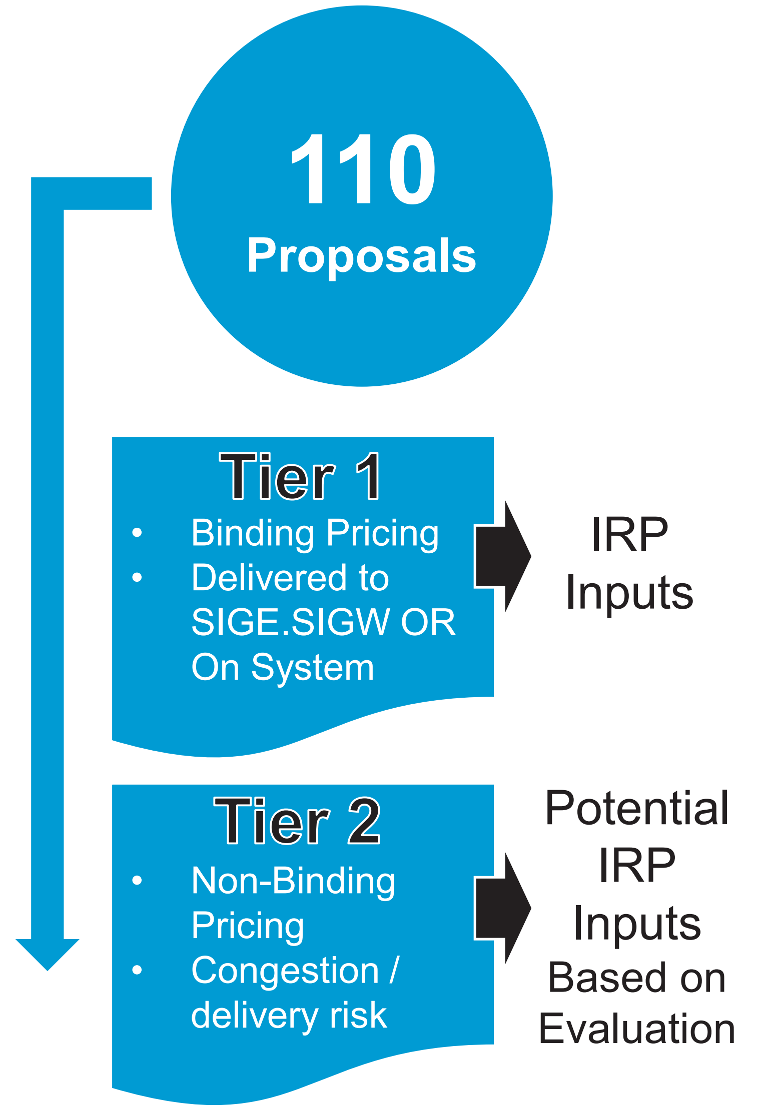
	Potential Grouping	RFP Count	Tier 1 Proposals	Tier 2 Proposals
1	Coal PPA	2	0	2
2	LMR/DR PPA	1	1	0
3	CCGT PPA	2	0	2
4	CCGT Purchase	5	0	5
5	Wind Purchase	2	0	2
6	12-15 Year Wind PPA	9	4	5
7	20 Year Wind PPA	2	1	1
8	Storage Purchase	4	4	0
9	Storage PPA	4	4	0
10	Solar + Storage PPA	6	5	1
11	Solar + Storage Purchase	9	5	4
12	Solar + Storage Purchase/PPA	4	1	3
13	Solar Purchase/PPA	6	1	5
14	12-15 Year Solar PPA	8	3	5
15	20 Year Solar PPA	16	7	9
16	25-30 Year Solar PPA	9	3	6
17	Solar Purchase	18	4	14
N/A	Energy Only	3	0	3
	Total	**110**	**43**	**67**

- Total installed capacity of RFP bids in Tier 1 ~5X greater than Vectren's peak load
- Resource options from the technology assessment will supplement these options as needed



MISO RENEWABLE PENETRATION TRENDS

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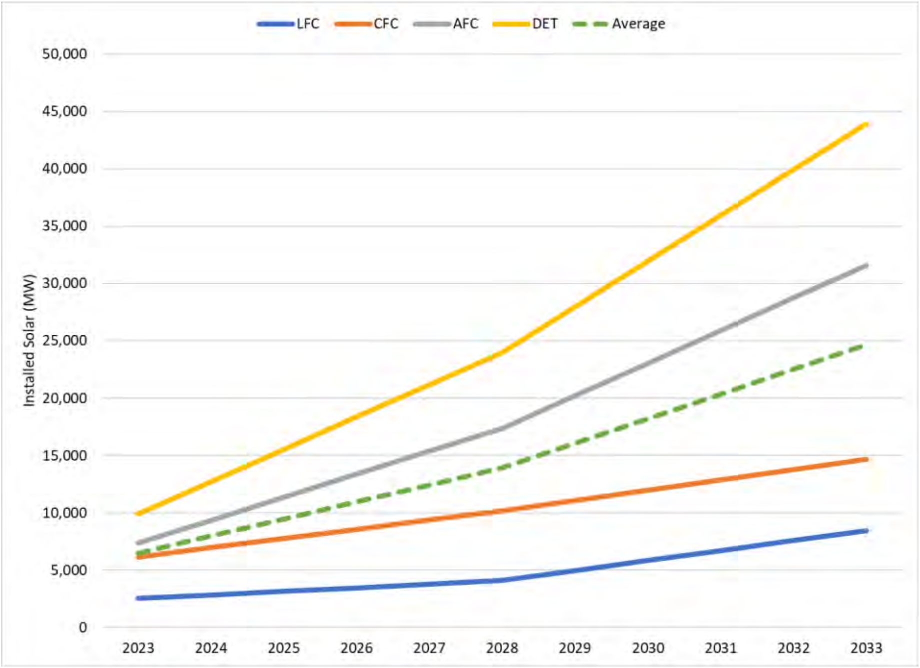
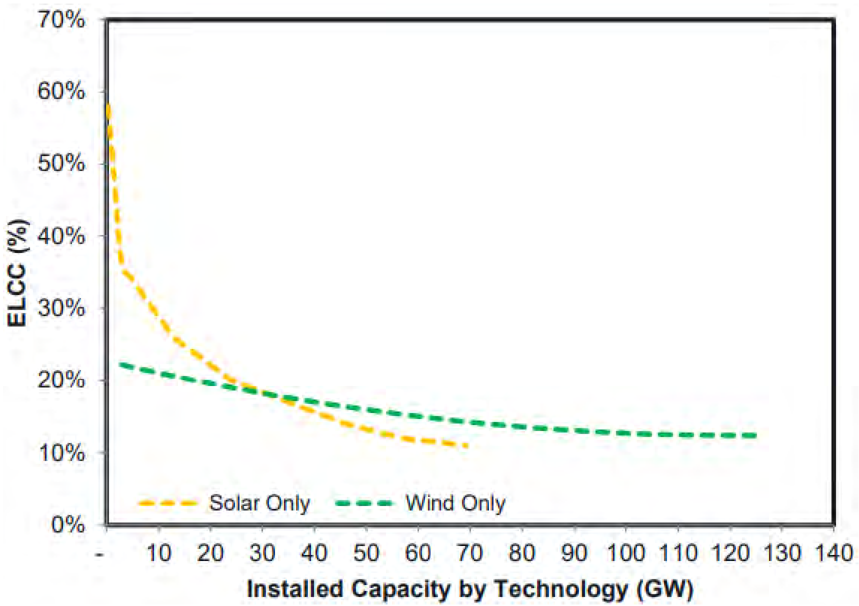
MTEP19 future solar capacity projections



https://cdn.misoenergy.org/MTEP19%20Futures%20Summary291183.pdf
MISO Transmission Expansion Plan (MTEP) study years 2023, 2028, and 2033. Data between study years is linearly interpolated.

Effects of increasing installations

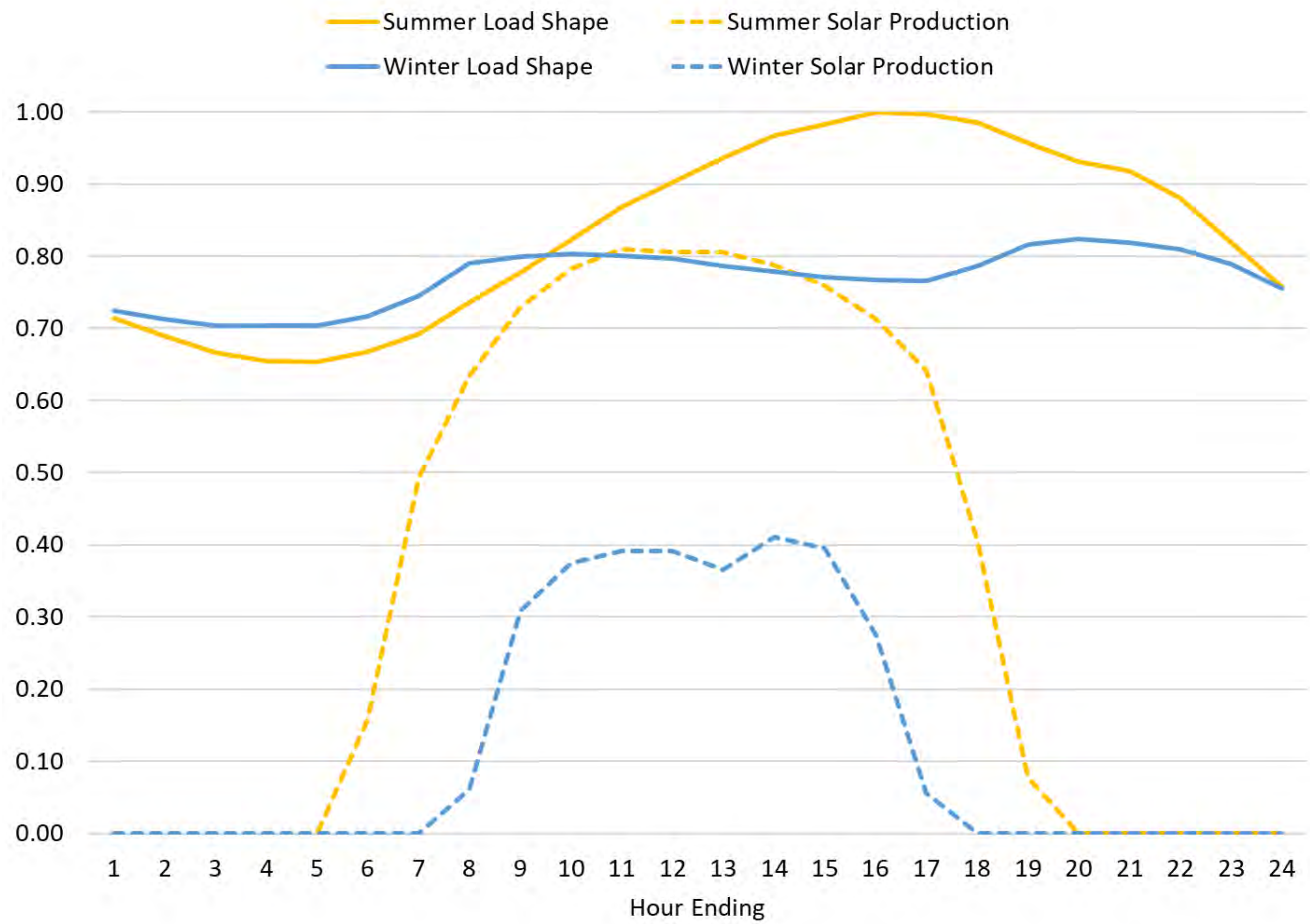


https://cdn.misoenergy.org/RIIA%20Assumptions%20Doc_v7429759.pdf

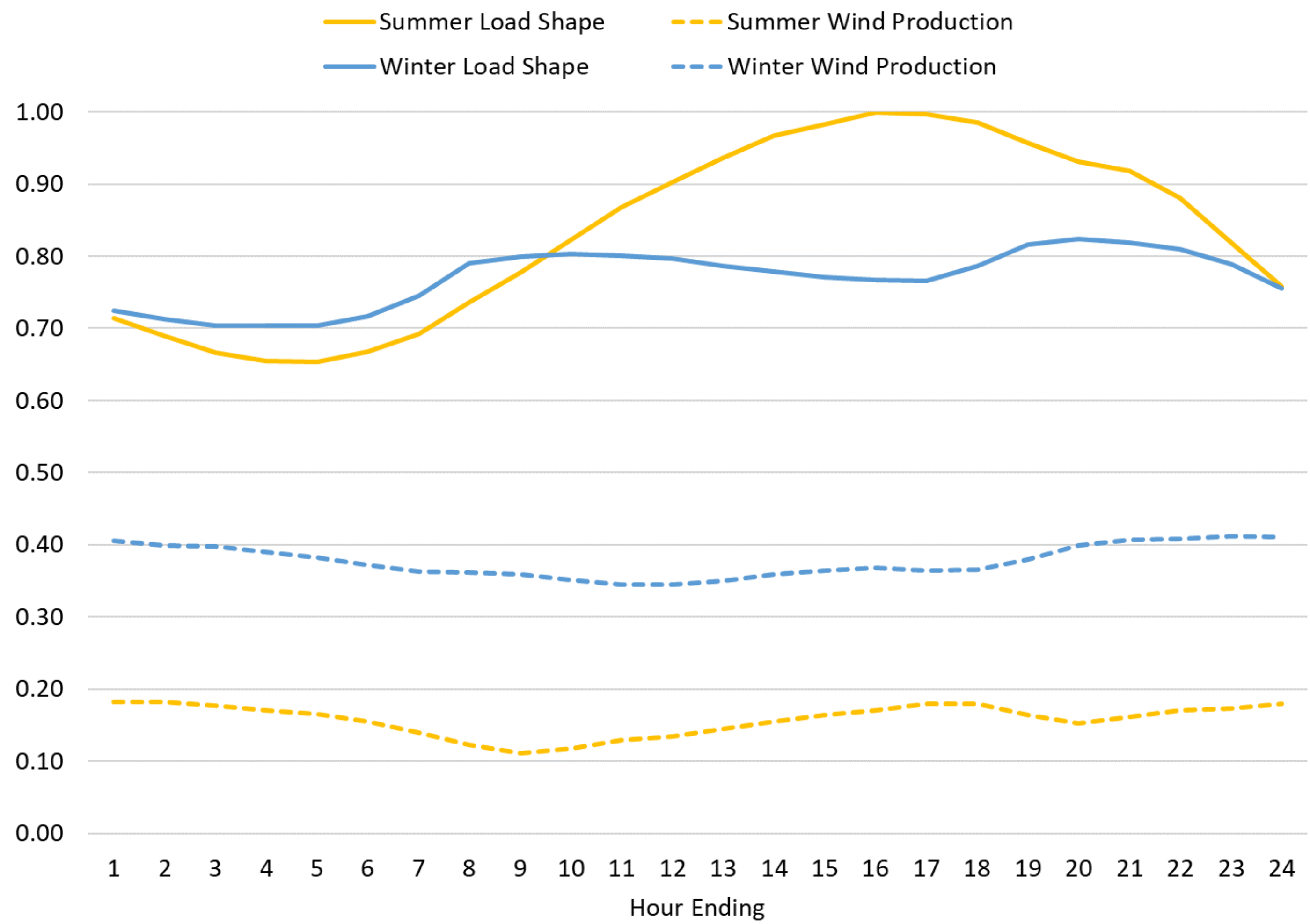
As installed capacity (ICAP) goes ⬆… Accreditable capacity (UCAP) goes ⬇

ELCC – Effective Load Carrying Capability

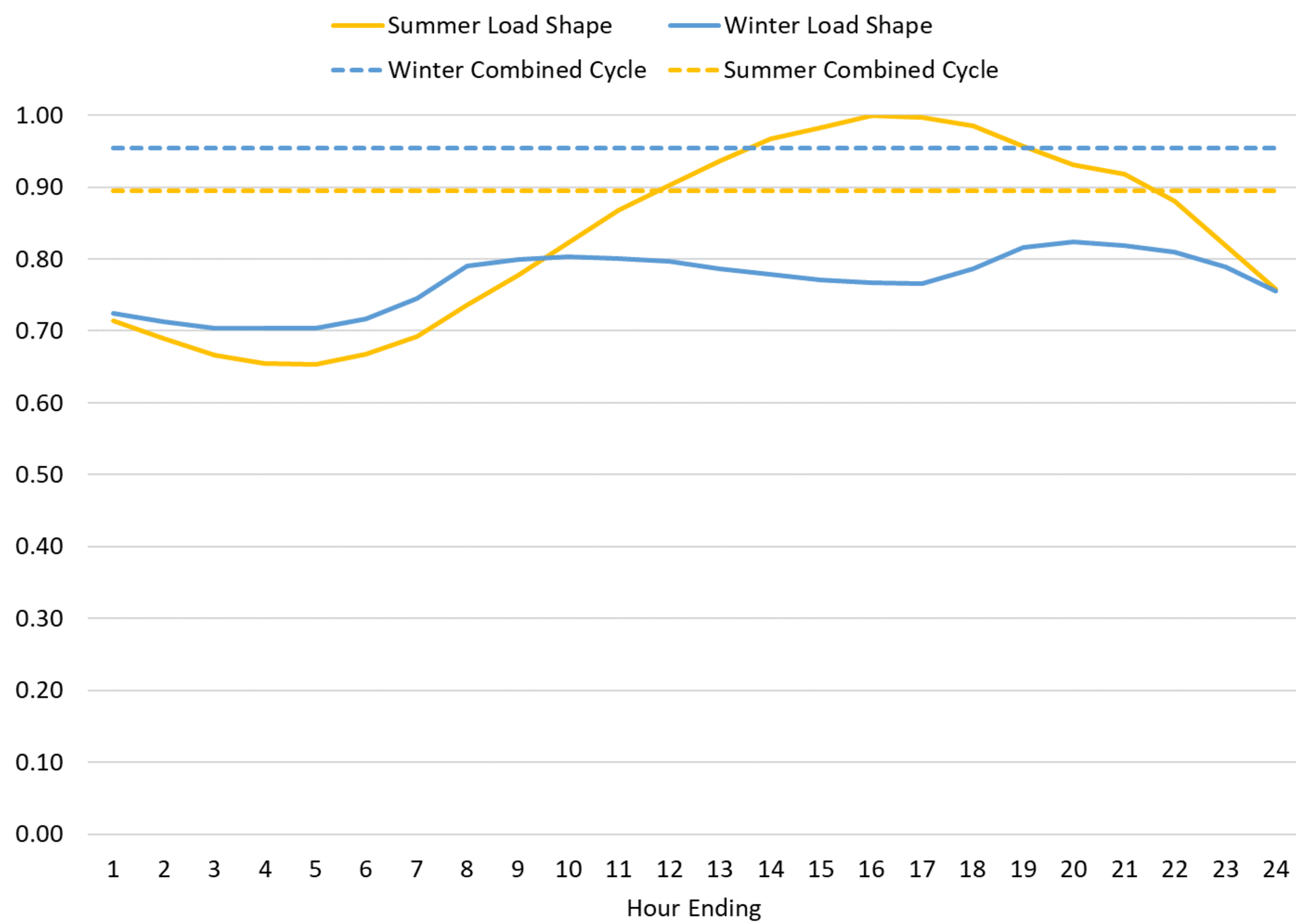
SOLAR SEASONAL DIFFERENCES



WIND SEASONAL DIFFERENCES



COMBINED CYCLE SEASONAL DIFFERENCES



ZONE 6 SEASONAL ACCREDITATION

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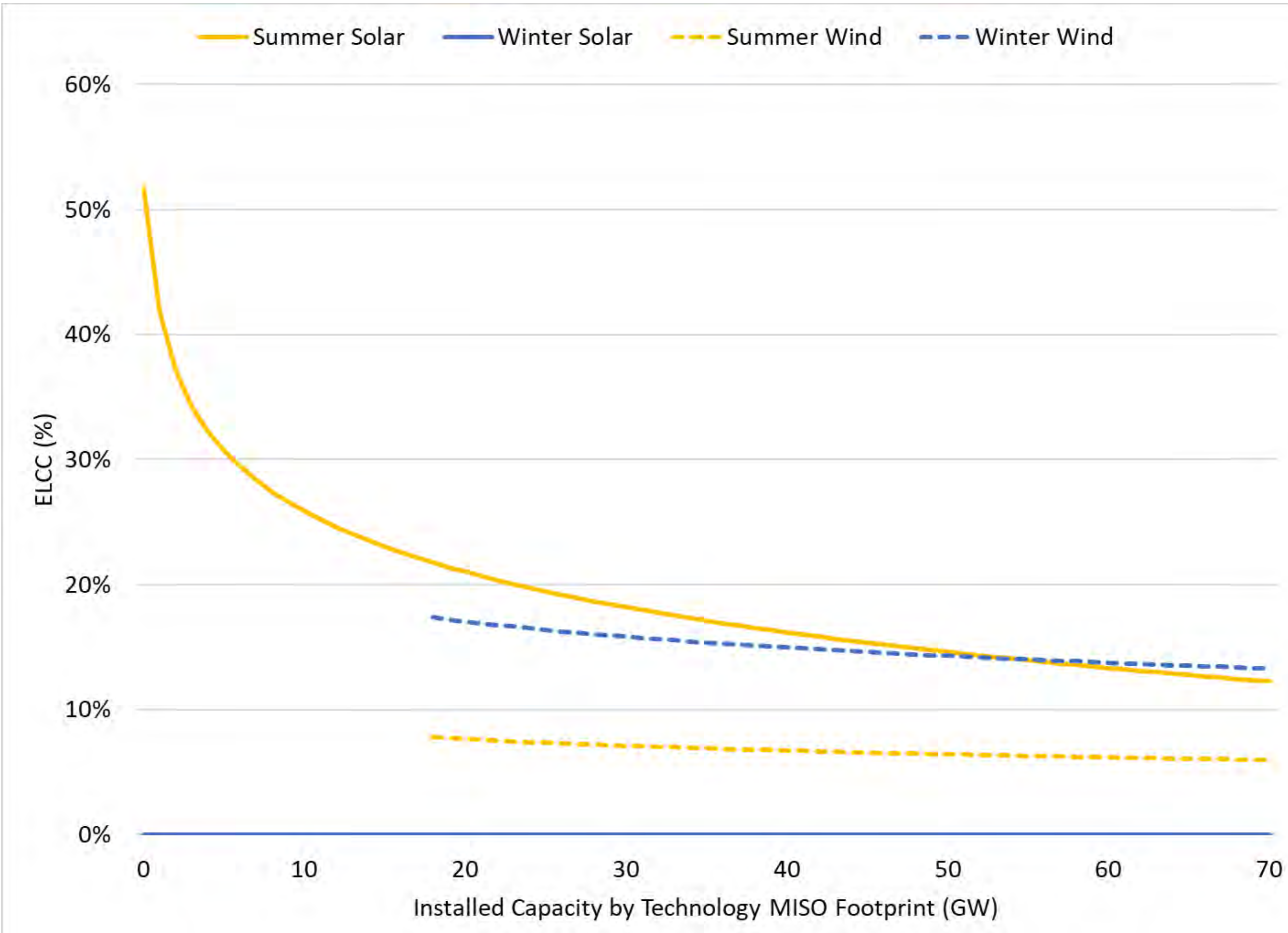

Winter accreditation based on similar methodology to summer

SEASONAL CAPACITY CREDIT FORECAST

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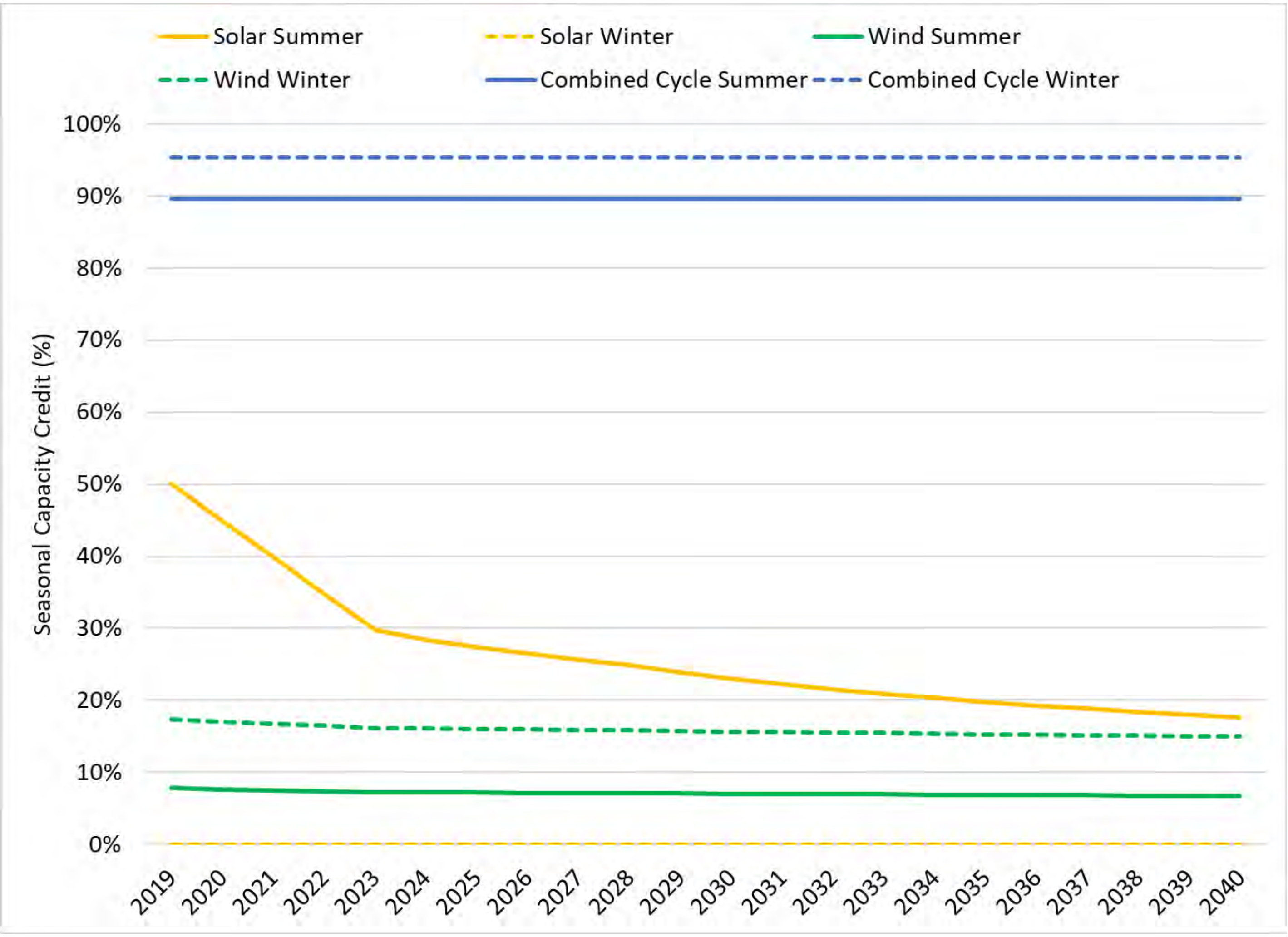

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DSM MODELING IN THE IRP

JEFFREY HUBER

MANAGING DIRECTOR, GDS ASSOCIATES

Demand Side Management Process (DSM) and the Integrated Resources Plan (IRP)

VECTREN
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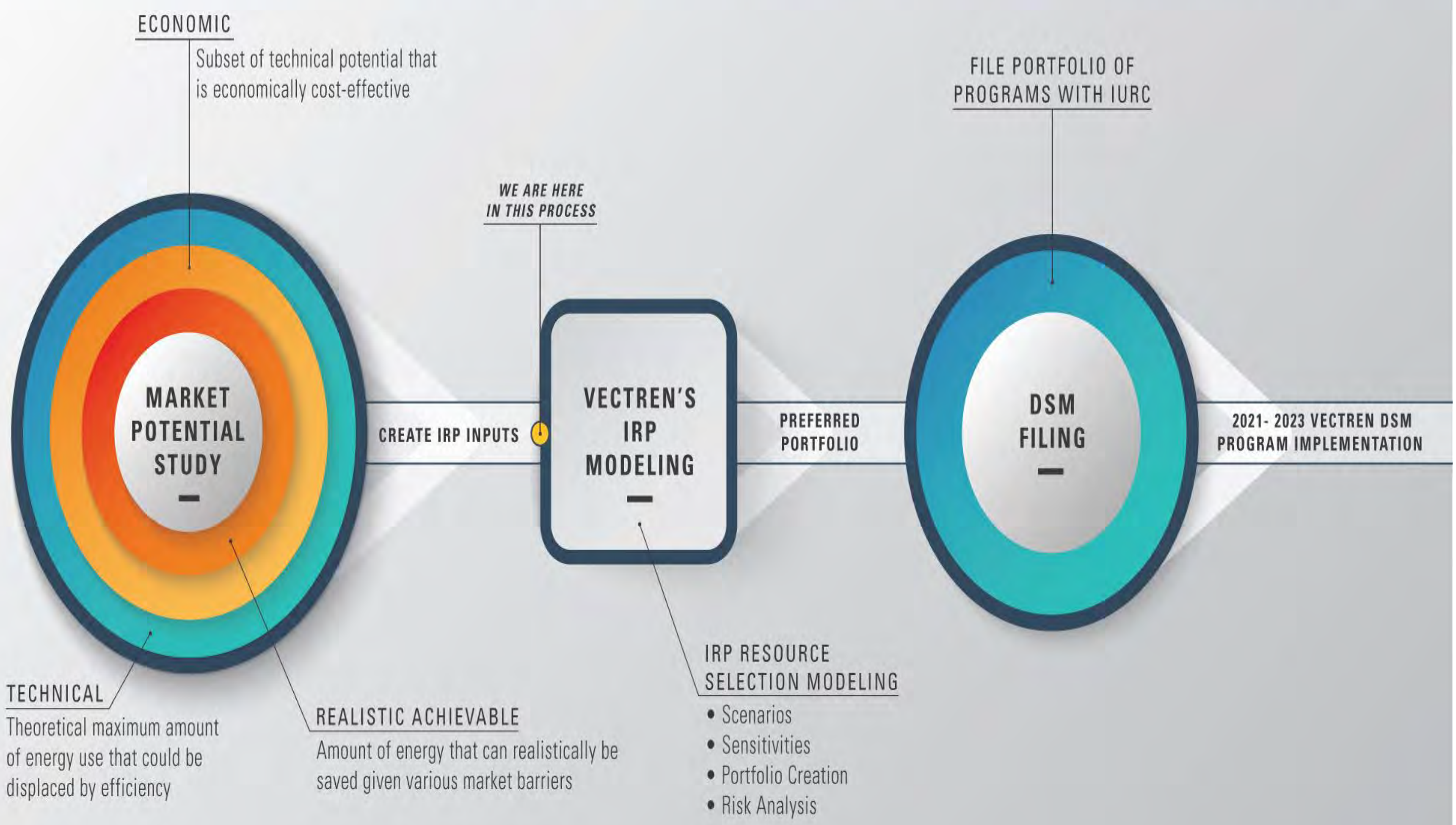


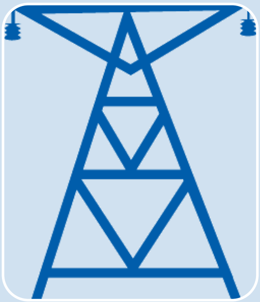
ENERGY EFFICIENCY MODELING ASSUMPTIONS

No minimum level of EE has been embedded into our sales and demand forecast

EE savings for 2018-2020 will be based on EE plan approved in Cause 44927

Total of 10 bundles, of which 8 can be selected including DR.

7 EE bundles are available at 0.25% of eligible sales



The model may select up to 1.75% of eligible sales annually. Aligns with realistic achievable potential in MPS

EE bundles represent bundle of low cost to high cost programs

For optimization runs, EE bundle selection will run for a 3 year period for the 1st 6 years

IMPROVEMENTS SUMMARY

- 2019 modeled savings and costs will tie directly to latest Market Potential Study (completed 2019)
  - MPS analysis reliant on empirical/historical data derived from DSM effects by Vectren customers
- Initial years savings disconnected from later years
- Utilize bundle specific load shapes
- Include demand response bundles
- Conduct sensitivities

DSM BUNDLES IN IRP MODELING APPROACH OVERVIEW

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BASE CASE

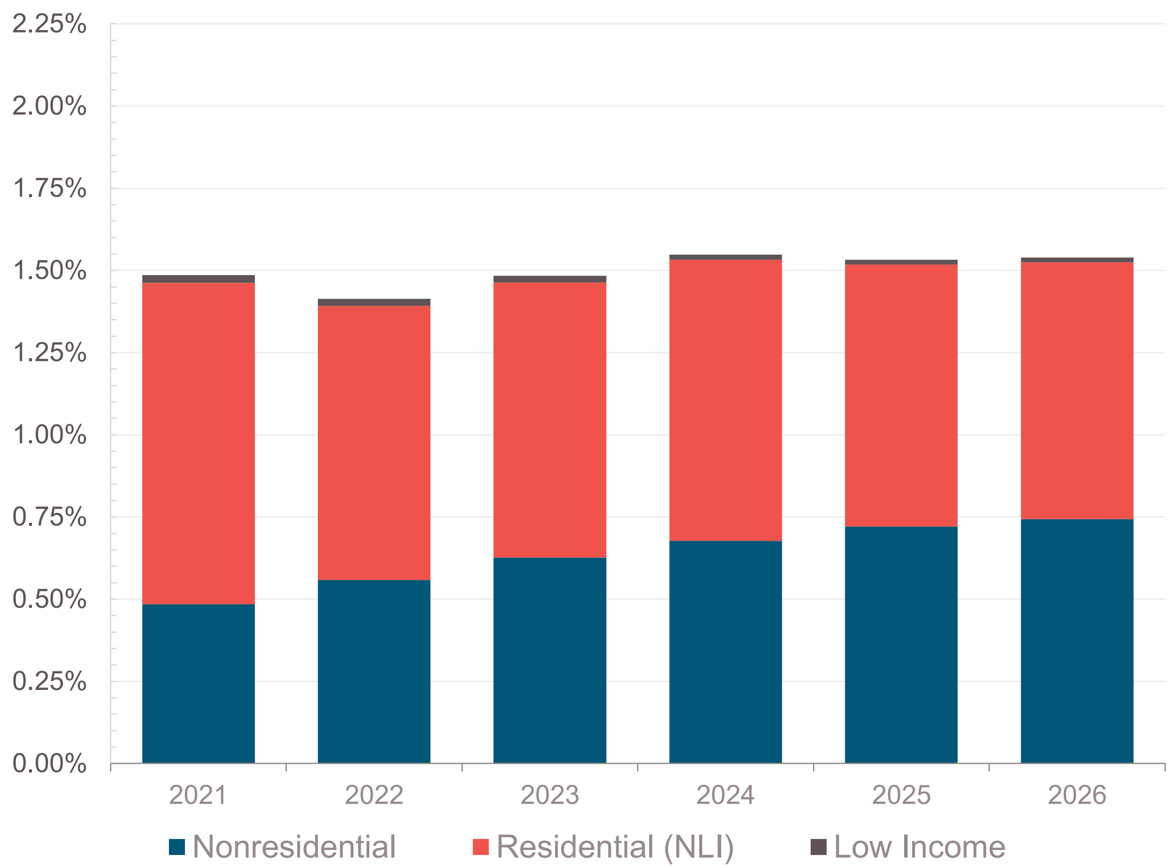
- DSM Bundles are 0.25% of annual load excluding opt-out sales
- Bundles are developed using the results from the 2018 Market Potential Study's (MPS) Realistic Achievable Potential
- Each bundle can have a mixture of residential and non-residential electric energy efficiency measures
- Each bundle has an associated loadshape and cost/MWh that serves as inputs into the IRP model
- Up to 10 bundles will be included as a selectable resource in the IRP model
    - 7 Energy Efficiency
    - 1 Low income
    - 2 Demand Response

DSM BUNDLES IN IRP MODELING INCREMENTAL SAVINGS FROM MPS

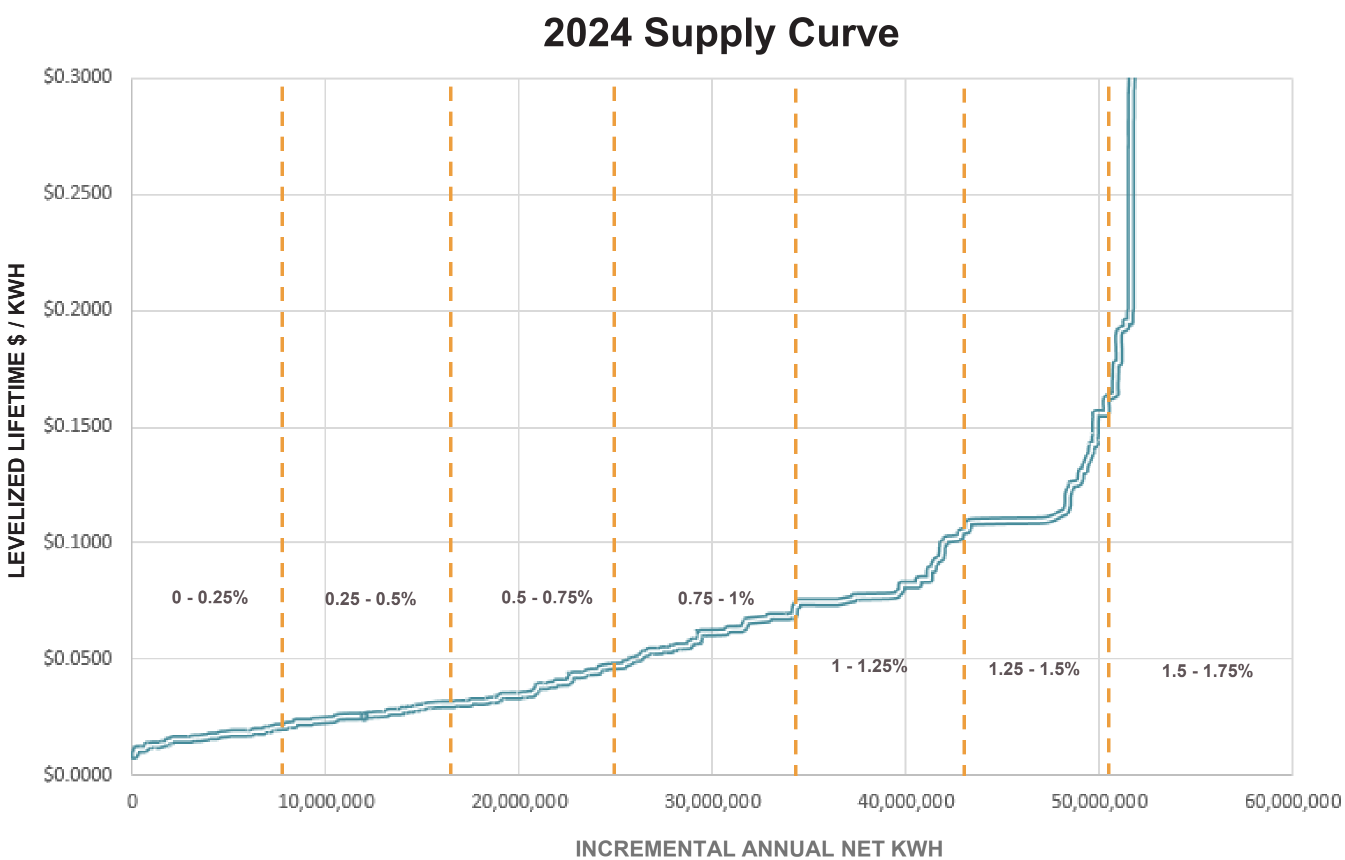
Step 1: *Initial RAP Potential Estimates from MPS*

Step 2: *Apply NTG Ratios (used latest evaluated NTG ratios)*

Step 3: *Align Low Income Savings based on Historcal Spend*



DSM BUNDLES IN IRP MODELING
SUPPLY CURVE BUNDLE DEVELOPMENT



- Residential and Non-residential electric energy efficiency measures were ranked from cheapest to most expensive
- Measures were then bundled into groups of roughly 0.25% ***net*** energy savings, with each progressive bundle more expensive then the prior bundle
- Total amount of savings (and # of bundles) is dependent on the realistic achievable potential identified each year
- In 2024 example, the RAP allows for 6 complete bundles, and a partial 7th bundle

DSM BUNDLES IN IRP MODELING
BASE CASE LEVELIZED COST PER KWH

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	1	2	3	4	5	6	7	LI
	Gross Projected Cost per KWh; Cumulative by Bundle							
2021	$0.0144	$0.0189	$0.0209	$0.0240	$0.0279	$0.0328		$0.1517
2022	$0.0144	$0.0189	$0.0226	$0.0266	$0.0300	$0.0347		$0.1670
2023	$0.0147	$0.0190	$0.0226	$0.0271	$0.0314	$0.0359		$0.1839
2024	$0.0151	$0.0188	$0.0228	$0.0279	$0.0326	$0.0348	$0.0374	$0.2115
2025	$0.0156	$0.0204	$0.0244	$0.0298	$0.0346	$0.0381	$0.0390	$0.2265
2026	$0.0160	$0.0212	$0.0258	$0.0312	$0.0360	$0.0396	$0.0406	$0.2398
2027	$0.0166	$0.0223	$0.0269	$0.0329	$0.0376	$0.0411	$0.0421	$0.2583
2028	$0.0172	$0.0235	$0.0288	$0.0342	$0.0393	$0.0429	$0.0442	$0.2630
2029	$0.0181	$0.0245	$0.0306	$0.0367	$0.0410	$0.0454		$0.2648
2030	$0.0190	$0.0268	$0.0318	$0.0371	$0.0424	$0.0474		$0.2608
2031	$0.0198	$0.0277	$0.0325	$0.0390	$0.0436	$0.0482		$0.2686
2032	$0.0208	$0.0286	$0.0353	$0.0409	$0.0455	$0.0506		$0.2459
2033	$0.0220	$0.0297	$0.0373	$0.0439	$0.0470	$0.0520		$0.2494
2034	$0.0228	$0.0307	$0.0394	$0.0455	$0.0487	$0.0539		$0.2164
2035	$0.0188	$0.0243	$0.0294	$0.0366	$0.0420	$0.0441	$0.0491	$0.2411
2036	$0.0190	$0.0241	$0.0291	$0.0363	$0.0413	$0.0441	$0.0491	$0.2538
2037	$0.0190	$0.0242	$0.0291	$0.0357	$0.0412	$0.0442	$0.0490	$0.2064
2038	$0.0198	$0.0233	$0.0294	$0.0353	$0.0406	$0.0452	$0.0499	$0.2118
2039	$0.0206	$0.0238	$0.0302	$0.0354	$0.0415	$0.0459	$0.0505	$0.2175

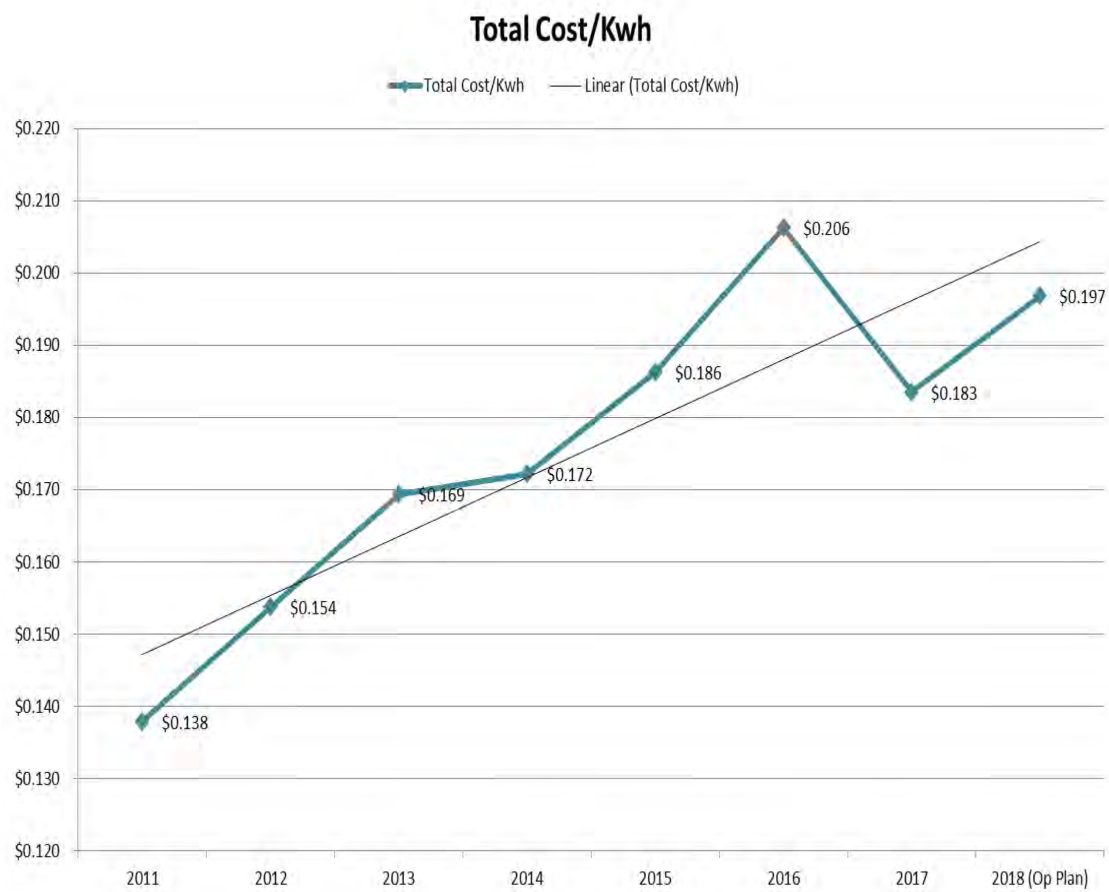
- LI Costs reflect paying 100% incentives for measures.
- Aligned to historical levels to produce an annual budget of $1.15 million per year
- Annual savings range from 457 MWh to 889 MWh

- Cost per bundle and annual costs are based on 2018 MPS costs, with two exceptions:
- IRP bundles reduced non-residential incentive costs in early years to more closely align with historical and 2019 planned Vectren data
- Non-incentive program costs were escalated at an annual estimated rate of inflation of 2.2% (in lieu of 1.6%) to be consistent with other IRP planning assumptions

DSM BUNDLES IN IRP MODELING
DSM BUNDLE SENSITIVITIES

HIGH/LOW CASE

- Sensitivity to reflect alternative DSM Costs
- Used 2011-2018 actual portfolio costs
  Calculated one standard deviation from the mean ($0.02097)
- Results in 11.9% increase/reduction in levelized cost
- No sensitivity performed on low-income potential



DSM BUNDLES IN IRP MODELING
DEMAND RESPONSE BUNDLES

- Two Demand Response bundles
- First bundle includes AC DLC as well as Smart Thermostat DR (from Smart Cycle Program) (fixed)
  - Slow phase out of DLC Switch and replacement with Thermostat-controlled DR through 2039
  - Projected Summer Peak impacts range from 17.5 MW (2020) to 36.9 MW (2039)
- Second bundle include BYOT Thermostat DR (selectable)

FEEDBACK AND DISCUSSION

STAKEHOLDER BREAKOUT SESSION: STRATEGY DEVELOPMENT

GARY VICINUS

MANAGING DIRECTOR FOR UTILITIES, PACE GLOBAL

STAKEHOLDER BREAKOUT SESSION

- The purpose of this breakout session is to allow stakeholders to discuss and develop several different strategies to meet load obligations over the next 20 years
- Specifically, stakeholders are asked to collaborate to develop alternative or additional strategies to the ones already being modeled, i.e. 80% reduction in CO_2 by 2050
- We will run a least-cost portfolio run for various strategies
- Breakout Process:

1. Separate into groups
2. Discuss potential strategies to meet load obligations over the next 20 years, i.e. least cost, minimizing CO_2, diversification, etc.
3. Designate a spokes person for each table (those on the phone are welcome to send in suggestions at irp@centerpointenergy.com)
4. In the next meeting, strategies will be defined as model structures
5. Structures will be consolidated into several portfolios for further evaluation. We will take your into consideration and ultimately develop 10-15 portfolios for modeling. Final portfolios will be discussed in the third stakeholder meeting

PORTFOLIO STRATEGY WORKSHEET

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Create a set of strategies for a portfolio and the timeframe for implementation:

Strategy	Timeframe

Short-term=2019-2021; Medium-term=2022-2028; Long-term=2029-2039

FEEDBACK AND DISCUSSION

APPENDIX

ADDITIONAL STAKEHOLDER FEEDBACK

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Request	Response
Scenarios: Include the social cost of carbon.	Included in the High Regulatory scenario.
Portfolio development: Provide a list of potential portfolio strategies within the Q&A document to help groups prepare for the portfolio development workshop.	Included within meeting minutes Q&A posted to vectren.com/irp
Portfolio development: Flag portfolios that meet Intergovernmental Panel on Climate Change (IPCC) criteria.	IPCC criteria can be raised during the portfolio development discussion to ensure that we build portfolios that meet the criteria.
Listen to a local talk on Indiana Climate Change (Purdue).	Vectren attended the local meeting.
Please provide historic delivered coal prices, compared to projections	Please see the appendix for this slide.
Identify impacts on different customer groups (e.g. disadvantaged)	Price impacts are a big consideration within portfolio evaluation, captured in the scorecard. However, impacts of eventual rate making proceedings are not within scope of an IRP.
Post meeting minutes in Q&A format	Meeting minutes Q&A posted to vectren.com/irp

FOLLOW-UP QUESTION
DELIVERED COAL COST

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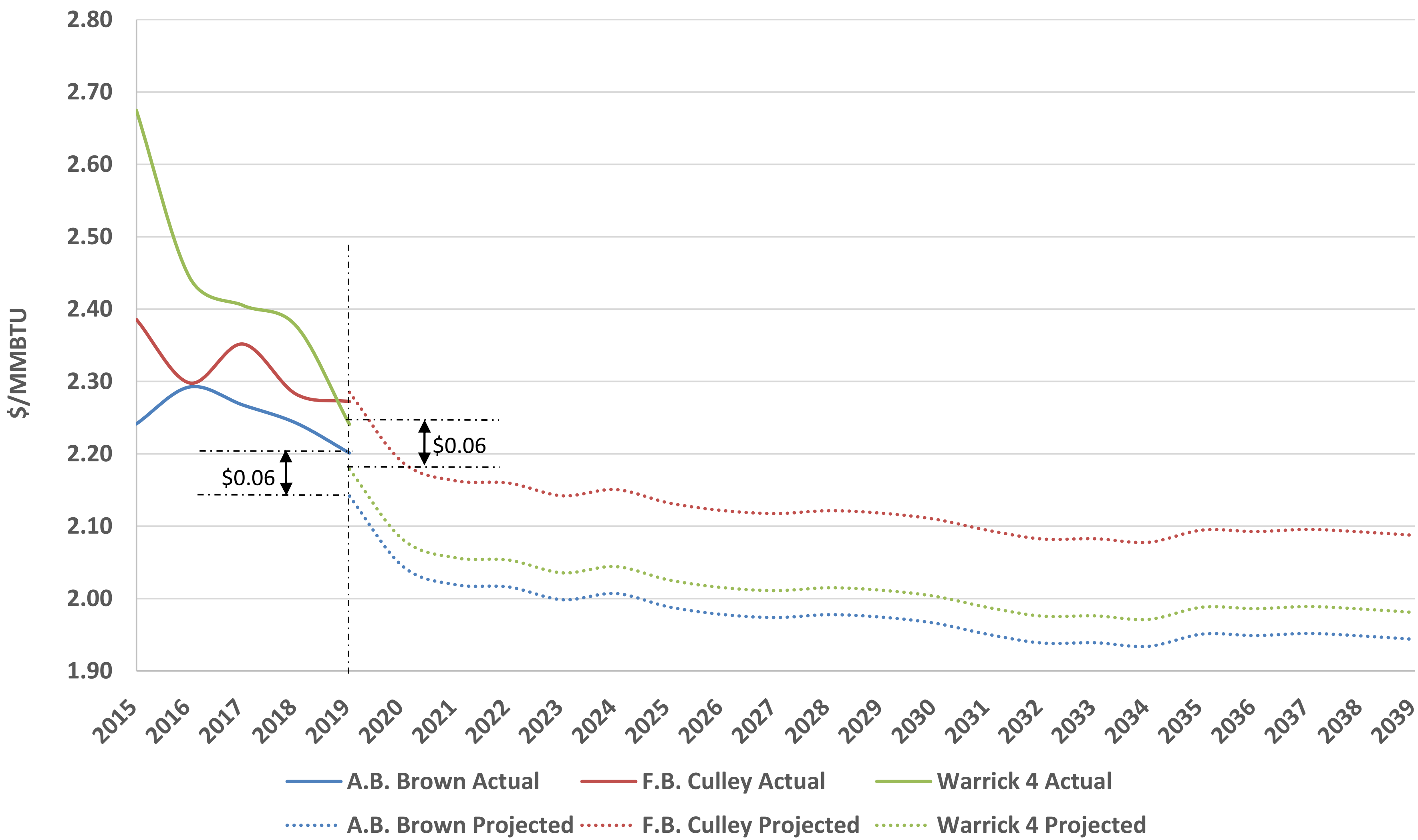

DRAFT BASE CASE INPUTS

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Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.64	1.63	1.61	1.61	1.59	1.58	1.59	1.59	1.58
CO2	2018$/ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	3.06	3.24	3.38	3.49	3.62	3.78	3.96	4.09	4.17
Vectren Peak Load	MW	1,115	1,102	1,168	1,176	1,183	1,192	1,200	1,209	1,219	1,229	1,239
Wind (200 MW)	2018$/kW	1,334	1,330	1,328	1,326	1,324	1,324	1,324	1,324	1,326	1,328	1,330
Solar (100 MW)	2018$/kW	1,524	1,362	1,290	1,247	1,204	1,162	1,129	1,100	1,070	1,050	1,029
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,654	1,518	1,452	1,391	1,342	1,301	1,263	1,232	1,201
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,450	2,242	2,116	1,996	1,892	1,803	1,719	1,651	1,586
Gas CC (442 MW + DF)	2018$/kW	1,122	1,114	1,100	1,088	1,079	1,072	1,063	1,056	1,049	1,042	1,034
Gas CT (237 MW)	2018$/kW	548	544	536	529	525	521	517	513	510	506	502
USC Coal w/ CCS	2018$/kW	5,421	5,339	5,231	5,121	5,016	4,916	4,814	4,717	4,624	4,531	4,445

DRAFT LOW REGULATORY CASE INPUTS

VECTREN
A CenterPoint Energy Company

Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.64	1.63	1.61	1.61	1.59	1.58	1.59	1.59	1.58
CO2	2018$/ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	4.10	5.12	5.20	5.62	5.60	5.95	6.12	6.23	6.85
Vectren Peak Load	MW	1,115	1,102	1,217	1,311	1,314	1,352	1,357	1,390	1,381	1,386	1,423
Wind (200 MW)	2018$/kW	1,334	1,330	1,328	1,326	1,324	1,324	1,324	1,324	1,326	1,328	1,330
Solar (100 MW)	2018$/kW	1,524	1,362	1,290	1,247	1,204	1,162	1,129	1,100	1,070	1,050	1,029
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,654	1,518	1,452	1,391	1,342	1,301	1,263	1,232	1,201
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,450	2,242	2,116	1,996	1,892	1,803	1,719	1,651	1,586
Gas CC (442 MW + DF)	2018$/kW	1,122	1,114	1,100	1,088	1,079	1,072	1,063	1,056	1,049	1,042	1,034
Gas CT (237 MW)	2018$/kW	548	544	536	529	525	521	517	513	510	506	502
USC Coal w/ CCS	2018$/kW	5,421	5,339	5,231	5,121	5,016	4,916	4,814	4,717	4,624	4,531	4,445

DRAFT HIGH TECHNOLOGY CASE INPUTS

VECTREN
A CenterPoint Energy Company

Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.49	1.27	1.25	1.25	1.25	1.25	1.25	1.25	1.25
CO2	2018$/ton	0.00	0.00	0.00	1.20	2.06	2.38	2.94	3.89	5.46	6.85	8.50
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	2.82	2.33	2.13	2.04	2.13	2.02	2.12	2.07	2.20
Vectren Peak Load	MW	1,115	1,102	1,217	1,311	1,314	1,352	1,357	1,390	1,381	1,386	1,423
Wind (200 MW)	2018$/kW	1,334	1,330	1,249	1,167	1,123	1,160	1,152	1,166	1,139	1,142	1,143
Solar (100 MW)	2018$/kW	1,524	1,362	1,202	1,041	1,026	999	952	929	866	856	865
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,513	1,214	1,156	1,096	1,042	965	928	901	894
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,220	1,774	1,678	1,538	1,408	1,231	1,268	1,124	1,020
Gas CC (442 MW + DF)	2018$/kW	1,122	1,114	1,100	1,088	1,079	1,072	1,063	1,056	1,049	1,042	1,034
Gas CT (237 MW)	2018$/kW	548	544	536	529	525	521	517	513	510	506	502
USC Coal w/ CCS	2018$/kW	5,421	5,339	5,231	5,121	5,016	4,916	4,814	4,717	4,624	4,531	4,445

80% REDUCTION CASE INPUTS

Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.49	1.27	1.25	1.25	1.25	1.25	1.25	1.25	1.25
CO_2	2018$/ton	0.00	0.00	0.00	3.57	5.10	6.63	7.65	9.18	11.22	14.79	19.89
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	3.06	3.24	3.38	3.49	3.62	3.78	3.96	4.09	4.17
Vectren Peak Load	MW	1,115	1,102	1,131	1,060	1,025	1,039	1,038	1,038	1,053	1,053	1,065
Wind (200 MW)	2018$/kW	1,334	1,330	1,249	1,167	1,123	1,160	1,152	1,166	1,139	1,142	1,143
Solar (100 MW)	2018$/kW	1,524	1,362	1,202	1,041	1,026	999	952	929	866	856	865
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,513	1,214	1,156	1,096	1,042	965	928	901	894
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,220	1,774	1,678	1,538	1,408	1,231	1,268	1,124	1,020
Gas CC (442 MW + DF)	2018$/kW	1,122	1,114	1,100	1,088	1,079	1,072	1,063	1,056	1,049	1,042	1,034
Gas CT (237 MW)	2018$/kW	548	544	536	529	525	521	517	513	510	506	502
USC Coal w/ CCS	2018$/kW	5,421	5,339	5,231	5,121	5,016	4,916	4,814	4,717	4,624	4,531	4,445

DRAFT HIGH REGULATORY CASE INPUTS

Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.49	1.27	1.25	1.25	1.25	1.25	1.25	1.25	1.25
CO2	2018$/ton	0.00	0.00	50.40	52.28	54.17	56.05	57.94	60.06	62.41	64.77	67.12
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	4.39	6.03	7.10	8.37	7.17	8.40	8.95	8.75	8.63
Vectren Peak Load	MW	1,115	1,102	1,168	1,176	1,183	1,192	1,200	1,209	1,219	1,229	1,239
Wind (200 MW)	2018$/kW	1,334	1,330	1,249	1,167	1,123	1,160	1,152	1,166	1,139	1,142	1,143
Solar (100 MW)	2018$/kW	1,524	1,362	1,202	1,041	1,026	999	952	929	866	856	865
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,513	1,214	1,156	1,096	1,042	965	928	901	894
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,220	1,774	1,678	1,538	1,408	1,231	1,268	1,124	1,020
Gas CC (442 MW + DF)	2018$/kW	1,122	1,114	1,100	1,088	1,079	1,072	1,063	1,056	1,049	1,042	1,034
Gas CT (237 MW)	2018$/kW	548	544	536	529	525	521	517	513	510	506	502
USC Coal w/ CCS	2018$/kW	5,421	5,339	5,231	5,121	5,016	4,916	4,814	4,717	4,624	4,531	4,445

DSM BUNDLES IN IRP MODELING
DSM BUNDLE SENSITIVITIES

VECTREN
A CenterPoint Energy Company

	1	2	3	4	5	6	7
	Gross Projected Cost per KWh; Cumulative by Bundle (LOW CASE)						
2021	$0.01270	$0.01668	$0.01840	$0.02112	$0.02461	$0.02891	
2022	$0.01265	$0.01660	$0.01992	$0.02346	$0.02643	$0.03053	
2023	$0.01298	$0.01676	$0.01994	$0.02385	$0.02764	$0.03165	
2024	$0.01332	$0.01654	$0.02009	$0.02460	$0.02868	$0.03064	$0.03291
2025	$0.01374	$0.01798	$0.02149	$0.02623	$0.03043	$0.03356	$0.03434
2026	$0.01408	$0.01872	$0.02274	$0.02744	$0.03172	$0.03487	$0.03578
2027	$0.01461	$0.01964	$0.02373	$0.02895	$0.03316	$0.03623	$0.03708
2028	$0.01515	$0.02067	$0.02537	$0.03010	$0.03460	$0.03783	$0.03895
2029	$0.01593	$0.02158	$0.02695	$0.03237	$0.03616	$0.03999	
2030	$0.01671	$0.02358	$0.02804	$0.03272	$0.03732	$0.04174	
2031	$0.01742	$0.02439	$0.02864	$0.03436	$0.03838	$0.04250	
2032	$0.01829	$0.02515	$0.03111	$0.03605	$0.04009	$0.04459	
2033	$0.01942	$0.02617	$0.03285	$0.03866	$0.04136	$0.04582	
2034	$0.02010	$0.02701	$0.03467	$0.04009	$0.04292	$0.04749	
2035	$0.01656	$0.02140	$0.02586	$0.03225	$0.03697	$0.03889	$0.04328
2036	$0.01674	$0.02122	$0.02561	$0.03197	$0.03641	$0.03886	$0.04329
2037	$0.01670	$0.02129	$0.02566	$0.03146	$0.03627	$0.03897	$0.04315
2038	$0.01742	$0.02048	$0.02591	$0.03110	$0.03577	$0.03984	$0.04399
2039	$0.01814	$0.02097	$0.02656	$0.03122	$0.03652	$0.04043	$0.04449

	1	2	3	4	5	6	7
	Gross Projected Cost per KWh; Cumulative by Bundle (HIGH CASE)						
2021	$0.01613	$0.02119	$0.02337	$0.02682	$0.03126	$0.03673	
2022	$0.01607	$0.02109	$0.02530	$0.02979	$0.03357	$0.03877	
2023	$0.01649	$0.02129	$0.02533	$0.03029	$0.03510	$0.04020	
2024	$0.01691	$0.02100	$0.02552	$0.03125	$0.03643	$0.03892	$0.04181
2025	$0.01745	$0.02283	$0.02730	$0.03332	$0.03866	$0.04262	$0.04362
2026	$0.01788	$0.02377	$0.02888	$0.03486	$0.04029	$0.04429	$0.04544
2027	$0.01856	$0.02495	$0.03014	$0.03677	$0.04212	$0.04601	$0.04710
2028	$0.01924	$0.02626	$0.03222	$0.03823	$0.04394	$0.04805	$0.04947
2029	$0.02023	$0.02742	$0.03423	$0.04111	$0.04593	$0.05080	
2030	$0.02122	$0.02995	$0.03561	$0.04156	$0.04740	$0.05302	
2031	$0.02212	$0.03098	$0.03638	$0.04364	$0.04875	$0.05398	
2032	$0.02323	$0.03195	$0.03951	$0.04579	$0.05092	$0.05663	
2033	$0.02466	$0.03324	$0.04173	$0.04911	$0.05253	$0.05820	
2034	$0.02553	$0.03431	$0.04404	$0.05092	$0.05452	$0.06032	
2035	$0.02103	$0.02718	$0.03284	$0.04096	$0.04696	$0.04939	$0.05498
2036	$0.02126	$0.02695	$0.03253	$0.04060	$0.04625	$0.04936	$0.05499
2037	$0.02121	$0.02704	$0.03259	$0.03996	$0.04607	$0.04949	$0.05480
2038	$0.02212	$0.02601	$0.03291	$0.03950	$0.04544	$0.05060	$0.05587
2039	$0.02304	$0.02663	$0.03374	$0.03965	$0.04638	$0.05135	$0.05650

DSM BUNDLES IN IRP MODELING
BASE CASE LEVELIZED COST PER KWH

VECTREN
A CenterPoint Energy Company

	1	2	3	4	5	6	7
	Gross Projected Cost per KWh; Cumulative by Bundle						
2021	$0.0144	$0.0189	$0.0209	$0.0240	$0.0279	$0.0328	
2022	$0.0144	$0.0189	$0.0226	$0.0266	$0.0300	$0.0347	
2023	$0.0147	$0.0190	$0.0226	$0.0271	$0.0314	$0.0359	
2024	$0.0151	$0.0188	$0.0228	$0.0279	$0.0326	$0.0348	$0.0374
2025	$0.0156	$0.0204	$0.0244	$0.0298	$0.0346	$0.0381	$0.0390
2026	$0.0160	$0.0212	$0.0258	$0.0312	$0.0360	$0.0396	$0.0406
2027	$0.0166	$0.0223	$0.0269	$0.0329	$0.0376	$0.0411	$0.0421
2028	$0.0172	$0.0235	$0.0288	$0.0342	$0.0393	$0.0429	$0.0442
2029	$0.0181	$0.0245	$0.0306	$0.0367	$0.0410	$0.0454	
2030	$0.0190	$0.0268	$0.0318	$0.0371	$0.0424	$0.0474	
2031	$0.0198	$0.0277	$0.0325	$0.0390	$0.0436	$0.0482	
2032	$0.0208	$0.0286	$0.0353	$0.0409	$0.0455	$0.0506	
2033	$0.0220	$0.0297	$0.0373	$0.0439	$0.0470	$0.0520	
2034	$0.0228	$0.0307	$0.0394	$0.0455	$0.0487	$0.0539	
2035	$0.0188	$0.0243	$0.0294	$0.0366	$0.0420	$0.0441	$0.0491
2036	$0.0190	$0.0241	$0.0291	$0.0363	$0.0413	$0.0441	$0.0491
2037	$0.0190	$0.0242	$0.0291	$0.0357	$0.0412	$0.0442	$0.0490
2038	$0.0198	$0.0233	$0.0294	$0.0353	$0.0406	$0.0452	$0.0499
2039	$0.0206	$0.0238	$0.0302	$0.0354	$0.0415	$0.0459	$0.0505

	1	2	3	4	5	6	7	8
	2016 Projected Cost per kWh (Cumulative)							
2017	$0.03462	$0.03480	$0.03498	$0.03516	$0.04402	$0.04998	$0.05429	$0.05756
2018	$0.03607	$0.03626	$0.03645	$0.03664	$0.04547	$0.05142	$0.05572	$0.05899
2019	$0.03759	$0.03779	$0.03798	$0.03818	$0.04698	$0.05291	$0.05720	$0.06046
2020	$0.03917	$0.03938	$0.03958	$0.03979	$0.04855	$0.05446	$0.05873	$0.06197
2021	$0.04082	$0.04103	$0.04124	$0.04146	$0.05018	$0.05606	$0.06030	$0.06354
2022	$0.04254	$0.04276	$0.04298	$0.04320	$0.05187	$0.05771	$0.06193	$0.06514
2023	$0.04433	$0.04456	$0.04479	$0.04502	$0.05362	$0.05942	$0.06361	$0.06680
2024	$0.04619	$0.04643	$0.04667	$0.04691	$0.05544	$0.06118	$0.06534	$0.06851
2025	$0.04813	$0.04837	$0.04862	$0.04888	$0.05732	$0.06301	$0.06713	$0.07027
2026	$0.05016	$0.05042	$0.05068	$0.05094	$0.05928	$0.06491	$0.06898	$0.07209
2027	$0.05227	$0.05254	$0.05281	$0.05309	$0.06132	$0.06687	$0.07090	$0.07397
2028	$0.05447	$0.05475	$0.05503	$0.05532	$0.06343	$0.06890	$0.07286	$0.07589
2029	$0.05676	$0.05705	$0.05735	$0.05765	$0.06562	$0.07101	$0.07491	$0.07789
2030	$0.05914	$0.05945	$0.05976	$0.06007	$0.06789	$0.07318	$0.07702	$0.07995
2031	$0.06163	$0.06195	$0.06227	$0.06260	$0.07026	$0.07544	$0.07920	$0.08207
2032	$0.06422	$0.06456	$0.06489	$0.06523	$0.07271	$0.07777	$0.08145	$0.08426
2033	$0.06693	$0.06728	$0.06758	$0.06795	$0.07524	$0.08017	$0.08376	$0.08651
2034	$0.06974	$0.07010	$0.07046	$0.07083	$0.07790	$0.08269	$0.08618	$0.08885
2035	$0.07268	$0.07306	$0.07343	$0.07382	$0.08066	$0.08529	$0.08867	$0.09127
2036	$0.07573	$0.07613	$0.07652	$0.07692	$0.08351	$0.08798	$0.09125	$0.09375

Vectren 2019 IRP
2nd Stakeholder Meeting Minutes Q&A
October 10, 2019, 9:00 a.m. – 3:00 p.m.

Lynnae Wilson (CenterPoint Energy Indiana Electric Chief Business Officer) – Welcome and Safety Message (distracted driving) and Vectren introductions

> Subject Matter Experts in the room: Anna Nightingale, Justin Joiner, Ryan Wilhelmus, Matt Rice, Wayne Games, Tom Bailey, Steve Rawlinson, Rina Harris, Shane Bradford, Heather Watts, Angie Bell, Natalie Hedde, Angie Casbon-Scheller, Bob Heidorn, Cas Swiz.

Gary Vicinus (Moderator, Managing Director for Utilities, Pace Global) discussed the agenda and provided a summary of stakeholder process (last meeting and present meeting). Approximately 35 stakeholders attended in person. List of affiliations include the following:

CAC
Country Mark
Hallador Energy
IBEW Local 702
Inovateus Solar LLC
IURC
NIPSCO
Orion Renewable Energy Group LLC
OUCC
Sierra Club
Solarpack Development, Inc.
SUFG
Valley Watch

Approximately 35 registered to attend the webinar; several participated. Those registered included representatives from:

Advanced Energy Economy
AEP
Boardwalk Pipeline Partners
Development Partners Group
Ecoplexus
Energy and Policy Institute
Energy Futures Group
EQ Research
First Solar
Hoosier Energy
ICC
Indiana Distributed Energy Alliance
IPL
IURC

juwi Inc.

Lewis Kappes

MEEA

Morton Solar & Electric

NextEra

NextEra Energy Resources

OUCC

Sierra Club

Vote Solar

Matt Rice (Vectren Manager of Resource Planning) and **Gary Vicinus** (Pace Global, Managing Director for Utilities) – presented Follow-up Information Since Our Last Stakeholder Meeting - Slides 9-13

- Slide 13 Stakeholder Feedback Cont.:
  - Request for folks to introduce themselves in the room and on the phone
    - Response: We have a full agenda; maybe we can take 5 minutes if there is time.
- Slide 13 Stakeholder Feedback Cont.:
  - Question: Can we send you additional health benefits studies for your consideration?
    - Response: Yes
- Slides 17-18 Scenario Narratives:
  - Clarifying question: Can we focus more on these two slides, as I'm interested in discussing the changes?
    - Response: Yes, we can discuss at the end of this session.
- Slide 24: Feedback and Discussion:
  - Question: With regards to the uneconomic asset risk analysis, you mentioned that you would be running 200 iterations. Will you be considering an earthquake in one of those iterations when assessing a portfolio?
    - Response: We will be assessing changing market conditions; I would not say earthquakes. We will be assessing the costs of various portfolios to determine if a portfolio becomes uneconomic under various market conditions, including fuel, load, technology costs, etc.
  - Question: Last meeting, you said you would consider a carbon fee and dividend scenario. But what you've included doesn't look like what we proposed. It's apples and oranges. I'm suggesting a carbon dividend is national and would affect gas, coal, etc. right here in Indiana. By definition, a carbon dividend is Low Regulatory but it is lumped in here with High Regulatory. HR 763 is a pending bill at national level with 60+ co-sponsors that may very well become law [link: https://www.congress.gov/bill/116th-congress/house-bill/763]. This was recently highlighted in a January Wall Street Journal article [WSJ article link: https://www.wsj.com/articles/economists-statement-on-carbon-dividends-11547682910] with a letter signed by 3,500 prominent economists advocating for a carbon dividend that will happen within 20 year timeframe of IRP. You've put it in High Reg but it looks more like the 80% case. No one is talking about cap & trade anymore. Rather than generic terms, why not put in this pending legislation and why not put it in the Low Reg scenario? Use what the bill proposed: $15/ton in first year, escalates by $10/ton each year thereafter?
    - Response: We'll consider that feedback. We need to consider a range of carbon prices, and maybe what you've suggested will align better with another scenario.
  - Question: Why not use actual pending legislation based on Paris Accord?
    - Response: We are going to capture a very wide range of carbon prices in the analysis. We do consider the Paris Accord in our analysis; you will see the CO_2 graph that demonstrates this. You'll see very high carbon prices in one scenario,

a 2% solution, ACE, and we're also considering adding a carbon price to the Base Case.

- o Question: You mentioned using global warming potential of methane. Does CO_2 -e capture this?
  - ▪ Response: CO_2 -e will be captured in the stochastic runs (risk analysis and included in the scorecard). But within the scenario analysis, it is CO_2 .
- o Question: On Slide 21, Life Cycle Green House Gas (GHG) Emissions, what it really boils down to is methane. Credible reports show 2.3% methane leakage. Math is simple. Gas isn't any better than coal in terms of GHG emissions.
  - ▪ Response: This is based on an NREL study that considers upstream and downstream emissions, which includes methane leaks.
- o Statement: It's not complicated, 2.3% leakage and 87x more global warming potential. You can do it on a scratch pad.
  - ▪ Response: We are including methane leakage. We want to have quantitative measures in our scorecard. This rate includes what you're asking for.
- o Question: Are there only five possible scenarios in your modeling software? Can you add more, e.g., Lani Ethridge's scenario [HR 763]?
  - ▪ Response: I would like to hold this question until we discuss the scenario inputs and show you the wide range of scenarios that we've created. Additionally, we will gather strategies to create other portfolios later today.
- o Question: Please let folks on phone ask questions. Thank you for the tentative 10/24 Aurora call with Energy Exemplar. However, the $5k cost raises incredibly grave concerns for us, particularly as this process is supposed to lessen disputes before we enter litigation phase. This cost forecloses stakeholder participation and charging us for transparency is problematic. Also, according to Indiana Administrative Code 170 IAC 4-7-2.5, Vectren doesn't comply if we can't access the model at this cost. In Michigan, a utility was granted ~10 licenses within their subscription.
  - ▪ Response: We'll talk about that during the call on 10/24.
- o Question: On Slide 21, happy to see Life Cycle GHG emissions; however, the NREL study is very dated, especially on solar. Can I provide updated studies?
  - ▪ Response: Yes, please send, though what we liked about the NREL study was that it considered many other studies and multiple perspectives, even if it is a little dated.
- o Question: All the closures and retirements in the 2016 IRP, is that the base case in this IRP?
  - ▪ Response: This IRP is an update, and we are re-evaluating. Wayne Games will discuss how we will be evaluating existing resources.
- o Question: So, it's possible that AB Brown could stay open?
  - ▪ Response: Yes.
- o Question: Can we please try again for the phone?
  - ▪ Response: Please type questions. We do not see any typed questions at the moment.

Justin Joiner (Director of Power Supply Services) – MISO Considerations – slides 25-32:

- Slide 26 MISO Summary
  - o Question: Why do you attribute changing resource mix to accreditation when weather, forced outages at fossil fuels plants, etc. can also be a driver?
    - ▪ Response: We'll address in detail shortly but changing resource mix is one of the main drivers. Outrages or load are other contributing factors.
  - o Question: Wouldn't an increase in emergency events change accreditation?
    - ▪ Response: No, let's address shortly.
- Slide 28 Congestion
  - o Question: Please explain price separation in zone 6.
    - ▪ Response: Overnight when there are low load periods and high wind output, MISO sends a negative price signal, which lowers the price that we are receiving

    - there. The $5 price difference is a simple average over the last 12 months on an hourly basis.
  - Question: Do we need more transmission since we're talking about congestion?
    - Response: Yes, the next slide discusses MISO planning. MISO has two processes. (Slide 29) Interconnection queue (paid by new generators) and transmission planning process (paid for by all MISO participants, thus socialized across MISO footprint) helps to plan for new transmission needs to remedy congestion.
- Slide 31 All MISO Considerations Need to Be Accounted for During the IRP
  - Question: Which zones saw maximum generation events?
    - Response: Most recent maximum generation event was several zones (the North Central Region), including LRZ6 but up to Minnesota. The prior maximum generation events were more in MISO-South. We can follow-up on other events, if needed.
  - Question: How, within Aurora, does Vectren intend to try to account for seasonal accreditation?
    - Response – Pace can speak to this in more detail if needed, but you can set UCAP values in Aurora and the PRM requirement monthly.
  - Question: You mentioned one event was due to non-firm gas delivery. Wasn't the gas line to supply your formerly proposed gas plant with a non-firm contract?
    - Response: We were planning on serving that plant with firm delivery to ensure that we had high priority on delivery list.
  - Question: For transmission over 345 kW you mentioned costs would be distributed across MISO participants. Would that be true if a hydro unit was installed at the Meyers dam?
    - Response: I apologize, we're talking about 345 kV, so transmission delivery, not energy. We are talking about the rating of the line (line size).
  - Question: Were you involved with Duff Coleman transmission? I was involved as a property owner. Looking at current transmission corridors, and the effect of eminent domain on property owners. I think Vectren needs to consider corridors, competitor lines. How can you consider existing corridors?
    - Response: Planning is typically to use existing corridors. Vectren is not involved in the construction of the Duff Coleman transmission line (MISO opened it up to bids). MISO must consider all of this when planning transmission Right of Ways.
  - Comment: It is premature to modify reserve margin requirement based on max gen events. There are other options besides a seasonal resource adequacy construct. Could it help to address those issues with coordinated outage/maintenance schedules? It is perfectly fine to model as a base case sensitivity but not a base case assumption.
    - Response: MISO already implemented coordinated maintenance schedule reporting, which Vectren is already complying with. On seasonal construct, this is driven by MISO and we can't ignore or avoid; Vectren is only one stakeholder among many. Four season construct is already planned for implementation in 2021 by MISO. Vectren is looking at two seasons, not four, which is a conservative assumption that could potentially limit impact.
  - Question: Will recorded NPVs be based on deterministic modeling or stochastic modeling?
    - Response: Both. We'll look at portfolio performance on an expected (probabilistic) basis (from 200 iterations in the risk analysis) as well as deterministic NPV results (from the scenario analysis).
  - Question: Can you count on MISO to fill gaps for a year or two after coal is retired but before new resources are online? It seems like that would create some flexibility in how you move forward.
    - Response: We do have the ability to account for purchases to fill in gaps. That's part of the economic analysis.
  - Question: Does MISO plan to mitigate max gen events with solar+storage or even stand-alone storage?

        - Response: MISO requires four consecutive hours of output. So, if nameplate storage is 100 MW, then accreditation is 25 MW over four hours. To your question, MISO seasonal accreditation planning is meant to better align actual output with accreditation.
    - Question: When is MISO planning on incorporating new technology resources into their planning?
        - Response: They try to be as responsive but given all the stakeholders they can be a little slow at times for the latest technologies. They are responsive. To get changes done in the marketplace, that process usually takes 12-18 months to implement in new tariffs, etc. They also try to make market rules (with a year lag) based on annual transmission planning process, with respect to state planning processes.

Gary Vicinus (Pace Managing Director for Utilities) - Scenario Modeling Inputs – slides 33-48:
Slide 48 Feedback and Discussion:

- Question: You're showing these inputs, but what about distributed generation? If you lift policy caps on solar, your demand would drop a lot with solar as well as behind-the-meter storage. Don't the caps limit solar DG (in schools, etc.)? We could get there at a reasonable cost because the investment comes from individuals.
    - Response: We don't cap the amount of distributed solar considered, but payback calculation within the model is affected by net metering structure. We are going to analyze a wide range for peak loads; Itron did a sensitivity on rooftop solar that falls within this range.
- Comment: I'd like to see intentional changes in policy to promote distributed energy and how would that affect the rest of your modeling (and Behind The Meter, bi-directional batteries)? I would like to see incentives.
    - Response: I would suggest that this be one of the strategies for the group breakout session.
- Comment: Under Energy Innovation and Carbon Dividend Act being considered in congress right now, in 2022 CO_2 would be $15 but in 2039 it would be $185. That would change the outlook considerably.
- Question: Also, why is coal price lower if costs are higher?
    - Response: Lower coal prices follow from lower coal demand. With reduced demand, only the most efficient will survive.
- Question: The peaks and valleys on these graphs would indicate to me that the same distribution is not being assumed in any given year. For example, the distribution is not always normal. For the capital costs in particular, that strikes me as a level of precision that does not actually exist. For example, why would two standard deviations give you a wider range of distributions in 2033 vs. 2036 for solar? In general, I would reiterate the feedback that we have given previously. Stochastic simulation is not a good tool for capex (just for volatile variables like gas). Will these standard deviations be applied to the bids received from the RFP?
    - Response: Distributions do vary over time, as one would expect, as uncertainty increases over time. It's correct to say the distributions are not always normal (e.g., gas wouldn't fall below $2 because costs must be recovered). Market conditions drive the upper end. Many of our distribution are skewed to the upward side. To say that stochastic simulation is not a good test, I would say that is a point of view. We use stochastics in many jurisdictions and it is widely accepted. It is intended to reflect not only the volatility but also the uncertainty as we go forward.
- Question: Why do distributions widen, narrow, widen, etc., if uncertainty grows? And using stochastics for solar capital costs standard deviations doesn't reflect how actual capital costs move. Why not use sensitivities, which is what is typically seen in IRPs?
    - Response: A lot of these graph reflect monthly variations as opposed to annual. They tend to smooth out when you look at them on an annual basis. Ultimately, we will do some annual smoothing. I agree that the monthly variations are not easily explained, but they tend to level out on an annual basis.
    - Question: Will you apply distributions to bid prices?

        - Response: We will use for the various years where we have bid information as an input at base levels. After the bid years, the stochastic distributions will be reflected.
    - Question: If a bid resource would come online in 2022, you wouldn't apply distributions there?
        - Response: In your example, we will utilize the bid information for 2022 and use the distributions going forward (beyond 2022). We will set up a follow-up conversation.
- Question: How did you come up with 2.2% inflation assumption?
    - Response: It is a projection from Moodys.com.
- Question: When do the probability distributions come into effect (after bids)?
    - Response: Bids come in in different years, then we start uncertainty shortly thereafter.

Michael Russo (Sr. Forecast Consultant, Itron) – Long term Base Energy and Demand Forecast – slides 49-60:

- Slide 57 C&I Sales Forecast:
    - Question: Can you pull out Electric Vehicle (EV) owners who have solar Distributed Generation (DG)? EV owners aren't adding to load given that they have solar DG too.
        - Response: We start with 200 registered EV owners but Itron doesn't have info on who also has solar distributed generation. Theimpact won't be large given the small starting number.
- Slide 60 Feedback and Discussion:
    - Question: You did the forecasts for the 2016 IRP. How accurate were those forecasts?
        - Response: We did not specifically look at the last couple of years, but in general we do look at forecasting error. We do hold out the last year of the model and compare how well the model performs, now that we have the actuals. Our Mean Absolute Percentage Errors (MAPE) on the residential and commercial side is typically around 2%. They are higher on the industrial and peak models.
    - Question: On Slide 59, you show significant drops in both energy and demand that don't seem to be reflected in residential and C&I.
        - Response: That is a large industrial customer that is modeled separately (and not included on Slide 56 C&I Sales Forecast).
    - Question: The industrial growth is very significant. Can you say more?
        - Response: We can't comment on individual load additions publicly. What we can say is that there are two public projects in Southwest Indiana that received air permits in the past two years (in public domain). We have formulated expected MWs and MWhs from potential customers that have come to us. We have signed NDAs for projects (required for all economic development opportunities), but large industrials account for the majority of industrial uptick. We have an obligation to serve this load.
    - Question: How will these load forecasts be translated into high/low load forecasts, particularly given large industrial customers? I have similar concern to the CAC.
        - Response: The answer depends upon the component. Looking at higher/lower EV forecast, we take that input in developing upper/lower boundary scenarios. Pace starts with what Vectren/Itron provides us, then we look at uncertainties around this. Even when individual components such as EV or solar, we're still within the boundaries showed earlier. We haven't finalized load, so we'll look at individual components and adjust accordingly.
    - Question: Is the coal to diesel plant reflected in to the two permits that you discussed earlier?
        - We are not going to comment on those two specific permits.
    - Question: Is Southern Indiana petrochemical facility included in industrial outlook?
        - Response: Cannot comment on specific projects.
    - Comment: The coal-to-diesel plant won't happen, so if you're considering this in the forecast, you need a new forecast. If they're already permitted, why can't you discuss them?

        - Response: We have signed NDAs with perspective customers at their request. and so, we can't discuss their load for competitive reasons.
    - Comment: I've been having a moment at these meetings. It struck me when we looked the slide about trended normal weather. It feels to me like we're rearranging deck chairs on the Titanic. I think that the issue that we need to be basing our decisions on is around that exact fact. Climate crisis demands we act, not because we're forced to by any rule, but because we need to act for our children. I feel like what we're talking about is not what is important.
        - We're basing off historical weather trends, which is used by government and others.

<u>Wayne Games</u> (Vice President power Generation Operations) – Existing Resource Overview – slides 61-75:

- Slide 75 Feedback and Discussion:
    - Question: (Clarification on solar resources) Do you plan to build 54 MWs of solar or over 100 MWs (referring to slides 64 Summary of Current Resource UCAP Accreditation for Summer Peak and 66 Renewables)?
        - Response: We have two 2 MW projects and plan to build an additional 50 MWs.
    - Comment: These options for AB Brown, etc.…these plants are obsolete now. It seems awkward to invest more in dying technologies.
        - Response: I'm not saying we should or shouldn't. We're required to look at all options and some stakeholders have asked us to look at these options.
    - Comment: Even when you show 80% carbon reduction by Paris Treaty, that doesn't reflect what we face now. Right now, there is a lake in Siberia that is bubbling up methane because we under-projected. We need a Greta Thunberg portfolio, which means we put everything possible into cutting carbon emissions. We need a crisis scenario.
    - Comment: On carbon, Vectren should be looking into technology to sequester carbon. Where can Vectren use science, like Duke Energy, to get today's youth involved in STEM classes. You need to look at the bigger environmental picture.
    - Comment: There were a lot of numbers and analysis. We'd like to work with you to get access to your numbers, including Slide 74 A.B. Brown FGD Options, derived from outside engineering studies.
    - Question: Where will 50 MW solar plant be built?
        - Response: East side of Spencer County.
    - Question: I don't understand why you use historical weather when Purdue University. uses different projections? I don't understand why your projections don't look like their projections.
        - Response: What we use is consistent with what EIA uses. We did not use the Purdue data set.
    - Question: So, you're saying you should use historical approach because you expect nothing out of the usual?
        - Response: Our forecast is different than what we've done in the past to address the trended weather concern.
    - Comment: Have you looked at Purdue report?
        - Response: We attended the talk the other night and looked at the website. If you'd like to send me the report, we'll look. We will reach out to Purdue to understand their dataset.

<u>Matt Lind</u> (Resource Planning & Market Assessments Business Lead, Burns and McDonnell) Potential New Resources and MISO Accreditation – slides 76-92:

    - Question (Slide 81 Technology Details): Can you explain difference between estimated potential capacity and estimate feasible capacity and estimated optimal capacity?

        - Response: We would need to look more closely, but I believe that the Estimated Potential Capacity is the technical potential, not necessarily the most economic option.
    - Question: On slide 84 & 80, does solar+storage mean exclusively charged by solar or charged by grid?
        - Response: The former (exclusively supplied by the sun) is generally the case, depending on the bids.
    - Question: On slide 84 Proposal Location Review, what is the difference between proposal installed and project installed capacities?
        - Response: Proposal includes double- and triple-counting.
    - Question: On Slide 85 Participating Companies, is Duke Energy a participant?
        - Response: Yes
- Slide 87 MISO Renewable Penetration Trends
    - Question: Counterintuitive – Your credit to solar shouldn't go down as installed capacity goes up. It's counterintuitive to me.
        - Response: As more solar, a non-dispatchable resource, is added to the system accreditation goes down. As you add more solar, the risk of being deficient from a resource perspective shifts to the evening hours. ELCC is a calculation that MISO has been using for wind resources for several years.
    - Question: Is the ELCC based on fixed or tracking solar?
        - Response: Orientation, geography, etc. are all considered, but accreditation (the amount of credit MISO is projected to provide for resource) will still decline over time.
    - Question: Prices are higher than I've seen. Are these prices typical or representative of actual bids?
        - Response: This is technology assessment data, not bid data.
    - Question: Wouldn't MISO accreditation change with storage?
        - Response: Yes, though even standalone storage would be affected given the duration of storage. To be eligible for full accreditation for storage, you need more than 4 hours of storage. This reinforces the diversity of resources and the location of resources.
- Slide 89 Wind Seasonal Differences
    - Question: So, you're making changes for Southern Indiana based on MISO which encompasses Canada to Gulf of Mexico. Doesn't this skew things?
        - Response: MISO provides a unique geographic accreditation to each Local Resource Zone, though it is still tied to the MISO peak.

Feedback and Discussion slide 92:

- Comment: I noticed a combination that may be cost effective. We worked on this during the prior CCGT case. That is repowering one of the Brown units coupled with the smaller CCGT. The new gas pipeline doesn't need to be double-counted. You could use one pipeline to serve both units.
- Question: When does wind and solar become dispatchable (with sufficient storage)?
    - Response: Storage round-trip efficiency is a net load to the system. Today's technology is not there yet. You'd have to add a lot of storage, but there would still be a net load. It depends on technology, consumer behavior, etc. Battery experts are researching this. I don't see it in the near term.
- Question: Would bigger installations of PV panels or turbines lead to less need for storage?
    - Response: That is a strategy people are looking at, particularly to take advantage of tax credits.
- Question: Why does solar capacity credit start at 50% and not 60% on Slide 87 MISO Renewable Penetration Trends? Also, can you show us specific data showing forecast for renewable and storage penetration?
    - Response: We took the average across the MISO Transmission Expansion Plan (MTEP) futures. The average installation grows from 6,000 MW in 2023 to about 25,000 MW by 2033. We extrapolated that trend line beyond 2033. On slide 91 Zone

6 Seasonal Accreditation, we used 50% during the first year of operation, per MISO ELCC figures.
  - Question: What is the basis for 0% capacity accreditation in winter?
    - Response: Peak hours are in the H20-H22 range when there is no solar production.

Jeffrey Huber (Managing Director, GDS Associates) - DSM Modeling in the IRP – Slides 93-103:

Slide 103 Feedback and Discussion:

- Comment: Thank you Vectren and Jeff for working with the CAC on this through the Oversight Board. We look forward to seeing how this all works through the IRP process.
- Question: About interruptible tariff (not part of this DSM analysis), will we continue that process?
  - Response: We're in the process of truing up our interruptible tariff with MISO in mid- to late-November, which would true up notification times.
- Question: I'm interested in economic curtailment.
  - Response: We're working on language changes (ongoing) and we'll get back to you on that.

Gary Vicinus (Pace Managing Director of Utilities) – Stakeholder Breakout Session Strategy Development – Slides 104-107:

- Instructions given: Examples: Impose an Renewable Portfolio Standard (RPS) of X% by X year, or a portfolio with no coal by X year, etc.
- See Slide 106 Portfolio Strategy Worksheet – use this for strategies and timeframes
- Group 1: Six strategies:
  1. Plants scheduled in 2016 IRP – Do that by 2024 and replace closures with renewable energy capacity
  2. Culley 3 be closed by 2030, also replaced by renewable energy
  3. Lobby to extend net metering at 1-to-1 ratio, no cap, by 2022
  4. Close gas-fired plants by 2030 and replace with renewable energy (solar)
  5. Maximize Energy Efficiency efforts immediately (by 2020) through incentives
  6. Increase storage in timeframes to accommodate bringing on renewable energy (~5 years, timed to retirements, focused on Behind the Meter solar)
- Group 2:
  1. Do what NIPSCO is doing. As resources retire, replace with renewable energy. (Clarification from stakeholder – NIPSCO in 2026 is adding a price on carbon, whereas Vectren Base Case is $0 for 20 years)
  2. Go for 100% renewable energy by end of 2030
  3. Have 100% reduction in CO_2 and equivalents at the end of 20 years
  4. Have other experts review how you're using our recommendations (to ensure it is being treated fairly in the modeling)
- Group 3:
  1. We want to access all the runs under the Nondisclosure Agreement (NDA).

VECTREN PUBLIC STAKEHOLDER MEETING

DECEMBER 13, 2019

WELCOME AND SAFETY SHARE

LYNNAE WILSON

INDIANA ELECTRIC CHIEF BUSINESS OFFICER

SAFETY SHARE

Holiday Safety Tips

- Inspect electrical decorations for damage before use. Cracked or damaged sockets, loose or bare wires, and loose connections may cause a serious shock or start a fire
- Do not overload electrical outlets. Overloaded electrical outlets and faulty wires are a common cause of holiday fires. Avoid overloading outlets
- Use LED lights. Never connect more than three strings of incandescent lights. More than three strands can cause a fire
- Use battery-operated candles. Candles start almost half of home decoration fires (National Fire Protection Association - NFPA)
- Keep combustibles at least three feet from heat sources. Heat sources that are too close to a decoration are a common factor in home fires
- Protect cords from damage. To avoid shock or fire hazards, cords should never be pinched by furniture, forced into small spaces such as doors and windows, placed under rugs, located near heat sources, or attached by nails or staples
- Stay in the kitchen when something is cooking. Unattended cooking equipment is the leading cause of home cooking fires (NFPA).
- Turn off, unplug, and extinguish all decorations when going to sleep or leaving the house. Half of home fire deaths occur between the hours of 11pm and 7am (NFPA).

2019/2020 STAKEHOLDER PROCESS

August 15, 2019	October 10, 2019	December 13, 2019	March 20, 2020[1]
• 2019/2020 IRP Process • Objectives and Measures • All-Source RFP • Environmental Update • Draft Reference Case Market Inputs & Scenarios	• RFP Update • Draft Resource Costs • Sales and Demand Forecast • DSM MPS/ Modeling Inputs • Scenario Modeling Inputs • Portfolio Development	• Draft Portfolios • Draft Reference Case Modeling Results • All-Source RFP Results and Final Modeling Inputs • Scenario Testing and Probabilistic Modeling Approach and Assumptions	• Final Reference Case and Scenario Modeling Results • Probabilistic Modeling Results • Risk Analysis Results • Preview the Preferred Portfolio

1 Updated

AGENDA

Time		
9:00 a.m.	Sign-in/Refreshments	
9:30 a.m.	Welcome, Safety Message	Lynnae Wilson, CenterPoint Energy Indiana Electric Chief Business Officer
9:50 a.m.	Follow-up Information Since Our Last Stakeholder Meeting	Matt Rice, Vectren Manager of Resource Planning
10:30 a.m.	Break	
10:40 a.m.	Draft Reference Case Results	Peter Hubbard, Manager of Energy Business Advisory, Pace Global
11:40 a.m.	Lunch	
12:40 p.m.	Final RFP Modeling Inputs	Matt Lind, Resource Planning & Market Assessments Business Lead, Burns and McDonnell
1:40 p.m.	Break	
1:50 p.m.	Portfolio Development	Matt Rice, Vectren Manager of Resource Planning
2:20 p.m.	Scenario Testing and Probabilistic Modeling	Peter Hubbard, Manager of Energy Business Advisory, Pace Global
2:50 p.m.	Next Steps	Matt Rice, Vectren Manager of Resource Planning
3: 00 p.m.	Adjourn	

MEETING GUIDELINES

1. Please hold most questions until the end of each presentation. Time will be allotted for questions following each presentation. (Clarifying questions about the slides are fine throughout)
2. For those that wish to participate remotely, please log in via the link provided Link to join in your RSVP and follow the phone instructions when prompted. To speak during the meeting, please make a request in the chat function, and we will open up your individual line.
3. If you wish to listen only, you may call in with the phone number provided in your RSVP: 1-415-655-0003 | Access code: 806 147 760. You will not be able to speak during the meeting utilizing this option.
4. There will be a parking lot for items to be addressed at a later time.
5. Vectren does not authorize the use of cameras or video recording devices of any kind during this meeting.
6. Questions asked at this meeting will be answered here or later.
7. We will do our best to capture notes but request that you provide written feedback (concepts, inputs, methodology, etc.) at IRP@CenterPointEnergy.com following the meeting. Additional questions can also be sent to this e-mail address.

FOLLOW-UP INFORMATION SINCE OUR LAST STAKEHOLDER MEETING

MATT RICE

VECTREN MANAGER OF RESOURCE PLANNING

VECTREN COMMITMENTS FOR 2019/2020 IRP

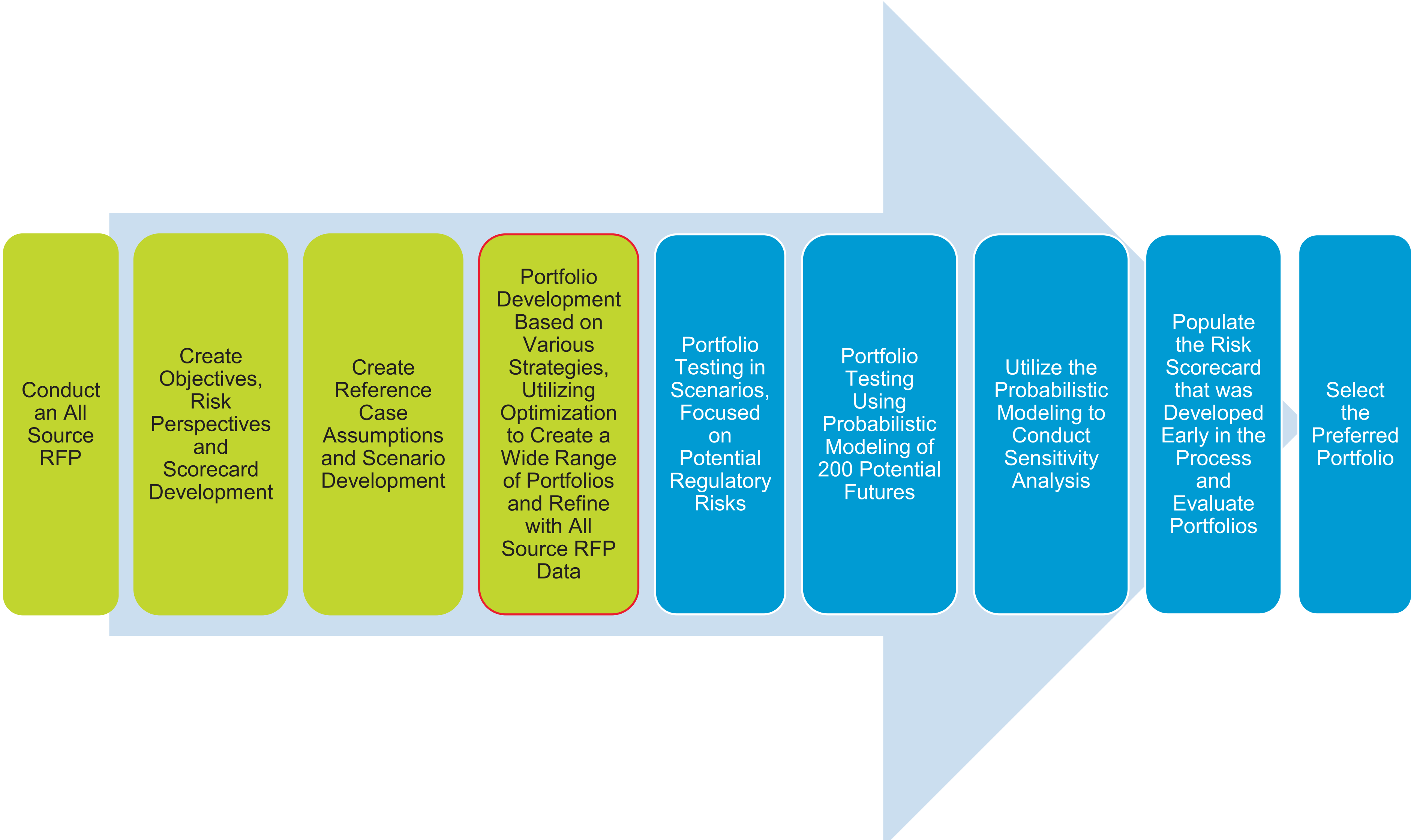
By the end of this stakeholder meeting Vectren will have made significant progress towards the following commitments

- ✓ Utilizing an All-Source RFP to gather market pricing & availability data
- ✓ Including a balanced, less qualitative risk score card; draft was shared at the first public stakeholder meeting
- ✓ Performing an exhaustive look at existing resource options
- ✓ Using one model for consistency in optimization, simulated dispatch, and probabilistic functions
- ✓ Working with stakeholders on portfolio development
- ✓ **Modeling more resources simultaneously**
- ✓ **Testing a wide range of portfolios in scenario modeling and ultimately in the risk analysis**
- ✓ **Providing a data release schedule and provide modeling data ahead of filing for evaluation**
- ✓ **Striving to make every encounter meaningful for stakeholders and for us**

Vectren will continue to work towards the remaining commitments over the next several months

- Ensuring the IRP process informs the selection of the preferred portfolio
- Conducting a sensitivity analysis
- Including information presented for multiple audiences (technical and non-technical)

2019/2020 IRP PROCESS



TENTATIVE DATA RELEASE SCHEDULE

- Modeling files
  - Reference Case modeling files (confidential – available February 2020)
  - Scenarios modeling files (confidential – available April 2020)
  - Probabilistic modeling files (confidential – available May 2020)
- Sales and Demand Forecast
  - Report (not confidential – available now)
- RFP
  - Bid information (confidential)
  - Report (confidential – available March 2020)
- Various Power Supply Reports
  - Conversion (confidential – available February 2020)
  - Scrubber options (confidential – available February 2020)
  - ACE Study (confidential – available February 2020)
  - ELG (confidential – available February 2020)
  - Brown 1x1 CCGT (confidential – available March 2020)
- Pipeline cost assumptions (confidential – available February 2020)

STAKEHOLDER FEEDBACK

Request	Response
Add a scenario or replace a scenario with a Carbon Dividend modeled after HB 763, which includes a CO_2 price in 2022 of $15, increasing by $10 per ton each year ($185 by 2039)	Our High regulatory case includes a high CO_2 fee and dividend. While there is no guarantee that a carbon dividend future would exactly mirror HB 763, we will run a sensitivity for portfolio development based on HB 763 to determine what type of portfolio it creates. Assuming that it is different than other portfolios that we are considering, we can include the portfolio in the risk analysis. We do not plan to create a 6th scenario
A cap and trade scenario is not a likely potential future	Cap and Trade is a real possibility. Beyond ACE, it was the only carbon compliance law in the US to date. The 80% reduction of CO_2 future, which is in alignment with the Paris Accord, is a reasonable potential future (our middle bound). Scenarios are not predictions of the future but provide plausible futures boundary conditions
It is premature to model a seasonal construct, referring to summer and winter (MISO) UCAP accreditation	As mentioned in the last meeting, MISO is moving to a seasonal construct. Vectren evaluated other potential calculations for accrediting solar with capacity in the winter. Determined that a weighted average of daily peak conditions could yield an 11% UCAP for solar in the winter, as opposed to 0%. Increased solar penetration would still reduce this amount of accreditation over time

STAKEHOLDER FEEDBACK

Request	Response
Referring to hydro studies cited at the 2nd stakeholder meeting, please clarify what the difference between estimated potential capacity, estimate of feasible capacity, and estimated optimal capacity is. Additionally, there was a request to increase the Vectren hydro modeling assumption from 50 MWs at each nearby dam to 100 MWs each	The DOE/NREL study, which provided estimated potential capacity, is a high level estimate of potential using generic modeling assumptions and not taking economics into consideration. The Army Corp of Engineers uses specific conditions on the Ohio to refine the DOE/NREL initial estimates into realistic project potential. 50 MWs at each dam is more in line with the range provided in the Army Corp of Engineers study. Vectren will evaluate two blocks of 50 MWs within scenario modeling and portfolio development
The NREL Life Cycle GHG study is dated	We had a discussion with First Solar on their perspective regarding lifecycle of greenhouse gas emissions for solar resources. An IEA study with updated assumptions on solar found a similar result to the NREL study for local solar resources. Additionally, Vectren likes the fact that NREL's study is fairly comprehensive. Vectren plans to utilize the NREL Study for estimated life cycle CO_2e for most resource types
NREL Life Cycle GHG study does not consider storage	Evaluating options
NREL Life Cycle GHG study does not consider gas resources and Vectren should simply utilize an alternate calculation for natural gas resources	The NREL study did consider gas resources. Various gas studies considered for the analysis included methane leaks as part of the study (see appendix)

STAKEHOLDER FEEDBACK

Request	Response
Add a CO_2 price to the Reference Case	We have added the mid-range CO_2 price to the Reference Case. ACE runs for 8 years and is replaced (see slide 20)
Your trended weather projections do not look anything like Purdue's	We reached out to Purdue University. They provided some clarification on the differences between their study and ours, including using different set points for heating and cooling degree days. Itron reviewed and estimated that the HDD trend is the same, while the CDD trend is nearly two times higher in the Purdue dataset. Utilizing the Purdue CDD trend would add approximately 40 MWs to Vectren's forecast over the next 20 years, which is well within our high bound forecast. We do not plan to update our load forecast, based on this analysis
Follow-up on updates to Industrial DR tariff	Report back progress in the next IRP stakeholder meeting
$5k for Aurora is paying for transparency	Met with CAC, Pace, and Energy Exemplar (Aurora) on Oct. 24^{th}. To address CAC's concern, Pace will work to provide relevant input tables from modeling, which include model settings. Each table will need to be exported separately. Additionally each relevant help function page will be exported separately. While time consuming, Pace will work to accommodate this request for stakeholders. Modeling files will be shared later in the process as timely analysis takes precedent

MISO UPDATE

- John Bear, CEO of MISO, recently testified before the Subcommittee on Energy. Reiterated the importance of the Renewable Integration Impact Assessment (RIAA) analysis
  - While MISO is fuel source neutral, they have learned that renewable penetration of 30% would challenge MISO's ability to maintain the planning reserve margin and operate the system within acceptable voltage and thermal limits
  - Maintaining reliability at 40% renewable level becomes significantly more complex. Currently MISO is studying 50% penetration level
  - Implications include tight operating conditions (need to utilize emergency procedures to manage reliability risk)
  - Requires a shift in market processes and protocols
    - We can no longer be confident that the system will be reliable year round based on peak demand in the summer. **All hours matter**
    - Resources must provide enough, and the right kinds of critical attributes needed to keep the system operating in a reliable, steady state, such as frequency response, voltage control, and black-start capability
    - We can no longer be confident that the existing transmission system can adapt to the new paradigm of smaller, decentralized intermittent renewable resources
  - Fleet of the future: improved availability, flexibility, and visibility. MISO is working to hold members responsible to deliver attributes and is developing incentives for these attributes

CCR / ELG – PROPOSED RULE SUMMARIES

- CCR
  - Advances date the cease use of all unlined ponds by 2 months, from October 31, 2020 to **August 31, 2020**
  - Short-term extension available to November 30, 2020
  - Site-specific extension available which would allow continued use of pond until **October 15, 2023**. Requires submitting a demonstration and work plan to EPA for approval
  - Permanent Cessation of Boiler extension
    - AB Brown – use of pond until October 17, 2028 if closure is <u>completed</u> by same date
      - This extension option is not feasible for AB Brown due to size and scope of closure
    - FB Culley – use of pond until October 17, 2023 if closure is completed by same date
- ELG
  - No extension for Bottom Ash Transport Water (BATW)
  - Revised limits for BATW on an "as needed" basis
    - 10% volume discharge on a 30-day rolling average
  - Boilers retiring by 2028 would only be subject to TSS limits; however, the earlier CCR deadline to cease disposal by October 2023 is the driver for compliance at AB Brown

CCGT STUDY

- No firm bids were received for gas CCGTs and nothing was on/near our system
- FERC recently updated a rule that allows for an expedited process within the MISO Queue to replace existing resources at or below existing interconnection rights
- As part of the IRP, it is prudent to study options with regards to existing resources, which includes existing Vectren sites
- Currently performing a study to obtain a +/- 10% cost estimate for a small/midsized 1x1 CCGT (F-class and H-class) at the Brown site to be included in final IRP modeling (consistent with CCGT units included within the tech. assessment at +/- 50%)
- Benefits of the Brown site
  – Electric infrastructure in place to support a 400-500 MW unit
  – Would allow Vectren to utilize existing assets at the site
  – Would preserve tax base and jobs in Posey County

BAGS 2 RETIRED

- Retiring Broadway Avenue Generating Station 2 (65 MWs of installed capacity) by the end of the year
  - Typical life is 30-40 years; Unit has been in service for 38 years
  - Highest heat rate (least efficient) of current generating fleet
  - Recent five year capacity factor just over 1%
  - Several million dollars needed for known repairs
  - High probability of additional expenses in the near future given current age and condition

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DRAFT REFERENCE CASE MODELING RESULTS

PETER HUBBARD

MANAGER OF ENERGY BUSINESS ADVISORY, PACE GLOBAL

WIDE RANGE OF PORTFOLIOS

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The final reference case is 1 of 15 potential portfolios that will be analyzed over the coming months. The preferred portfolio will be selected based on the results of the full risk analysis

Bridges
- 7) Gas Conversion ABB1
- 8) Gas Conversion ABB1 & ABB2
- 9) Gas Conversion + CCGT
- 10) BAU 2029

Scenario Based
- 2) Low Regulatory
- ***3) Reference Case***
- 4) High Tech
- 5) 80% CO_2 Reduction
- 6) High Regulatory

Diverse
- 11) Small CCGT with renewables and coal
- 12) Mid CCGT with renewables and coal

Status Quo
- 1) Business as Usual (BAU)

Risk Analysis

Renewables Focused
- 13) Close All Fossil by 2030
- 14) Renewables + flexible gas (close coal by 2034 and no CCGT)
- 15) HB 763

FINAL DRAFT REFERENCE CASE INPUTS

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Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.64	1.63	1.61	1.61	1.59	1.58	1.59	1.59	1.58
CO2	2018$/ton	0.00	0.00	0.00	0.00	3.57	5.10	6.63	7.65	9.18	11.22	14.79
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	3.06	3.24	3.38	3.49	3.62	3.78	3.96	4.09	4.17
Vectren Peak Load	MW	1,115	1,102	1,168	1,176	1,183	1,192	1,200	1,209	1,219	1,229	1,239
Customer-Owned Solar DG Capacity*	MW	9.3	14.6	20.7	27.1	34.2	41.7	49.6	57.7	66.3	75.1	84.3
EV Peak Load**	MW	0.4	2.0	9.8	13.8	17.8	21.8	25.9	30.0	34.2	38.3	42.3
Energy Efficiency and Company DG	MW	6.0	9.2	15.7	22.6	28.8	33.1	39.0	45.2	48.8	50.5	47.6
Demand Response	MW	35.2	51.7	52.7	61.6	64.4	67.3	70.1	73.0	75.8	78.7	81.5
Wind (200 MW)	2018$/kW	1,334	1,330	1,328	1,326	1,324	1,324	1,324	1,324	1,326	1,328	1,330
Solar (100 MW)	2018$/kW	1,414	1,264	1,205	1,168	1,130	1,096	1,064	1,038	1,012	993	973
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,654	1,518	1,452	1,391	1,342	1,301	1,263	1,232	1,201
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,450	2,242	2,116	1,996	1,892	1,803	1,719	1,651	1,586
Gas CC F-Class (442 MW with DF)	2018$/kW	1,301	1,291	1,275	1,261	1,251	1,242	1,233	1,224	1,216	1,207	1,199
Gas CT F-Class (237 MW)	2018$/kW	712	707	697	688	683	677	672	667	662	657	653
USC Coal w/ CCS	2018$/kW	5,621	5,536	5,424	5,309	5,201	5,097	4,992	4,891	4,794	4,698	4,605

** Res/Com Demand Impact = 0.295*
*** EV Coincident Factor = 0.211*

Revised from last meeting

DRAFT REFERENCE CASE EXISTING RESOURCE OPTIONS

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			2023					2026	2029	2039
Unit	**Fuel**	**Installed Net Capacity (MW)**	**Upgrade Path 1 *(FGD, ELG, CCR, ACE)***	**Upgrade Path 2 *(ELG, CCR, ACE)***	**Convert to Gas**	**Continue Agreement / Exit Agreement**	**Retire**	**Exit Agreement**		
ABB1	Coal	245	Option	Option	Option	n/a	Option	n/a	If Upgrade Path 2, unit retires in 2029	If Upgrade Path 1 or Convert, unit to run to 2039
ABB2	Coal	245	Option	Option	Option	n/a	Option	n/a	If Upgrade Path 2, unit retires in 2029	If Upgrade Path 1 or Convert, unit to run to 2039
ABB3	Gas	85								Unit to run to 2039
ABB4	Gas	85								Unit to run to 2039
FBC2	Coal	90	n/a	Option	Option	n/a	Option	n/a	n/a	If Upgrade Path 2 or Convert, unit to run to 2039
FBC3	Coal	270								Unit to run to 2039
W4	Coal	150	n/a	n/a	n/a	Option	n/a	Exit	n/a	n/a
OVEC	Coal	32								Ownership share to run to 2039
Benton	Wind	30								PPA for 30 MW thru 2028
Fowler	Wind	50								PPA for 50 MW thru 2030
Troy	Solar	50								Self-build solar to run to 2039

DRAFT REFERENCE CASE NEW RESOURCE OPTIONS

Type	Resource	Limitations	Capacity Options			
RE and Storage	Hydroelectric	Max 2 units	50 MW			
	Wind Energy	400 MW per year	200 MW			
	Wind plus Storage	150 MW per Year	50 MW wind (10 MW/40 MWh battery)			
	Solar Photovoltaic	500 MW per year	10 MW	50 MW	100 MW	
	Solar plus Storage	150 MW per Year	50 MW solar (10 MW / 40 MWh battery)			
	Lithium-Ion Battery Storage	300 MW per year	10 MW / 40 MWh	50 MW / 200 MWh		
	Flow Battery Storage	400 MW per Year	10 MW / 60 MWh	10 MW / 80 MWh	50 MW / 300 MWh	50 MW / 400 MWh
Demand Side Management*	Low Income Energy Efficiency	Required	0.7 MW			
	Optional Energy Efficiency	7 optional resources	Bin 1: 2.2 MW	Bin 2: 2.3 MW	Bin 3: 2.4 MW	Bin 4: 2.5 MW
			Bin 5: 2.2 MW	Bin 6: 2.3 MW	Bin 7: 0.5 MW	
	Demand Response	1 required, 1 optional	Bin 1: 21.1 MW	Bin 2: 5.8 MW		
Coal	Supercritical with CCS	Max 1 unit	500 MW			
	Ultrasupercritical with CCS	Max 1 unit	750 MW			
Waste to Energy	Chipped Wood Biomass	3 units per year	50 MW			
	Landfill Gas	3 units per year	4.5 MW			
Combined Heat & Power	2x 9MW Recip Wartsila	4 units per year	18 MW			
	1 x Titan 250 CTG	4 units per year	20 MW			
Combined Cycle	1x1 F Class CCGT Unfired	1 Per Year	357 MW			
	1x1 F Class CCGT Fired	1 Per Year	443 MW			
	1x1 G/H Class Unfired	1 Per Year	410 MW			
	1x1 G/H Class Fired	1 Per Year	511 MW			
Simple Cycle	1x E Class Frame SCGT	Max 3 units	85 MW			
	1x F Class Frame SCGT		237 MW			
	1x G/H Class Frame SCGT		279 MW			

* EE and DR bins are modeled as supply-side resources and are divided into 2020-2023, 2024-2026, and 2027-2039; Shown here is the max reduction averaged from 2020 to 2039

Note: Simple cycle aeroderivatives have been excluded from the resource options due to high pressure gas requirements. Reciprocating engines were excluded based on cost.

DRAFT REFERENCE CASE MODELING PARAMETERS

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- Maximum of 3 gas CTs (E/F/H class) are allowed as early as 1/1/2024
- Maximum of 1 gas CC is allowed as early as 6/1/2024. 2x1 CCGT (600-800 MW) is not included as a resource option
- Aeroderivative CTs are excluded from the resource options due to requirements for high-pressure gas supply. Reciprocating engines were excluded based on cost
- Capacity market purchases 2020-2023 are limited to 300 MW per year, after which they are limited to 180 MW per year
- Renewable energy builds can be as much as 400 MW wind per year, 500 MW solar per year, 300-400 MW storage per year, and 150 MW RE+storage per year, while hydroelectric plants are limited to 2 in total

DRAFT REFERENCE CASE PERFORMANCE CHARACTERISTICS

- All coal units except FB Culley 3 are retired at the end of 2023
- The 3 combustion turbine replacements for retired coal capacity operate at an average capacity factor of 7% over the forecast period
- The Planning Reserve Margin target (UCAP basis) is 8.9%. Apart from the CT's that replace coal capacity, the target is adhered to via capacity market purchases that average 90 MW from 2023-2039 or 8% of Vectren coincident (to MISO) peak demand
- Prior to coal retirements, Vectren is a net exporter of energy into MISO. After the coal retirements, Vectren would become a net importer of energy
- Relative to the first year of analysis (2019), CO_2 emissions decline by 47% in the year following coal retirements and decline by 61% by 2039
- Energy Efficiency was selected and equates to approximately 1% of sales

DRAFT REFERENCE CASE SEES 3 F-CLASS CT'S (697 MW) REPLACE 730 MW OF COAL CAPACITY

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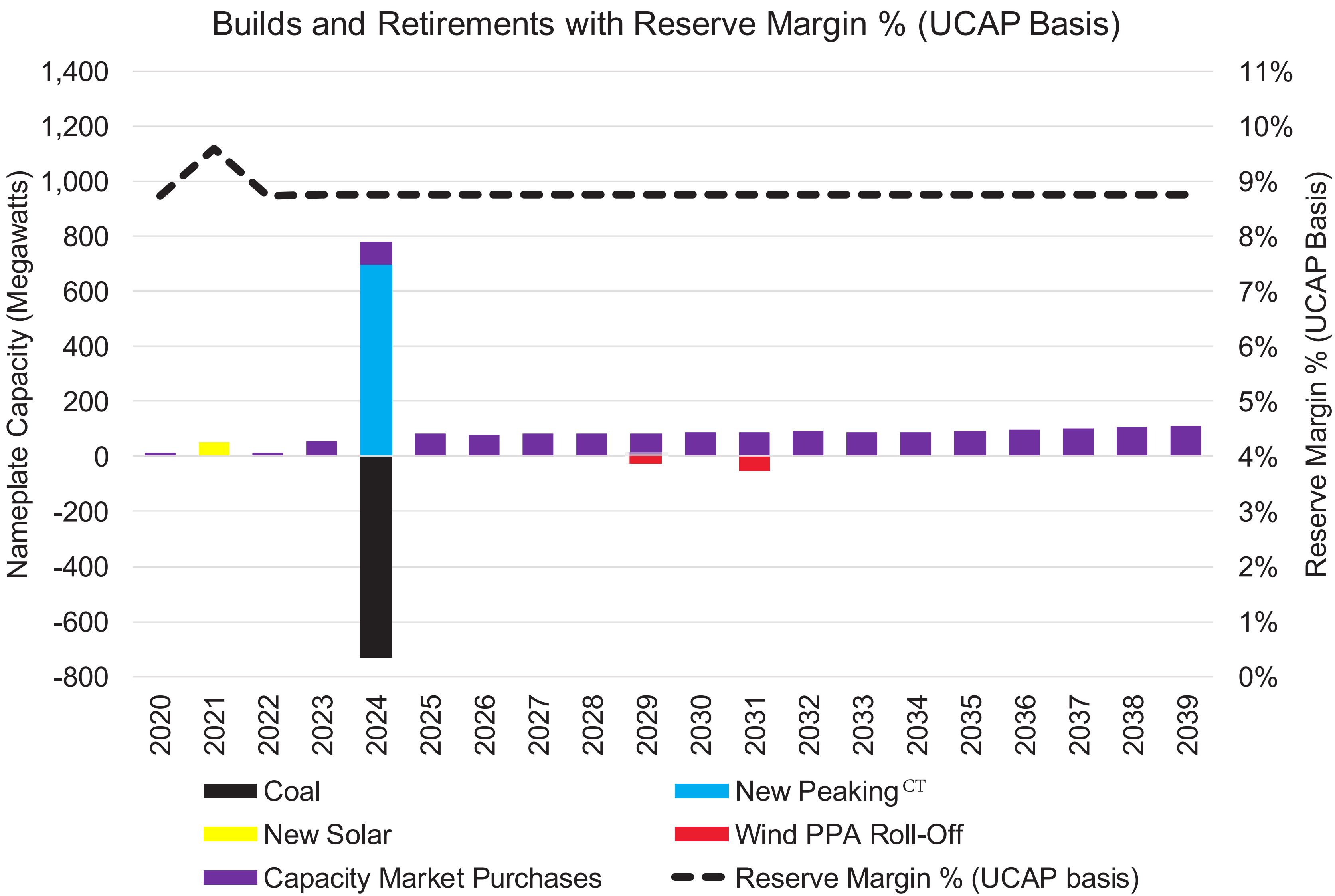

DRAFT REFERENCE CASE DISTRIBUTED GENERATION AND ENERGY EFFICIENCY

VECTREN
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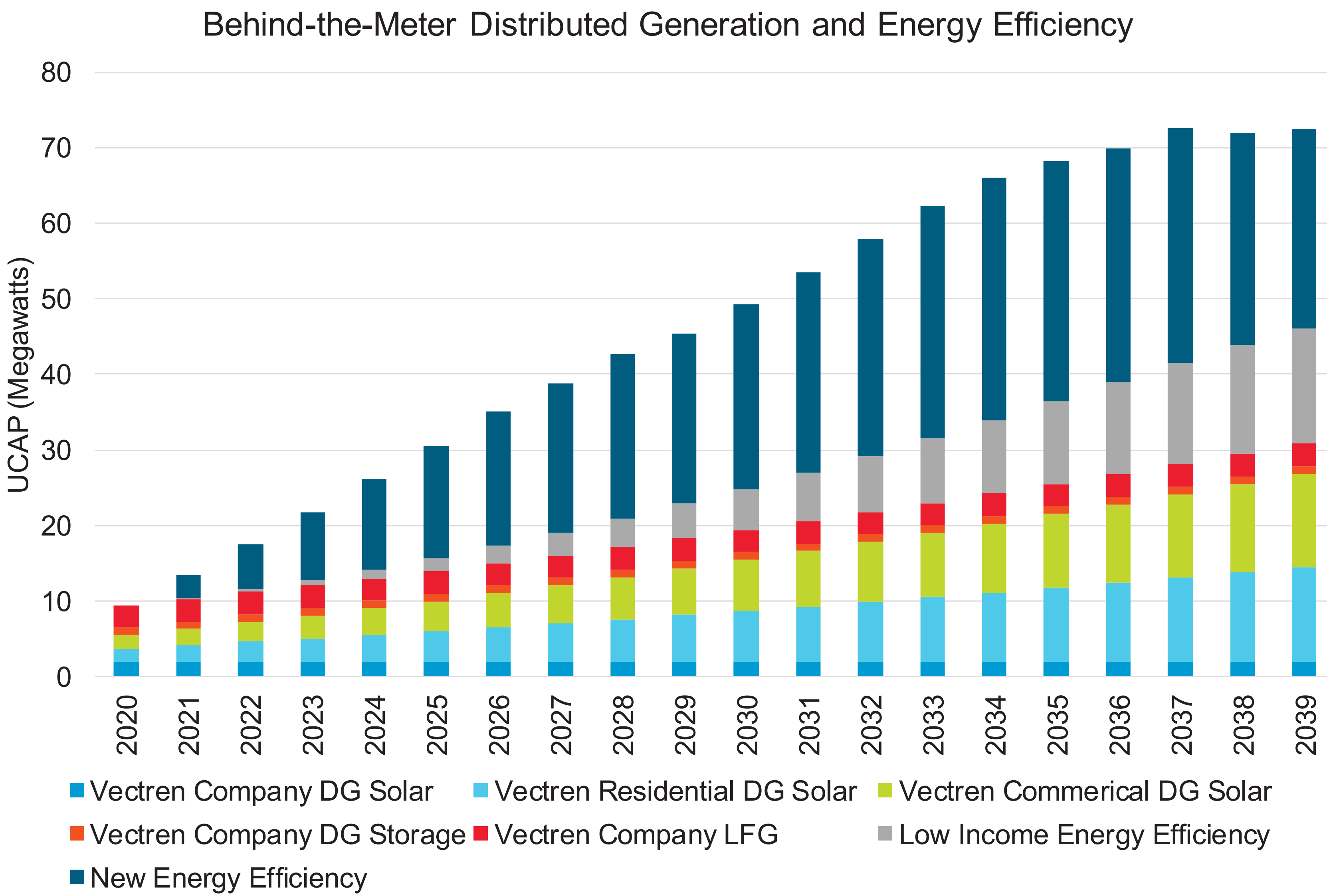
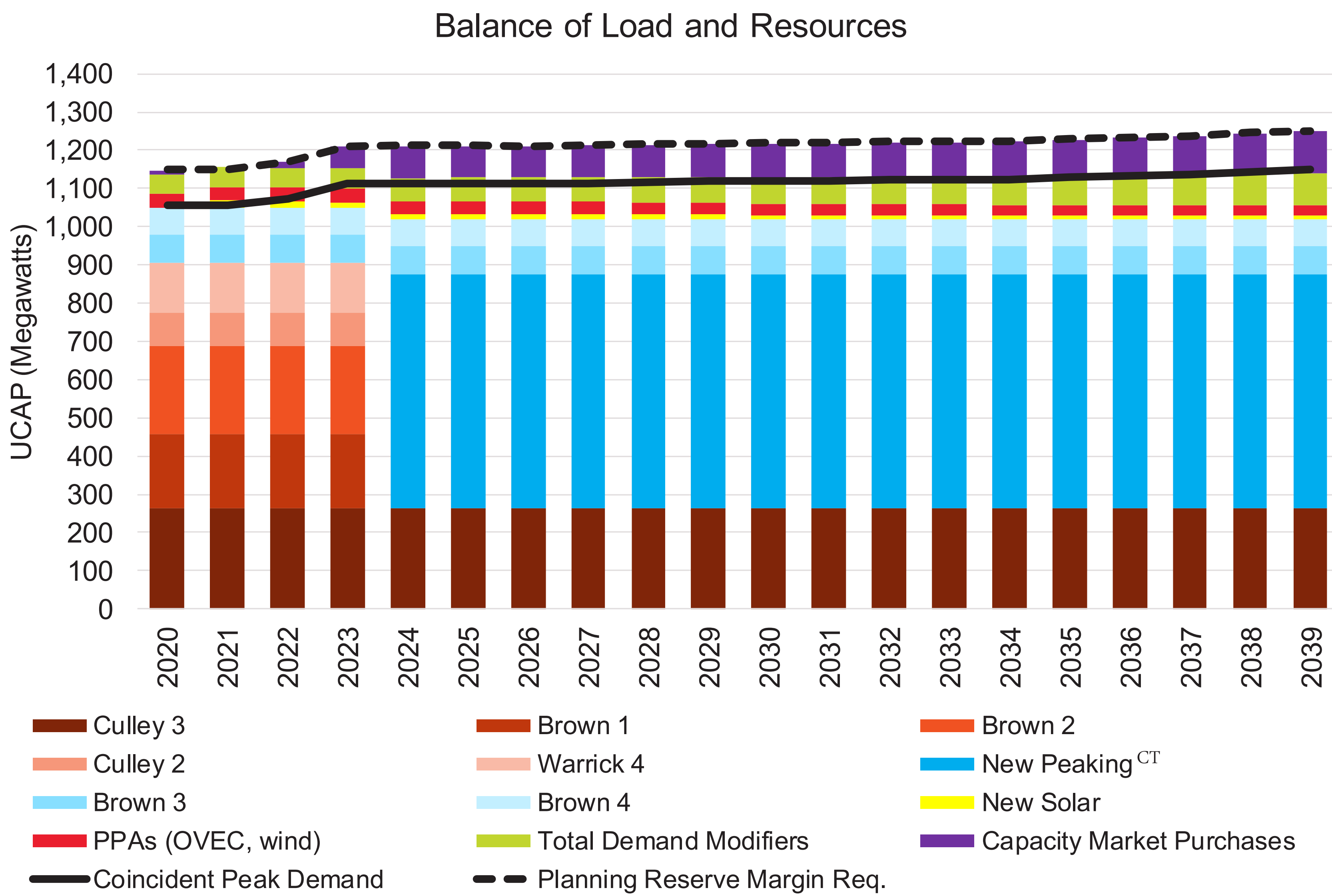


DRAFT REFERENCE CASE PORTFOLIO



SCENARIO MODELING CONSIDERATIONS

- Reference Case modeling will be updated. Final results may vary
  - RFP results will be included
  - 1x1 CCGT costs will be refined with +/-10% estimates
  - Pipeline costs will be refined for CT options
- Other scenarios with lower costs for renewables and Energy Efficiency may select more of these resources
- Reference Case results show the least cost portfolio given the determined future. This portfolio may not ultimately be least cost once subjected to probabilistic modeling (200 future states)
- Vectren will select a portfolio among approximately 15 based on the results of the full risk analysis

DRAFT FGD SCRUBBER SENSITIVITY ANALYSIS

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- All FGD scrubber options for replacing the Dual Alkali system were found to have significantly higher NPVs relative to the Reference Case
- Early results indicate that the Limestone Inhibited Oxidation scrubber has the lowest portfolio NPV of these 4 technologies
  - Four Flue Gas Desulfurization (FGD) scrubber technologies were evaluated in the reference case
  - Note that some options cause other environmental control systems to be modified or replaced. These cost estimates are included in the analysis.
  - Each of the four options was examined in an otherwise identical portfolio and modeled to 2039
- The lowest portfolio NPV of each option will be utilized for the Business as Usual (BAU) portfolio

FGD Scrubber Option
Ammonia Based (NH3)
Circulating Dry Scrubber (CDS)
Limestone Forced Oxidation (LSFO)
Limestone Inhibited Oxidation (LSIO)

Ammonia Based and LSFO have the potential for future by-product sales.

FINAL RFP MODELING INPUTS

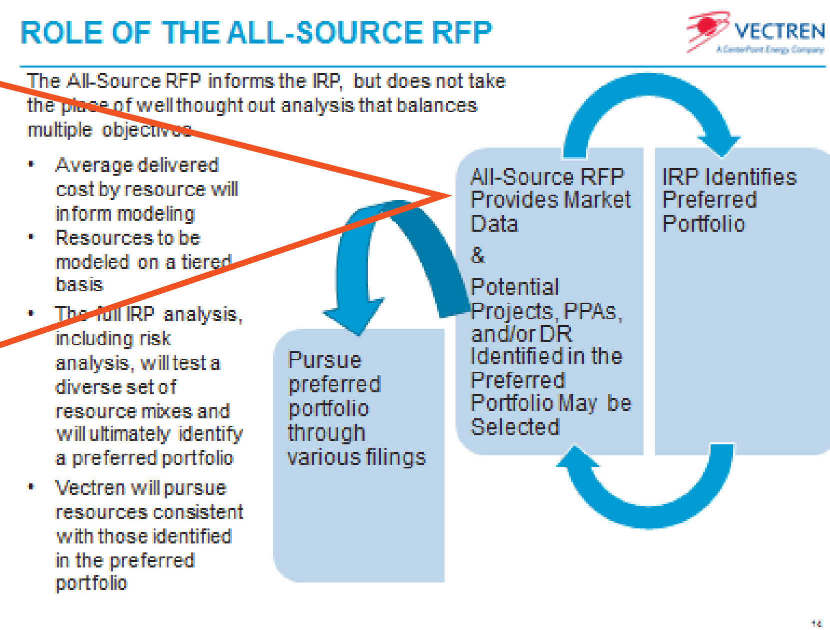
MATT LIND

RESOURCE PLANNING & MARKET ASSESSMENTS
BUSINESS LEAD, BURNS AND MCDONNELL

RFP PROCESS UPDATE

VECTREN
A CenterPoint Energy Company

- Received Proposals
- Initial Proposal Review
- Clarified Information with Bidders
- Group Proposals
- Interconnection & Network Upgrade Analysis
- Evaluation of Proposals
- Aggregated Group Data for IRP
- Receive Results from IRP
- Due Diligence and Negotiations
- Definitive Agreements Executed
- File Petitions with Regulatory Bodies



RFP PROPOSALS

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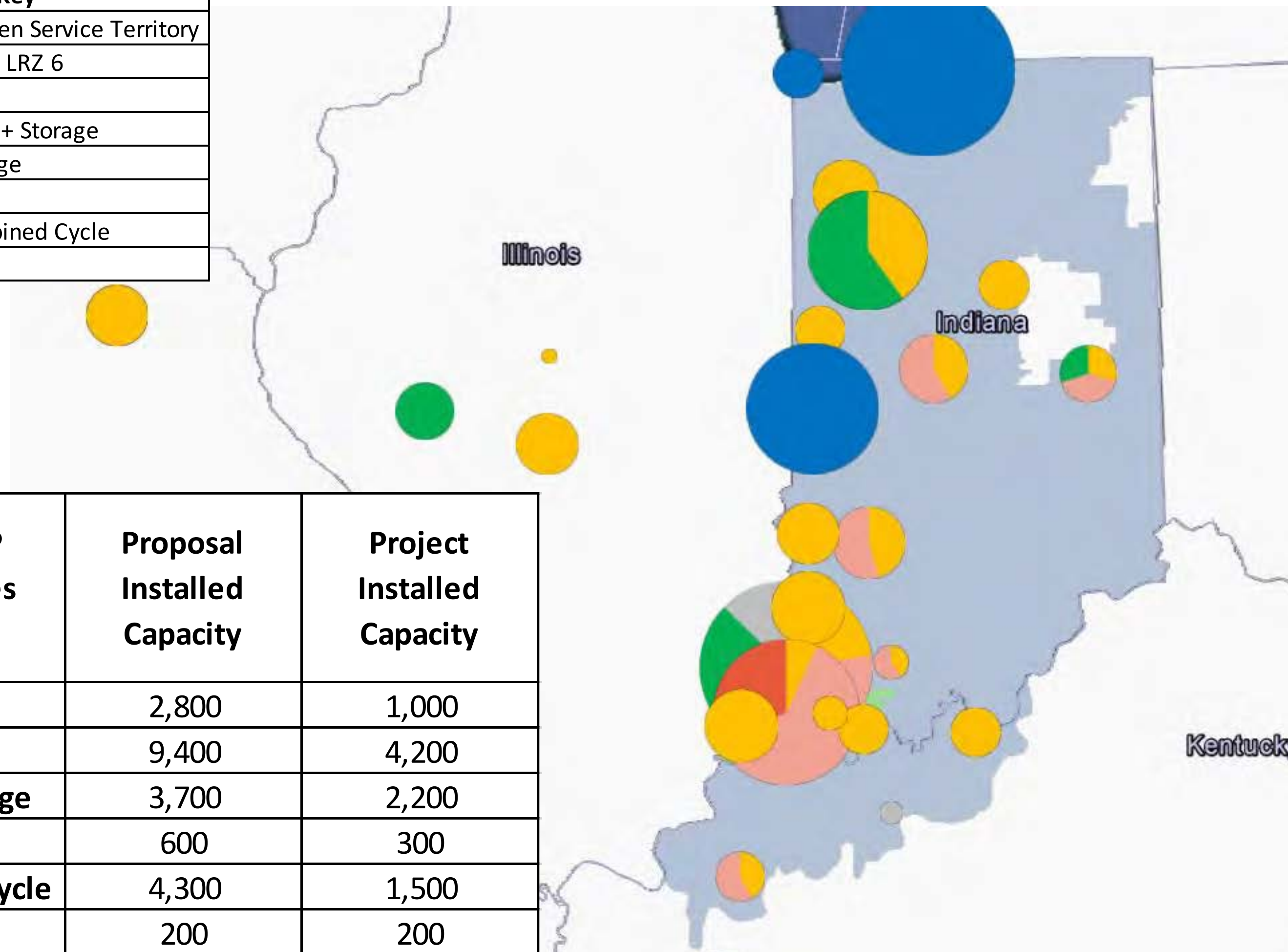
Key	
(light green)	Vectren Service Territory
(light blue)	MISO LRZ 6
(yellow)	Solar
(pink)	Solar + Storage
(red)	Storage
(green)	Wind
(blue)	Combined Cycle
(grey)	Coal



2019 RFP Responses (MW)	Proposal Installed Capacity	Project Installed Capacity
Wind	2,800	1,000
Solar	9,400	4,200
Solar + Storage	3,700	2,200
Storage	600	300
Combined Cycle	4,300	1,500
Coal	200	200
LMR/DR	100	100
System Energy	300	100
Total	**21,400**	**9,600**

RFP PROPOSALS - TIER 1

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Key	
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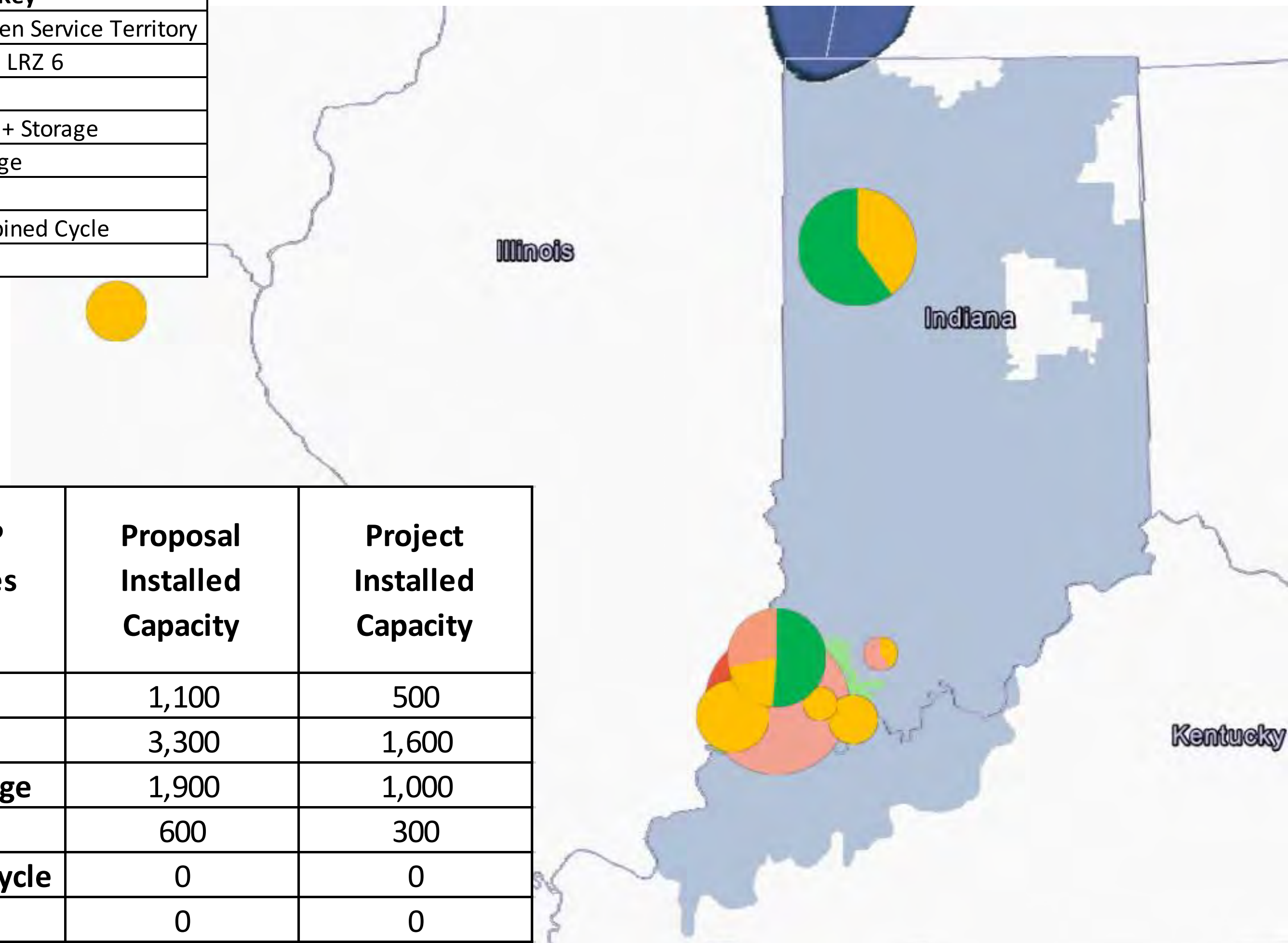
	MISO LRZ 6
	Solar
	Solar + Storage
	Storage
	Wind
	Combined Cycle
	Coal



2019 RFP Responses (MW)	Proposal Installed Capacity	Project Installed Capacity
Wind	1,100	500
Solar	3,300	1,600
Solar + Storage	1,900	1,000
Storage	600	300
Combined Cycle	0	0
Coal	0	0
LMR/DR	100	100
System Energy	0	0
Total	**7,000**	**3,500**

PROPOSAL GROUPING

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	Grouping[1]	RFP Count	Tier 1	Tier 2
1	Coal PPA	2	0	2
2	LMR/DR PPA	1	1	0
3	CCGT PPA	2	0	2
4	CCGT Purchase	5	0	5
5	Wind Purchase	2	0	2
6	12-15 Year Wind PPA	9	4	5
7	20 Year Wind PPA	2	1	1
8	Storage Purchase	4	4	0
9	Storage PPA	4	4	0
10	Solar + Storage PPA	6	5	1
11	Solar + Storage Purchase	9	5	4
12	Solar + Storage Purchase/PPA	4	1	3
13	Solar Purchase/PPA	6	1	5
14	12-15 Year Solar PPA	8	3	5
15	20 Year Solar PPA	16	10	6
16	25-30 Year Solar PPA	9	3	6
17	Solar Purchase	18	7	11
N/A	Energy Only	3	0	3
	Total	**110**	**49**	**61**

110 Proposals

Tier 1
- Binding Pricing
- Delivered to SIGE.SIGW OR On System

IRP Inputs

Tier 2
- Non-Binding Pricing
- Congestion / delivery risk

Potential IRP Inputs Based on Evaluation

- Total installed capacity of RFP bids in Tier 1 ~5X greater than Vectren's peak load
- Resource options from the technology assessment will supplement these options as needed

1. Updated Tier 1 & Tier 2 classification based on interactions with bidders

TRANSMISSION INTERCONNECTION COSTS

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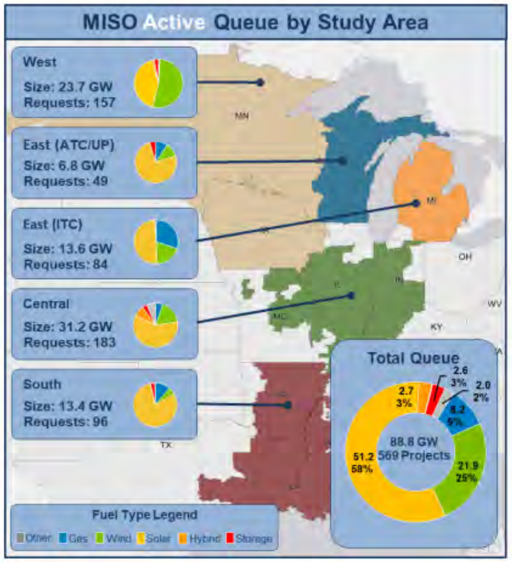
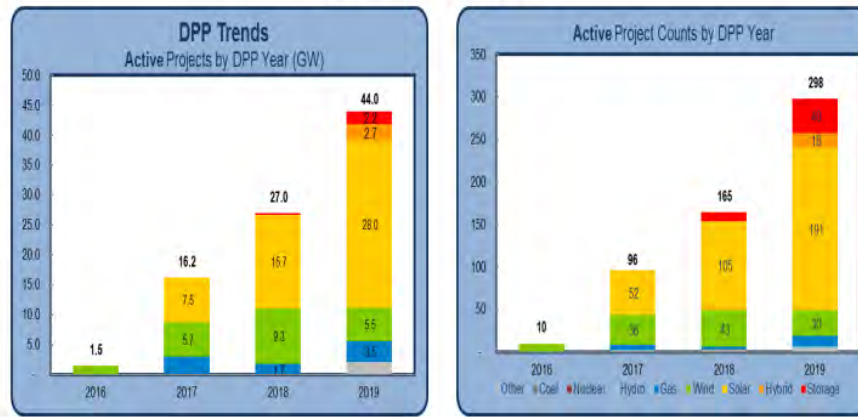
Generator Interconnection: Overview

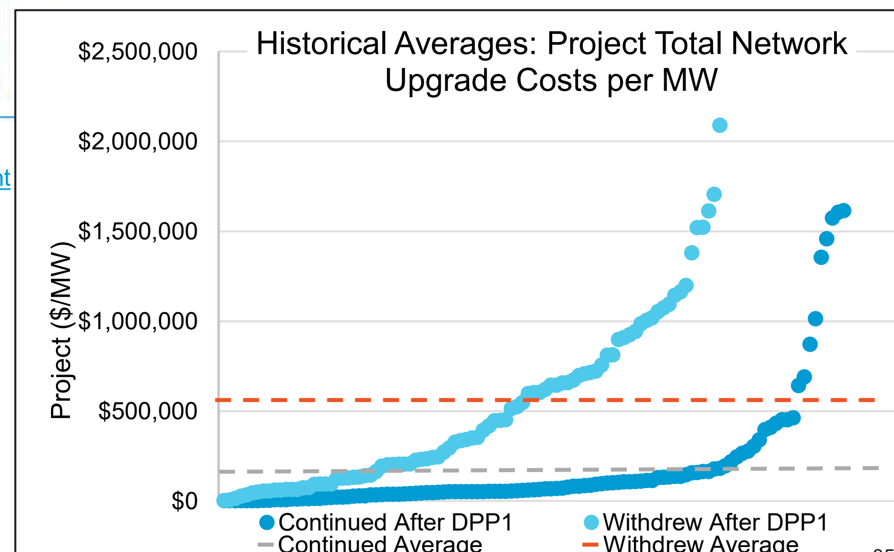
The current generator interconnection active queue consists of 569 projects totaling 88.8 GW



DPP Project Trends



https://www.misoenergy.org/planning/policy-studies/Renewable-integration-impact-assessment



TIER 1 COST SUMMARY

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	Bid Group	# Proposals	# Projects	Proposal ICAP (MW)	Project ICAP (MW)	Capacity Weighted Average LCOE ($2019/MWh)	Capacity Weighted Purchase Price ($/kW)[2]
1	Coal PPA	0					
2	LMR/DR PPA	0					
3	CCGT PPA	0					
4	CCGT Purchase	0					
5	Wind Purchase	0					
6	12-15 Year Wind PPA	4	1	800	200		
7	20 Year Wind PPA	1	1	300	300		
8	Storage Purchase	4	2	305	152	$157	
9	Storage PPA	4	2	305	152	$135	
10	Solar + Storage PPA	5	3	902	526	$44	
11	Solar + Storage Purchase	5	3	862	486	TBD[1]	$1,417[3]
12	Solar + Storage Purchase/PPA	1	1	110	110		
13	Solar Purchase/PPA	1	1	80	80		
14	12-15 Year Solar PPA	3	2	350	225	$32	
15	20 Year Solar PPA	10	8	1,522	1,227	$35	
16	25-30 Year Solar PPA	3	2	400	275	$34	
17	Solar Purchase	7	6	902	732	TBD[1]	$1,262

1. The method for realizing tax incentives is being reviewed by Vectren
2. $/kW costs are in COD$, purchase option cost is the purchase price unsubsidized by applicable tax incentives and does not reflect ongoing operations and maintenance costs
3. Cost based on simultaneous MW injectable to the grid

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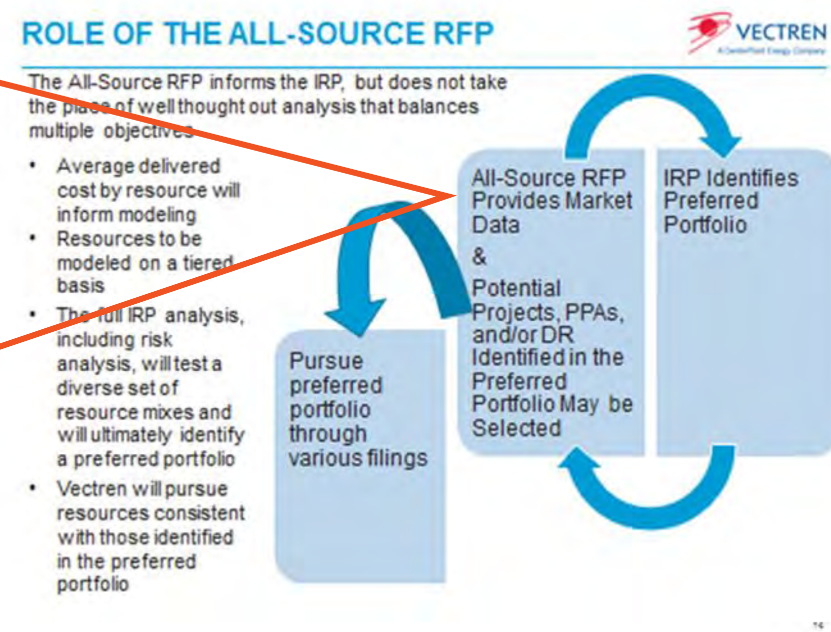

PORTFOLIO DEVELOPMENT

MATT RICE

VECTREN MANAGER OF RESOURCE PLANNING

STAKEHOLDER PORTFOLIO FEEDBACK

Request	Response
Small CCGT and conversion at Brown	We will run this portfolio with generic assumptions, but need to acknowledge some challenges. Should this portfolio look attractive, additional study would be needed around air permits, water use, and use of the switchyard. Additionally, this option does not benefit from expedited study at MISO due to capacity beyond current levels at the Brown site
HR 763 Portfolio	Will run a sensitivity to create a portfolio based on HR 763 CO_2 price assumptions and compare to other portfolios. If significantly different, we include in the risk analysis
100% RPS by 2030 Portfolio	Will include this portfolio
NIPSCO like portfolio	We understand the environmental perspective that this means no new fossil and close coal as soon as possible. NIPSCO currently has a gas CCGT and two gas peaker plants. Each utility has different circumstances. We do not plan to run a portfolio that completely mirrors NIPSCO
Close all Coal by 2024	We plan to move forward with approved upgrades for Culley 3 and therefore, do no plan to run this portfolio. We will include a portfolio that closes Culley 3 by 2030 and by 2034 in another portfolio
CT and Renewables, Close all coal by 2030	Will include a similar portfolio
Business as Usual (BAU) portfolio	Will include this portfolio
BAU Until 2029 Portfolio	Will include this portfolio
100% RPS by 2039	Will include a similar portfolio

STAKEHOLDER PORTFOLIO FEEDBACK

Request	Response
Lobby to Extend Net Metering (Remove cap)	If that the net metering law were to be updated to full, traditional net metering, Vectren's load forecast would decline. The IRP takes into account a low load forecast within probabilistic modeling and deterministic scenarios. Portfolios will be developed and tested in low load conditions
Distributed gen (rooftop solar + battery storage)	This option would require an extensive study to be conducted with attributes similar to an EE program. We know from experience that building distributed solar and storage is costly, complicated, and requires risk mitigation. We do not plan to run this portfolio. This could be evaluated in future IRPs
Various bridge portfolios to provide off ramps	We will model both short-term and long-term bridge options

WIDE RANGE OF PORTFOLIOS

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All portfolios considered include stakeholder input, directly or indirectly.

Bridges
- Gas Conversion ABB1
- Gas Conversion ABB1 & ABB2
- Gas Conversion + CCGT
- BAU 2029

Scenario Based
- Low Regulatory
- Reference Case
- High Tech
- 80% CO2 Reduction
- High Regulatory

Diverse
- Small CCGT with renewables and coal
- Mid CCGT with renewables and coal

Status Quo
- Business as Usual (BAU)

Renewables Focused
- Close All Fossil by 2030
- Renewables + flexible gas (close coal by 2034 and no CCGT)
- HB 763

Risk Analysis

We will consider short term bridge options (extension of W4 contract, market capacity purchase, short term ppa, etc.) for portfolio development in all scenarios and in other portfolios where it makes sense

STATUS QUO

- The Business As Usual portfolio can be considered a reference portfolio
  - Vectren ends joint operations of W4 in 2024
  - Includes known costs to comply with known EPA rules (ELG/CCR, ACE, 316b) to continue to run Vectren coal plants through 2039
  - Resource need will be optimized based on least cost modeling (All resources available)

Stakeholder Input:
- Fully explore options at AB Brown plant

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Business As Usual (BAU)

PLANNING RESERVE MARGIN REQUIREMENT SURPLUS\DEFICIT - BAU

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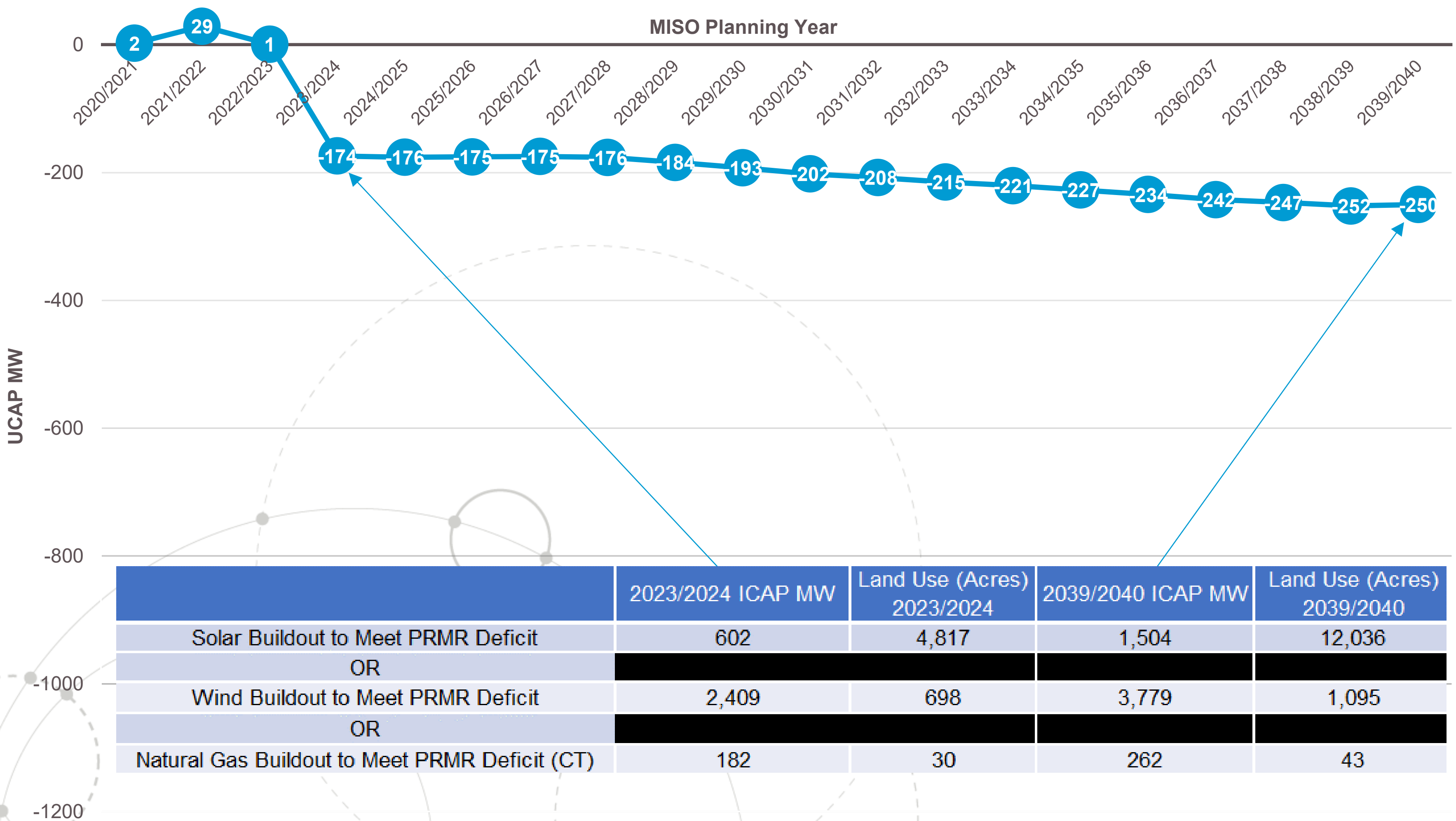

	2023/2024 ICAP MW	Land Use (Acres) 2023/2024	2039/2040 ICAP MW	Land Use (Acres) 2039/2040
Solar Buildout to Meet PRMR Deficit	602	4,817	1,504	12,036
OR				
Wind Buildout to Meet PRMR Deficit	2,409	698	3,779	1,095
OR				
Natural Gas Buildout to Meet PRMR Deficit (CT)	182	30	262	43

PRMR - Planning Reserve Margin Requirement

SCENARIO BASED PORTFOLIOS

- Scenarios were created with stakeholder input. A portfolio will be created for each potential deterministic future based on least cost optimization. Insights will be gathered:
  - Potential selection of long and short-term bridge options
  - How resource mixes change given varying futures
  - Range of portfolio costs
- Once run, Vectren will utilize insights to help shape portfolio development
- Portfolios will be compared for similarities and differences. If each varies significantly, they will all be included in the risk analysis
- Insights gained may be included in developing other portfolios

Stakeholder Input:
- Reference Case CO_2
- Lower renewables and storage costs
- CO_2 Fee and Dividend

↓

Scenario Based
- Low Reg.
- Reference Case
- High Tech
- 80% CO_2
- High Reg.

BRIDGES

- Vectren is considering various bridge options, including converting coal units to gas
  - Convert AB Brown 1 & 2 by 2024 and run for 10 years. Close FB Culley 2 and end joint operations of Warrick 4 by 2024. Optimize for need (all resources available)
  - Convert AB Brown 1 and retire AB Brown 2 by 2024 + add a small CCGT in 2025. Optimize for need (All resources available). Short term bridge options will be considered
- Vectren will also create a portfolio that continues operation of existing coal units through 2029. We will allow the model to optimize (all resources available) beyond 2030

Stakeholder Input:
- Fully consider gas conversion
- Consider running coal until 2030
- Don't run coal beyond 2030
- Include a portfolio that converts ABB1 and adds a small CCGT
- Consider flexibility

- Gas Conversion
- Gas Conversion + CCGT
- BAU 2029

PLANNING RESERVE MARGIN REQUIREMENT SURPLUS\DEFICIT - BRIDGE

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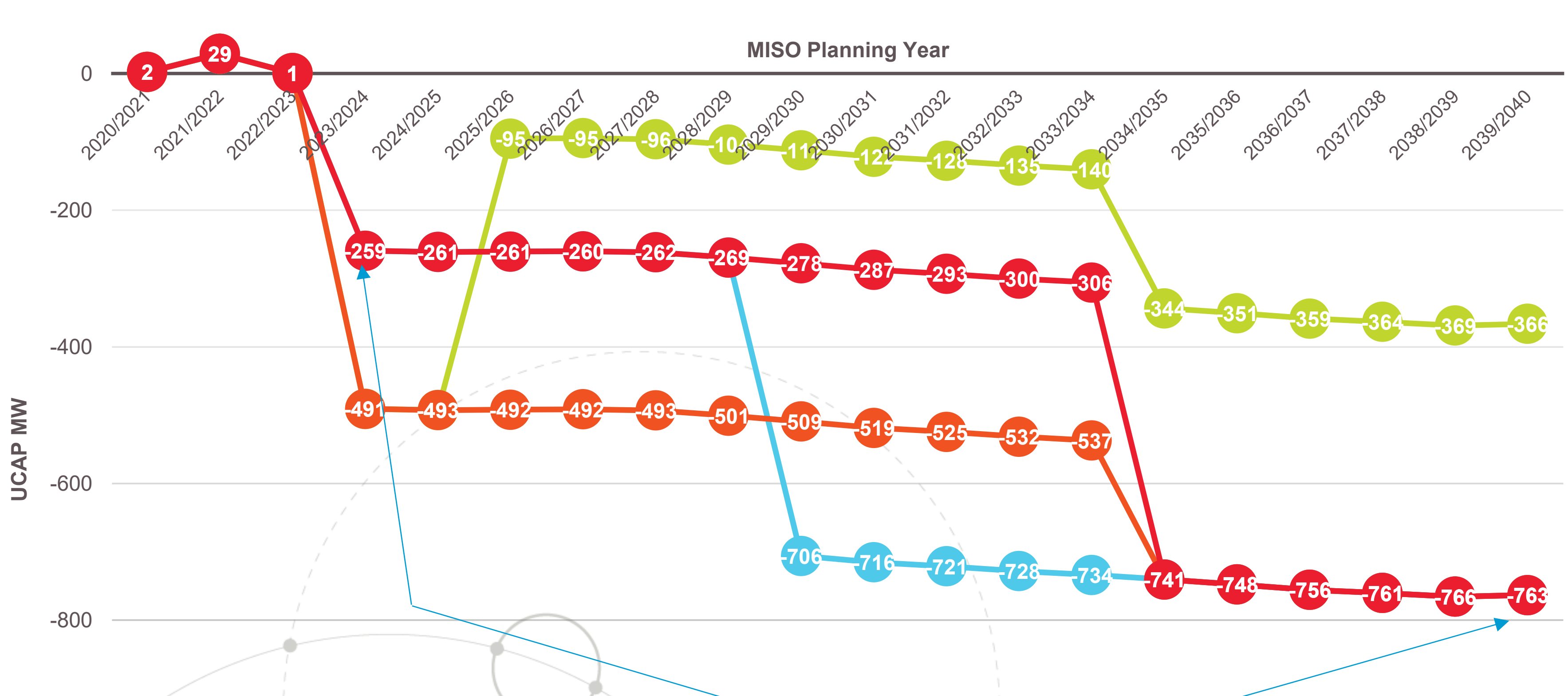

Bridge - Convert Brown 1 & Brown 2	2023/2024 ICAP MW	Land Use (Acres) 2023/2024	2039/2040 ICAP MW	Land Use (Acres) 2039/2040
Solar Buildout to Meet PRMR Deficit	897	7,176	4,594	36,754
OR				
Wind Buildout to Meet PRMR Deficit	3,589	1,040	11,541	3,345
OR				
Natural Gas Buildout to Meet PRMR Deficit (CCGT)	272	44	800	131

PRMR - Planning Reserve Margin Requirement

DIVERSE

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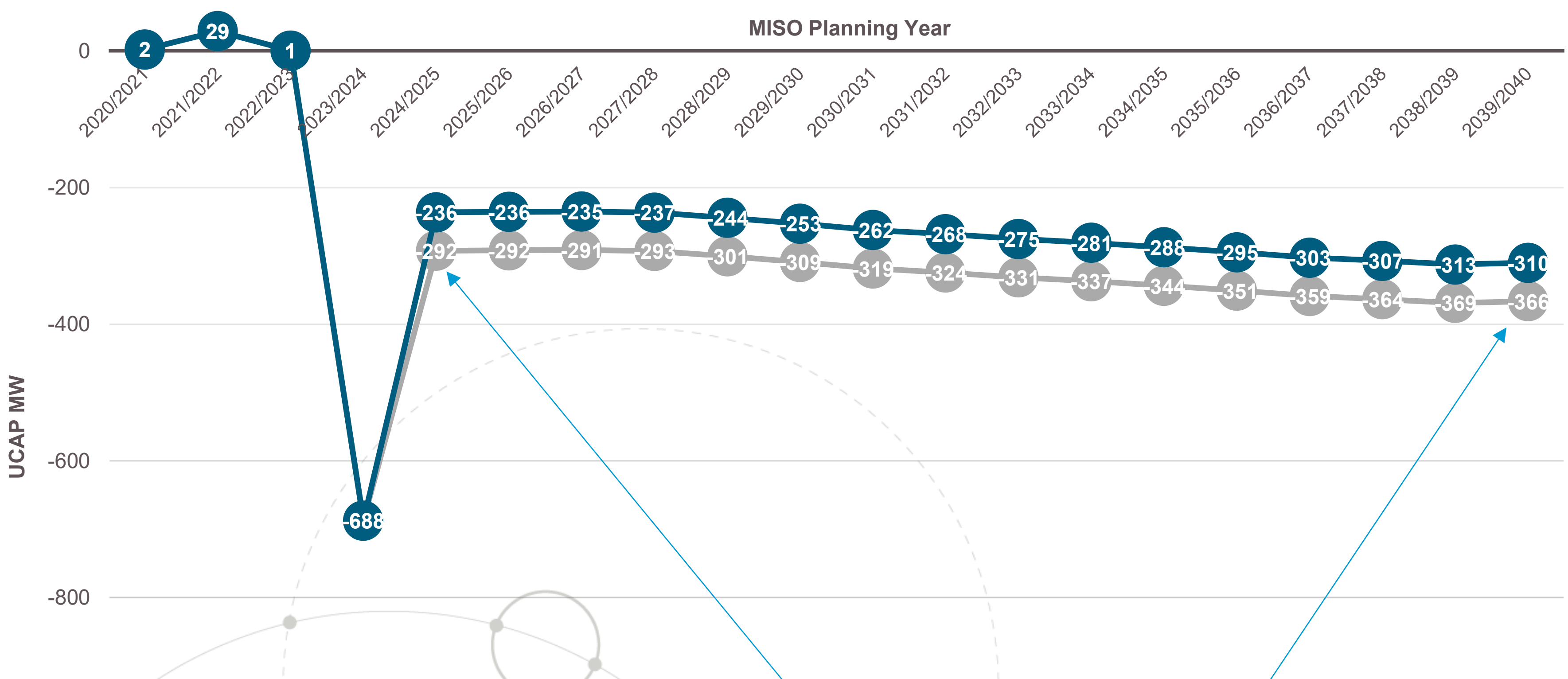
- One of Vectren's objectives is resource diversity. As such, Vectren is evaluating portfolios that contain some coal, some gas, and some renewables/DSM/storage options
  - Small CCGT ~400 MWs at the Brown site will be included, along with Culley 3. Optimize with renewables, DSM, and storage for remaining need
  - Mid-sized CCGT ~500 MWs will be included at the Brown site, along with Culley 3. Optimize with renewables, DSM, and storage for remaining need
- A 2x1 CCGT (600-800 MW) will not be considered in portfolio development
- The Brown site offers several advantages: existing interconnection rights, reuse of some equipment and facilities, tax base for Posey county, and jobs for existing employees
- Short term bridge options will be considered

Stakeholder Input:
- Gas plant too large for a small utility
- Did not consider smaller gas plant options in the risk analysis

-Small CCGT with renewables and coal
-Mid-sized CCGT with renewables and coal

PLANNING RESERVE MARGIN REQUIREMENT SURPLUS\DEFICIT - DIVERSE



Diverse 400 MW CCGT	2024/2025 ICAP MW	Land Use (Acres) 2024/2025	2039/2040 ICAP MW	Land Use (Acres) 2039/2040
Solar Buildout to Meet PRMR Deficit	1,065	8,518	2,205	17,642
OR				
Wind Buildout to Meet PRMR Deficit	4,065	1,178	5,540	1,606
OR				
Natural Gas Buildout to Meet PRMR Deficit (CCGT)	306	50	384	63

Diverse 400 MW CCGT   Diverse 500 MW CCGT

PRMR - Planning Reserve Margin Requirement

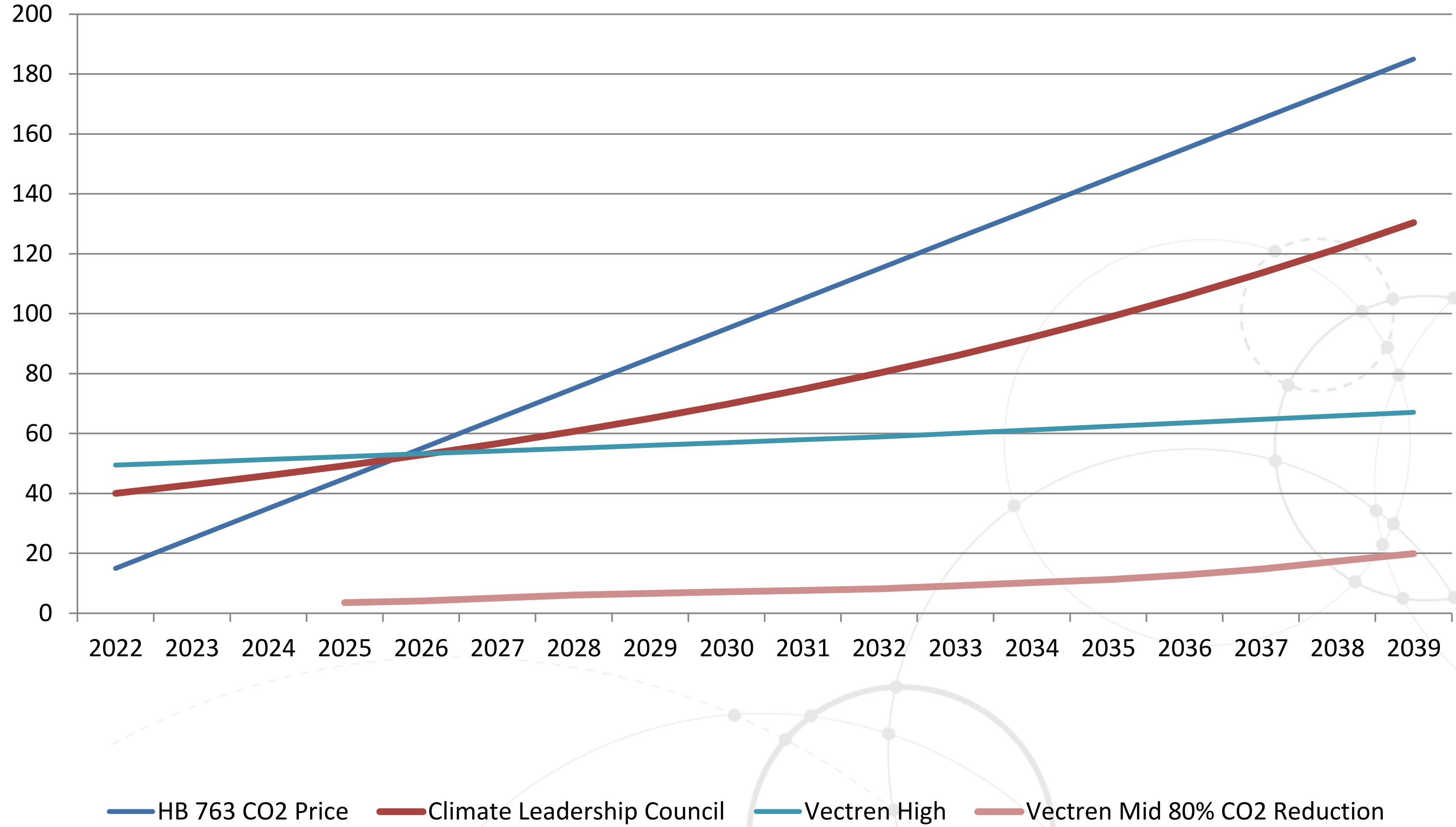
RENEWABLES FOCUSED

- Vectren continues to fully explore renewable resources through market pricing and portfolio development
  - Close all fossil generation by 2030. Will require voltage support. Optimize for renewables, demand response, energy efficiency, and storage
  - Close all coal by 2034 (All but Culley 3 are closed in 2024). Optimize for renewables, demand response, energy efficiency, and Storage. Flexible gas (CTs) will be allowed within the optimization for capacity (No CCGTs)
  - Build a portfolio based on House Bill 763, which includes a \$15 CO_2 price, escalating to \$185 by 2039. Compare and determine if portfolio is sufficiently different from other renewables portfolios. Optimize for need

Stakeholder Input:
- Fully consider renewable resources
- 100% renewable by 2030
- Consider flexible gas and renewables
- Include a scenario on HB763

- Close All Fossil by 2030
- Renewables + flexible gas (close all coal by 2034)
- HB 763

CO_2 PRICE RANGES WITH HB 763



PLANNING RESERVE MARGIN REQUIREMENT SURPLUS\DEFICIT - RENEWABLES

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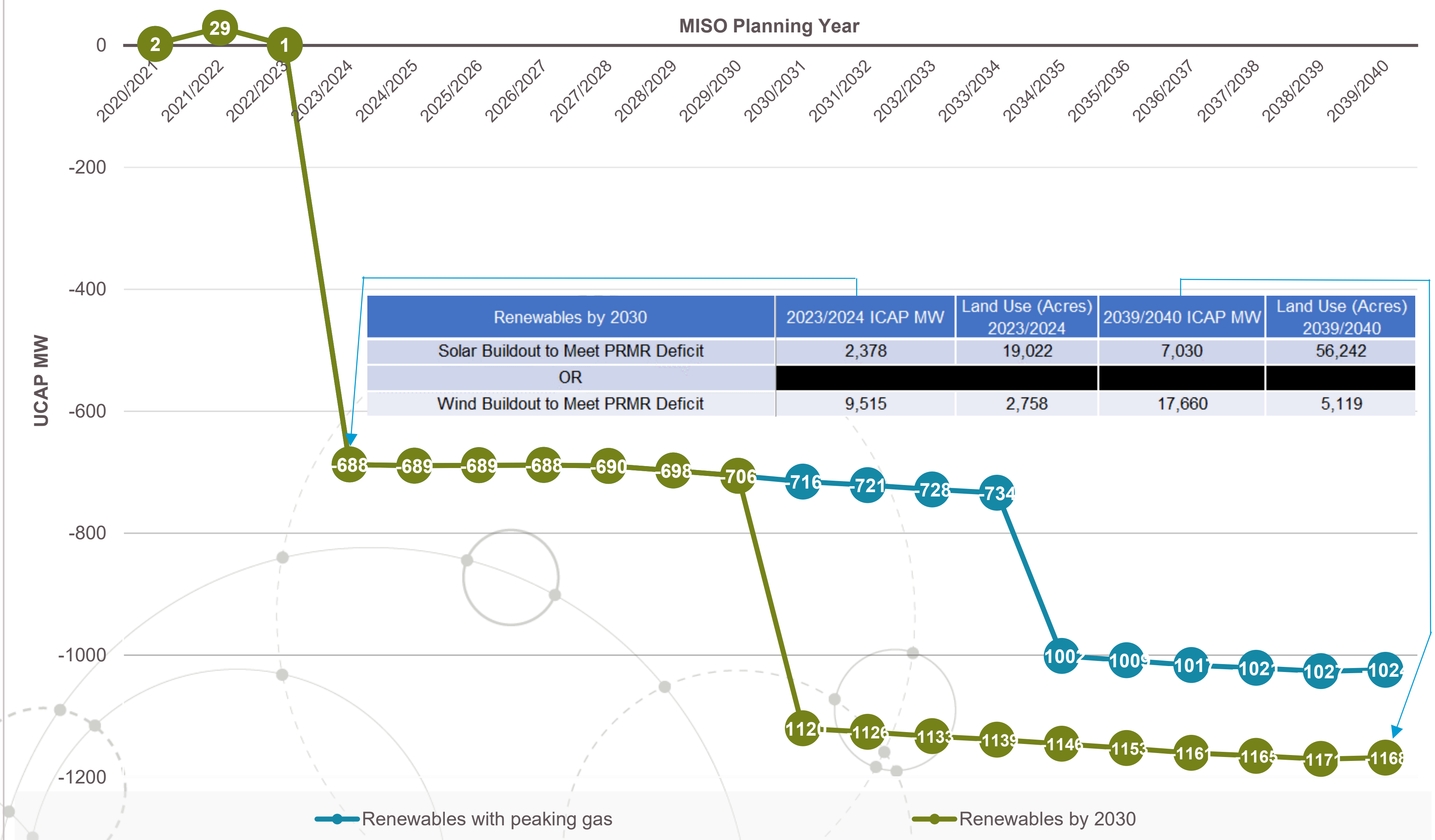

Renewables by 2030	2023/2024 ICAP MW	Land Use (Acres) 2023/2024	2039/2040 ICAP MW	Land Use (Acres) 2039/2040
Solar Buildout to Meet PRMR Deficit	2,378	19,022	7,030	56,242
OR				
Wind Buildout to Meet PRMR Deficit	9,515	2,758	17,660	5,119

PRMR - Planning Reserve Margin Requirement

SCENARIO TESTING AND PROBABILISTIC MODELING

PETER HUBBARD

MANAGER OF ENERGY BUSINESS ADVISORY, PACE GLOBAL

PORTFOLIOS WILL BE TESTED BOTH IN SCENARIOS AND PROBABILISTIC FRAMEWORK

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Deterministic Modeling (Scenarios) and Probabilistic Modeling (Stochastics) Provide Complementary Analysis

Probabilistic Modeling is the basis for Portfolio Risk Analysis and Balanced Scorecard results

Advantages
- Exhaustive potential futures can be analyzed
- Uses impartial statistical rules and correlations

Disadvantages
- Link between statistical realizations and the real world can be difficult to understand

Deterministic Modeling complements Stochastics; Portfolios will be simulated in each Scenario

Advantages
- Well-suited for testing a wide range of regulatory req's
- Deterministic modeling is transparent, easy to understand

Disadvantages
- Does not capture the full range of key inputs
- Does not capture volatility
- Time consuming to run several potential futures

Market Driver	Varied Stochastically
Load	✔
Natural Gas Prices	✔
Coal Prices	✔
CO2 Prices	✔
Capital Costs for New Entry	✔

LOW REGULATORY CASE INPUTS

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Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.64	1.63	1.61	1.61	1.59	1.58	1.59	1.59	1.58
CO2	2018$/ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	4.10	5.12	5.20	5.62	5.60	5.95	6.12	6.23	6.85
Vectren Peak Load	MW	1,115	1,102	1,217	1,311	1,314	1,352	1,357	1,390	1,381	1,386	1,423
Customer-Owned Solar DG Capacity*	MW	9.3	14.6	21.6	30.2	38.0	47.3	56.1	66.3	75.1	84.7	96.8
EV Peak Load**	MW	0.4	2.0	10.2	15.4	19.8	24.7	29.3	34.5	38.7	43.2	48.6
Energy Efficiency and Company DG	MW	6.0	9.2	15.7	22.6	28.8	33.1	39.0	45.2	48.8	50.5	47.6
Demand Response	MW	35.2	51.7	52.7	61.6	64.4	67.3	70.1	73.0	75.8	78.7	81.5
Wind (200 MW)	2018$/kW	1,334	1,330	1,328	1,326	1,324	1,324	1,324	1,324	1,326	1,328	1,330
Solar (100 MW)	2018$/kW	1,414	1,264	1,205	1,168	1,130	1,096	1,064	1,038	1,012	993	973
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,654	1,518	1,452	1,391	1,342	1,301	1,263	1,232	1,201
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,450	2,242	2,116	1,996	1,892	1,803	1,719	1,651	1,586
Gas CC F-Class (442 MW with DF)	2018$/kW	1,301	1,291	1,275	1,261	1,251	1,242	1,233	1,224	1,216	1,207	1,199
Gas CT F-Class (237 MW)	2018$/kW	712	707	697	688	683	677	672	667	662	657	653
USC Coal w/ CCS	2018$/kW	5,621	5,536	5,424	5,309	5,201	5,097	4,992	4,891	4,794	4,698	4,605

** Res/Com Demand Impact = 0.295*
*** EV Coincident Factor = 0.211*

Revised from last meeting

HIGH TECHNOLOGY CASE INPUTS

Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.49	1.27	1.25	1.25	1.25	1.25	1.25	1.25	1.25
CO2	2018$/ton	0.00	0.00	0.00	1.20	2.06	2.38	2.94	3.89	5.46	6.85	8.50
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	2.82	2.33	2.13	2.04	2.13	2.02	2.12	2.07	2.20
Vectren Peak Load	MW	1,115	1,102	1,217	1,311	1,314	1,352	1,357	1,390	1,381	1,386	1,423
Customer-Owned Solar DG Capacity*	MW	9.3	14.6	21.6	30.2	38.0	47.3	56.1	66.3	75.1	84.7	96.8
EV Peak Load**	MW	0.4	2.0	10.2	15.4	19.8	24.7	29.3	34.5	38.7	43.2	48.6
Energy Efficiency and Company DG	MW	6.0	9.2	15.7	22.6	28.8	33.1	39.0	45.2	48.8	50.5	47.6
Demand Response	MW	35.2	51.7	52.7	61.6	64.4	67.3	70.1	73.0	75.8	78.7	81.5
Wind (200 MW)	2018$/kW	1,334	1,330	1,249	1,167	1,123	1,160	1,152	1,166	1,139	1,142	1,143
Solar (100 MW)	2018$/kW	1,414	1,264	1,120	975	964	942	897	877	818	809	818
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,513	1,214	1,156	1,096	1,042	965	928	901	894
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,220	1,774	1,678	1,538	1,408	1,231	1,268	1,124	1,020
Gas CC F-Class (442 MW with DF)	2018$/kW	1,301	1,291	1,275	1,261	1,251	1,242	1,233	1,224	1,216	1,207	1,199
Gas CT F-Class (237 MW)	2018$/kW	712	707	697	688	683	677	672	667	662	657	653
USC Coal w/ CCS	2018$/kW	5,621	5,536	5,424	5,309	5,201	5,097	4,992	4,891	4,794	4,698	4,605

** Res/Com Demand Impact = 0.295*

*** EV Coincident Factor = 0.211*

Revised from last meeting

80% REDUCTION CASE INPUTS

VECTREN
A CenterPoint Energy Company

Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.49	1.27	1.25	1.25	1.25	1.25	1.25	1.25	1.25
CO2	2018$/ton	0.00	0.00	0.00	3.57	5.10	6.63	7.65	9.18	11.22	14.79	19.89
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	3.06	3.24	3.38	3.49	3.62	3.78	3.96	4.09	4.17
Vectren Peak Load	MW	1,115	1,102	1,131	1,060	1,025	1,039	1,038	1,038	1,053	1,053	1,065
Customer-Owned Solar DG Capacity*	MW	9.3	14.6	20.0	24.4	29.6	36.3	42.9	49.5	57.3	64.3	72.5
EV Peak Load**	MW	0.4	2.0	9.5	12.4	15.4	19.0	22.4	25.8	29.5	32.8	36.4
Energy Efficiency and Company DG	MW	6.0	9.2	15.7	22.6	28.8	33.1	39.0	45.2	48.8	50.5	47.6
Demand Response	MW	35.2	51.7	52.7	61.6	64.4	67.3	70.1	73.0	75.8	78.7	81.5
Wind (200 MW)	2018$/kW	1,334	1,330	1,249	1,167	1,123	1,160	1,152	1,166	1,139	1,142	1,143
Solar (100 MW)	2018$/kW	1,414	1,264	1,120	975	964	942	897	877	818	809	818
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,513	1,214	1,156	1,096	1,042	965	928	901	894
Flow Battery (50 MW, 6 hr)	2018$/kW	2,968	2,665	2,220	1,774	1,678	1,538	1,408	1,231	1,268	1,124	1,020
Gas CC F-Class (442 MW with DF)	2018$/kW	1,301	1,291	1,275	1,261	1,251	1,242	1,233	1,224	1,216	1,207	1,199
Gas CT F-Class (237 MW)	2018$/kW	712	707	697	688	683	677	672	667	662	657	653
USC Coal w/ CCS	2018$/kW	5,621	5,536	5,424	5,309	5,201	5,097	4,992	4,891	4,794	4,698	4,605

** Res/Com Demand Impact = 0.295*

*** EV Coincident Factor = 0.211*

Revised from last meeting

HIGH REGULATORY CASE INPUTS

Input	Unit	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037	2039
Coal (ILB mine)	2018$/MMBtu	1.78	1.66	1.49	1.27	1.25	1.25	1.25	1.25	1.25	1.25	1.25
CO2	2018$/ton	0.00	0.00	50.40	52.28	54.17	56.05	57.94	60.06	62.41	64.77	67.12
Gas (Henry Hub)	2018$/MMBtu	2.77	2.76	4.39	6.03	7.10	8.37	7.17	8.40	8.95	8.75	8.63
Vectren Peak Load	MW	1,115	1,102	1,168	1,176	1,183	1,192	1,200	1,209	1,219	1,229	1,239
Customer-Owned Solar DG Capacity*	MW	9.3	14.6	20.7	27.1	34.2	41.7	49.6	57.7	66.3	75.1	84.3
EV Peak Load**	MW	0.4	2.0	9.8	13.8	17.8	21.8	25.9	30.0	34.2	38.3	42.3
Energy Efficiency and Company DG	MW	6.0	9.2	15.7	22.6	28.8	33.1	39.0	45.2	48.8	50.5	47.6
Demand Response	MW	35.2	51.7	52.7	61.6	64.4	67.3	70.1	73.0	75.8	78.7	81.5
Wind (200 MW)	2018$/kW	1,334	1,330	1,249	1,167	1,123	1,160	1,152	1,166	1,139	1,142	1,143
Solar (100 MW)	2018$/kW	1,414	1,264	1,120	975	964	942	897	877	818	809	818
Li-Ion Battery (50 MW, 4 hr)	2018$/kW	2,088	1,811	1,513	1,214	1,156	1,096	1,042	965	928	901	894
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** Res/Com Demand Impact = 0.295*

*** EV Coincident Factor = 0.211*

Revised from last meeting

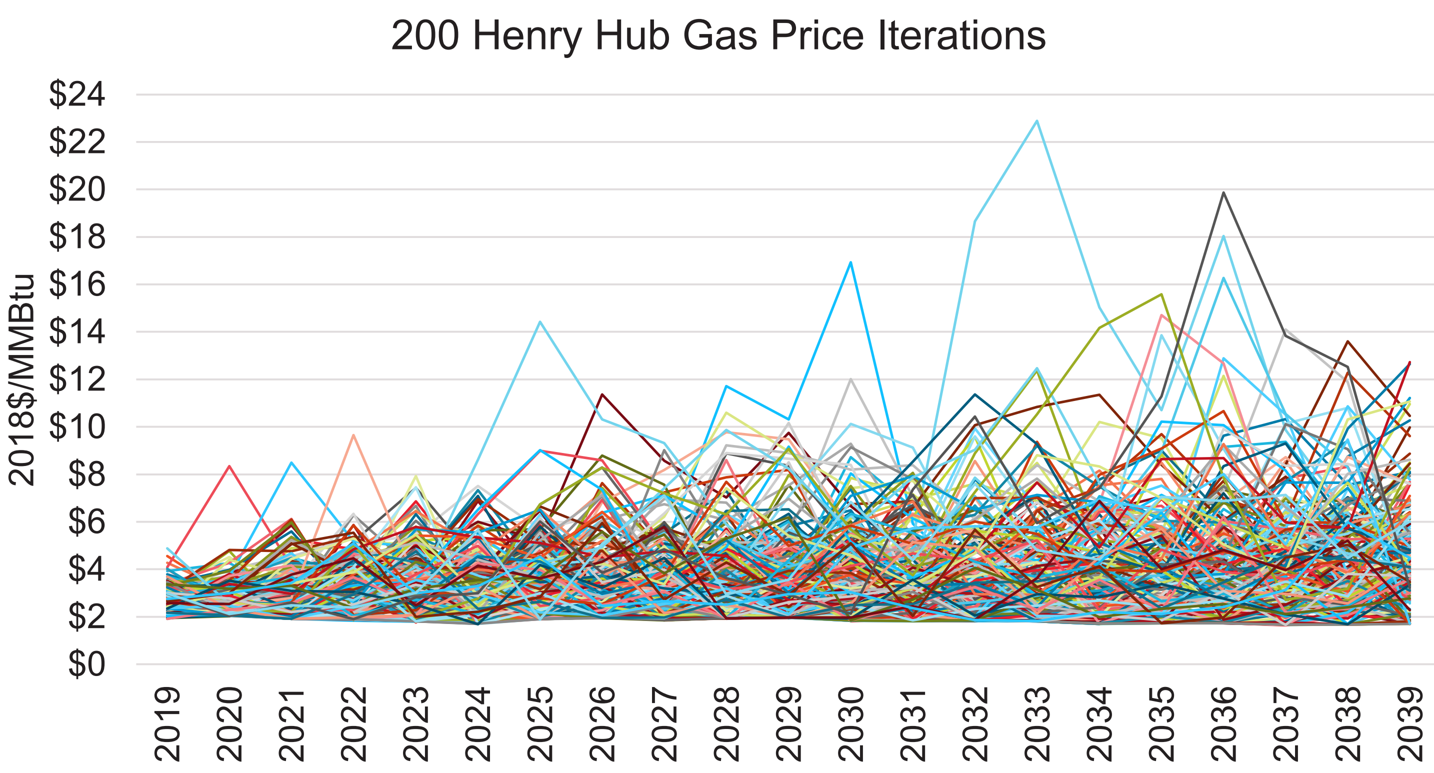
PROBABILISTIC MODELING PROVIDES THE BASIS FOR IRP SCORECARD METRICS

- By measuring each portfolio's performance across 200 iterations, we can quantify each of the measures associated with IRP objectives
- This provides a direct comparison of portfolio performance that will be summarized in the Balanced Scorecard

IRP Objective	Measure	Unit
Affordability	20-Year NPVRR	$
Price Risk Minimization	95^{th} percentile value of NPVRR	$
Environmental Risk Minimization	Life Cycle Greenhouse Gas Emissions	Tons CO_2e
Market Risk Minimization	Energy Market Purchases or Sales outside of a +/- 15% Band	%
	Capacity Market Purchases or Sales outside of a +/- 15% Band	%
Future Flexibility	Uneconomic Asset Risk	$

PROBABILISTIC MODELING

- Probabilistic modeling helps to measure risk from 200 potential future paths for each stochastic variable
- By running each portfolio through 200 iterations, each portfolio's performance and risk profile can be quantified across a wide range of potential futures



PROBABILISTIC VARIABLES AND DRIVERS

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1. Load

- Peak Load
- Average Load

Driver Variables:

- EV and Solar DG (also modeled stochastically)
- Weather
- GDP/ Personal Income
- Expert view on low, mid & high cases

2. Natural Gas

- Henry Hub
- Regional gas basis

Modeling based on:

- Historical Volatility
- Historical Mean Reversion
- Historical Correlation
- Expert view on low, mid & high cases

3. Coal

- ILB
- PRB
- CAPP & NAPP

Modeling based on:

- Historical Volatility
- Historical Mean Reversion
- Historical Correlation
- Expert view on low, mid & high cases

4. CO2

- National CO2 price

Modeling based on:

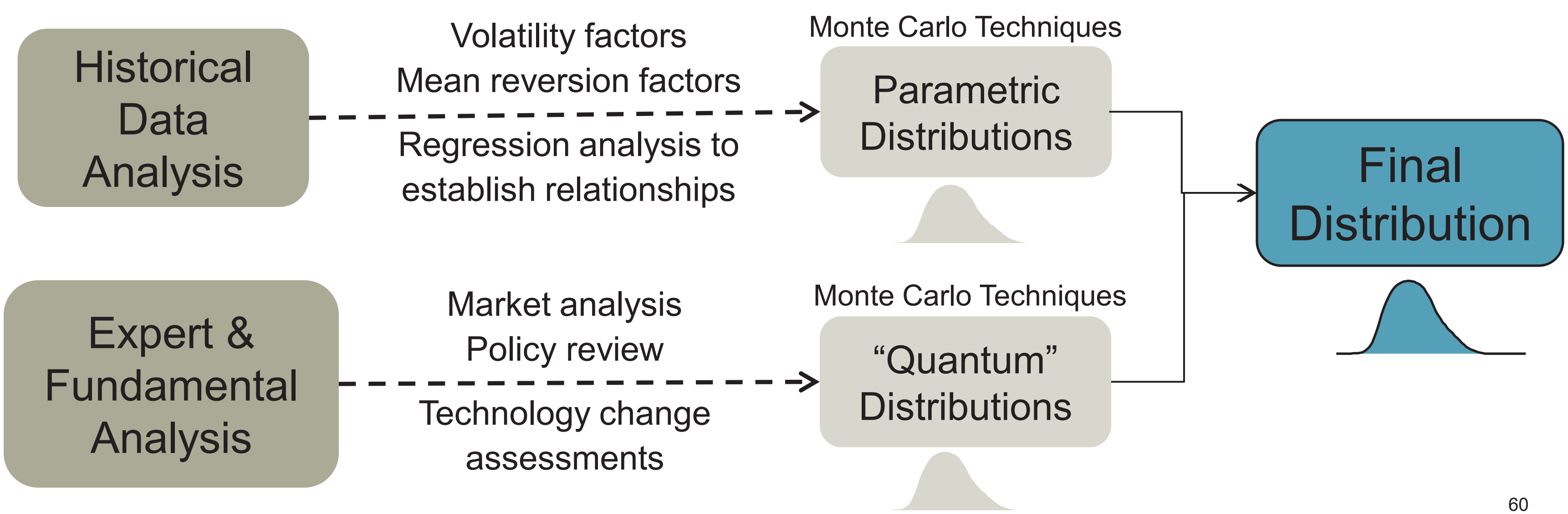
- Analysis of price required for Paris Agreement compliance
- Social cost of carbon analysis
- Expert view on low, mid & high cases

5. Capital Cost

- Relevant technologies included

Modeling based on:

- Expert view on low, mid & high cases



NEXT STEPS

MATT RICE

VECTREN MANAGER OF RESOURCE PLANNING

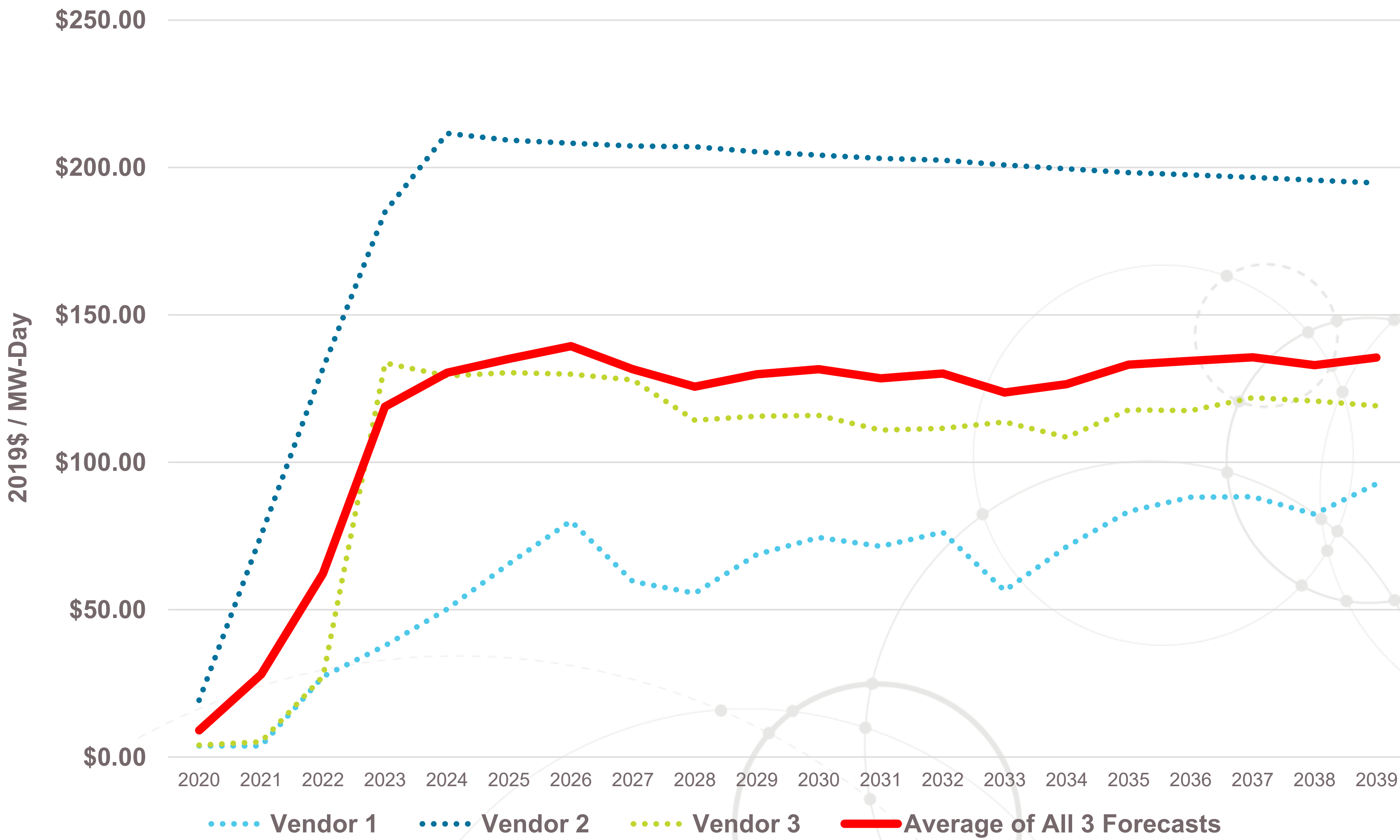
NEXT STEPS

There is a tremendous amount of work to be done between now and our next meeting in March

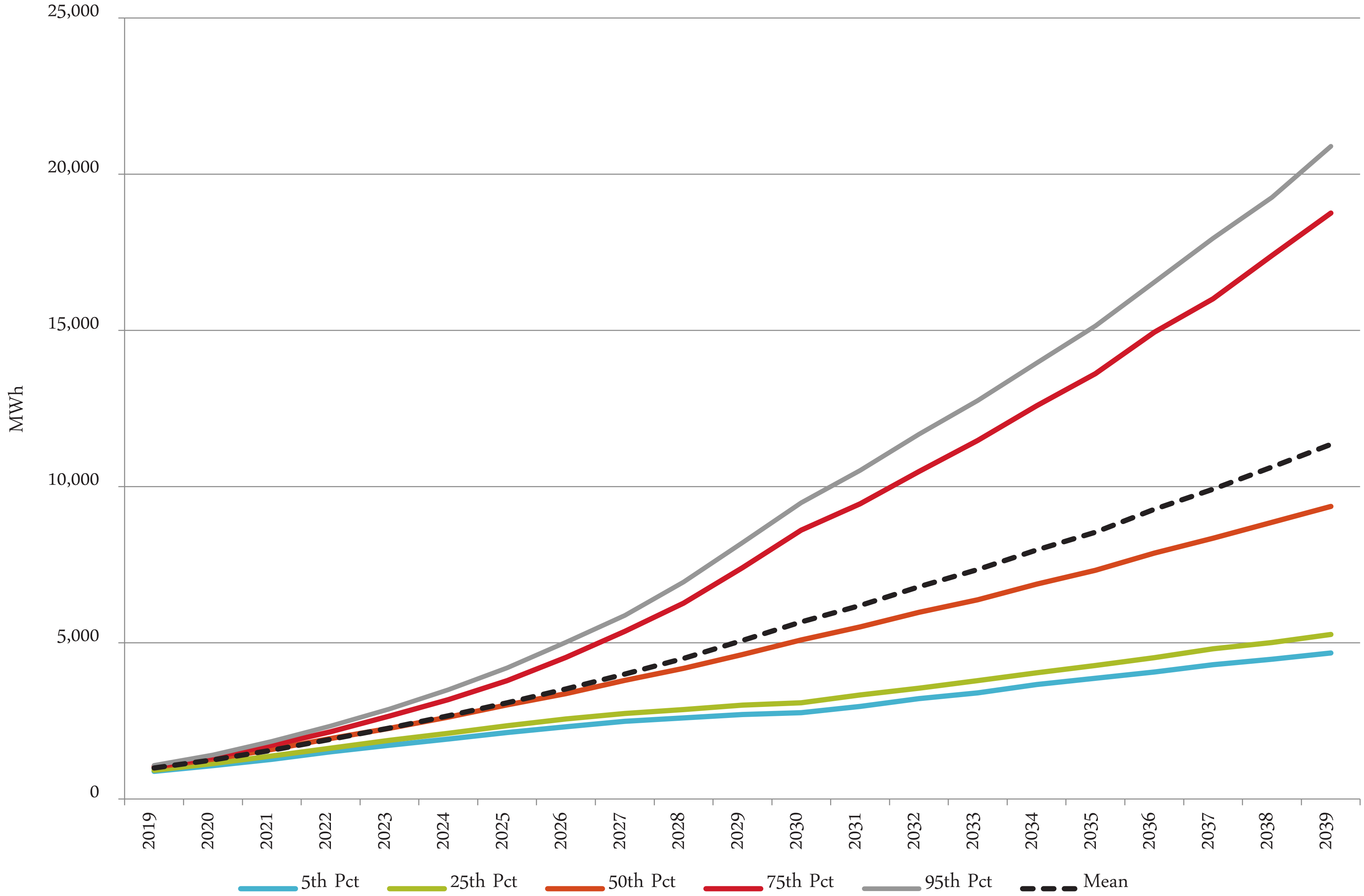
- Finalize all modeling inputs
- Update Reference Case modeling, including RFP results
- Develop scenario based portfolios
- Finalize additional portfolios with insights produced through scenario modeling
- Test portfolios within scenarios and probabilistic modeling
- Analyze results
- Select the preferred portfolio

APPENDIX

CONSENSUS CAPACITY PRICE FORECAST

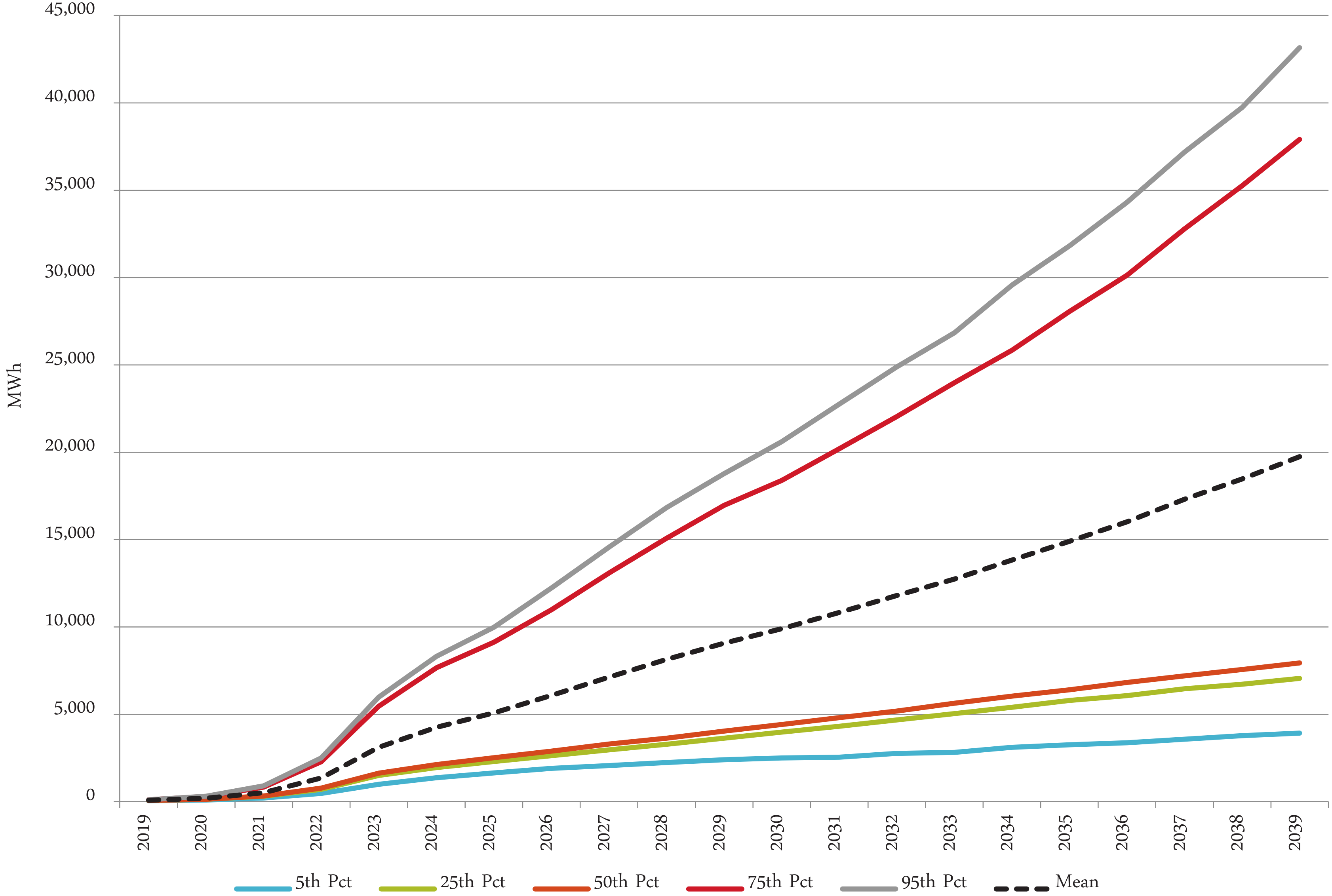


VECTREN SOLAR DISTRIBUTED GENERATION IS A DECREMENT TO VECTREN LOAD

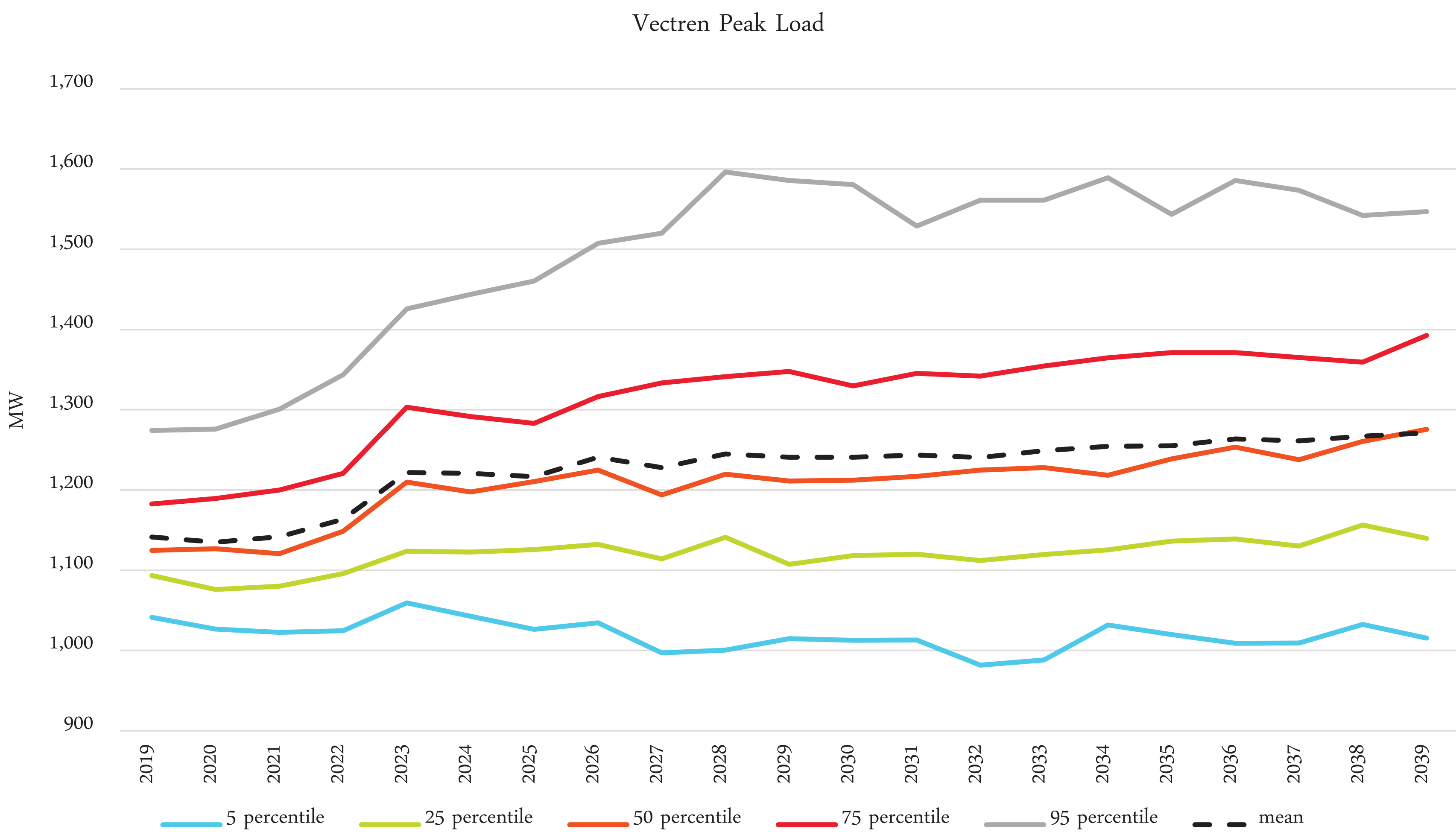


VECTREN ELECTRIC VEHICLE LOAD IS AN INCREMENTAL TO VECTREN LOAD

VECTREN
A CenterPoint Energy Company



DISTRIBUTIONS: VECTREN PEAK LOAD (NET OF SOLAR DG, EV LOAD)



LCA FOR NATURAL GAS ELECTRICITY GEN.

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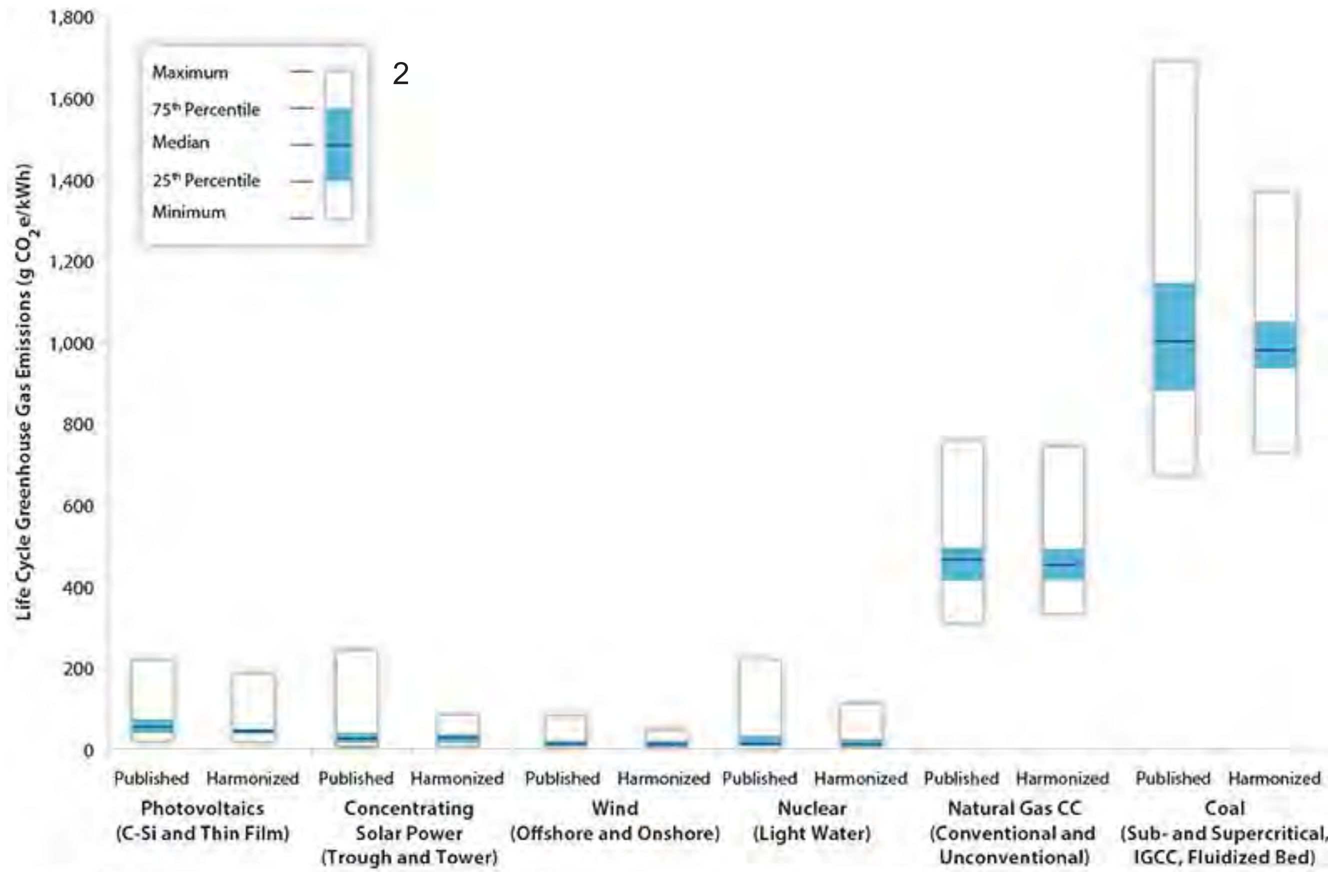
Multiple studies were considered for the NREL study from July 2014[1]

- Methane leakage was considered. Methane emissions rates ranged from 0.66% to 6.2% CH_4 loss/NG produced[1]
- The study noted that there is the possibility of differences in the definition of methane leakage. Some studies include fugitive emissions; some included vented emissions; others might additionally also include methane from combustion
- The NREL study is meant to provide an estimate of life cycle green house gas emissions for various resources. The study did not attempt to fine tune the analysis to a common definition of methane leakage



	Photovoltaics	Concentrating Solar Power	Wind	Nuclear	Natural Gas CC	Coal
Estimates	46	36	126	99	61	164
References	17	10	49	27	45	53

*CC = combined cycle

1 Source: Harmonization of Initial Estimates of Shale Gas Life Cycle Greenhouse Gas Emissions for Electric Power Generation, 2014 Table 1 Page 3 https://www.pnas.org/content/pnas/111/31/E3167.full.pdf

2 Source: https://www.nrel.gov/analysis/assets/images/lca_harm_ng_fig_2.jpg

Vectren 2019 IRP
3rd Stakeholder Meeting Minutes Q&A
December 13, 2019, 9:00 a.m. – 3:00 p.m.

Lynnae Wilson (CenterPoint Energy Indiana Electric Chief Business Officer) – Welcome and Safety Message (holiday safety tips) and Vectren introductions.

> Subject Matter Experts in the room: Matt Rice, Cas Swiz, Nick Kessler, Rina Harris, Jason Williams, Angie Casbon Scheller, Matt Lind, Kyle Combes, Jamie Bundren, Alyssia Oshodi, Natalie Hedde, Ryan Wilhelmus, Justin Joiner, Justin Hage, Bob Heidorn, Wayne Games, Christine Keck, Brad Ellsworth, Angie Bell, Tom Bailey, Steve Rawlinson, Ryan Abshier.

Stakeholders: Approximately 37 stakeholders attended in person. List of affiliations include the following:

- Bowen Engineering
- Citizens Action Coalition (CAC)
- Earth Charter Indiana
- Indiana Coal Council (ICC)
- Indiana Utility Regulatory Commission (IURC)
- Orion Renewable Energy Group LLC
- Office of Utility Consumer Counselor (OUCC)
- Sierra Club
- Southwest Indiana Chamber of Commerce
- State Utility Forecasting Group (SUFG)
- Tri-State Creation Care
- Valley Watch
- Vermillion Rise Mega Park
- Vote Solar

Approximately 38 registered to attend the webinar; several participated. Those registered included representatives from:

- Advanced Energy Economy
- AEP
- Boardwalk Pipeline Partners
- Development Partners Group
- Earth Justice
- Energy and Policy Institute
- Energy Futures Group
- EQ Research
- First Solar
- Hoosier Energy
- ICC
- Indiana Distributed Energy Alliance
- Inovateus Solar LLC

IPL

IURC

Lewis & Kappes

Midwest Energy Efficiency Alliance (MEEA)

Morton Solar, LLC

NextEra

Orion Renewable Energy Group LLC

OUCC

Sierra Club

Solarpack Development, Inc.

Whole Sun Designs Inc.

Matt Rice (Vectren Manager of Resource Planning) Reviewed Stakeholder Process and Presented Follow-up Information Since Our Last Stakeholder Meeting - Slides 4-17.

- Slide 4: Matt Rice noted that the date for the next stakeholder meeting has been moved to March 20, 2020.
- Slide 12 Stakeholder Feedback\Questions:
    - Request: In CO_2 life cycle analysis I want you to capture all greenhouse gas emissions associated with a process. Specifically, when burning coal, you should capture green house gas emissions associated with coal hauling vehicles, as well as the emissions associated with manufacturing coal handling equipment.
        - Response: What you describe is the purpose of using a life cycle analysis. It considers mining the coal, transporting it, burning it, etc. but we would need to refer to the study to clarify [if manufacture of equipment is included].
    - Question: Regarding the size of the hydro resources available for selection in the model, if other hydro owners evaluate local dams and identify there is more potential than 50 MW's will you consider changing the size of hydro resources in the model?
        - Response: We plan to stick with 50 MW's for the size of hydro resources but keep in mind the IRP is a guide, and if hydro is selected as a resource [in the preferred portfolio] we would then initiate further evaluation of the potential of local dams and refine the projected output.
    - Question: You are going to model 50 MW's but will you perform an analysis to determine what size dam would work properly?
        - Response: Hydro would need to be selected first before further analysis is completed.
    - Statement: Modeling 50 MW's seems arbitrary and it seems that you want to dismiss it.
        - Response: Hydro will be evaluated within the model along with all other resources.
    - Statement: Regarding methane leakage I urge you to include the results from the Science Magazine article from 18 months ago. It is more current than the National Renewable Energy Laboratory (NREL) study being used.
        - Response: Life cycle analysis of carbon is one of many factors we are using to select a preferred portfolio. The NREL study is the best study we can find to show the relative differences among resources. When we spoke with NREL, we told them how we intended to use the study, and they agreed that their study was appropriate for our analysis. We can set up a separate meeting to discuss if needed.
- Slide 11 Stakeholder Feedback:

- Question: Can you tell me who you spoke with at MISO that indicated they are moving toward a seasonal construct?
  - Response: Based on conversations with MISO personnel and public presentations it is clear to us that MISO is planning to move to a seasonal construct [or other mechanisms to adapt to intermittent, renewable resources] in the coming years. We can schedule a group call to make sure we are all on the same page if needed.
- Question: Can you share the documents you are looking at that indicate MISO is moving toward a seasonal construct.
  - Response: Yes, we will provide them.

- Slide 13 Stakeholder Feedback:
  - Statement: I appreciate that you are willing to export inputs and assumptions from Aurora to share with stakeholders that don't want to pay $5k for a read only license but I am concerned that the information exported will be difficult to interpret.
    - Response: There is a help function in the read only copy, and we will try to print as much of that information as we can to help provide a work around, but we cannot provide a read only copy [free of charge] of all the models we use to all stakeholders that want a copy. We will work to provide the transparency that is needed with this workaround.
- Slide 14 Stakeholder Question:
  - Questions: Can you explain the planning process between MISO and a utility? What does it mean that MISO is fuel source neutral? Isn't the planning reserve margin based on information you provide in your planning?
    - Response: Fuel source neutral means MISO doesn't care what fuel sources (coal, gas, solar, wind, hydro, etc.) we use to meet customer needs. They provide us with the planning reserve margin requirement.
    - Response: The planning reserve margin is the surplus power we need above expected customer peak demand. It is based on [load and performance] information of all resources in MISO.

<u>Peter Hubbard</u> (Manager of Energy Business Advisory, Pace Global) Presented Draft Reference Case Modeling Results - Slides 18-29.

- Slide 20 Stakeholder Questions:
  - Question: On slide 20 I don't see hydro. Is it included?
    - Response: This is not an all-inclusive list. It is included and is shown on slide 22.
  - Question: Can you explain what customer owned Distributed Generation (DG) capacity represents?
    - Response: It represents how much capacity is expected from solar installed by Vectren customers, over time in the reference case. These values can vary in different scenarios.
  - Question: Does this estimate include batteries?
    - Response: There could be a battery behind the customer owned solar, but this just represents the solar capacity.
- Slide 21 Stakeholder Question:
  - Question: Did House Bill 6 in Ohio have an impact on Vectren's ownership, operation, or cost of Ohio Valley Electric Corporation (OVEC) that would impact Vectren customers?
    - Response: No.
- Slide 22 Stakeholder Questions:
  - Question: Shouldn't hydro capacity be 100 MW's?
    - Response: It is 50 MW's for each resource, and 2 resources are available for selection (100 MW's total).
  - Question: How did you determine the solar and wind capacity limitations?
    - Response: It is based on what is a reasonable expectation for how many MW's can be constructed and brought on line in a year.
- Slide 24 Stakeholder Question:

- Question: Regarding CO_2 does your analysis include the potential use of the low sulfur diesel fuel that could be produced from the proposed coal to diesel facility in Spencer County?
  - Response: This analysis only includes natural gas as a fuel source [for resources that can be fired by natural gas or diesel].
- Statement: There is probably more carbon produced transforming coal to diesel than there is transforming oil to diesel.
  - Response: The Spencer County project is external to the IRP analysis.

- Slide 20 Stakeholder Questions:
  - Question: The amount of customer owned solar DG would depend upon net metering and how much customers are compensated. Are you putting caps on net metering and solar?
    - Response: The DG (solar) is looked at from a probabilistic point of view that determines what levels of DG could exist on the low end and on the high end. It captures a range of inputs for the model.
    - Response: We are also considering a low load forecast within scenarios that will produce a portfolio. We are considering a range. The assumptions in the reference case are based on existing law.
  - Question: So, you will only be as favorable to the homeowner as the law makes you be?
    - Response: We are modeling a wide range of load forecasts. Solar DG is accounted for as a reduction in load in the model. We've included existing law in the reference case but will also look at high and low bounds.
  - Question: When determining the cost of natural gas, do you assume the gas will come from CenterPoint Energy in Houston?
    - Response: There are several different sources for gas, so it would not necessarily come from CenterPoint. It would be on a low-cost basis and would come from one of the interstate gas pipelines.
  - Question: Does most of the gas come from the Texas area?
    - Response: It depends on the pipeline. Many pipelines that are in this area come from the Gulf Coast, but some come from other sources. The gas could from other areas (i.e. Pennsylvania).
    - Response: We have a diverse mix of gas interstate pipelines in Indiana. The gas could come from Canada, Ohio, New York, Pennsylvania, Colorado, or the Gulf Coast.
  - Question: Since a lot [of gas] comes from the Gulf Cost, is it figured in that climate change is likely to create record floods. The Houston area has had two 500-year floods in recent years. I assume more frequent and drastic flooding will impact the ability of the pipelines to work (for people to get to their jobs to do it). I hope that when you figure the cost and reliability of natural gas is, you consider the factor in the impact of climate change.
    - Response: When you look at the 2 flooding events in Houston, Vectren customers did not have an interruption. When you look at the interstate pipeline and the planning involved the diversity really helps [maintain reliability].
- Stakeholder Question:
  - Question: In April 2019, the IURC denied your proposal for an 850 MW gas plant. If the request for proposal that comes to fruition as a result of this IRP also gets rejected by the IURC will you continue to recommend oversized gas plants that favor CenterPoint's interests?
    - Response: Today, we are laying out the portfolios that we are considering. A large gas plant is not included. When you look at the planning reserve margin requirement graph [for the reference case] there is not a build larger than the requirement.
    - Response: It is important to note that meeting the planning reserve margin requirement is a capacity issue. When we retire base load coal capacity, we need to replace capacity. The model is picking gas peaking units, not a combined cycle [gas plant], which runs a lot. [In the reference case] the peaking

units are only projected to run 7% of the time. 90+% of the time other MISO units are being selected to run (create energy). When we evaluate all 15 portfolios through the risk analysis, the reference case may be low cost for capacity, but it is not a great energy selection. This leads to exposure to volatility of the energy market. The reference case is an option, but there are [up to] 14 other portfolios with 200 iterations of each, and all will be run through the risk analysis. That will lead us to a preferred plan. The preferred plan will perform [well] across all scenarios and [potential] costs.

- Slide 25 Stakeholder Question:
  - Question: How did you come up with 697 MWs to replace 730 MWs of coal capacity?
    - Response: The three combustion turbines selected by the model are 230 MW's each. The balance is made up for by purchasing capacity from the market.
- Slide 22 Stakeholder Question:
  - Question: Why is there a single 200 MW capacity option for wind energy? Is that a realistic capacity option viewed relative to the capacity of Vectren's existing wind resources (i.e., 30 MW and 50 MW)?
    - Response: Many wind farms are much larger than the 30 and 50 MW's that Vectren currently has contracted. The 200 MW size is reasonable from a tech assessment point of view, but it could be smaller.
- Stakeholder Question:
  - Question: What pipeline costs were included in the reference case modeling?
    - Response: Pipeline costs were included. Costs are subject to refinement but were included in the reference case.
- Slide 22 Stakeholder Question:
  - Question: Why did you constrain the reference case? It seems like it makes the most sense to let the model do as much optimization as possible.
    - Response: There are operational and commercial constraints that need to be considered. The analysis is meant to be least cost but subject to reasonable considerations.
  - Comment: I've seen other utilities use a max reserve margin instead of resource specific constraints. For renewables it does matter because the cost changes by year pending tax credits. Rather than you telling us it is reasonable, it would be nice if we could evaluate if it is reasonable too.
    - Response: We are preparing to put Request for Proposals (RFP) information into the model so we can evaluate what projects are out there and see if we need to change the limitations.
- Slide 23 Stakeholder Question:
  - Question: Why are aeroderivatives excluded from the model? I've seen that they are modeled in Puerto Rico, so why isn't is an option to Vectren?
    - Response: The required pressure is 900 psi which is higher than other potential resources. They have a higher pipeline cost and they are smaller resources [expensive] so we decided to screen them out.
  - Question: Do you have any data on the pipeline cost differences?
    - Response: It is subject to non-disclosure agreement but we can discuss.
  - Question: CenterPoint could hold the contract to supply gas to any unit that Vectren may build. Is that something you intend to do an RFP for?
    - Response: Currently, our practice is to go out for bid for fuel source supply for our generating facilities.
- Tri-State Creation Care (along with the Sierra Club) presented a petition with approximately 600 signatures encouraging Vectren to take future risk of CO_2 emissions on future generations into consideration. Emphasis was added that this is a moral decision to stop CO_2 production; it is not just an economic decision.
- A residential customer presented a petition of approximately 600 people effected by a large [600 acre] solar project in Vanderburgh County, requesting that Vectren consider land use in portfolio development. Emphasis was added that solar plants are large, industrial facilities and should be

zoned as such. Vectren should maximize use of brownfield sites and not pursue large solar projects on productive farm land near residential homes.

Matt Lind (Resource Planning & Market Assessments Business Lead, Burns and McDonnell) Presented Final RFP Modeling Inputs - Slides 30-37.

- Slide 36 Stakeholder Question
  - Question: Is cost incorporated over the life of the asset including initial build cost and O&M?
    - Response: It includes initial build and O&M.
  - Question: Some resources, depending on the fuel source, will have an increase in price that will be difficult to model. I suspect that as some resources become more scarce their cost will increase exponentially. How are those types of variables accounted for?
    - Response: In the RFP we are focused on specific projects. To the extent that some of these resources are going to burn fuel, the IRP risk analysis will consider and evaluate that.
- Stakeholder Comment
  - Comment: Every day a river or aquifer is destroyed, and the cost can't be determined; it can't be replaced.
    - Response: Thank you for your comment. In the IRP, the assumption is that all resources meet existing regulations which include costs associated with avoiding instances that you described.
- Slide 34 Stakeholder Question
  - Question: Was there a particular duration in hours [for storage] that made it into Tier 1 where as others didn't?
    - Response: Duration did not go into categorizing resources into tier 1 or tier 2. It was based on [firm bids and] if the energy was settled at Vectren's load node or located on their system. There was not a distinction on duration to qualify for tier 1.
- Slide 36 Stakeholder Question
  - Question: How does the project shown in group 13 [Solar Purchase/PPA] compare to projects in group 14 [12-15 Year Solar PPA]? Is that where you are purchasing from homeowners?
    - Response: No. That project was a hybrid where some portion of it would be owned and some would be a PPA with the developer. There was only one bid in that category, so we didn't show cost to keep it confidential.
- Slide 36 Stakeholder Question
  - Question: Is solar+storage only charged by solar? How are you accounting for carbon footprint if charged by the grid?
    - Response: With solar+storage and how tax credits are structured, it is favorable to charge based on renewable energy. It is bid specific; they may have the ability to be grid charged and discharged to the grid.
    - Response: Carbon is accounted for in the energy price. We are still determining the best way to apply the life cycle of carbon analysis to storage.

Matt Rice (Vectren Manager of Resource Planning) Presented Portfolio Development - Slides 38-51.

- Slide 40 Stakeholder Question
  - Question: If the net metering cap were to be doubled, tripled, or quadrupled do you have a factor that incorporates the increase in the cap into different portfolios?
    - Response: Indirectly, yes. We will run a scenario that has a lower load than the reference case.
  - Comment: But the lower load would vary based on what the cap is.

        - Response: If there is something that induces more solar on rooftops, that would result in a reduction to our load. We are considering reduction to load within the scenarios and probabilistic modeling.
    - Comment: But the lower load could be 5-20% lower so you don't know what that reduction is.
        - Response: Our bounds are very wide.
- Slide 41 Stakeholder Question
    - Question: How many portfolios do you think this will end up being?
        - Response: We are planning for up to 15.
- Slide 50 Stakeholder Comment:
    - Comment: Thank you for including the HB 763 but on the chart on slide 50 the cost should be $45 in 2025 and $205 by 2039.
        - Reply: Thank you, please see me at the end of the day.
- Slide 43 Stakeholder Question
    - Question: Why does it take so much solar ICAP (installed capacity) to meet 174 MW UCAP (accredited capacity of approximately 29%)? I thought MISO offered 50% accreditation starting off but could be even higher, particularly with tracking.
        - Response: As more solar penetrates the MISO footprint, the solar is netted out which shifts the [net] peak hour out into the evening hours. Then resources other than solar must serve that net peak load. The projection for UCAP declines over time as more solar penetrates the MISO footprint.
    - Question: In California the same thing has happened, but the simple solution is to add 4 hours of storage to get the solar back to a high capacity value. In your lists you include solar+storage but in these lists you didn't include solar+storage as a potential buildout.
        - Response: We are just showing these as reference points. We will evaluate solar+storage consistent with the bids received in our RFP.
- Stakeholder Feedback:
    - Comment: In Germany they put a lot of solar on rooftops and we should do that here. There are a lot of buildings here that don't have solar.
        - Response: That is an option, but it is more expensive and more complex. We have seen this with the Urban Living Research Center. We had to work with the developer on the design of the building to make sure it would support the amount of solar we wanted to install on it. We are modeling utility scale [universal solar] that is much more cost effective.
- Stakeholder Question
    - Question: Can you explain how peak load can shift to the evening?
        - Response: It is the net peak that shifts which is the peak load less the renewable generation (how MISO calculates). The remaining load must be served by something that is dispatchable.
- Stakeholder Question:
    - Question: When you are projecting into the future, do you extend today's values into the future or have other sources?
        - Response: It depends on the input. Some inputs we develop ourselves, some by others but we are diligent to have a basis for all assumptions that are fed into the models.
- Stakeholder Question:
    - Question: How does Vectren's profitability plan into the analysis?
        - Response: When each portfolio is analyzed, it will have a net present value [over the planning period]. The net present value includes a rate of return on resources that we own.
- Stakeholder Statement:
    - Statement: In the last IRP you chose a large CCGT which was going to be highly profitable because it was a large capital investment. It doesn't seem like there is an incentive to go to the lowest cost because profits would be lower.

        - Response: In the last IRP each scenario produced a gas plant as the lowest cost option to serve customer load. In a few slides we will show that affordability is one of the objectives in this IRP to be balanced against other objectives.
- Stakeholder Question:
    - Question: You said that hydro is very expensive initially but it seemed like you said we can't carry that cost over the 50-100 years that it would operate?
        - Response: We will need to review the tech assessment and see what the life is expected to be and put it in the notes. [Upon review, 40 years is included in the tech. assessment. It would not necessarily lower cost by extending the life to 50-100 years as this would take further capital investment that is not included in our estimate.]

<u>Peter Hubbard</u> (Manager of Energy Business Advisory, Pace Global) Presented Scenario Testing and Probabilistic Modeling - Slides 52-60.

- Stakeholder Question:
    - Question: Are there any incremental solutions where you reassess every 2 years and add resources as needed?
        - Response: Every three years the IRP analysis is revisited and updated based on current assumptions.
- Slide 55 Stakeholder Question:
    - Question: In the high regulatory case how were the natural gas prices determined?
        - Response: It is based on a fracking ban. We used historical pricing (pre-shale gas boom) and sustained those high gas prices throughout the forecast (the 95th percentile every year of the forecast).
- Slide 58 Stakeholder Question:
    - Question: There is more to environmental risk minimization than greenhouse gas emissions. There is ecosystem destruction from coal mining and fracking as well as health issues from burning those fuels. How are you modeling those factors?
        - Response: It isn't just carbon; CO_2 equivalent considers emissions involved from cradle to grave for each technology. Additionally, we are also assuming compliance with EPA regulations. We are accounting for a lot of potential impacts.
- Slide 54-57 Stakeholder Question\Comment:
    - Question: Are you modeling variable O&M probabilistically?
        - Response: We are modeling fuel and CO_2 emissions probabilistically. We are not varying non-fuel variable O&M probabilistically.
    - Question: The list shows CO_2 prices and capital cost (will be varied). I am concerned because I don't think we have enough data to develop a stochastic distribution for CO_2 price. For capital costs, the RFP should provide certainty for those costs and you should be able to extrapolate those costs going forward.
        - Response: The RFP response will tighten up the short-range distribution of capital costs. There is less uncertainty in the short term. However, over 20 years we don't know where those costs will go. The capital cost could be higher or lower than the reference case in the long term.
    - Comment: I think the only thing that lends itself to stochastics are load and fuel prices. I don't think you should test capital costs and CO_2 prices.
        - Response: Thank you for your feedback.
- Stakeholder Question:
    - Question: In essence the IRP is a 3-year plan because you will have another IRP in 3 years. What is going to be done in the next three years that becomes irreversible?
        - Response: Long term there is a bit of uncertainty that goes into this but the IRP incorporates specific market feedback on what the short term might look like. In the very short term, it is based on real figures the market can provide. There is a wide range of technologies that came out of the RFP, and you want to look at

        - how they perform in the long term. We will look at how they perform in a wide range of conditions.
    - Feedback: I think this process is a short-term planning process but would prefer that it be a long-term planning process.
        - Response: We are looking at a wide range of portfolios, and in each case, we are looking at how those portfolios will perform over a 20-year horizon.
- Stakeholder Question:
    - Question: Have you asked your rate payers if they would be willing to pay a higher rate for renewable energy?
        - Response: Yes. We do survey our customers to understand their needs. There is a segment of the population that is willing to pay more for renewables.
- Stakeholder Question:
    - Question: Vectren ratepayers pay some of the highest rates in the state for a fleet primarily fueled by fossil fuels. I wonder why there is a high value on fossil fuels when utilities that are opting for renewables have lower rates.
        - Response: We are working on a long-term plan, and affordability will be on the scorecard.
    - Question: Has affordability not been on the scorecard in the past? Why do we pay higher rates than others in the state?
        - Response: Affordability is always on the scorecard for the IRP.
- Stakeholder Question:
    - Question: Does Vectren have a renewable energy rider? If not, that could be a consideration and a benchmark to see how many customers are interested in renewable energy.
        - Response: We do not [currently have a renewable energy rider]. We performed an analysis on community solar in recent years to gauge the interest of our customers. At the time, there was slight interest, but we will look at this again as we move forward.
- Stakeholder Comment:
    - Comment: The CAC disagrees that renewable energy riders can gauge customer interest in renewable energy. Buying into these programs does not change the energy portfolio of the utility serving that customer.
        - Response: Thank you for your feedback.
- Slide 16 Stakeholder Question:
    - Question: There was a mention that there weren't any bids received for combined cycle units. I thought I had heard through press releases that you did receive bids for Combined Cycle Gas Turbine (CCGT) projects. Is purchasing power from independent sources woven into your analysis?
        - Response: On slide 32 it shows that we did have some bids for CCGT projects, but they did not qualify to be considered tier 1 projects based on the criteria to be a firm bid, be on our system, or have a delivered price. We are evaluating attractive tier 2 bids and are performing congestion analysis to determine the congestion cost to get the energy to our customers.
- Slide 33 Stakeholder Question:
    - Question: Why are some of the values [in the table] on slide 33 shown on the screen different than the handouts?
        - Response: There was a typo on the slide that we originally posted/printed for this meeting. What is on the screen is accurate. We will post an update to the website.

VECTREN PUBLIC STAKEHOLDER MEETING

JUNE 15, 2020

WELCOME AND SAFETY SHARE

LYNNAE WILSON

INDIANA ELECTRIC CHIEF BUSINESS OFFICER

SAFETY SHARE – FIREWORK SAFETY

In 2017, eight people died (half children and young adults under age 20) and over 12,000 were injured badly enough to require medical treatment after fireworks-related incidents

- According to the National Fire Protection Association, sparklers alone account for more than 25% of emergency room visits for fireworks injuries

If consumer fireworks are legal to buy where you live and you choose to use them, be sure to follow the following safety tips:

- Never allow young children to handle fireworks
- Older children should use them only under close adult supervision
- Never use fireworks while impaired by drugs or alcohol
- Anyone using fireworks or standing nearby should wear protective eyewear
- Never hold lighted fireworks in your hands
- Only use them away from people, houses and flammable material
- Only light one device at a time and maintain a safe distance after lighting
- Do not try to re-light or handle malfunctioning fireworks
- Soak both spent and unused fireworks in water for a few hours before discarding
- Keep a bucket of water nearby to fully extinguish fireworks that don't go off or in case of fire

Source: https://www.nsc.org/home-safety/tools-resources/seasonal-safety/summer/fireworks

MEETING GUIDELINES, AGENDA, AND FOLLOW-UP INFORMATION

MATT RICE

VECTREN MANAGER OF RESOURCE PLANNING

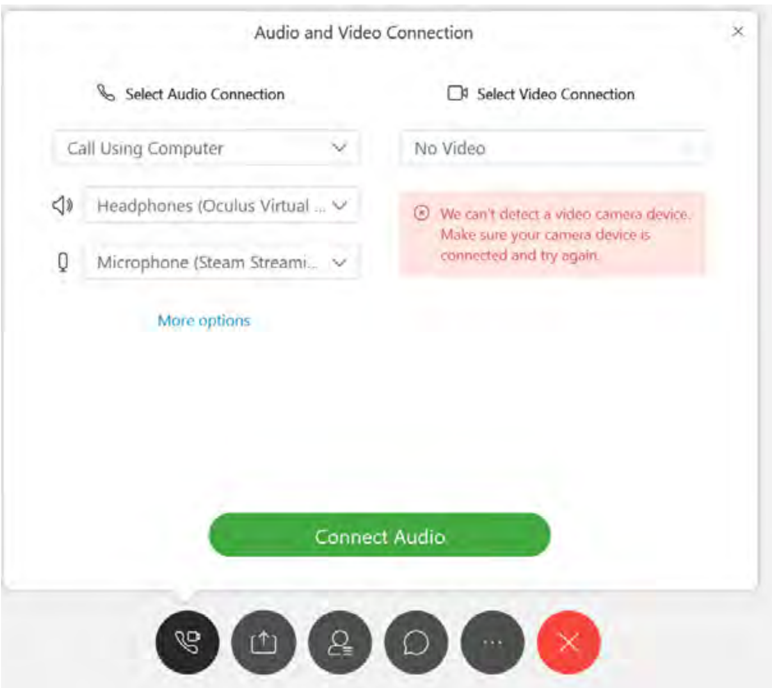
AGENDA

Time		
1:00 p.m.	Welcome, Safety Message	Lynnae Wilson, Indiana Electric Chief Business Officer
1:10 p.m.	Meeting Guidelines and Stakeholder Process Review	Matt Rice, Manager of Resource Planning
1:20 p.m.	Presentation of the Preferred Portfolio	Lynnae Wilson, Indiana Electric Chief Business Officer & Matt Rice, Manager of Resource Planning
1:50 p.m.	Portfolio Analysis and Balanced Scorecard	Peter Hubbard, Pace Global, Siemens Energy Business Advisory
2:20 p.m.	Next Steps	Justin Joiner, Director of Power Supply Services
2:30 p.m.	Stakeholder Questions/Comments	
3:30 p.m.	Adjourn	

MEETING GUIDELINES

- Meeting participants must enter their name when logging into WebEx to facilitate question responses and improve communication
- Please type all questions into the chat function
  - If you would like to follow-up on your question, please use the raise hand function (to the right of your name on the participant list). Your phone line will be opened
  - One follow up question at a time will be allowed to give everyone an opportunity to have their questions answered
  - Any unanswered questions will be addressed after the meeting
  - Additional questions can be sent to: IRP@CenterPointEnergy.com
- Stakeholders may request 2 minutes at the end of the meeting to offer any additional comments. Those that have signed up ahead of the meeting will go first.

HOW TO CONNECT AUDIO



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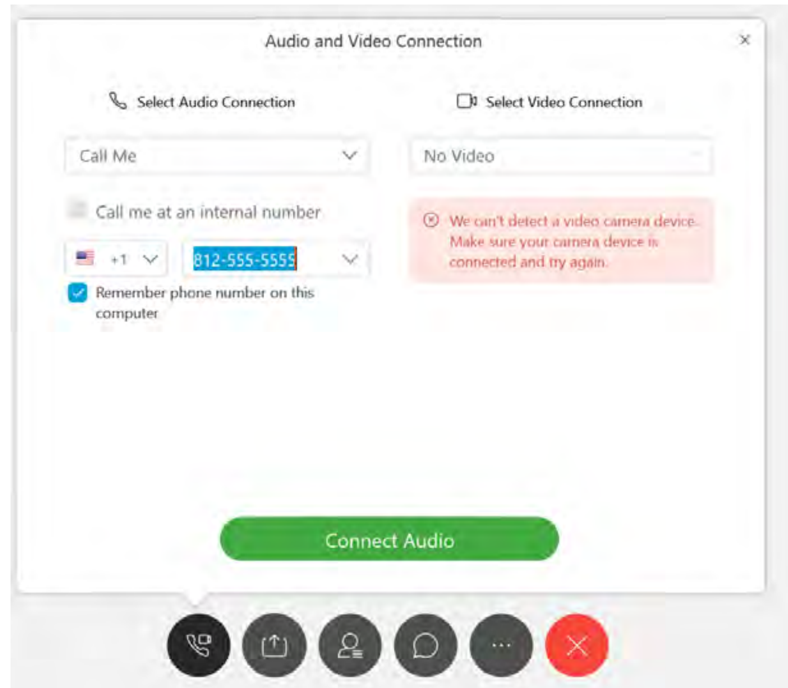
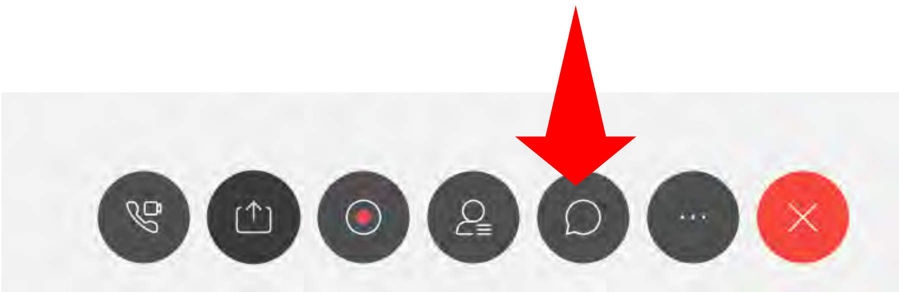


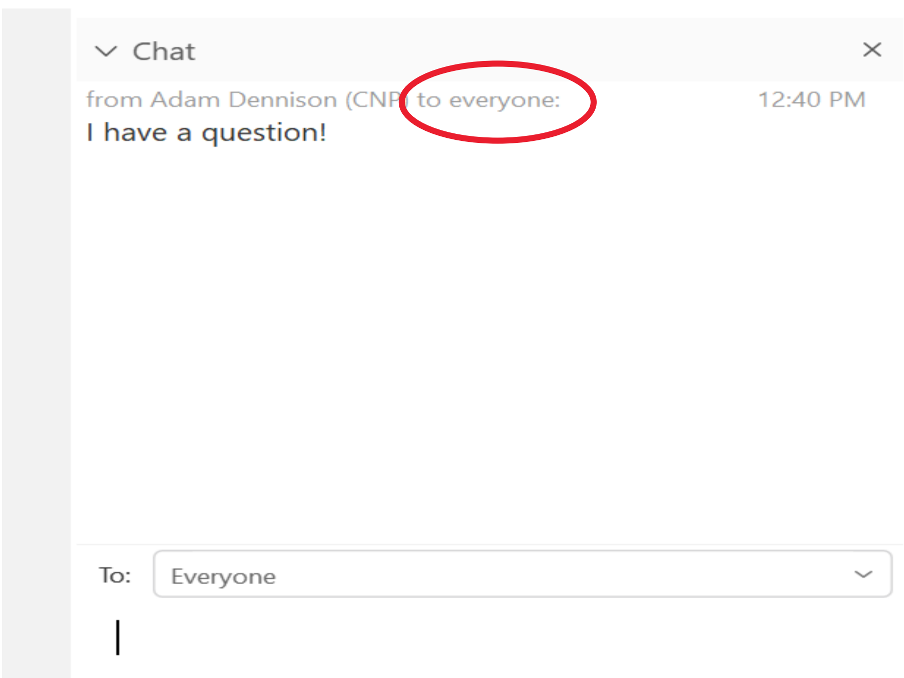
Call Using Computer if you would like to use your computer's microphone and speakers

Call Me if you would like to use a phone to connect. Enter in phone number and WebEx automatically call

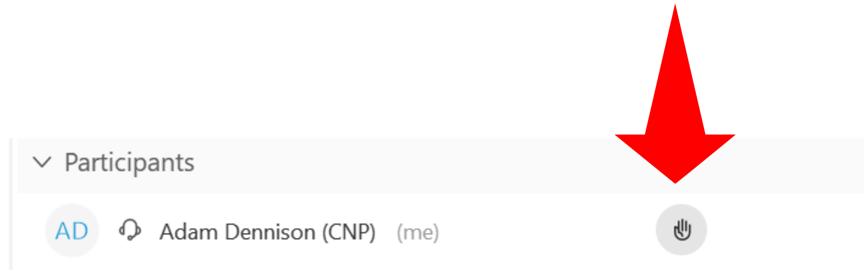
HAVE A QUESTION?

Ask "everyone" in chat.

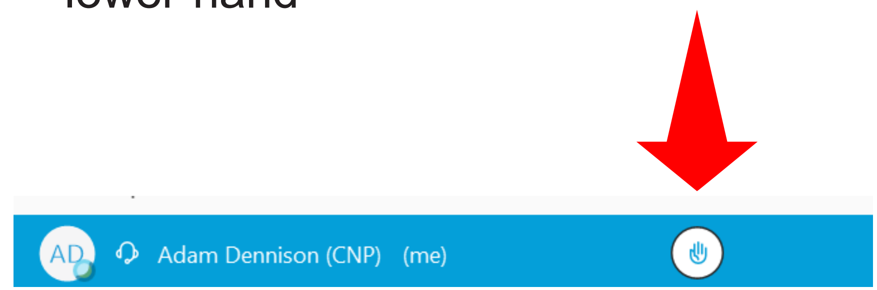




Raise Hand for a Follow-up



After question has been answered, lower hand



2019/2020 STAKEHOLDER PROCESS

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August 15, 2019

- 2019/2020 IRP Process
- Objectives and Measures
- All-Source RFP
- Environmental Update
- Draft Reference Case Market Inputs & Scenarios

October 10, 2019

- RFP Update
- Draft Resource Costs
- Sales and Demand Forecast
- DSM MPS/ Modeling Inputs
- Scenario Modeling Inputs
- Portfolio Development

December 13, 2019

- Draft Portfolios
- Draft Reference Case Modeling Results
- All-Source RFP Results and Final Modeling Inputs
- Scenario Testing and Probabilistic Modeling Approach and Assumptions

June 15, 2020

- Final Reference Case and Scenario Modeling Results
- Probabilistic Modeling Results
- Risk Analysis Results
- Preview the Preferred Portfolio

All Source RFP

Create Objectives, Risk Perspectives and Scorecard Development

Create Reference Case Assumptions and Scenario Development

Portfolio Development

Portfolio Testing in Scenarios, Focused on Potential Regulatory Risks

Portfolio Testing Using Probabilistic Modeling of 200 Potential Futures

Conduct Sensitivity Analysis

Evaluate Portfolios

Select the Preferred Portfolio

VECTREN COMMITMENTS FOR 2019/2020 IRP

- ✓ Utilized an All-Source RFP to gather market pricing & availability data
- ✓ Included a balanced, less qualitative risk score card; draft was shared at the first public stakeholder meeting
- ✓ Performed an exhaustive look at existing resource options
- ✓ Used one model for consistency in optimization, simulated dispatch, and probabilistic functions
- ✓ Worked with stakeholders on portfolio development
- ✓ Modeled more resources simultaneously
- ✓ Tested a wide range of portfolios in scenario modeling and ultimately in the risk analysis
- ✓ Conducted a sensitivity analysis
- ✓ Provided a data release schedule and provide modeling data ahead of filing for evaluation
- ✓ Ensured the IRP process informs the selection of the preferred portfolio
- ✓ Included information presented for multiple audiences (technical and non-technical)
- ✓ Strived to make every encounter meaningful for stakeholders and for us

BACKGROUND

Vectren continually monitors major developments in the energy industry. While the IRP is developed at a point in time, Vectren works to evaluate current and expected future environments. Recently, several developments have helped to shape our view on what to expect in the near, mid, and long-term.

– The generation mix continues to transition towards renewables and gas resources due to economics

– Evolving MISO market rules to ensure reliability, signaling future incentives for resources that are dispatchable, flexible, and visible

– Energy storage is an emerging flexible resource with great potential. Price continues to come down, but there are still no cost-effective long duration storage options

– The need for flexibility to mitigate risk in an uncertain future

– Customer desire for local renewable resources while maintaining reliability

– Guidance from recent Commission orders and the Director's Report that called for diversity, local resources, risk mitigation, and flexibility

PREFERRED PORTFOLIO

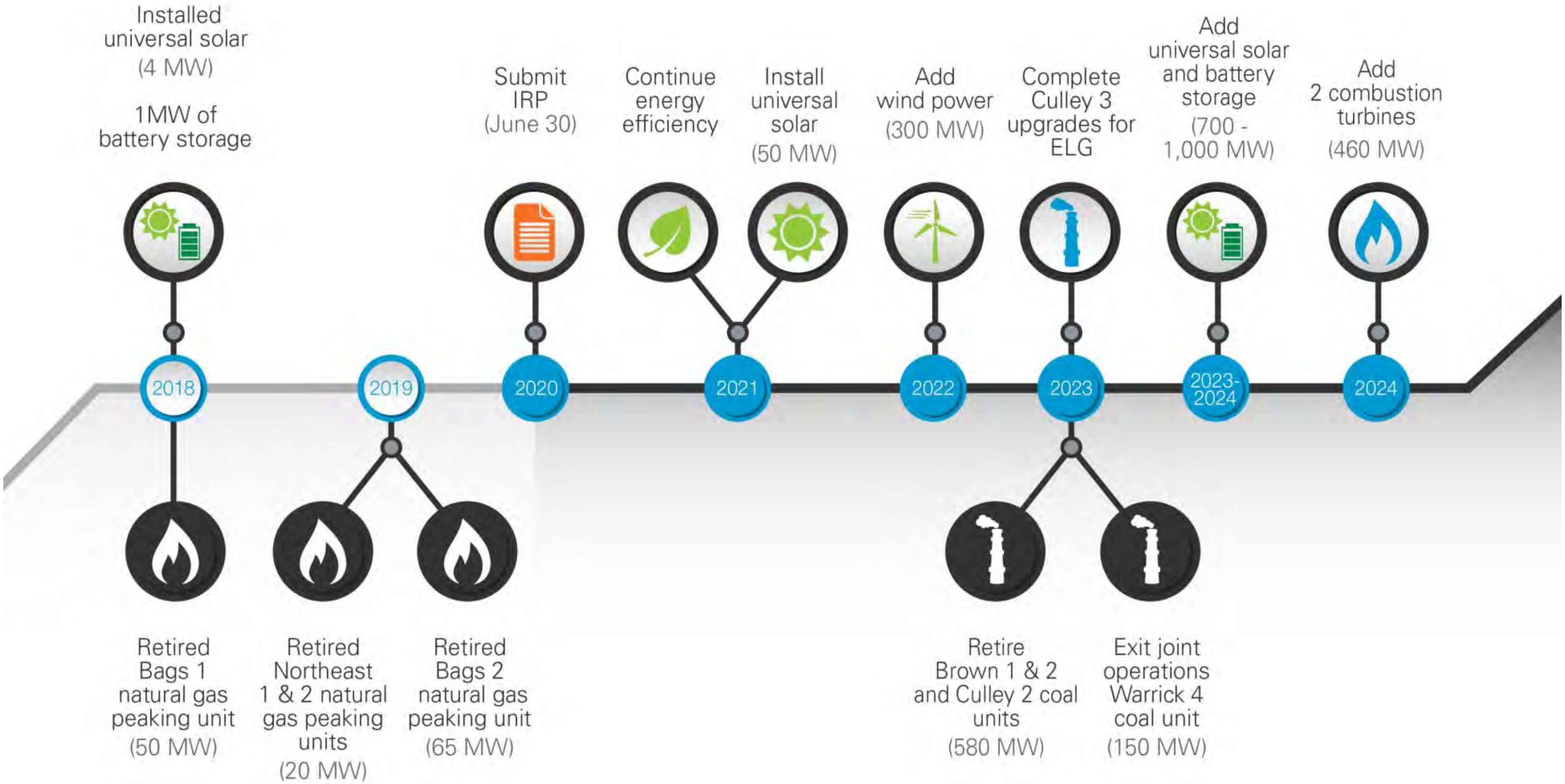
LYNNAE WILSON

INDIANA ELECTRIC CHIEF BUSINESS OFFICER

MATT RICE

VECTREN MANAGER OF RESOURCE PLANNING

VECTREN PREFERRED IRP PORTFOLIO[1]



Bags = Broadway Avenue Gas Turbines
ELG = Effluent Limitations Guidelines
MW = Megawatt

[1]Subject to change based on availability and approval

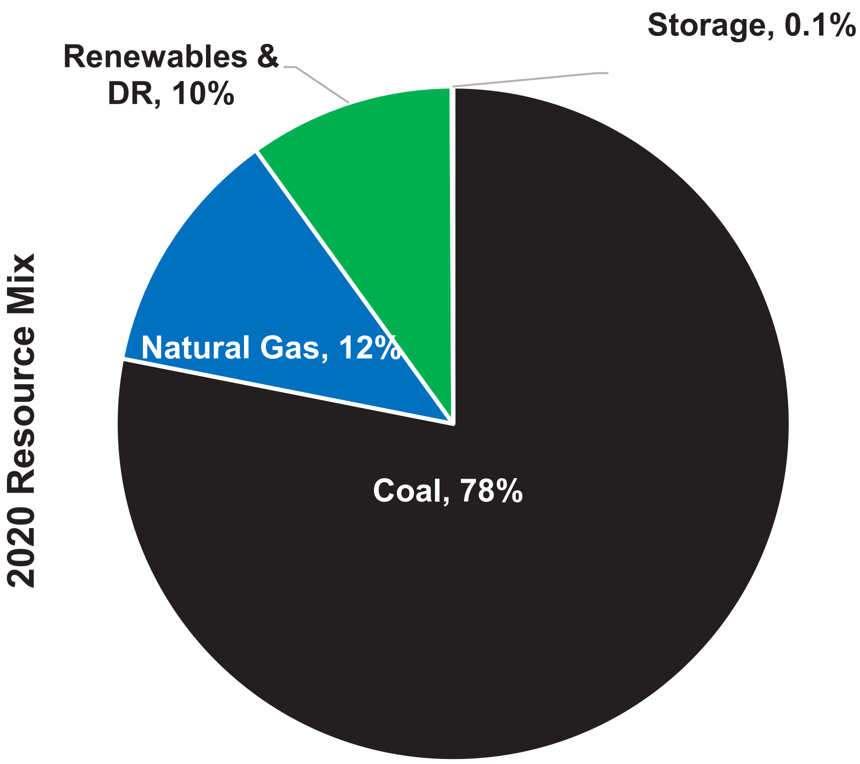
WHY WAS THIS PORTFOLIO CHOSEN?

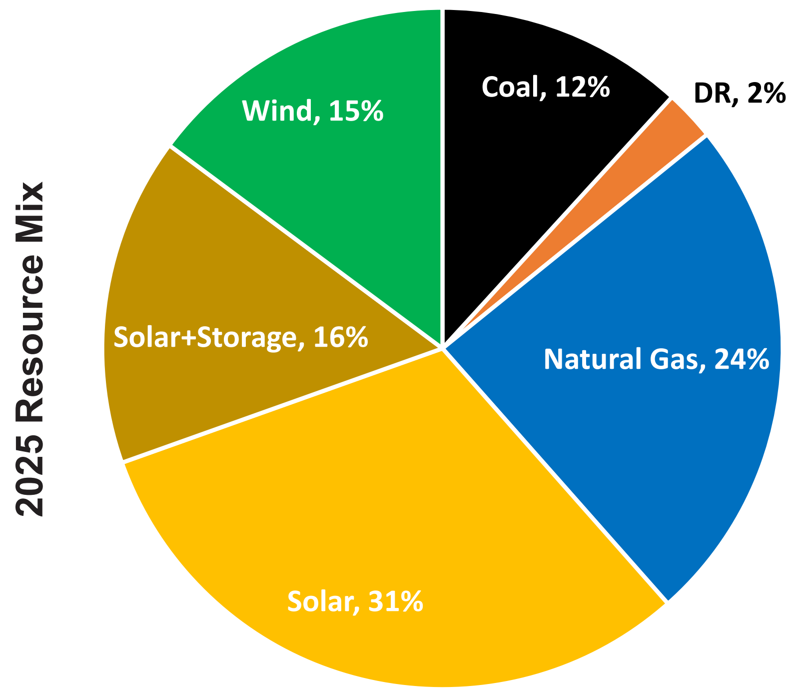
- Preferred portfolio[1] replaces 730 MWs of coal with approximately 700-1,000 MWs of Solar & Solar + Storage, 300 MWs of Wind, 460 MWs of gas Combustion Turbines (CT) and 30 MWs of Demand Response (DR) (aka High Technology Portfolio[2])
- Preferred portfolio provides the following characteristics:
  - Reliability: dispatchable capacity and energy that is available on demand
  - Cost effective: net present value (NPV) that is among the lowest portfolios in the near, mid, and long-term; saving up to $320 million over the next 20 years
  - Flexibility: ability to meet future load needs via additional resources, including renewables
  - Diversity: capacity and energy from a blend of renewables, coal and natural gas
  - Regulatory risk mitigation and sustainability: a lower NPV and reduces CO_2 nearly 75% by 2035 over 2005 levels
  - Timely: CTs can come online in 2024, thereby reducing market reliance and in-service lag, to replace coal generation that retires in 2023

[1]Large build out of renewable generation helps to replace energy from coal generation., while combustion turbines help to replace a portion of dispatchable capacity from the coal units.
[2] The preferred portfolio was created utilizing the High Technology future scenario. The preferred portfolio is also referenced as the High Technology Portfolio throughout this presentation.

PREFERRED PORTFOLIO RESOURCE MIX

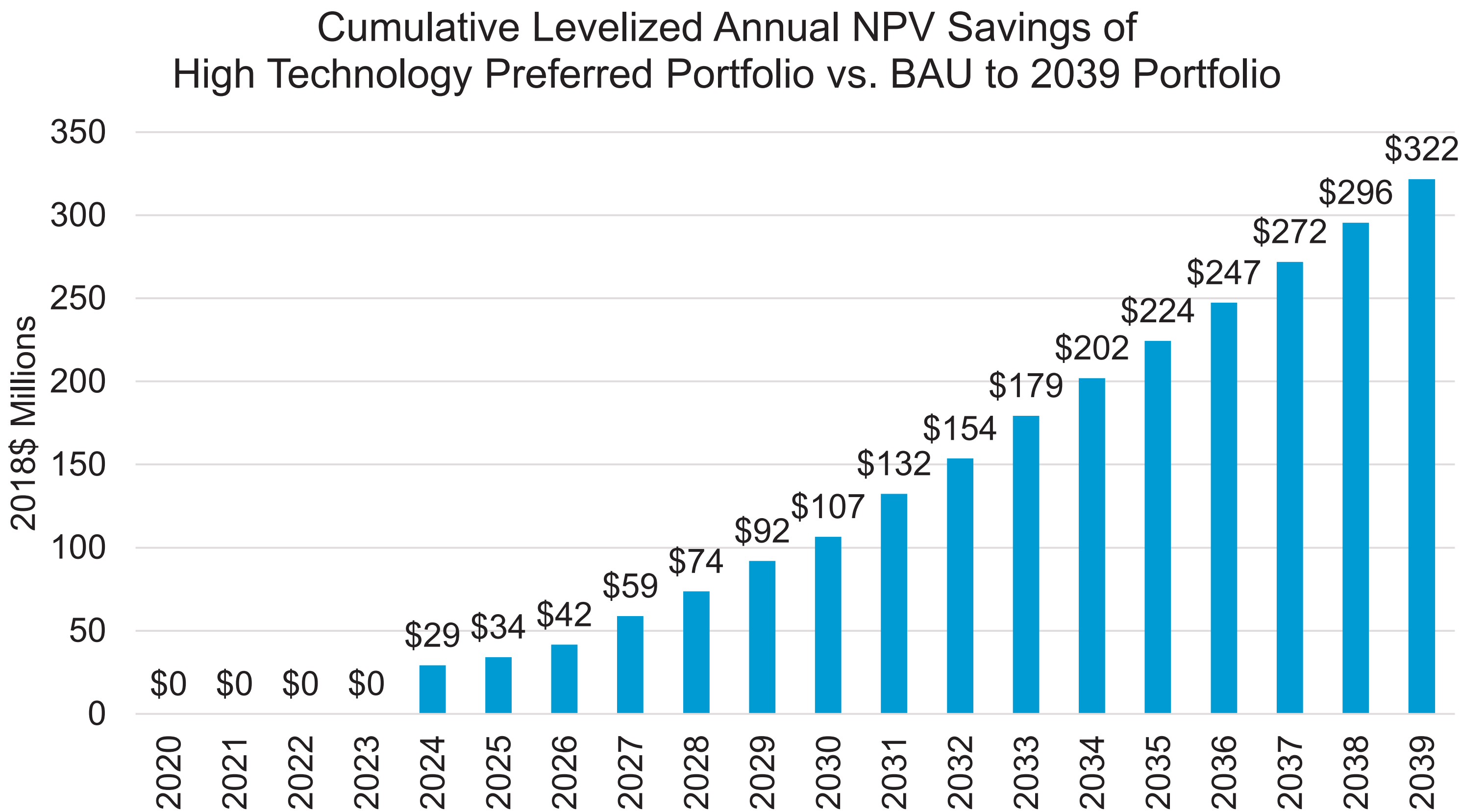
Shift in total installed capacity from 90% fossil to 36%, while renewables and DR increase from 10% to 64%. Near term transition to a diverse set of resources better positions Vectren for the future by 2025, while maintaining the reliability that our customers expect





PREFERRED PORTFOLIO SAVINGS VS. BAU TO 2039 PORTFOLIO

The High Technology (preferred) portfolio provides an annual average savings of $20 million (2024-2039) compared to the Business as Usual to 2039 portfolio and a cumulative savings of more than $320 million in constant NPVRR 2018$.



DIFFERENT DIRECTION FROM 2016 IRP

In 2016, Vectren selected a Large 2x1 CCGT (700-850 MWs). In 2020, the preferred portfolio includes a large build out of renewable resources, providing low cost energy, backed up by 2 highly flexible combustion turbines that provide low cost capacity.

- Lower relative customer impact than many of the portfolio options
- More diverse set of resources, including wind, solar, battery energy storage, EE, DR, gas, and coal
- Faster construction than a CCGT, offsetting market risk more quickly
- Less greenhouse gas emissions and water usage
- Lower dependence on expected market sales to lower cost to customer
- Better support in a high intermittent solar penetration environment (faster ramp)
- Modern CTs have a better heat rate than existing Vectren CTs and coal units

PREFERRED PORTFOLIO ADDITIONS AND RETIREMENTS

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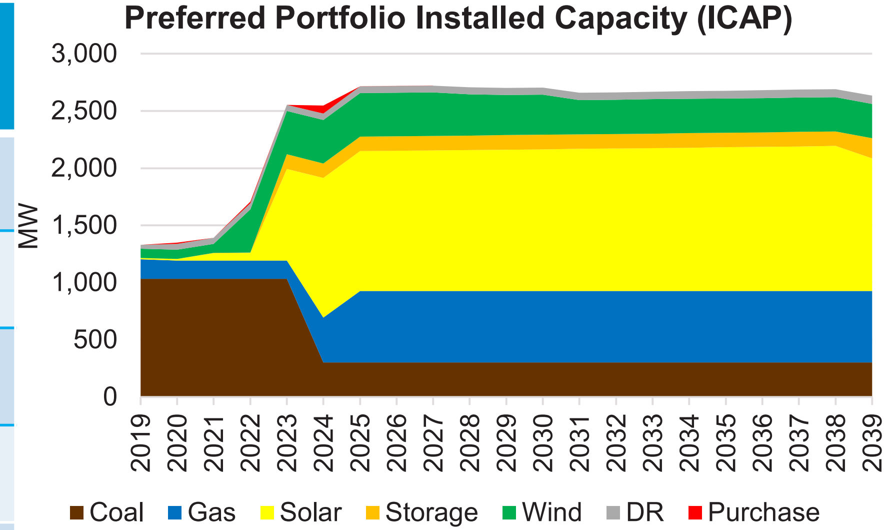
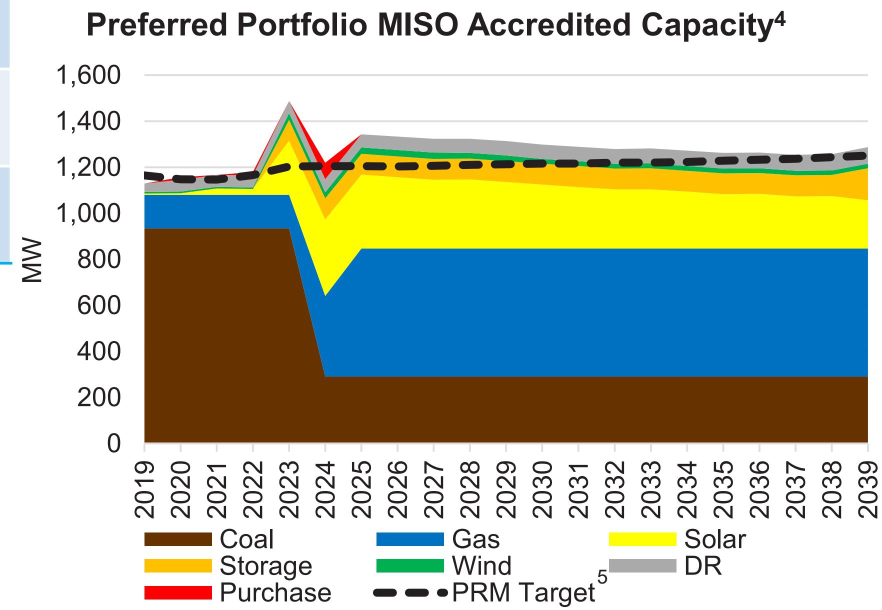
2025-2026 Planning Year	ICAP (MW)	% ICAP	Accred-itation[1]	2025-2026 UCAP (MW)	% UCAP
Coal	302	12%	96%	290	22%
DR[1]	62	2%	100%	62	5%
Natural Gas	622	24%	89%	553	41%
Solar[2]	796	31%	26%	207	16%
Solar+ Storage[3]	400	16%	48%	194	15%
Wind	380	15%	7%	28	2%
Total Resources	2,562	100%		1,333	100%

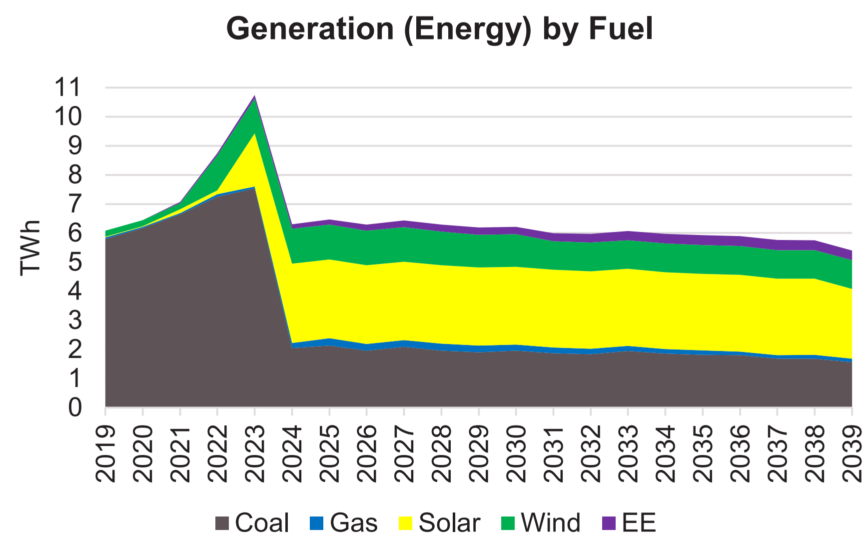
[1] ≈35 MWs at risk due to MISO operational changes
[2] Solar accreditation may vary depending on penetration
[3] UCAP credit includes 90 MW 4-hour battery. Modeled as 126 MW 3-hour battery, consistent with bids
[4] Unforced Capacity (UCAP)
[5] Assumes coincident peak factor of 95.99%, PRM% 8.9%, and Transmission losses of 1.7%

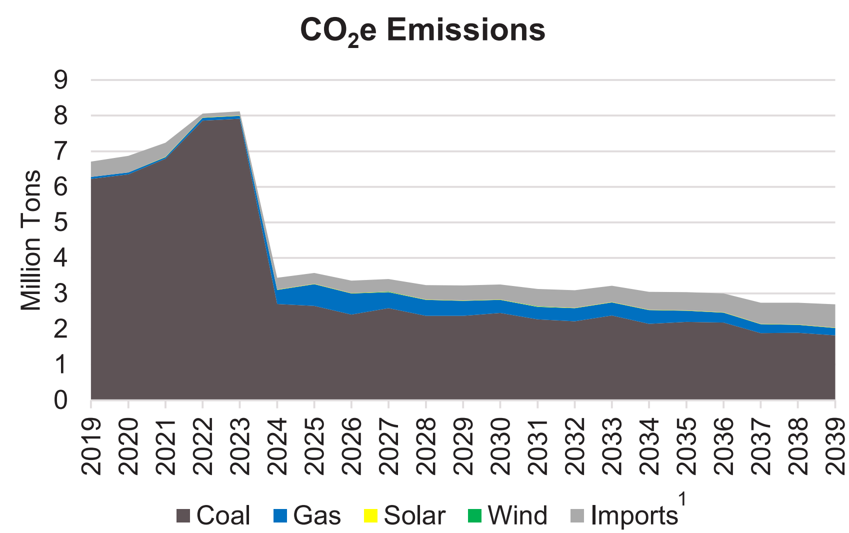




PREFERRED PORTFOLIO ANNUAL GENERATION AND EMISSIONS

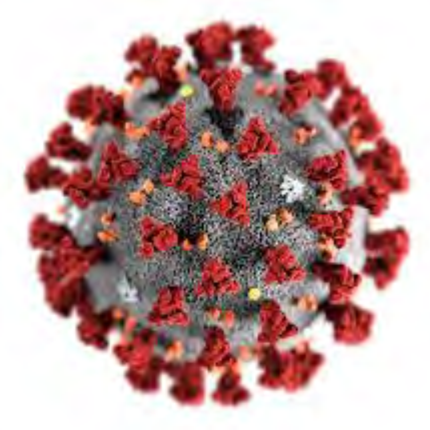
- Generation will shift significantly from coal to renewable resources in the near term, reducing variable fuel costs. Nearly two thirds of total energy produced by 2025 will come from renewable resources.
- The coal retirements and exit by December 31, 2023 result in a significant decline in lifecycle CO_2e emissions. Market imports are estimated to comprise a quarter of portfolio CO_2e emissions by the end of the forecast period





[1] Not produced by Vectren generating resources. Estimate based on projected market reliance, MISO buildout, and NREL lifecycle GHG study

COVID AND THE PLAN



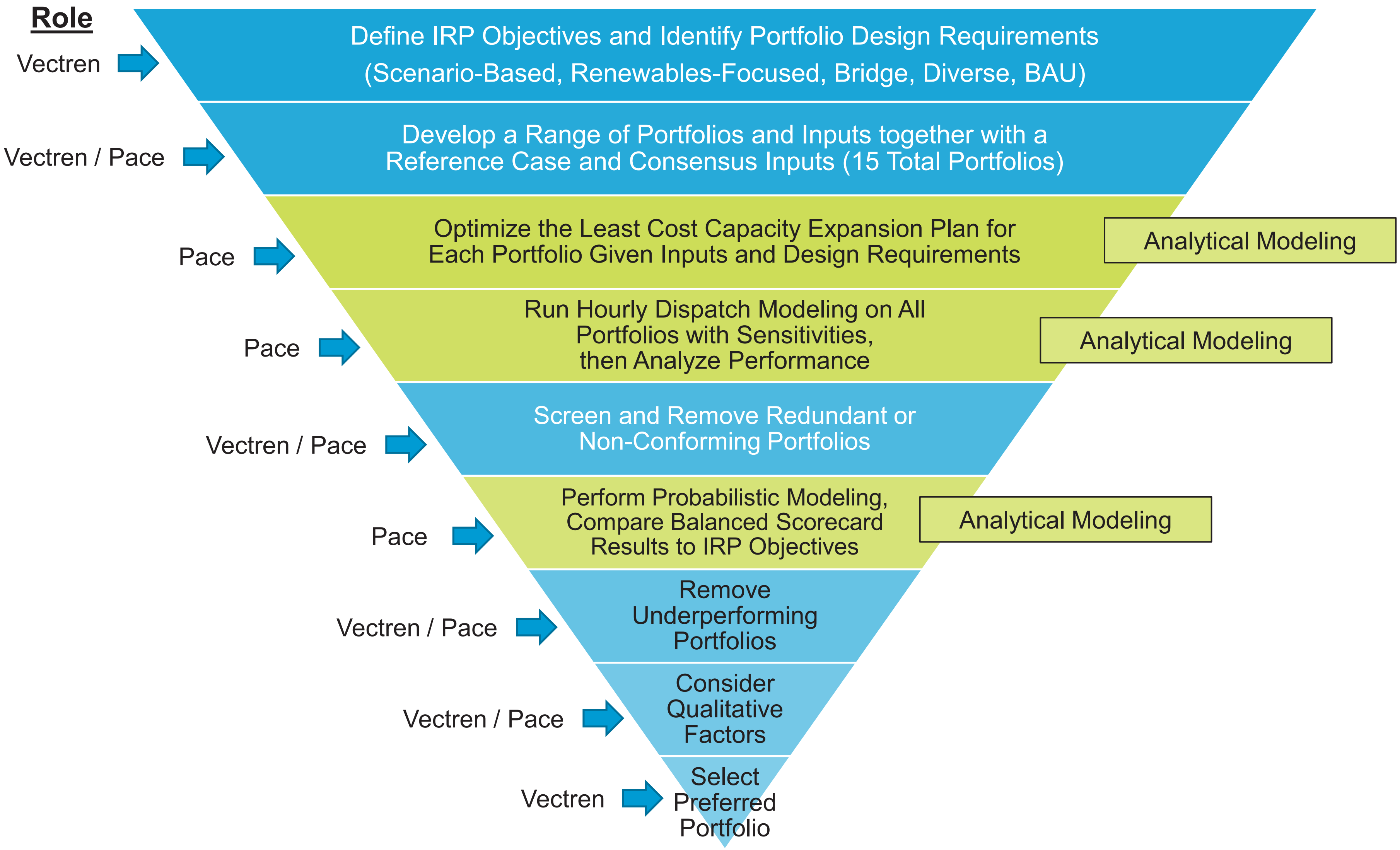
- Vectren will continue to monitor the COVID-19 situation
- Too soon to understand all of the long term impacts; however, the plan is well positioned to meet customer needs in the near, mid, and long-term
  - Flexible
    - Mix of owned resources and term-based PPAs
  - Performed well across multiple future states
  - Numerous resources in spread over several locations and most resources can be operated remotely
  - Less costly to customers than the status quo

RISK ANALYSIS

PETER HUBBARD

PACE GLOBAL, MANAGER SIEMENS ENERGY BUSINESS ADVISORY

IRP PORTFOLIO EVALUATION AND SELECTION PROCESS



STRUCTURED SCREENING PROCESS TO ADDRESS ISSUES EFFICIENTLY

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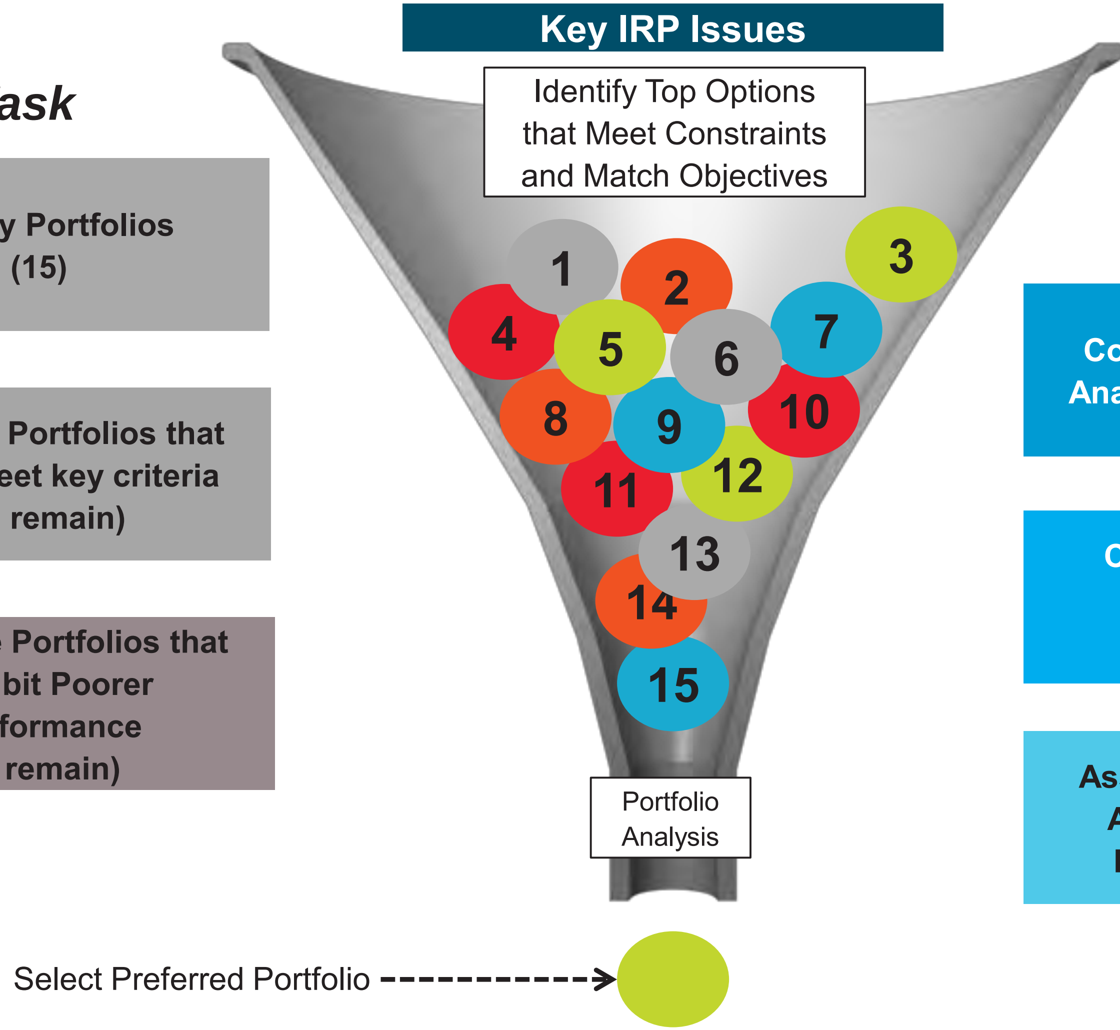
Task

Identify Portfolios (15)

Eliminate Portfolios that do not meet key criteria (10 remain)

Eliminate Portfolios that Exhibit Poorer Performance (4 remain)



Approach

Conduct Deterministic Analysis of 15 portfolios

Conduct Stochastic Analysis (200 iterations)

Assess Most Important Attributes to Select Preferred Portfolio

15 OPTIMIZED PORTFOLIOS DEVELOPED

Portfolio	Group	Portfolio
1	Reference	Optimized Portfolio in Reference Case conditions
2	BAU	Business as Usual to 2039
3		Business as Usual to 2029
4	Bridge	ABB1 Conversion to Gas
5		ABB1 + ABB2 Conversions to Gas
6		ABB1 Conversion to Gas + Small CCGT
7	Diverse	Diverse with Renewables, Coal, Small CCGT
8		Diverse with Renewables, Coal, Medium CCGT
9	Renewables	Renewables + Flexible Gas
10		All Renewable by 2030 (No Fossil)
11		HB 763 (High CO_2 Price)[1]
12	Scenario-Based	Optimized Portfolio in Low Regulatory conditions, Dispatched with Ref Case
13		Optimized Portfolio in High Technology conditions, Dispatched with Ref Case
14		Optimized Portfolio in 80% Reduction conditions, Dispatched with Ref Case
15		Optimized Portfolio in High Regulatory conditions, Dispatched with Ref Case

1 Created based upon stakeholder request. Utilized reference case assumptions with updated CO_2 price based on House Bill 763

STRATEGIES CONSISTENT ACROSS MAJORITY OF PORTFOLIOS

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The full analytical process informed the development of several strategies that are consistent across portfolios:

- Optimized results
  - Pursue universal solar capacity of up to ~1,000 MW through 2024
  - Pursue universal wind capacity of up to 300 MW by 2023
  - Retire A B Brown 1 and 2 and F B Culley 2 units by the end of 2023
- Pursue Energy Efficiency at 1.25% of eligible sales (+ Low Income measures) for the first three years and Demand Response resources (Summer Cycler switch out to Wi-Fi thermostats). Applied to all portfolios.
  - Did not want to rely solely on reference case conditions to decide the appropriate level of EE. The reference case selected 0.75% EE, while other scenarios selected 1.25%
  - 1.25% More consistent with historic levels
  - 1.25% vs 0.75% increases NPVRR by only 0.15%

SUMMARY RESULTS FROM ALL PORTFOLIO DETERMINISTIC RUNS

Renew
Gas
Coal
EE,DG
Purchase

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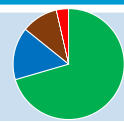
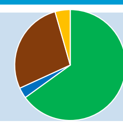
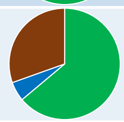
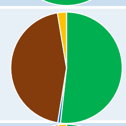
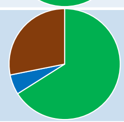
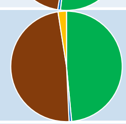
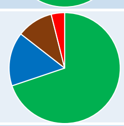
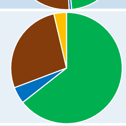
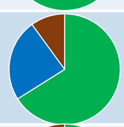
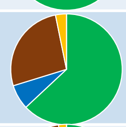
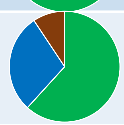
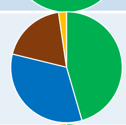
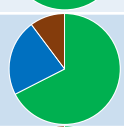
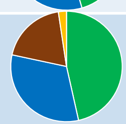
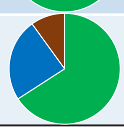
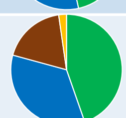
	Portfolio	Portfolio Capacity Mix in 2026	Generation in 2026	NPV $Billion * (% vs. Ref Case)	Net Sales as % of Generation	Average Capacity Mkt Purchases (2024-39)
Ref.	Reference Case			$2.625	7%	138 MW
BAU	Business as Usual to 2039			$3.140 (+19.6%)	23%	0 MW
	Business as Usual to 2029			$2.835 (+8.0%)	19%	102 MW
Bridge	Gas Conversion ABB1			$2.727 (+3.9%)	9%	133 MW
	Gas Conversion ABB1 + ABB2			$2.887 (+10.0%)	11%	56 MW
	Gas Conversion ABB1 + CCGT			$2.954 (+12.6%)	37%	16 MW
Diverse	Diverse Small CCGT			$2.763 (+5.2%)	38%	23 MW
	Diverse Medium CCGT			$2.785 (+6.1%)	41%	18 MW

Increasing CCGT size added cost and market exposure without an increase in portfolio reliability or other value

* Deterministic NPV not used for final Affordability metric

SUMMARY RESULTS FROM ALL PORTFOLIO DETERMINISTIC RUNS

- Renew
- Gas
- Coal
- EE,DG
- Purchase

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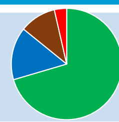
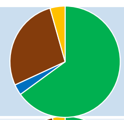
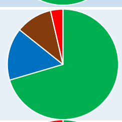
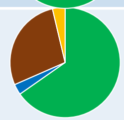
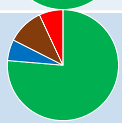
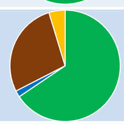
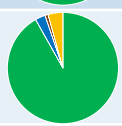
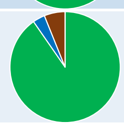
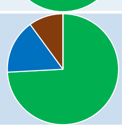
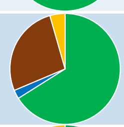
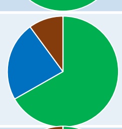
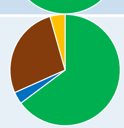
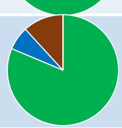
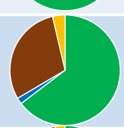
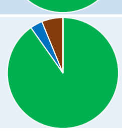
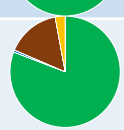
	Portfolio	Portfolio Capacity Mix in 2026	Generation in 2026	NPV $Billion * (% vs. Ref Case)	Net Sales as % of Generation	Average Capacity Mkt Purchases (2024-39)
Ref.	Reference Case			$2.625	7%	138 MW
Renewables	Renewables + Flexible Gas			$2.600 (-1.0%)	6%	135 MW
	Renewable 2030			$2.679 (+2.1%)	10%	170 MW
	HB 763			$1.425 (-45.7%)	105%	10 MW
Scenario	Low Regulatory			$2.762 (+5.2%)	46%	12 MW
	High Technology (Preferred Portfolio)			$2.686 (+2.3%)	6%	4 MW
	80% Reduction			$2.642 (+0.7%)	36%	203 MW
	High Regulatory			$4.196 (+59.9%)	117%	10 MW

Unrealistic Net Sales Revenue

High Net Sales

Market Exposure

High Cost and High Net Sales

* Deterministic NPV not used for final Affordability metric

STRUCTURED SCREENING PROCESS TO ADDRESS ISSUES EFFICIENTLY

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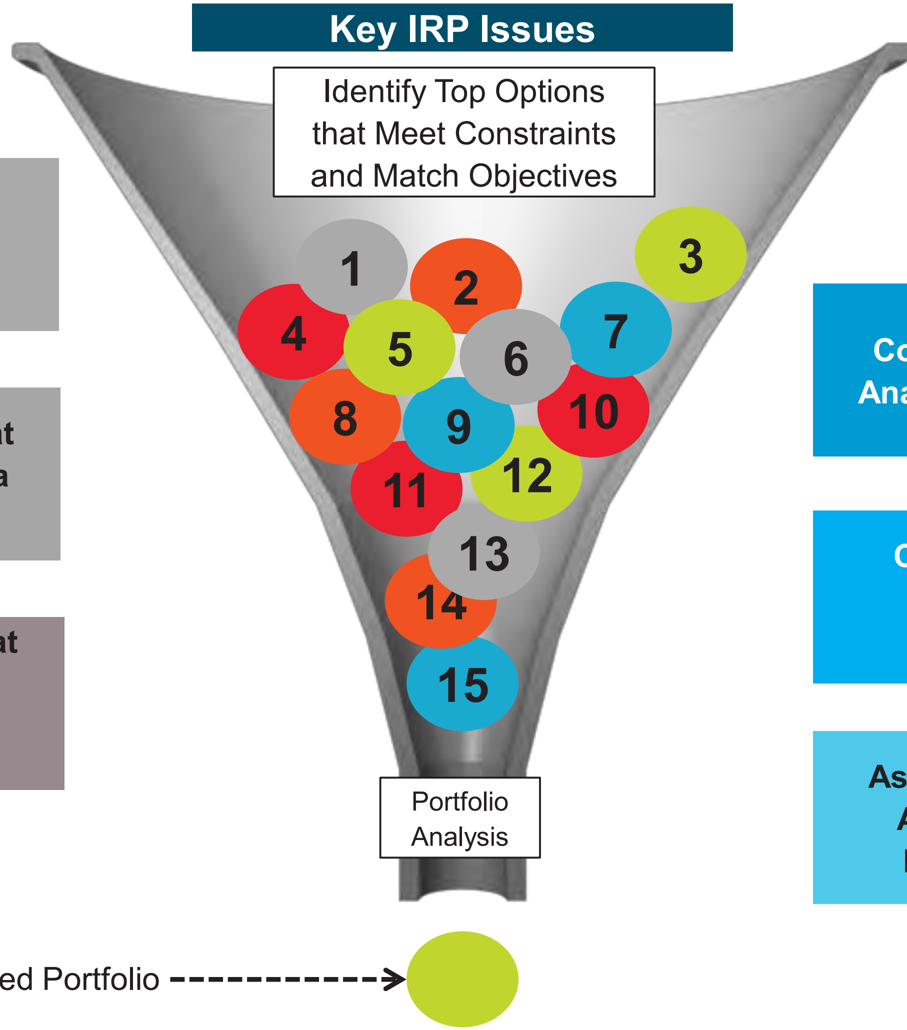
Task

Identify Portfolios (15)

Eliminate Portfolios that do not meet key criteria (10 remain)

Eliminate Portfolios that Exhibit Poorer Performance (4 remain)



Select Preferred Portfolio

Approach

Conduct Deterministic Analysis of 15 portfolios

Conduct Stochastic Analysis (200 iterations)

Assess Most Important Attributes to Select Preferred Portfolio

SENSITIVITIES WERE CONDUCTED TO FURTHER UNDERSTAND AND REFINE THE PORTFOLIOS

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- Each portfolio was optimized on a seasonal peak demand construct to ensure resource adequacy as peak capacity credit declines for renewables. All portfolios had sufficient seasonal resources
- Solar costs were increased 30% to determine continued economic selection and were found to be economic
- Sensitivities on the Reference Case by replacing the only CT capacity with battery storage:
  - Replacing the CT with battery storage increased portfolio costs by $51 million
  - CT provided long-duration capacity vs. 4 hour limit with battery storage

SENSITIVITY: NPV COST OF PORTFOLIOS DISPATCHED IN ALTERNATIVE SCENARIOS

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20-Year Net Present Value - Percentage of Reference Case

	Reference Case	Low Regulation	High Technology	80% Reduction of CO2 by 2050	High Regulation
Reference Case	100.0%	100.0%	100.0%	100.0%	100.0%
Business as Usual to 2039	119.7%	101.2%	120.7%	117.1%	112.5%
Business as Usual to 2029	108.0%	100.9%	108.5%	106.4%	104.8%
ABB1 Conversion + Small CCGT	112.6%	112.6%	111.5%	111.2%	107.4%
ABB1 Conversion	103.9%	104.5%	104.5%	103.9%	102.0%
ABB1 + ABB2 Conversions	110.0%	110.0%	110.1%	109.9%	105.5%
Diverse Small CCGT	105.3%	105.3%	104.2%	103.5%	102.7%
Renewables + Flexible Gas	98.4%	101.4%	98.2%	98.1%	97.7%
All Renewables by 2030	101.4%	108.2%	105.0%	100.5%	94.3%
Preferred Portfolio	102.3%	102.6%	101.3%	102.1%	102.2%

Alternative Scenario Changes vs. Ref Case

Scenario	Load	CO2 Prices	Gas Prices	Coal Prices	RE Cost
Low Reg	Higher	N/A	Higher	Ref	Ref
High Tech	Higher	Lower	Lower	Lower	Lower
80%	Lower	Ref	Ref	Lower	Lower
High Reg	Ref	Higher	Very High	Lower	Lower

STRUCTURED SCREENING PROCESS TO ADDRESS ISSUES EFFICIENTLY

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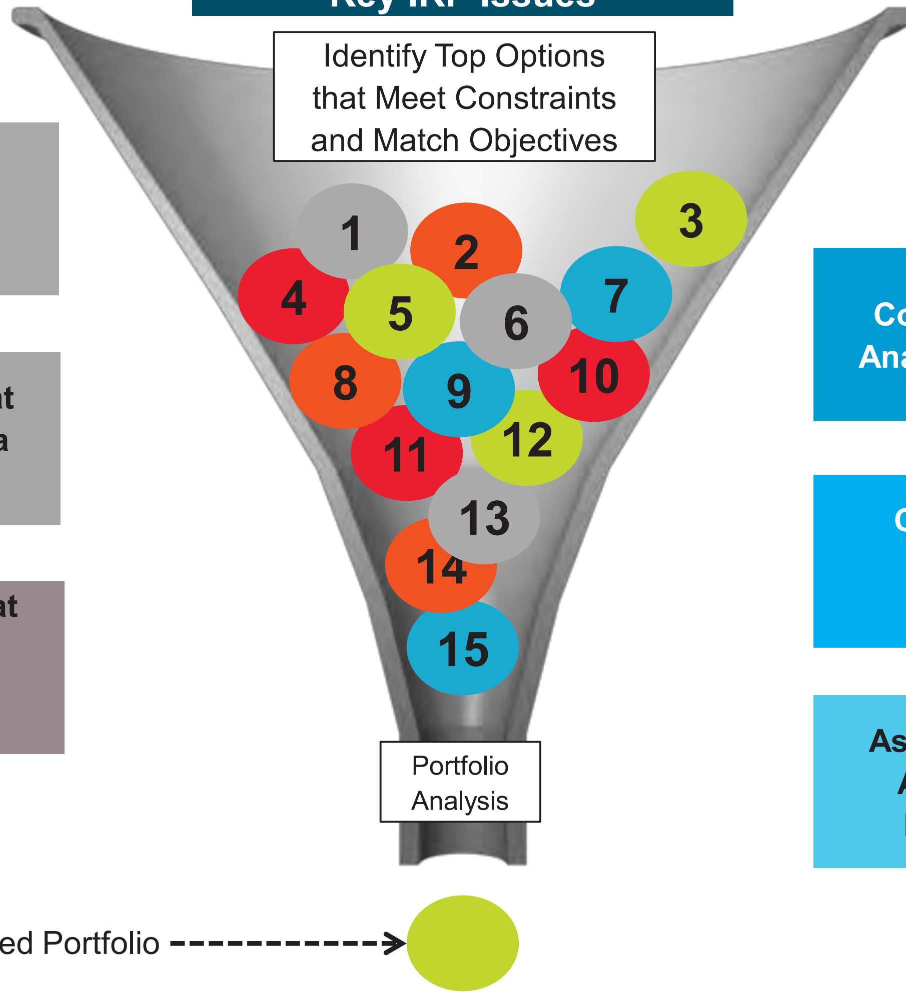
Key IRP Issues



Task

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Eliminate Portfolios that do not meet key criteria (10 remain)

Eliminate Portfolios that Exhibit Poorer Performance (4 remain)

Approach

Conduct Deterministic Analysis of 15 portfolios

Conduct Stochastic Analysis (200 iterations)

Assess Most Important Attributes to Select Preferred Portfolio

Select Preferred Portfolio

BALANCED SCORECARD RESULTS OF PROBABILISTIC ANALYSIS

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- Each portfolio was then dispatched 200 times under varying market conditions, with results populating a Balanced Scorecard (green=better scoring).

Balanced Scorecard	Stochastic Mean 20-Year NPVRR	95th Percentile Value of NPVRR	% Reduction of CO2e (2019-2039)	Energy Purchases as a % of Generation	Energy Sales as a % of Generation	Capacity Purchases as a % of Peak Demand	Capacity Sales as a % of Peak Demand
Reference Case	$2,536	$2,919	58.1%	16.8%	26.8%	9.7%	1.2%
Business as Usual to 2039	$2,912	$3,307	35.2%	12.0%	36.5%	0.1%	11.1%
Business as Usual to 2029	$2,689	$3,090	61.9%	15.2%	31.4%	7.1%	4.3%
ABB1 Conversion + Small CCGT	$2,872	$3,268	47.9%	6.6%	31.8%	1.3%	10.1%
ABB1 Conversion	$2,675	$3,045	61.5%	19.2%	26.4%	9.3%	1.2%
ABB1 + ABB2 Conversions	$2,834	$3,212	61.5%	18.5%	27.5%	4.0%	5.6%
Diverse Small CCGT	$2,680	$3,071	47.9%	6.4%	31.1%	1.7%	3.7%
Renewables + Flexible Gas	$2,526	$2,926	77.4%	21.5%	27.7%	9.4%	1.2%
All Renewables by 2030	$2,613	$3,002	79.3%	26.1%	31.9%	11.9%	1.7%
High Technology (Preferred Portfolio)	$2,590	$2,978	59.8%	16.7%	26.9%	0.4%	4.6%

- Several portfolios (marked in red) were not considered further due to high cost, high price risk, over-reliance on the market for sales and associated revenues, or over-exposure to market purchases and associated costs.

REMAINING OPTIONS A BETTER OPTION FOR CUSTOMERS THAN CONTINUING COAL OR CONVERSION

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Continuing use of the Brown units with Coal or Bridge options (Conversion) did not perform well in our analysis.

- Less Affordable – BAU and Conversion options cost customers more over the twenty year period than 4 remaining portfolios in all scenarios.
  - Higher O&M –requires more people to operate
  - Higher on-going capital expenditures to keep the units running
  - Less flexibility to capture benefits of the market
- Continuing to utilize coal has a higher initial capital investment than remaining options. Conversion has slightly less upfront capital investment. Due to On-going capital expenditures to keep these options running, the remaining book life of these assets do not fully depreciate
- Less Flexible – slow start time (8-24 hrs.) and slow ramp rate (2-3 MW/Min) do not position us well to support our customers in a future with high solar penetration
- Less Reliable – converted units continue to utilize old equipment that is prone to break down more than new equipment
- Less efficient – conversion is of units designed to burn coal has a worse heat rate (11,200) than modern combustion turbines. New CTs (9,900) have a better heat rate than existing Brown coal units (10,500) and existing peaking units (12,200)

OPTIMIZED PORTFOLIO BUILDOUTS & RETIREMENTS

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Year	Reference Case	Renewables + Flexible Gas	Renewables 2030	High Technology
2021-23	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency
2022	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)
2023	New Solar (731 MW), New Storage (126 MW)	New Solar (731 MW) New Storage (126 MW)	New Solar (731 MW) New Storage (278 MW)	New Solar (731 MW) New Storage (126 MW)
2023	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)
2024	New Combustion Turbine (236 MW)	New Combustion Turbine (236 MW)	-	New Combustion Turbine (236 MW)
2024	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response
2024-26	0.75% Energy Efficiency	0.75% Energy Efficiency	1.00% Energy Efficiency	0.75% Energy Efficiency
2025		-	-	New Combustion Turbine (236 MW)
2027-39	0.75% Energy Efficiency	0.75% Energy Efficiency	1.00% Energy Efficiency	0.75% Energy Efficiency
2029-32	-	-	Retire FBC3, ABB3, ABB4 (427 MW), New Storage (360 MW), Solar (700 MW)	-
2033-39	New Solar (250 MW)	Retire FBC3 (270 MW), New Combustion Turbine (236 MW)	New Solar (450 MW)	New Storage (50 MW)
2024-39	Average Annual Capacity Market Purchases (137 MW)	Average Annual Capacity Market Purchases (135 MW)	Average Annual Capacity Market Purchases (170 MW)	Average Annual Capacity Market Purchases (4 MW)

BALANCED SCORECARD RESULTS OF PROBABILISTIC ANALYSIS

The four remaining portfolios were evaluated under a range of factors including metrics and other factors.

Balanced Scorecard	Stochastic Mean 20-Year NPVRR	95th Percentile Value of NPVRR	% Reduction of CO2e (2019-2039)	Energy Purchases as a % of Generation	Energy Sales as a % of Generation	Capacity Purchases as a % of Peak Demand	Capacity Sales as a % of Peak Demand
Reference Case	$2,536	$2,919	58.1%	16.8%	26.8%	9.7%	1.2%
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High Technology (Preferred Portfolio)	$2,590	$2,978	59.8%	16.7%	26.9%	0.4%	4.6%

The High Technology portfolio performed well across all factors in the balanced scorecard and was selected as the preferred portfolio. It hedges risk well against the energy and capacity markets relative to the remaining portfolios and maintains the flexibility.

- The reference case has a long term reliance on the capacity market, is less reliable (1 CT vs 2), less able to ramp in high renewables penetration environment, and provides less flexibility in the future
- The principal difference between the renewables + flexible gas portfolio and the preferred portfolio was a heavy reliance on market capacity purchases and the retirement date of Culley 3. Would lose $50M in construction efficiencies on building the 2nd CT (not reflected in NPVRR)
- The all renewables portfolio by 2030 would require an additional $20-30M in reliability upgrades (not reflected in NPVRR), relies heavily on emerging technology, and is very exposed to the capacity and energy markets

QUALITATIVE CONSIDERATIONS: THE PREFERRED PORTFOLIO IS A GOOD OPTION FOR CUSTOMERS

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The preferred portfolio offers a transition pathway away from coal while providing the optionality to adapt to future technology and market changes. This diverse set of resources offers customers the benefit of clean renewable energy, with the reliability required by our customers.

- Two highly dispatchable combustion turbines (460 MW) allow for a high penetration of renewables, ensuring reliability and hedges against the energy and capacity markets
  - Assurance of reliable service. Thermal resources are still needed to maintain reliable service in multiday periods of cloud cover and no wind
  - Two CTs provide better support than one. Better coverage should a unit go down to provide a hedge against high energy prices and provide system support when issues arise
  - Two CTs keeps existing interconnection rights, which shields customers from potential transmission upgrade costs in the future should Vectren have to re-enter the MISO Queue (a three year process)
  - Two CTs provide fast start (10 min) & more fast ramping capability (80 MW/minute vs 40 MW/minute) to support for intermittent solar and allows for a smooth transition into a renewables future locally and regionally as the MISO system adapts to higher levels of renewables across the system
  - Two CTs replace required capacity and shields customers from potential future high capacity prices in the MISO market
  - Two CTs built at the same time provide $50M in construction cost savings vs. a 10 year delay of the 2nd CT (Renewables + Flexible Gas Portfolio – not reflected in NPVRR)
  - Two CTs provide a high degree of flexibility in the future

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NEXT STEPS

JUSTIN JOINER

VECTREN DIRECTOR OF
POWER SUPPLY SERVICES

CONTINUE MONITORING EXTERNAL DEVELOPMENTS AND FACTORS

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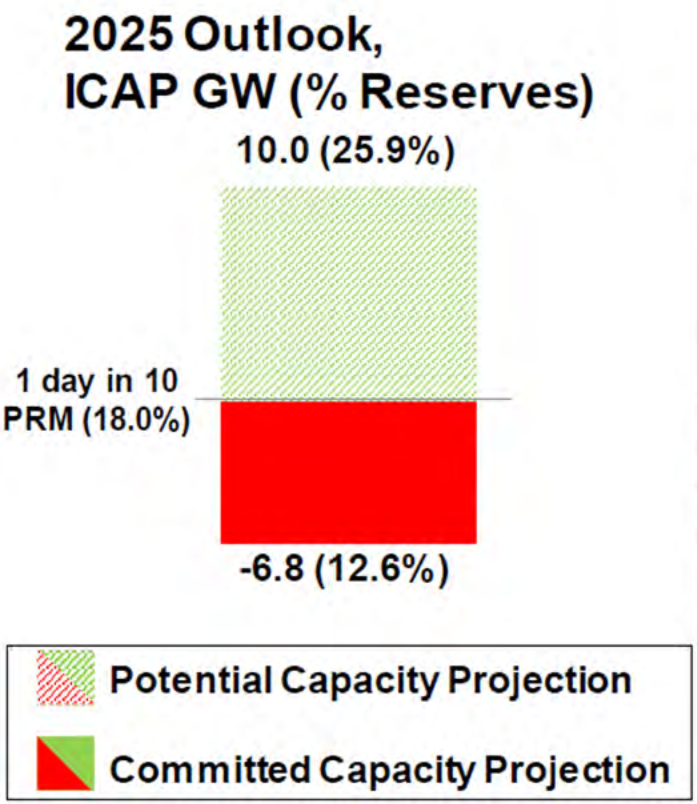
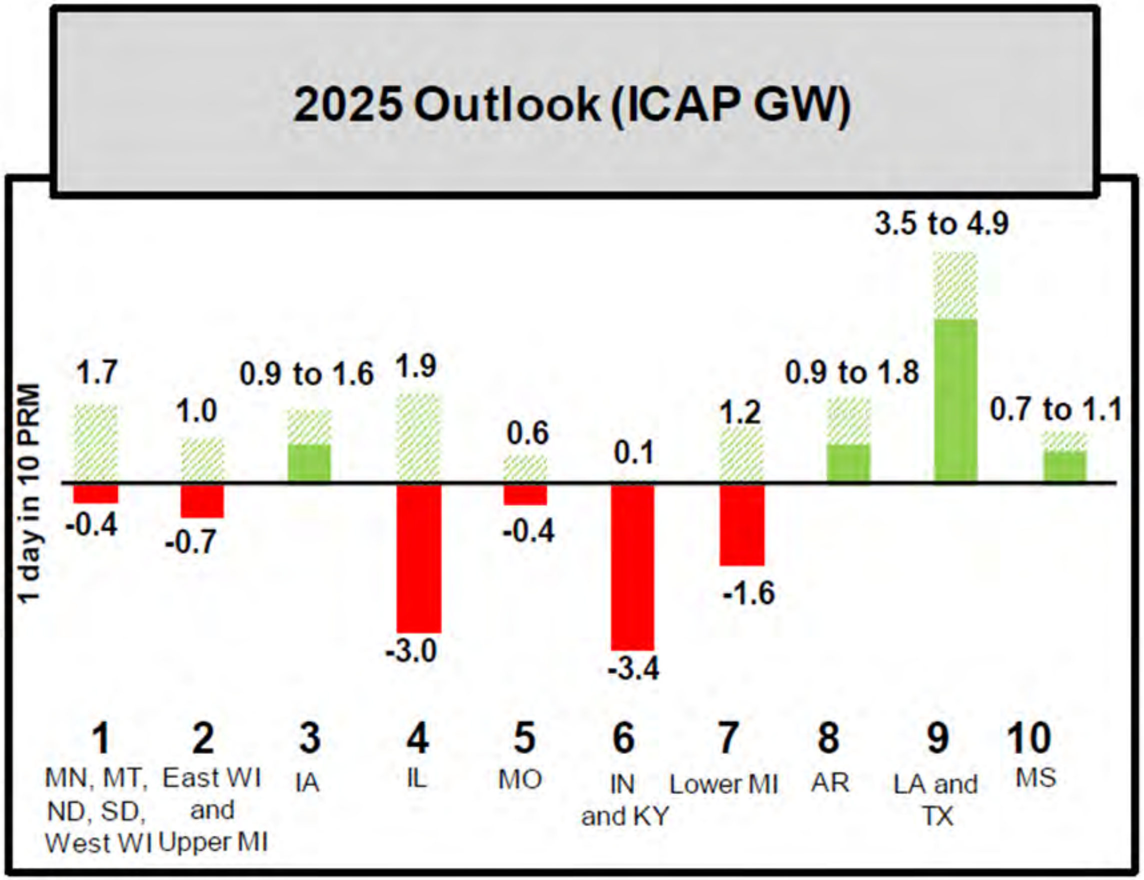
Will continue to evaluate the paradigm shift underway in the industry towards renewables, while the Preferred Portfolio provides needed flexibility, reliability, diversity and affordability that is needed to accommodate

- **Customer**
  - Demand for clean energy and emerging technology
  - ESG goals and requirements
- **State of Indiana**
  - Announced and recently completed generation retirements
  - Legislative taskforce
  - Economic development
- **MISO**
  - Resource adequacy now and in the future
  - Wholesale energy market construct now and in the future
  - Transmission system configuration ability to meet needs now and in the future

2020 OMS-MISO SURVEY RESULTS

Latest Resource Adequacy results demonstrate the generation shift underway MISO-wide and that is carried out through unit retirements and new generation builds, thus producing less certainty in future years around available capacity





*Per June MISO presentation of 2020 OMS-MISO Survey results

- Regional surpluses and potential resources will be critical for all zones to serve their deficits while meeting local requirements
- Positions include reported inter-zonal transfers, but do not reflect other possible transfers between zones
- Exports from Zones 8, 9, and 10 were limited by the Sub-regional Power Balance Constraint

NEXT STEPS

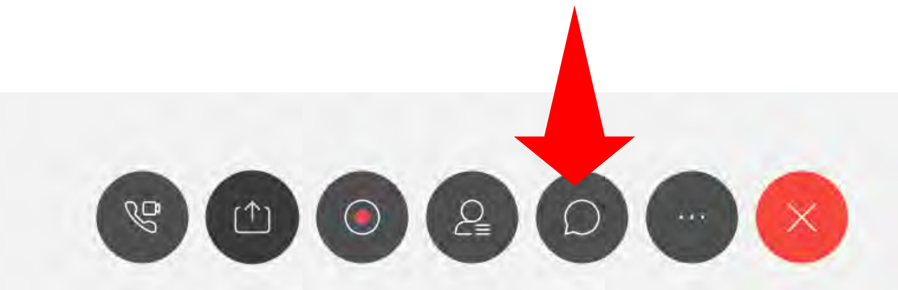
To maximize the $320M in customer savings that the Preferred Portfolio presents, an action plan is in place that is focused on two phases

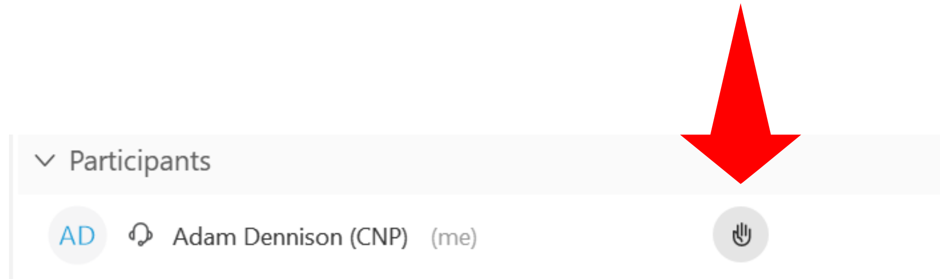
- **Near-term: next 6 months**
  - Enter into agreements with the most attractive projects received from 2019 All-Source RFP
    - To maximize tax credits for our customers, projects must be under-construction/in-service soon
  - Conduct a second RFP in the Fall to address remaining renewable needs identified in IRP
  - Continue monitoring state developments; Statewide Resource Plan, Legislative Taskforce, COVID-19
- **Mid-term: next 12 months**
  - File Certificate of Public Convenience and Necessity (CPCN) in 2021
  - Begin permitting, civil engineering and preliminary site work for Combustion Turbines
    - Multi-year process
  - Continue advancement and refinement of renewable energy expertise
    - Work with developers to understand project attributes and ensure quality control and price certainty
    - Evaluate pricing of battery and determine appropriate timing install
    - Apply insights gained to future projects

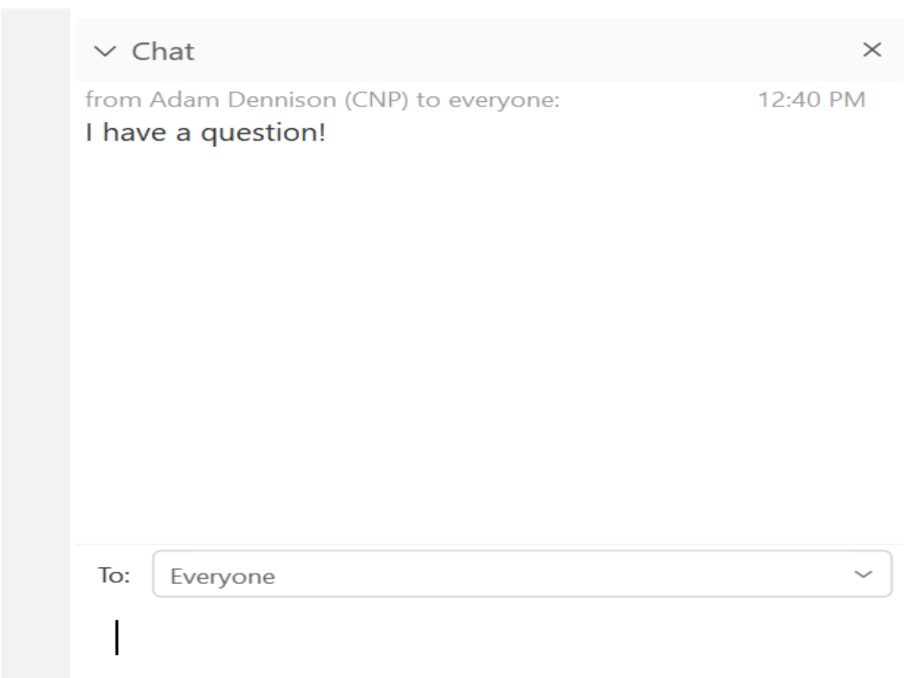
Q&A

Ask “everyone” in chat.

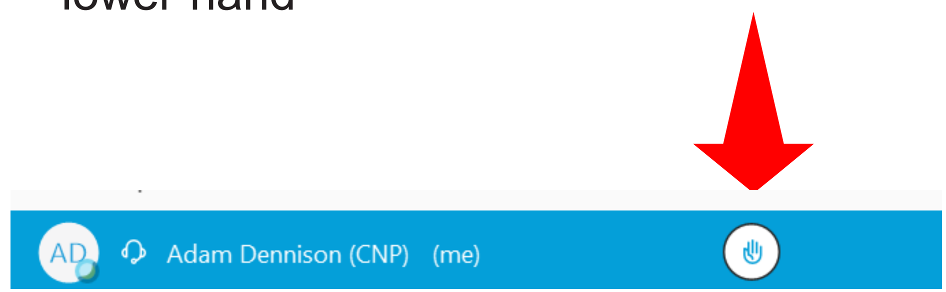
Raise Hand for a Follow-up







After question has been answered, lower hand



STAKEHOLDER COMMENT PERIOD

Speakers who have signed up ahead of the meeting will be allotted time to verbally provide comments (consider designating a speaker for each organization). Please type, I would like to make a comment in chat if you did not sign up early. We will accommodate as many requests as possible. Please pay attention to the on-screen prompts in order to allow for as many comments as possible.

One Minute

Two Minutes

Next Speaker

APPENDIX

OPTIMIZED PORTFOLIO BUILDOUTS & RETIREMENTS

Year	Reference Case	Business as Usual to 2039	Business as Usual to 2029	Gas Conversion ABB1	Gas Conversion ABB1 + ABB2
2021-23	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency
2022	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)
2023	New Solar (731 MW), New Storage (126 MW)	New Solar (731 MW), New Storage (126 MW)	New Solar (731 MW), New Storage (126 MW)	New Solar (731 MW), New Storage (126 MW)	New Solar (731 MW), New Storage (126 MW)
2023	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Scrubber control on ABB1 and ABB2, Exit Warrick (150 MW)	Exit Warrick (150 MW)	Retire ABB2, FBC2, Exit Warrick (485 MW)	Retire FBC2, Exit Warrick (240 MW)
2024	New Combustion Turbine (236 MW)	-	-	ABB1 Conversion (245 MW)	ABB1+ABB2 Conversions (490 MW)
2024	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response
2024-26	0.75% Energy Efficiency	0.75% Energy Efficiency	0.75% Energy Efficiency	0.75% Energy Efficiency	0.75% Energy Efficiency
2027-39	0.75% Energy Efficiency	0.25% Energy Efficiency	0.50% Energy Efficiency	0.75% Energy Efficiency	0.50% Energy Efficiency
2029-30	-	-	Retire ABB1, ABB2, FBC2 (580 MW), New Combustion Turbine (236 MW)	-	-
2033-34	-	-	-	Retire ABB1, New Combustion Turbine (279 MW)	Retire ABB1+ABB2, New Combustion Turbine (279 MW)
2037-39	New Solar (250 MW)	-	-	-	-
2024-39	Avg Annual Capacity Mkt Purchases (137 MW)	No Capacity Market Purchases	Avg Annual Capacity Mkt Purchases (101 MW)	Avg Annual Capacity Mkt Purchases (133 MW)	Avg Annual Capacity Mkt Purchases (56 MW)

OPTIMIZED PORTFOLIO BUILDOUTS & RETIREMENTS

VECTREN
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Year	Gas Conversion ABB1 + CCGT	Diverse Small CCGT	Diverse Medium CCGT	Renewables + Flexible Gas	Renewables 2030
2021-23	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency
2022	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)
2023	New Solar (731 MW) New Storage (126 MW)	New Solar (731 MW) New Storage (126 MW)	New Solar (731 MW) New Storage (126 MW)	New Solar (731 MW) New Storage (126 MW)	New Solar (731 MW) New Storage (278 MW)
2023	Retire ABB2, FBC2, Exit Warrick (485 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)
2024	ABB1 Conversion (245 MW)	-	-	New Combustion Turbine (236 MW)	-
2024	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response
2024-26	0.75% Energy Efficiency	0.75% Energy Efficiency	0.75% Energy Efficiency	1.00% Energy Efficiency	0.75% Energy Efficiency
2025	-	New Small CCGT (433 MW)	New Medium CCGT (497 MW)	-	-
2026	New Small CCGT (433 MW)	-	-	-	-
2024-26	0.50% Energy Efficiency	0.50% Energy Efficiency	0.25% Energy Efficiency	1.00% Energy Efficiency	0.75% Energy Efficiency
2029-32	-	-	-	-	Retire FBC3, ABB3, ABB4 (427 MW), New Storage (360 MW), Solar (700 MW)
2033-34	-	-	-	Retire FBC3 (270 MW), New Combustion Turbine (236 MW)	New Solar (450 MW)
2024-39	Avg Annual Capacity Mkt Purchases (16 MW)	Avg Annual Capacity Mkt Purchases (23 MW)	Avg Annual Capacity Mkt Purchases (18 MW)	Avg Annual Capacity Mkt Purchases (135 MW)	Avg Annual Capacity Mkt Purchases (170 MW)

OPTIMIZED PORTFOLIO BUILDOUTS & RETIREMENTS

VECTREN
A CenterPoint Energy Company

Year	HB 763	Low Regulatory	High Technology	80% Reduction of CO2 by 2050	High Regulatory
2021-23	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency	1.25% Energy Efficiency
2022	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)	New Wind (300 MW)
2023	New Solar (731 MW) New Storage (278 MW)	New Solar (731 MW) New Storage (278 MW)	New Solar (731 MW) New Storage (126 MW)	New Solar (731 MW) New Storage (202 MW)	New Solar (731 MW) New Storage (278 MW)
2023	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)	Retire ABB1, ABB2, FBC2, Exit Warrick (730 MW)
2024	New Landfill Gas (27 MW)	New Combustion Turbine (279 MW)	New Combustion Turbine (236 MW)	-	-
2024	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response	New Solar (415 MW) and Demand Response
2024-26	1.50% Energy Efficiency	1.25% Energy Efficiency	0.75% Energy Efficiency	0.75% Energy Efficiency	1.25% Energy Efficiency
2025	New Solar (550 MW) New Wind (650 MW) New Storage (50 MW)	-	New Combustion Turbine (236 MW)	-	New Solar (550 MW) New Wind (650 MW) New Storage (50 MW)
2026-39	New Solar (1,100 MW) New Wind (2,500 MW) New Storage (220 MW)	New Solar (1,000 MW) New Wind (2,400 MW)	-	-	New Solar (1,260 MW) New Wind (2,650 MW) New Storage (290 MW)
2027-39	1.25% Energy Efficiency	1.00% Energy Efficiency	0.75% Energy Efficiency	0.5% Energy Efficiency	0.50% Energy Efficiency
2033-39	-	-	New Storage (50 MW)	New Solar (800 MW) New Wind (2,750 MW) New Storage (190 MW)	-
2024-39	Avg Annual Capacity Mkt Purchases (10 MW)	Avg Annual Capacity Mkt Purchases (12 MW)	Avg Annual Capacity Mkt Purchases (4 MW)	Avg Annual Capacity Mkt Purchases (203 MW)	Avg Annual Capacity Mkt Purchases (11 MW)

STAKEHOLDER FEEDBACK

Request	Response
Will you please provide documents that lead you to believe that MISO is moving to a seasonal (sub-annual) construct?	Below are two examples: one from 2019 and the most recent https://cdn.misoenergy.org/20191106%20RASC%20Item%204b%20RAN%20Capacity%20Accreditation397077.pdf https://cdn.misoenergy.org/20200601%20RAN%20Workshop%20Item%2002%20PDP%20and%20RAN%20Overview449826.pdf
Will you consider modeling a larger hydro resource?	We plan to model the option for 2 - 50 MW projects, consistent with the tech assessment and reasonable assumptions for nearby dams.
Will you please provide the user manual for Aurora?	It is included in the read only copy of the model. Provided a work-around pdfs for help function material and put interested parties in touch with Aurora for access to on-line help function.
RFP provides price certainty for projects. I'm concerned that you are varying capital costs within stochastic modeling	We did not vary capital costs in the near term for stochastic modeling. It should be noted the on-going discussions with several bidders indicate higher prices than initially provided within bids.

CANDIDATE PORTFOLIOS FOR PROBABILISTIC ANALYSIS

Selected as Candidate

Not Selected

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Portfolio	Group	Portfolio	Reason
1	Reference	Reference Case	Serves as a baseline for other portfolios
2	BAU	BAU to 2039	Evaluate continued coal operation, capacity value
3		BAU to 2029	Evaluate limited coal operations, capacity value
4	Bridge	ABB1	Evaluate limited bridge option (1 conversion)
5		ABB1+ABB2	Evaluate performance of 2 conversions
6		ABB1+CCGT	Evaluate interaction with market, capacity value
7	Diverse	Diverse Small CCGT	Evaluate diverse mix, capacity value
8		Diverse Medium CCGT	Higher cost than small CCGT; no additional value
9	Renewables	Renewables+ Flexible Gas	Evaluate a mix of options, heavy with renewables
10		Renewable 2030	Evaluate a storage- and renewables-heavy portfolio
11		HB 763	Overbuilt with 6.2 GW renewables, high LMPs
12	Scenario-Based	Low Regulatory	Overbuilt with 4.8 GW renewables
13		High Technology (Preferred Portfolio	Evaluate performance of portfolio with 2 CTs
14		80% Reduction	Overbuilt with 5 GW renewables
15		High Regulatory	Overbuilt with 6.6 GW renewables, high LMPs

UNECONOMIC ASSET MEASURE CONSIDERED, BUT REMOVED FROM SCORECARD

Following the recent order on the 2x1 CCGT, Vectren worked with Pace Global and the stakeholders, to develop the following approach to address the concern over recovering large capital investments:

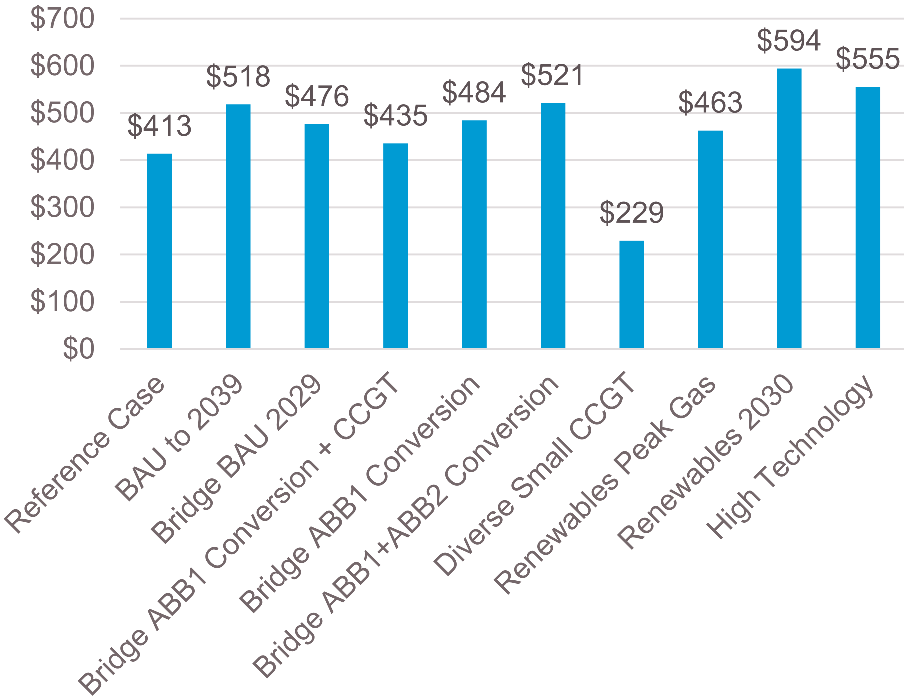
- Determine in any iteration (scenario) when for three years in succession, revenues (capacity + energy) did not cover costs (fixed and variable).
- Then calculate remaining undepreciated costs plus future losses. This is the uneconomic cost for that iteration, which is multiplied by 1/200 to calculate the Expected Value of the uneconomic cost for the portfolio.

The results were not anticipated - Portfolios with plants with large energy revenues (coal and combined cycle) performed better than combustion turbines, even though they require a larger capital spend than CTs.

CTs were immediately considered potentially uneconomic assets. This occurred for 3 reasons:

1. CTs were a hedge against an illiquid capacity market – but capacity prices were not a stochastic variable
2. Capacity prices averaged about 50% of CONE. This is less than the cost to recover CT investment.
3. CTs have low CFs, which result in low energy revenues

NPV of Total Uneconomic Asset Risk $ millions



Vectren 2019 IRP
4th Stakeholder Meeting Minutes Q&A
June 15, 2020, 1:00 p.m. – 3:30 p.m.

Lynnae Wilson (CenterPoint Energy Indiana Electric Chief Business Officer) – Welcome, Safety Message (Firework Safety Tips), and Vectren Introductions

> Subject Matter Experts in the Room: Matt Rice, Justin Joiner, Natalie Hedde, Bob Heidorn, Wayne Games, Angila Retherford, Jason Stephenson, Ryan Wilhelmus
>
> Subject Matter Experts Participating Via Webex: Ryan Abshier, Rina Harris, Shane Bradford, Angie Casbon-Scheller, Tom Bailey, Steve Rawlinson, Chris Leslie, Heather Watts, Cas Swiz, Matt Lind, and Gary Vicinus

Stakeholders: Approximately 180 stakeholders registered to participate in the Webex meeting. List of affiliations include the following:

ACES	First Solar	NextEra Energy Resources
Advanced Energy Economy	GE Gas Power	NIPSCO
AECOM	GSG Communications LLC	Origis Energy
AEP	Hallador Energy	Orion Renewable Energy Group
AES/IPL	Hoosier Energy	Ranger Power
Air Quality Services	I&M	Repower IN and Solarize Evansville
Alcoa Corp	IBEW Local 702	Shell Energy
Arevon Energy Management	Indeck Energy Services, Inc.	Sierra Club
AstraZeneca Pharmaceuticals	Indiana Coal Council	Solarize Indiana Inc
Boardwalk Pipelines	Indiana Office of Utility Consumer Counselor	Solarpack Development, Inc.
Bowen Engineering	Indiana DG	Southern Illinois Generation Company
Citizens Action Coalition of IN	Indivisible Evansville	Southwest Indiana Chamber of Commerce
City of Evansville	Inovateus Solar LLC	St. Joseph Phase II, LLC
Community Energy	Invenergy	State Utility Forecasting Group
CountryMark	IURC	Valley Watch
Earthjustice	juwi Inc.	Vectren Industrial Group
Economic Development Coalition of Southwest Indiana	MEEA	Vermillion Rise Mega Park
Energy Futures Group	Midwest Fertilizer	Vote Solar
Energy Ventures Analysis Inc	Morton Solar	Whole Sun Designs
ENGIE Solar	New Master Development LLC	[redacted]

Presentation Summary:

Lynnae Wilson (CenterPoint Energy Indiana Electric Chief Business Officer) **/ Matt Rice** (Vectren Manager of Resource Planning) Meeting Guidelines, Agenda, IRP Stakeholder Process, and the presenting of the Preferred Portfolio

Peter Hubbard (Manager of Energy Business Advisory, Pace Global) Risk Analysis Process and Results

Justin Joiner (Vectren Director of Power Supply Services) Future Considerations, MISO OMS Survey Results, and Next Steps

Lynnae Wilson (CenterPoint Energy Indiana Electric Chief Business Officer) Closing Comments

Stakeholder Q&A:

Question:
Wendy Bredhold: When do you plan to share the slides?
Jean Webb: I'd like to have it now to print out and mark up.
Suzanne Escudier: Will the PPT be available after the meeting?
Wendy Bredhold: Can you post slides now since we are done?
Answer:
The slides will be posted today at www.vectren.com\irp at 3:30 Central.

Question:
Wendy Bredhold: Are you building that wind in 2022?
Answer:
We will continue to evaluate this resource, and there could be a second RFP(timing is yet to be determined).

Question:
John Blair: Are you planning ownership or PPA for both wind and solar? If so, are you also prepared to use your power of eminent domain to secure the necessary sites for both? Last are you considering using useless, non-productive stripper pits as sites for your solar plants?
Answer:
Eminent domain would be a last resort.
Answer to Second Question:
We are looking at all of the above. We are looking at all of the land around us trying to determine the best plan forward.

Question:
Mike Mullett: Please define "universal solar" in relation to transmission-connected vs. distribution-connected solar and/or above/below 10 mw facilities.
Answer:
Universal solar is utility scale solar, which is the most cost-effective option for our customers. Customer owned solar connected to the distribution system was accounted for in our load forecast as a load reduction, reducing the resources needed to serve our customers. That forecast is included in a report at www.Vectren.com\irp, titled 2019 Long Term Electric Energy and Demand Forecast Report.
https://www.vectren.com/assets/downloads/planning/irp/IRP-2019-Vectren-Sales-and-Demand-Forecast-Documentation.pdf

Question:
Wendy Bredhold: What is the retirement date for Culley 3 in this plan?
Answer:
The preferred portfolio continues to run Culley 3 throughout the forecast, but that can be determined at a later date.

Question:
Laura Arnold: Are there any phone numbers available for someone to call who is experiencing Internet difficulties?
Answer:
Phone number: 1-415-655-0003, access code: 1332773493

Question:
Emily Medine: What is assumed about MISO dispatchability of wind and solar?
Answer:
For solar it was assumed capacity factor would be around 24% and 38% for wind.

Question:
Emily Medine: No. MISO's right to dispatch
Answer:
We use MISO's current practices and provide a forecast and then MISO dispatches our units based on that forecast.

Question:
Mike Mullett: Please comment on the Forum Energy - Great River Energy Agreement re very long duration storage -- see, e.g. , https://www.greentechmedia.com/articles/read/form-energys-first-project-pushes-long-duration-storage-to-new-heights-150-hour-duration
Answer:
We will review this after the meeting. We did model 8-hour flow batteries but they were not cost effective, thus not selected.

Question:
Mike Mullett: Please comment on the Vectren Electric capex requirements for the Preferred Portfolio, especially regarding BAU and other portfolios evaluated.
Answer:
There aren't any capital requirements for the preferred portfolio but all paths forward cost money, including BAU which would require a large investment. We don't know what capital spend will be at this point because we haven't determined how much solar and wind will be PPA vs. an ownership option.

Question:
Michael Smith: With renewables and DR increasing to 64% of portfolio, what percentage of that 64% renewables will be Vectren-owned resources or will the energy be procured through 3rd party PPAs?
Answer:
This is yet to be determined.

Question:
John Haselden: Will the gas pipeline to the CT's be sized for additional future resources?

Answer:
This is yet to be determined.

Question:
Suzanne Escudier: Can you type in the website where we can find the presentation after the meeting?
Answer:
www.vectren.com\irp. At this site you will also find all materials from past meetings. The deck will be posted today at 3:30 p.m.

Question:
Jean Webb: So, the reason for not selecting the renewables by 2030 portfolio is because of your limits on market sales/purchases? How much is now purchased from market as a reference.
Answer:
This portfolio had a heavy reliance on the market for both capacity and energy and we felt that the preferred portfolio performed better overall. This portfolio also relies heavily on battery storage which is an emerging technology. It also requires an additional $20-$30 million in transmission system upgrades. With renewables it is important to have dispatchable resources to back them up when not available. [In 2019, Vectren purchased approximately 9% of its need as a percentage of generation].

Question:
Jean Webb: Will the current wind contracts be renewed? Benton and Fowler Ridge.
Answer:
We will look at all resource available in the RFP. Also, these contracts don't expire for several more years (late 2020's).

Question:
John Blair: What are your current plans for Warrick 4?
Answer:
We currently plan to exit joint operation of Warrick 4 in 2023.

Question:
Mary Lyn Stoll: As noted in the presentation, technology and renewable energy markets are in a period of rapid growth and transition. Given how quickly these changes occur, does Vectren have a formal policy in place to continue to actively review the latest updates and changes to quickly determine whether and when a higher proportion of renewables would become the best option given Vectren's goals?
Answer:
This IRP is a first step in this process, and the analysis will be performed again in 2022.

Question:
Anna Sommer: Where do you stand with respect to negotiations with respondents to the RFP? Are you planning to acquire these planned new resources from those respondents and the question is whether those acquisitions are PPA or asset transfers? Or is there some other resource acquisition process anticipated?
Answer:
We've been in communication with respondents to gain more clarity on the status of the projects. We are still working to determine what projects will be PPA and which will be utility owned. A second RFP would be the other resource acquisition process at this point.

Question:
Crystal Young: Is there any plan for electric vehicle infrastructure buildout?
Answer:
We are actively investigating this enterprise wide to determine our best steps forward for both the Houston area, as well as southern Indiana. We did include an EV forecast as an addition to load so we've thought through what the need would be from a generation standpoint.

Question:
Mike Mullett: How is OVEC contract being modeled, and for how long in the Preferred Portfolio?
Answer:
OVEC was modeled as a PPA and is included as a resource in the preferred portfolio throughout the forecast.

Question:
Michael Smith: Assuming the 2 each, GTs (460MW) are simple cycle and not a 2 x 1 CCGT with HRSTG boiler and steam turbine for waste heat?
Answer:
Correct. These are 2 simple cycle gas turbines.

Question:
Sadie Holzmeyer: Since it is currently financially beneficial for business and homeowners to invest in their own solar panels to not only sustain their own energy needs by generating their own renewable energy independent from Vectren's energy production, but also save money into the future, could Vectren not consider something like incorporating rooftop solar to supplement their renewable energy demands?
Answer:
We modeled universal solar because it is the most cost-effective solution for our customers.

Question:
Jean Webb: I had asked about modeling expanding net-metering so that rooftop solar expanded, and therefore less capacity would need to be built. Was that done?
Answer:
We modeled about 84 MW's of installed capacity from rooftop solar as a reduction to our load. There was not a portfolio where we modeled leasing space on customer roofs to install solar. There is a lot of cost and legal issues with this approach. Large scale solar is more efficient; plus, we would not get capacity credit from MISO with rooftop solar.

Question:
Mike Mullett: When will next all-source RFP be conducted? Will there be stakeholder engagement on the terms and conditions of that RFP?
Answer:
The RFP in the fall would not be all-source. The next all-source would potentially be for the next IRP but we've found there are many difficulties with this process. The long time frame makes it difficult for developers to hold their projects and pricing plus many projects are picked up by other groups while the IRP analysis is being performed.

Question:
Niles Rosenquist: On an annual basis, how much of the power production did you show earlier is projected to be from the gas turbines?

Answer:
Matt Rice reviewed the generation graph on slide 19 showing a small amount of generation from combustion turbines.

Question:
Anna Sommer: When does Vectren anticipate coming in for regulatory approvals for these new resources? And what steps remain before that happens?
Answer:
We are working on evaluating the best time to make our submissions, but it will likely be done over a period of time. We will likely start with some of the renewable resources we need later this year and the gas CT's will likely be in 2021.

Question:
Jean Webb: What years will the gas plants open?
Answer:
We are projecting they will be in service in the 2024-2025 planning year.

Question:
Jean Webb: Where will they be built?
Answer:
This is yet to be determined, but the A.B. Brown site offers many benefits including close proximity to the 345 KV transmission line, existing equipment that can be utilized by the CT's, as well as existing interconnection rights.

Question:
Jean Webb: Update on coal ash ponds there?
Answer:
We have contracts in place to recycle the ash from the Brown ash pond for use in a concrete application. We would anticipate filing our application with IDEM for approval probably in 2021. The west pond at Culley is almost complete and should be complete later this year. We are currently evaluating the east pond at Culley to determine how we will close it.

Question:
Pam Locker: Can you remind me of the expected cost of the natural gas plant?
Answer:
Two CT's are around $300-$320 million. We will have a better idea after the equipment is sent out for bids.

Question:
Jean Webb: Does that cost include the gas lines our will that go on our bills as a rider?
Answer:
If a pipeline is needed then yes, it would be part of customer rates. We won't know exact cost until we determine where the CT's will be built. [Pipeline cost estimates were included in the modeling as a firm gas service.]

Question:
Wendy Bredhold: How do you justify to continue to run Culley 3 when it isn't a least cost option?
Answer:
When we looked at Culley 3 in 2016 there was a little bit of premium to run that unit but we received approval to upgrade the plant and plan to implement those upgrades for diversity of our fleet.

Stakeholder Feedback:

Mike Mullett: Thank you for a very informative and interactive presentation, especially given the virtual nature of the meeting. For me, at least, the internet quality was very high, both in terms of the slides and the audio. The use of the Chat for Q&A was also very helpful.

Pam Locker: Thank you for increasing the percentage of renewable resources.

Attachment 4.1 2019 Vectren Long-Term Electric Energy and Demand Forecast Report

Knowledge to Shape Your Future

Electric | Gas | Water
information collection, analysis and application

2019 Long-Term Electric Energy and Demand Forecast Report

Vectren

Submitted to:

Vectren, a CenterPoint Energy Company
Evansville, Indiana

Submitted by:

Itron, Inc.
20 Park Plaza
Suite 428
Boston, Massachusetts 02116
(617) 423-7660

October 2019

Contents

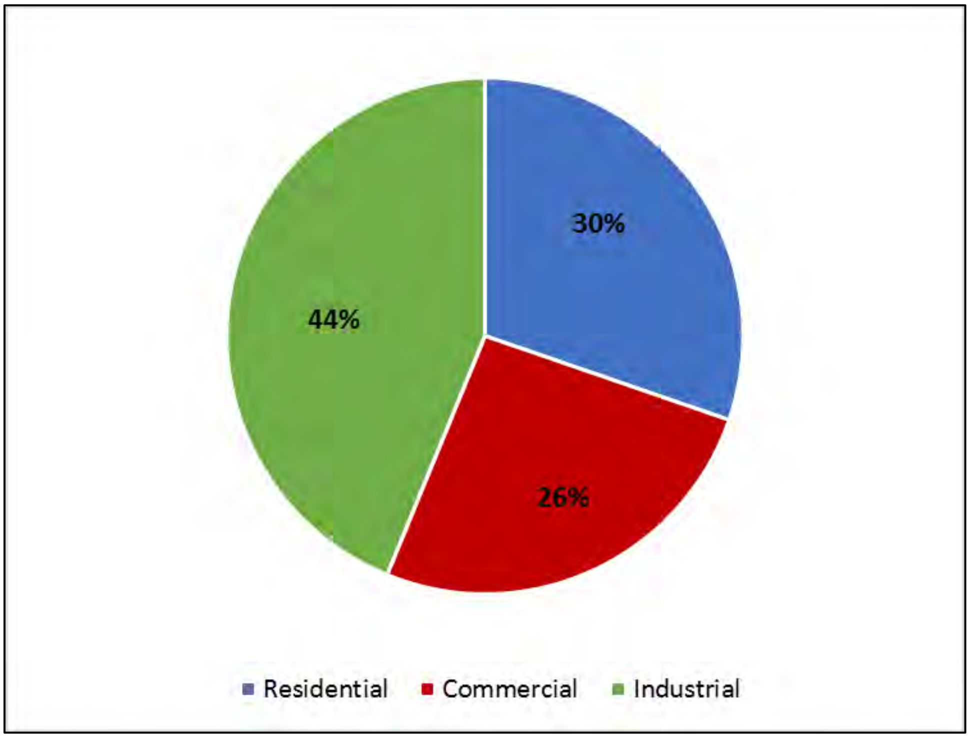
1 Overview

Itron, Inc. was contracted by Vectren to develop a long-term load forecast to support the 2019/20 Integrated Resource Plan. The energy and demand forecasts extend through 2039. It is based on a bottom-up approach that starts with residential, commercial, and industrial load forecasts that then drive system energy and peak demand. In addition, the forecast includes developing long-term behind-the-meter solar and electric vehicle load forecasts. This report presents the results, assumptions, and overview of the forecast methodology.

1.1 VECTREN Service Area

Vectren serves approximately 146,000 electric customers in Southwest Indiana; Evansville is the largest city within the service area. The service area includes a large industrial base with industrial customers accounting for approximately 44% of sales in 2018. The residential class accounts for 30% of sales with approximately 128,000 customers and the commercial class 26% of sales; there are approximately 18,000 nonresidential customers. System 2018 energy requirements are 5,308 GWh with non-weather normalized system peak reaching 1,039.2 MW. Figure 1 shows 2018 class-level sales distribution.

Figure 1: 2018 Annual Sales Breakdown



Despite relatively weak economic growth, since 2010, customer growth has been modest with residential customer growth averaging 0.5% and commercial customer growth 0.3%. GDP has averaged 1.2% growth until recently with 2018 GDP increasing to 3.9% and an expected 3.6% increase in 2019. GDP growth slows to expected 1.9% growth over the next twenty years with employment growth of 0.6%. Steady economic and employment growth contributes to continued moderate long-term customer growth.

Appliance efficiency standards coupled with DSM program activity has held sales growth in check. Since 2010 weather-normalized average use has declined on average 1.4% per year; this translates into 0.9% annual decline in residential sales. Commercial sales have also been falling; normalized sales have declined 0.6% per year. The industrial sector is the only sector showing positive growth with industrial sales averaging 1.8% average annual growth (excluding loss of a large customer account). When combined, total normalized sales have averaged 0.3% annual growth.

While DSM activity has had a significant impact on sales, for the IRP filing, the energy and demand forecasts do not include future DSM energy savings; DSM savings are treated as a resource in determining the most cost-effective options. Excluding future DSM, energy requirements and peak demand are expected to increase on average 0.6% over the next twenty years. Table 1-1 shows the VECTREN energy and demand forecasts. The forecast excludes future DSM savings, but includes the impact of customer-owned distributed generation (mostly behind-the-meter solar) and electric vehicles. Vectren utility scale solar and other distributed generation are not included in this report but are accounted for within the IRP and the forecast submitted to MISO.

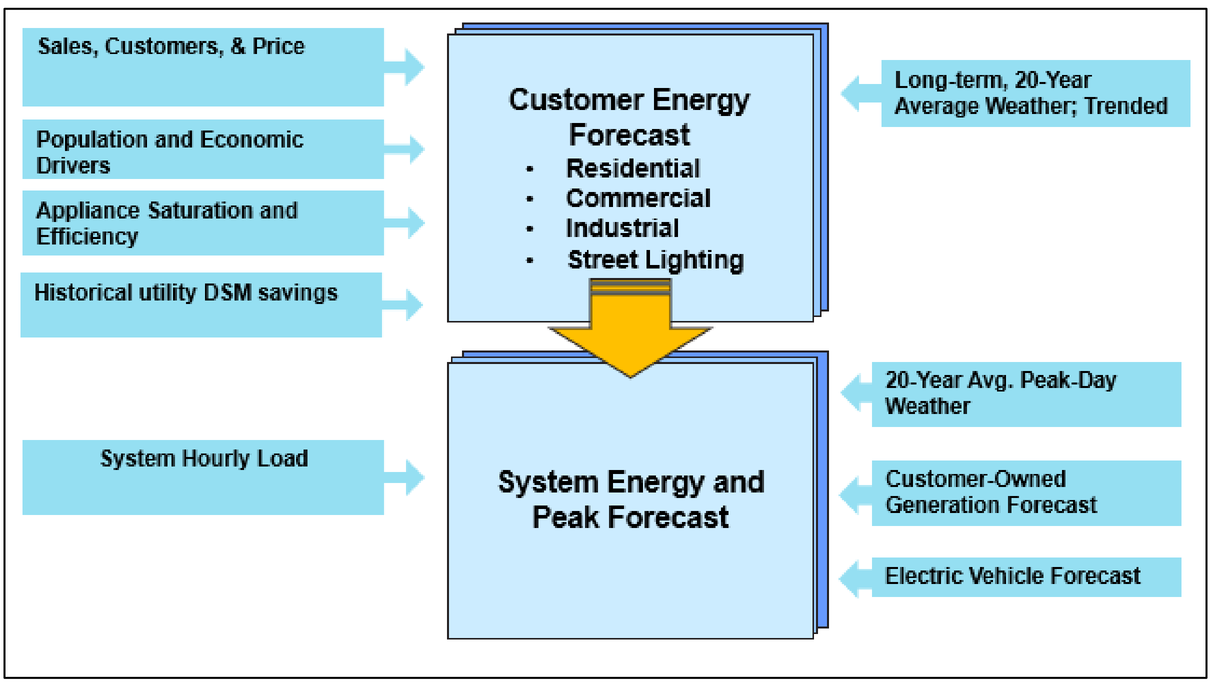
Table 1-1: Energy and Demand Forecast (Excluding DSM Program Savings)

Year	Energy (MWh)		Summer Peak (MW)		Winter Peak (MW)	
2019	5,169,366		1,075		786	
2020	5,395,568	4.4%	1,105	2.7%	834	6.1%
2021	5,402,326	0.1%	1,107	0.2%	831	-0.3%
2022	5,527,069	2.3%	1,131	2.1%	850	2.2%
2023	5,763,459	4.3%	1,173	3.7%	888	4.5%
2024	5,795,986	0.6%	1,178	0.5%	891	0.4%
2025	5,811,218	0.3%	1,181	0.3%	891	0.0%
2026	5,828,820	0.3%	1,184	0.3%	892	0.1%
2027	5,849,607	0.4%	1,188	0.3%	894	0.2%
2028	5,880,148	0.5%	1,194	0.5%	897	0.4%
2029	5,895,966	0.3%	1,197	0.3%	897	0.0%
2030	5,912,671	0.3%	1,201	0.3%	897	0.0%
2031	5,930,819	0.3%	1,205	0.3%	898	0.0%
2032	5,955,984	0.4%	1,210	0.4%	899	0.2%
2033	5,970,297	0.2%	1,214	0.3%	899	-0.1%
2034	5,991,229	0.4%	1,219	0.4%	900	0.1%
2035	6,013,551	0.4%	1,224	0.4%	901	0.1%
2036	6,040,644	0.5%	1,230	0.5%	903	0.3%
2037	6,055,140	0.2%	1,234	0.4%	902	-0.1%
2038	6,074,726	0.3%	1,239	0.4%	903	0.1%
2039	6,093,472	0.3%	1,244	0.4%	904	0.1%
CAGR 20-39		0.6%		0.6%		0.4%

2 Forecast Approach

The long-term energy and demand forecasts are based on a build-up approach. End-use sales derived from the customer class sales models (residential, commercial, industrial, and street lighting) drive system energy and peak demand. Energy requirements are calculated by adjusting sales forecast upwards for line losses. Peak demand is forecasted through a monthly peak-demand linear regression model that relates peak demand to peak-day weather conditions and end-use energy requirements (heating, cooling, and other use). System energy and peak are adjusted for residential and commercial PV adoption and EV charging impacts. Figure 2 shows the general framework and model inputs.

Figure 2: Class Build-up Model



In the long-term, both economic growth and structural changes drive energy and demand requirements. Structural changes include the impact of changing appliance owner-ship trends, end-use efficiency changes, increasing housing square footage, and thermal shell efficiency improvements. Changing structural components are captured in the residential and commercial sales forecast models through a specification that combines economic drivers with end-use energy intensity trends. This type of model is known as a Statistically Adjusted End-Use (SAE) model. The SAE model variables explicitly incorporate end-use saturation and efficiency projections, as well as changes in population, economic conditions, price, and weather. Both residential and commercial sales are forecasted using an SAE specification. Industrial sales are forecasted using a two-step approach, which includes a generalized econometric model that relates industrial sales to seasonal patterns and industrial economic activity. Streetlight sales are forecasted using a simple trend and seasonal model.

2.1 Residential Model

Residential average use and customers are modeled separately. The residential sales forecast is then generated as the product of the average use and customer forecasts.

Average Use. The residential average use model relates customer monthly average use to a customer's heating requirements (XHeat), cooling requirements (XCool), other use (XOther), and DSM activity per customer:

$$ResAvgUse_{ym} = (B_1 \times XHeat_{ym}) + (B_2 \times XCool_{ym}) + (B_3 \times XOther_{ym}) + (B_4 \times DSM_{ym}) + e_{ym}$$

Where:

y = year
m = month

The model coefficients (B_1, B_2, B_3, and B_4) are estimated using a linear regression model. Monthly average use data is derived from historical monthly billed sales and customer data from January 2010 to June 2019.

The model variables incorporate end-use saturation and efficiency projections, as well as changes in household size, household income, price, weather, and DSM activity. The model result is an estimate of monthly heating, cooling, and other use energy requirements on a kWh per household basis, which includes the impact of DSM. Incremental future DSM is then added back to the model results to arrive at an average use forecast that does not include the impact of future DSM.

Figure 3 to Figure 5 show the constructed monthly heating, cooling, and other end-use variables. The specific calculations of the end-use variables are presented in Appendix B.

Figure 3: Residential XHeat

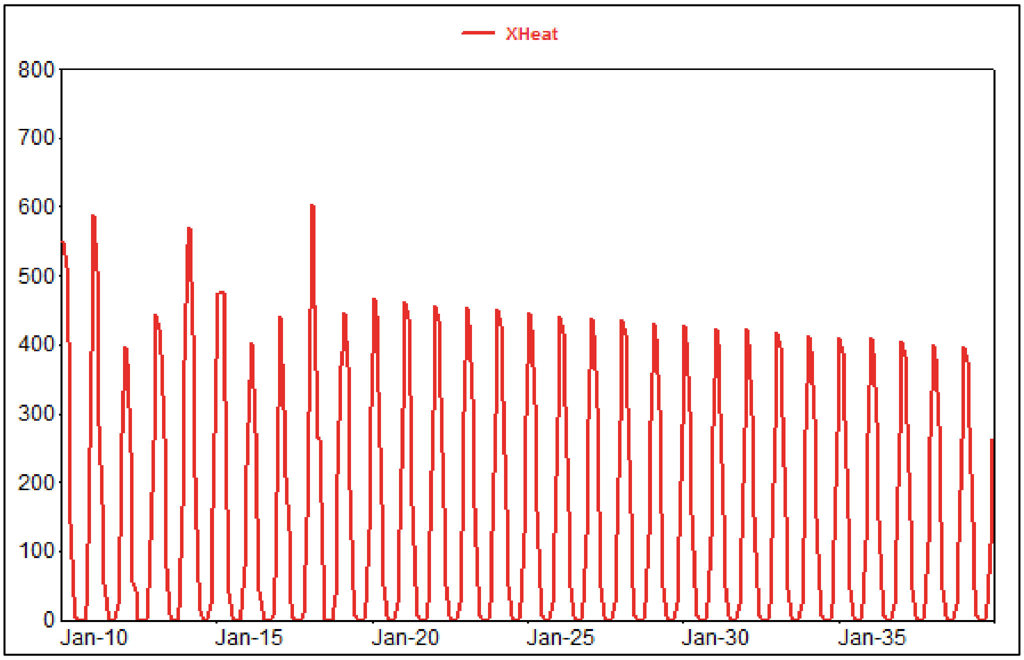


Figure 4: Residential XCool

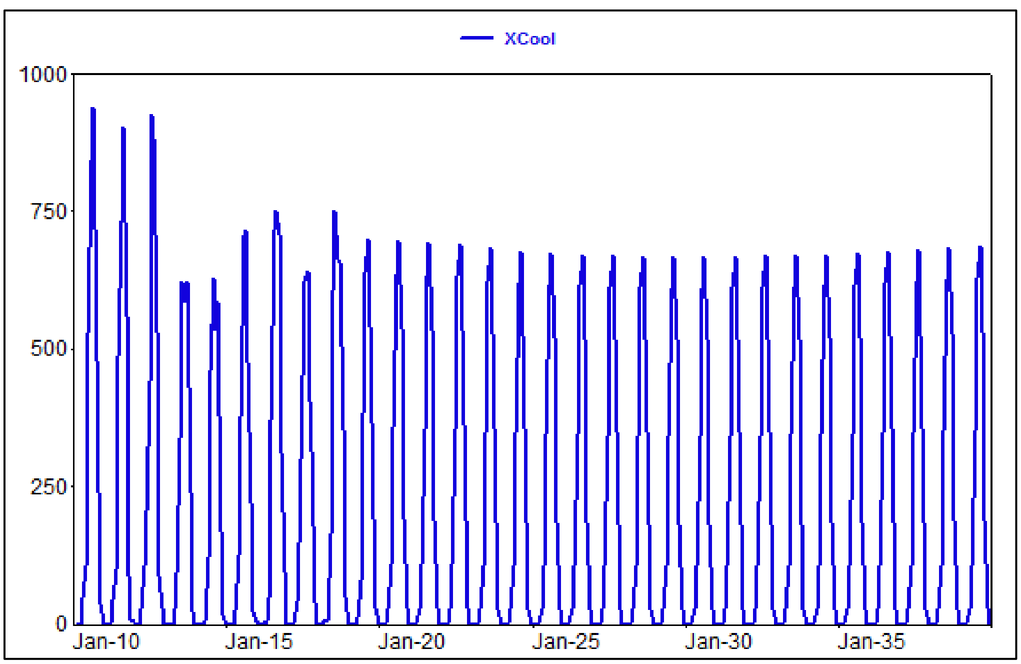
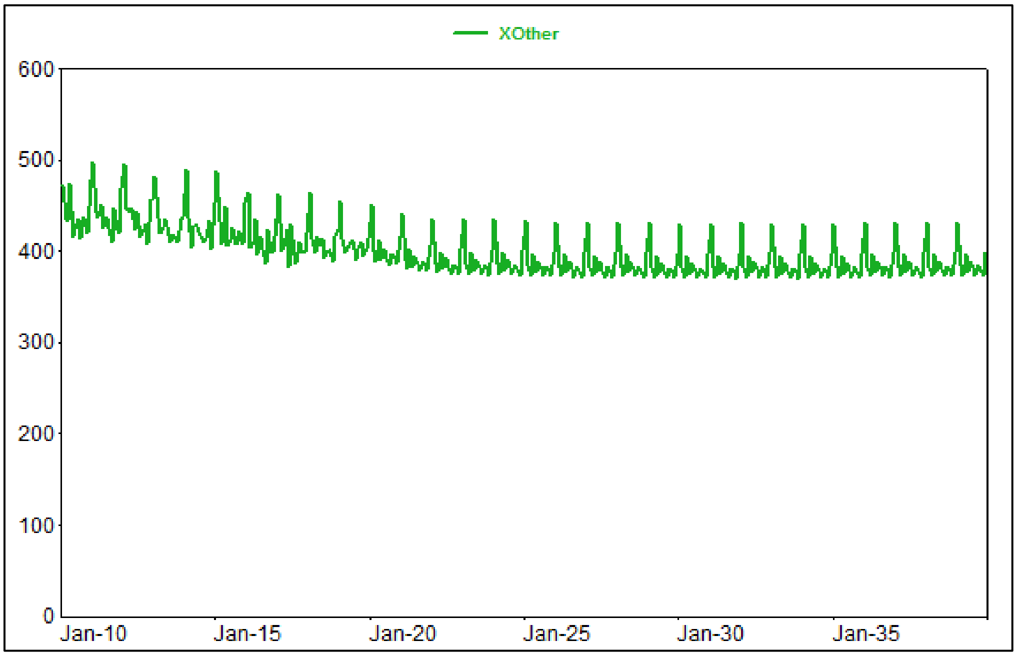


Figure 5: Residential XOther



The average use model is estimated over the period January 2010 through June 2019. The model explains historical average use well with an Adjusted R^2 of 0.98 and in-sample Mean Absolute Percent Error (MAPE) of 1.9%. Model coefficients are statistically significant at the 95% level of confidence and higher. Model coefficients and statistics are provided in Appendix A.

Customer Forecast

The customer forecast is based on a monthly regression model that relates the number of customers to Evansville MSA (Metropolitan Statistical Area) household projections. The model results in 0.4% long-term customer growth.

Sales Forecast

Excluding future DSM savings, average use through the forecast period is flat. With flat average use and 0.4% customer growth, residential sales averages 0.4% growth between 2020 and 2039. Table 2-1 summarizes the residential forecast.

Table 2-1: Residential Forecast (Excluding Future DSM)

Year	Sales (MWh)		Customers		AvgUse (kWh)	
2019	1,397,951		128,325		10,894	
2020	1,394,147	-0.3%	129,037	0.6%	10,804	-0.8%
2021	1,385,056	-0.7%	129,808	0.6%	10,670	-1.2%
2022	1,389,250	0.3%	130,762	0.7%	10,624	-0.4%
2023	1,393,879	0.3%	131,653	0.7%	10,588	-0.3%
2024	1,403,897	0.7%	132,458	0.6%	10,599	0.1%
2025	1,406,700	0.2%	133,214	0.6%	10,560	-0.4%
2026	1,412,868	0.4%	133,887	0.5%	10,553	-0.1%
2027	1,419,111	0.4%	134,474	0.4%	10,553	0.0%
2028	1,429,310	0.7%	135,002	0.4%	10,587	0.3%
2029	1,432,393	0.2%	135,503	0.4%	10,571	-0.2%
2030	1,439,085	0.5%	136,007	0.4%	10,581	0.1%
2031	1,446,125	0.5%	136,473	0.3%	10,596	0.1%
2032	1,456,783	0.7%	136,902	0.3%	10,641	0.4%
2033	1,460,392	0.2%	137,288	0.3%	10,637	0.0%
2034	1,467,666	0.5%	137,619	0.2%	10,665	0.3%
2035	1,475,665	0.5%	137,942	0.2%	10,698	0.3%
2036	1,487,624	0.8%	138,236	0.2%	10,761	0.6%
2037	1,492,228	0.3%	138,459	0.2%	10,777	0.1%
2038	1,499,727	0.5%	138,624	0.1%	10,819	0.4%
2039	1,506,655	0.5%	138,751	0.1%	10,859	0.4%
CAGR 20-39		0.4%		0.4%		0.0%

2.2 Commercial Model

The commercial sales model is also estimated using an SAE specification. The difference is that in the commercial sector, the sales forecast is based on a total sales model, rather than an average use and customer model. Commercial sales are expressed as a function of heating requirements, cooling requirements, other commercial use, and DSM activity:

$$ComSales_{ym} = (B_1 \times XHeat_{ym}) + (B_2 \times XCool_{ym}) + (B_3 \times XOther_{ym}) + (B_4 \times DSM_{ym}) + e_{ym}$$

Where:

y = year
m = month

The constructed model variables include Heating Degree Days (HDD), Cooling Degree Days (CDD), billing days, commercial economic activity variable, price, end-use intensity trends, and DSM activity. Figure 6 to Figure 8 show the constructed model variables. The specific variable construction is provided in Appendix B.

Figure 6: Commercial XHeat

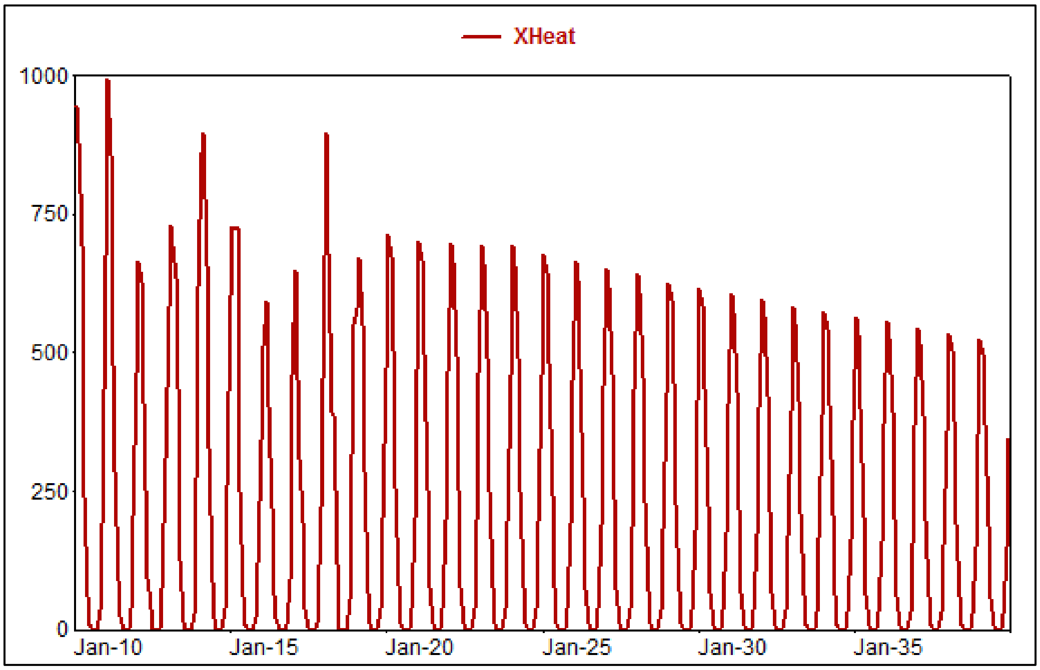


Figure 7: Commercial XCool

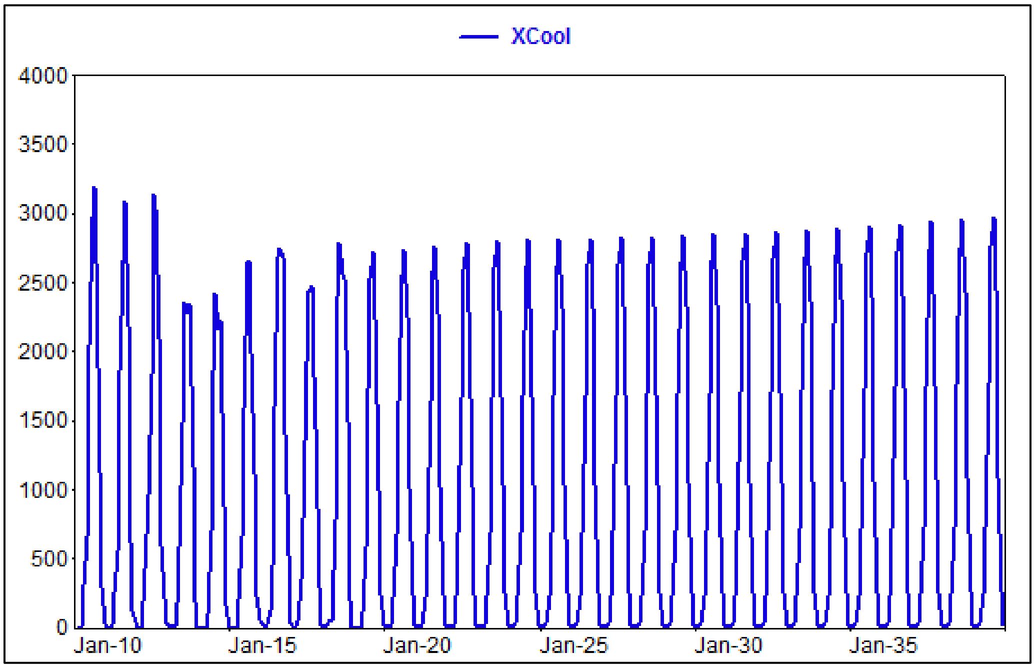
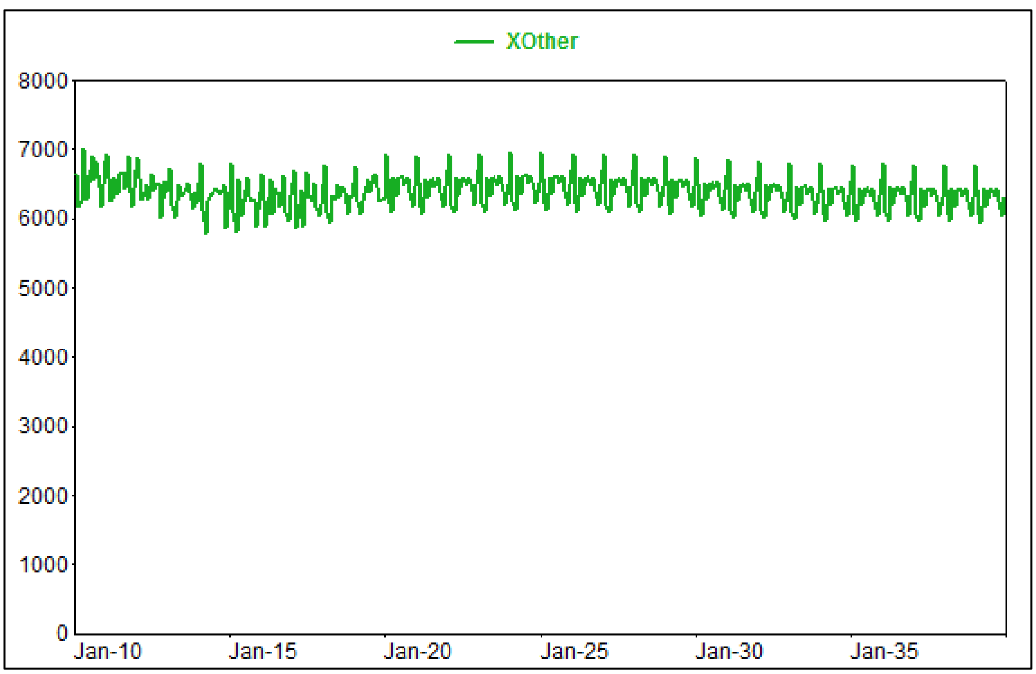


Figure 8: Commercial XOther



The estimated model coefficients (B_1, B_2, B_3, and B_4) calibrate the model to actual commercial sales data. The commercial sales model performs well with an Adjusted R^2 of 0.96 and an in-sample MAPE of 1.8%. The model is estimated with monthly billed sales data from January 2010 to June 2019. The model results include the impact of DSM. Incremental future DSM is then added back to the model results to arrive at a sales forecast that does not include the impact of future DSM.

Commercial sales average 0.2% annual growth through 2039, excluding the impact of future DSM savings. Commercial sales are driven by moderate residential customer and economic growth. Economic activity is captured by combining non-manufacturing output, non-manufacturing employment, and population through a weighted commercial economic variable called *ComVar*. *ComVar* is defined as:

$$ComVar_{ym} = \left(GDP_{ym}^{0.25}\right) \times \left(Employment_{ym}^{0.25}\right) \times \left(Population_{ym}^{0.5}\right)$$

Where:

y = year
m = month

The weights are determined by testing alternative sets of weights that generate the best in-sample and out-of-sample model statistics.

A separate model is estimated for commercial customers; customer projections are based on a monthly regression model that relates the number of customers to non-manufacturing employment in the Evansville MSA. The forecast excludes future DSM savings. Table 2-2 summarizes the commercial forecast.

Table 2-2: Commercial Forecast

Year	Sales (MWh)		Customers	
2019	1,268,993		18,731	
2020	1,281,221	1.0%	18,817	0.5%
2021	1,285,272	0.3%	18,870	0.3%
2022	1,292,595	0.6%	18,935	0.3%
2023	1,297,044	0.3%	18,999	0.3%
2024	1,303,746	0.5%	19,060	0.3%
2025	1,304,199	0.0%	19,122	0.3%
2026	1,305,034	0.1%	19,184	0.3%
2027	1,306,083	0.1%	19,247	0.3%
2028	1,310,084	0.3%	19,309	0.3%
2029	1,309,689	0.0%	19,371	0.3%
2030	1,308,851	-0.1%	19,434	0.3%
2031	1,308,792	0.0%	19,496	0.3%
2032	1,311,763	0.2%	19,560	0.3%
2033	1,310,653	-0.1%	19,624	0.3%
2034	1,312,270	0.1%	19,689	0.3%
2035	1,314,615	0.2%	19,754	0.3%
2036	1,319,551	0.4%	19,820	0.3%
2037	1,320,643	0.1%	19,887	0.3%
2038	1,324,172	0.3%	19,954	0.3%
2039	1,327,364	0.2%	20,021	0.3%
CAGR 20-39		0.2%		0.3%

2.3 Industrial Model

The industrial sales forecast is developed with a two-step approach. The first five years of the forecast is derived from Vectren's expectation of specific customer activity. The forecast after the first five years is based on the industrial forecast model. Vectren determines a baseline volume based on historical consumption use. The baseline use is then adjusted to reflect expected closures and expansions. Near-term sales are also adjusted for the addition of new industrial customers. After five years, the forecast is derived from the industrial sales model; forecasted growth is applied to the fifth-year industrial sales forecast.

The industrial sales model is a generalized linear regression model that relates monthly historical industrial billed to manufacturing employment, manufacturing output, CDD, and monthly binaries to capture seasonal load variation and shifts in sales data. The industrial economic driver is a weighted combination of manufacturing employment and manufacturing output. The industrial economic (*IndVar*) variable is defined as:

$$IndVar_{ym} = \left(ManufEmploy_{ym}^{0.5}\right) \times \left(ManufOutput_{ym}^{0.5}\right)$$

Where:

y = year
m = month

The imposed weights are determined by evaluating in-sample and out-of-sample statistics for alternative weighting schemes. The model Adjusted R^2 is 0.74 with a MAPE of 5.2%. The relatively low Adjusted R^2 and high MAPE are a result of the large month-to-month variations in industrial billing data. The industrial model excludes sales to one of VECTREN's largest customers, which is currently meeting most of its load through onsite cogeneration.

Excluding DSM, industrial sales average 1.0% annual growth with strong near-term growth. After 2023, industrial sales average 0.4% annual growth. Table 2-3 summarizes the industrial sales forecast.

Table 2-3: Industrial Forecast (Excluding Future DSM)

Year	Total Industrial	
2019	2,159,155	
2020	2,347,543	8.7%
2021	2,360,025	0.5%
2022	2,463,638	4.4%
2023	2,669,566	8.4%
2024	2,682,185	0.5%
2025	2,693,010	0.4%
2026	2,702,706	0.4%
2027	2,715,218	0.5%
2028	2,730,260	0.6%
2029	2,742,862	0.5%
2030	2,753,258	0.4%
2031	2,763,983	0.4%
2032	2,774,906	0.4%
2033	2,786,352	0.4%
2034	2,797,969	0.4%
2035	2,809,553	0.4%
2036	2,819,333	0.3%
2037	2,828,251	0.3%
2038	2,837,072	0.3%
2039	2,846,045	0.3%
CAGR 20-39		1.0%

2.4 Street Lighting Model

Streetlight sales are fitted with a simple exponential smoothing model with a trend and seasonal component. Street lighting sales are increasing at 0.2% annually throughout the forecast horizon. Table 2-4 shows the streetlight forecast.

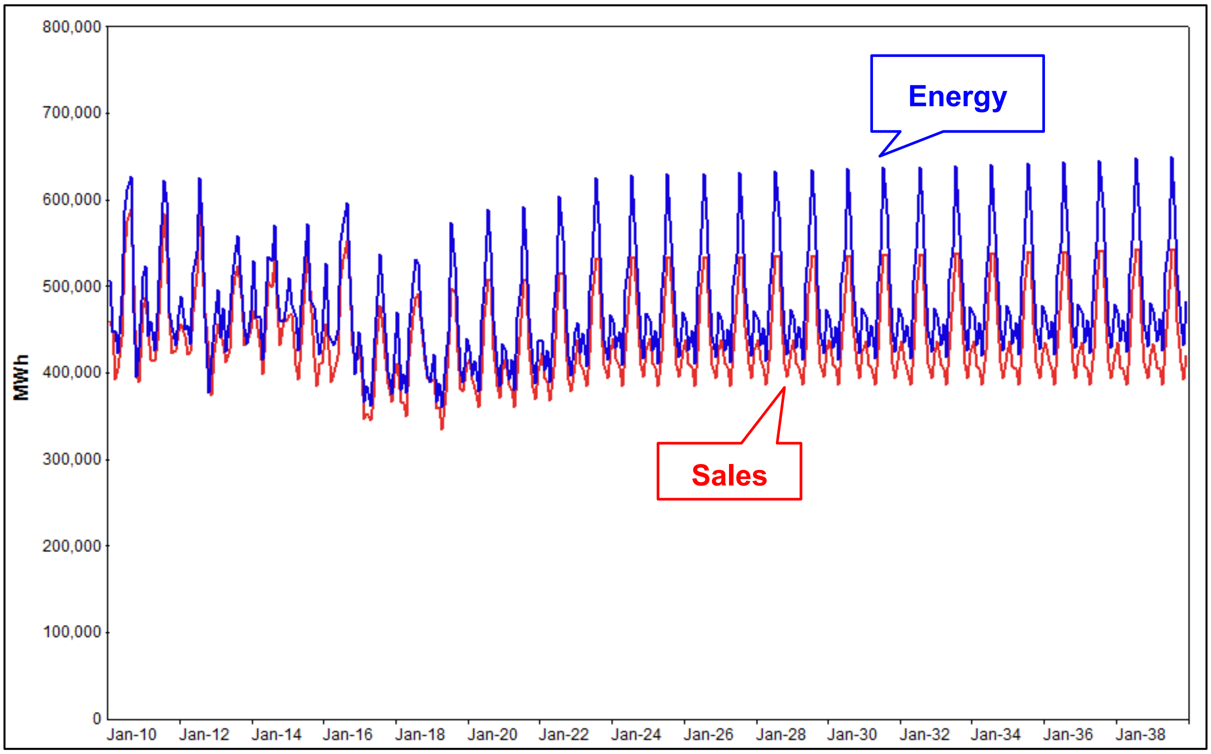
Table 2-4: Street Lighting Forecast

Year	Sales (MWh)	
2019	21,526	
2020	21,645	0.6%
2021	21,680	0.2%
2022	21,715	0.2%
2023	21,749	0.2%
2024	21,784	0.2%
2025	21,819	0.2%
2026	21,854	0.2%
2027	21,889	0.2%
2028	21,924	0.2%
2029	21,959	0.2%
2030	21,994	0.2%
2031	22,029	0.2%
2032	22,064	0.2%
2033	22,098	0.2%
2034	22,133	0.2%
2035	22,168	0.2%
2036	22,203	0.2%
2037	22,238	0.2%
2038	22,273	0.2%
2039	22,308	0.2%
CAGR 20-39		0.2%

2.5 Energy Forecast Model

The energy forecast is derived directly from the sales forecast by applying a monthly energy adjustment factor to the sales forecast. The energy adjustment factor includes line losses and any differences in timing between monthly sales estimates and delivered energy (*unaccounted for energy*). Monthly adjustment factors are calculated based on the historical relationship between energy and sales. The energy forecast is adjusted for rooftop solar generation and electric vehicles. Figure 9 shows the monthly sales and energy forecast, excluding the impact of future DSM.

Figure 9: Energy and Sales Forecast (Excluding DSM)



2.6 Peak Forecast Model

The long-term system peak forecast is derived through a monthly peak regression model that relates peak demand to heating, cooling, and base load requirements:

$$Peak_{ym} = B_0 + B_1 HeatVar_{ym} + B_2 CoolVar_{ym} + B_3 BaseVar_{ym} + e_{ym}$$

Where:

y = year
m = month

End-use energy requirements are estimated from class sales forecast models.

Heating and Cooling Model Variables

The residential and commercial SAE model coefficients are used to isolate historical and projected weather-normal heating and cooling requirements. Heating requirements are interacted with peak-day HDD and cooling requirements with peak-day CDD; this interaction allows peak-day weather impacts to change over time with changes in heating and cooling requirements. The peak model heating and cooling variables are calculated as:

- $HeatVar_{ym} = HeatLoadIdx_{ym} \times PkHDD_{ym}$
- $CoolVar_{ym} = CoolLoadIdx_{ym} \times PkCDD_{ym}$

  Where $HeatLoadIdx_{ym}$ is an index of total system heating requirements in year y and month m and $CoolLoadIdx_{ym}$ is an index of total system cooling requirements in year y and month m. $PkHDD_{ym}$ is the peak-day HDD in year y and month m and $PkCDD_{ym}$ is the peak-day CDD in year y and month m.

Figure 10 and Figure 11 show *HeatVar* and *CoolVar*. The variation in the historical period is a result of variation in peak-day HDD and CDD.

Figure 10: Peak-Day Heating Variable

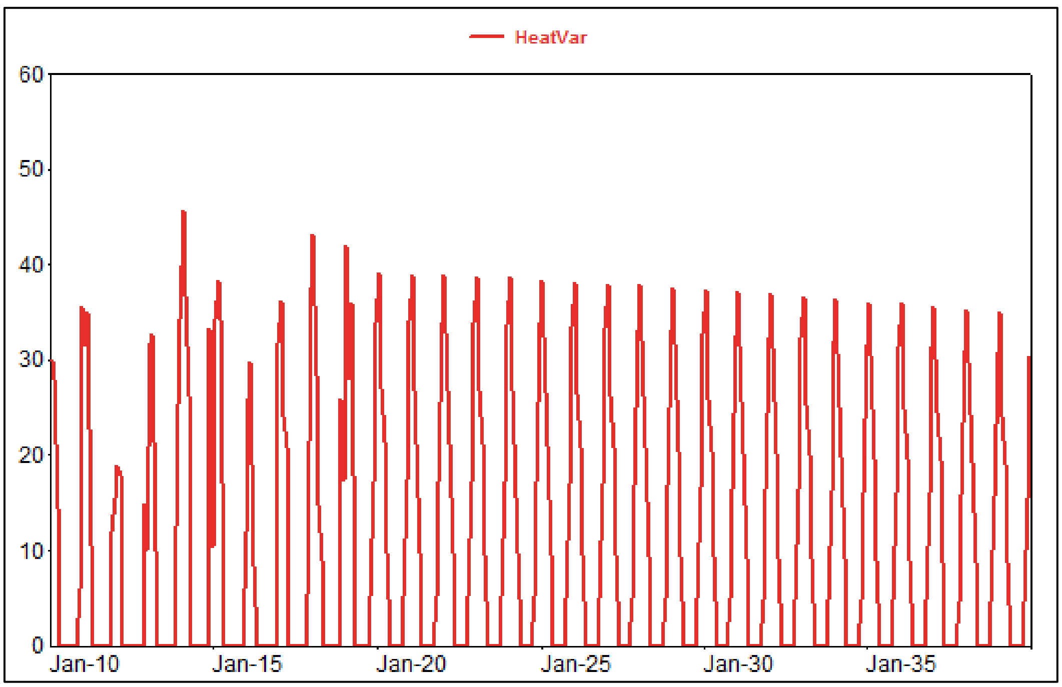
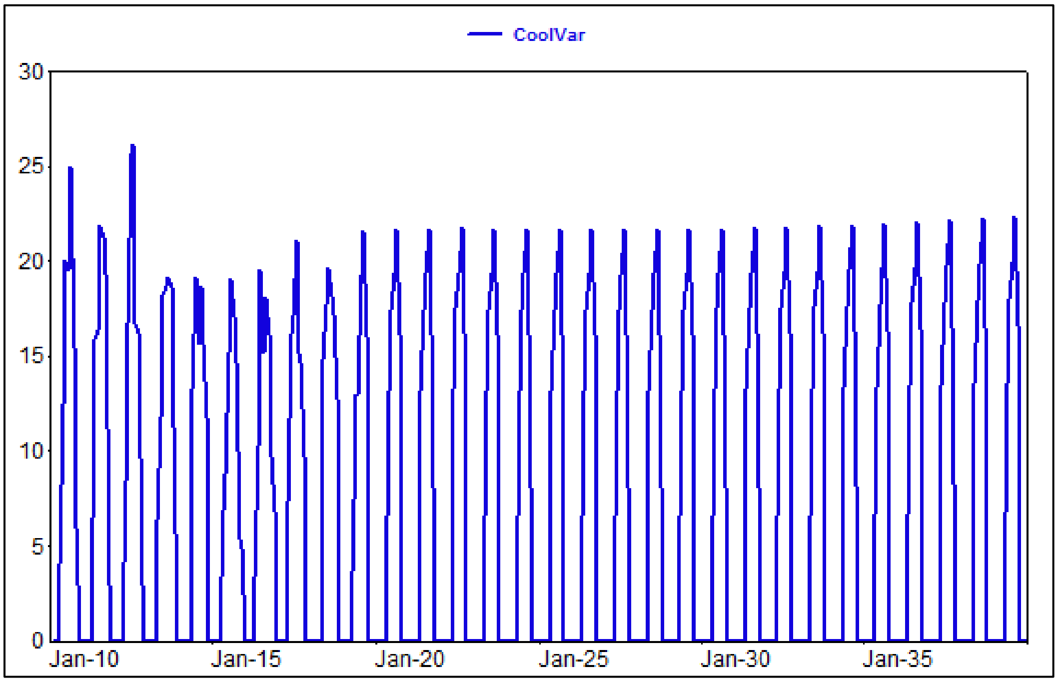


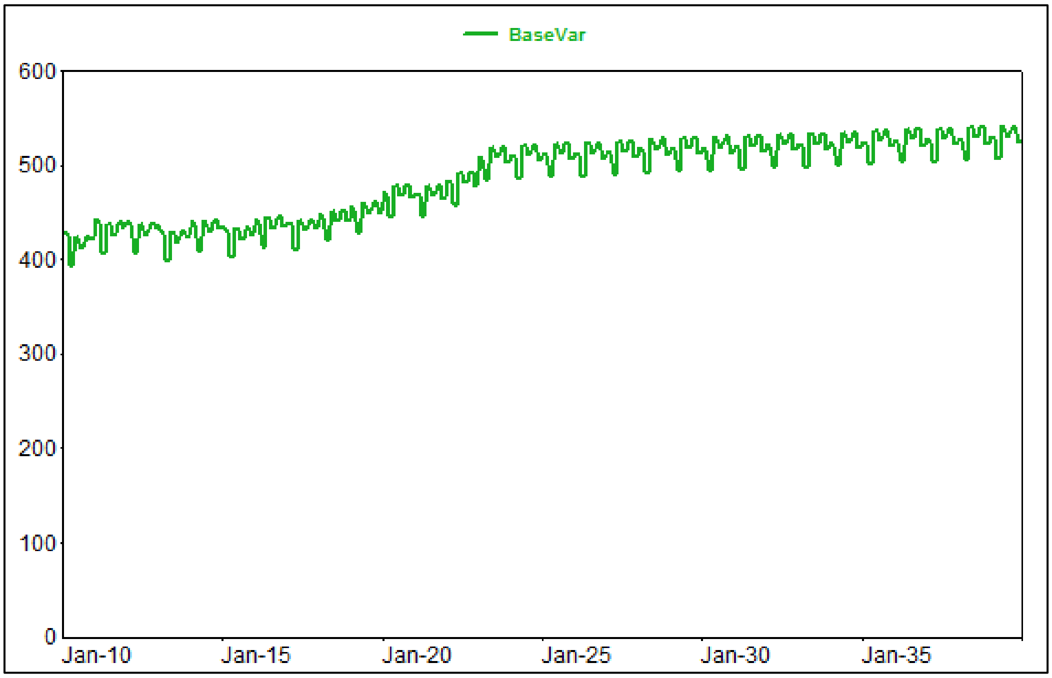
Figure 11: Peak-Day Cooling Variable



Base Load Variable

The base-load variable ($BaseVar_{ym}$) captures non-weather sensitive load at the time of the monthly peak. Monthly base-load estimates are calculated by allocating non-weather sensitive energy requirements to end-use estimates at the time of peak. End-use allocation factors are based on a set of end-use profiles developed by Itron. Figure 12 shows the non-weather sensitive peak-model variable.

Figure 12: Peak-Day Base-Use Variable



Model Results

The peak model is estimated over the period January 2010 to June 2019. The model explains monthly peak variation well with an adjusted R^2 of 0.95 and an in-sample MAPE of 2.81%. The end-use variables – *HeatVar*, *CoolVar*, and *BaseVar* are all highly statistically significant. Model statistics and parameters are included in Appendix A.

The peak demand forecast is adjusted for solar load and electric vehicle impacts, but excludes the impact of future DSM savings. Table 2-5 shows total energy and peak demand.

Table 2-5: Energy and Peak Forecast[1]

Year	Energy (MWh)		Summer Peak (MW)		Winter Peak (MW)	
2019	5,169,366		1,075		786	
2020	5,395,568	4.4%	1,105	2.7%	834	6.1%
2021	5,402,326	0.1%	1,107	0.2%	831	-0.3%
2022	5,527,069	2.3%	1,131	2.1%	850	2.2%
2023	5,763,459	4.3%	1,173	3.7%	888	4.5%
2024	5,795,986	0.6%	1,178	0.5%	891	0.4%
2025	5,811,218	0.3%	1,181	0.3%	891	0.0%
2026	5,828,820	0.3%	1,184	0.3%	892	0.1%
2027	5,849,607	0.4%	1,188	0.3%	894	0.2%
2028	5,880,148	0.5%	1,194	0.5%	897	0.4%
2029	5,895,966	0.3%	1,197	0.3%	897	0.0%
2030	5,912,671	0.3%	1,201	0.3%	897	0.0%
2031	5,930,819	0.3%	1,205	0.3%	898	0.0%
2032	5,955,984	0.4%	1,210	0.4%	899	0.2%
2033	5,970,297	0.2%	1,214	0.3%	899	-0.1%
2034	5,991,229	0.4%	1,219	0.4%	900	0.1%
2035	6,013,551	0.4%	1,224	0.4%	901	0.1%
2036	6,040,644	0.5%	1,230	0.5%	903	0.3%
2037	6,055,140	0.2%	1,234	0.4%	902	-0.1%
2038	6,074,726	0.3%	1,239	0.4%	903	0.1%
2039	6,093,472	0.3%	1,244	0.4%	904	0.1%
CAGR 20-39		0.6%		0.6%		0.4%

[1] Does not include Vectren owned distributed generation or projected DSM

3 Customer Owned Distributed Generation

The energy and peak forecasts incorporate the impact of customer-owned photovoltaic systems. System adoption is expected to increase as solar system costs decline, which is partially offset by changes in net metering laws that will credit excess generation at a rate lower than retail rates in the future. As of June 2019, VECTREN had 421 residential solar customers and 65 commercial solar customers, with an approximate installed capacity of 8.9 MW.

3.1 Monthly Adoption Model

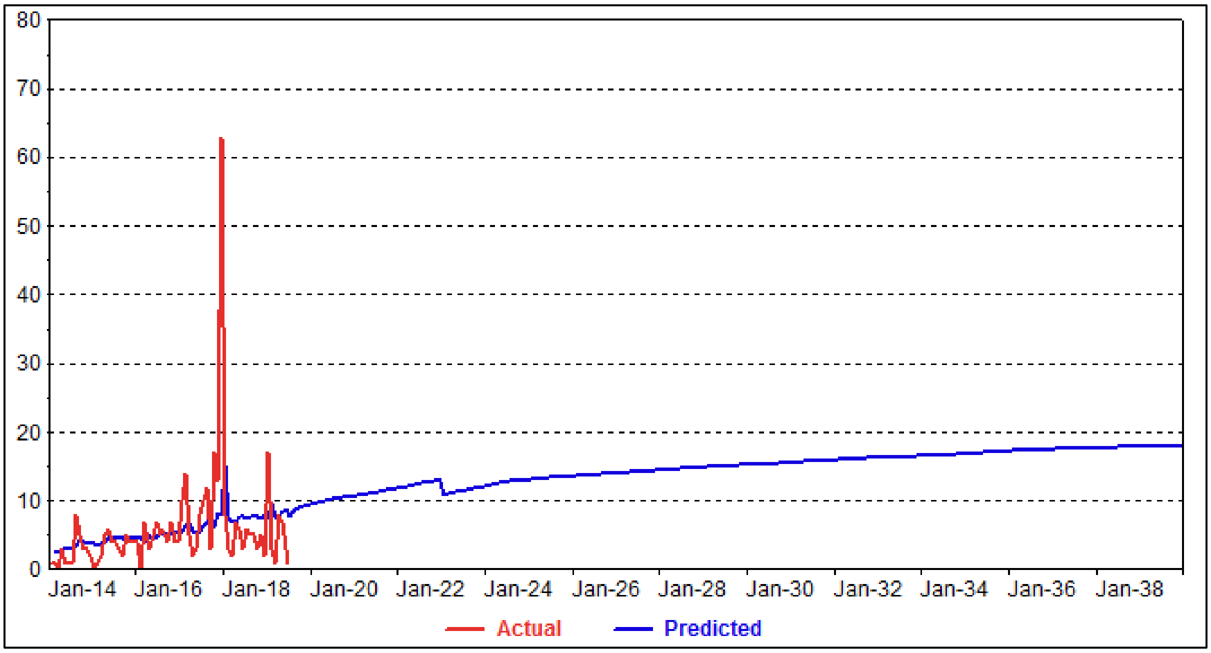
The primary factor driving system adoption is a customer's return-on-investment. A simple payback model is used as proxy. Simple payback reflects the length of time needed to recover the cost of installing a solar system - the shorter the payback, the higher the system adoption rate. From the customer's perspective, this is the number of years until electricity is "free." Simple payback also works well to explain leased system adoption as return on investment drives the leasing company's decision to offer leasing programs. Solar investment payback is calculated as a function of system costs, federal and state tax credits and incentive payments, retail electric rates, and treatment of excess generation (solar generation returned to the grid). Currently, excess generation is credited at the customer's retail rate. In the next few years excess solar generation will be credited at the wholesale cost plus 25%.

One of the most significant factors driving adoption is declining system costs; costs have been declining rapidly over the last five years. In 2010, residential solar system cost was approximately $7.00 per watt. By 2017 costs had dropped to $3.70 per watt. For the forecast period, we assume system costs continue to decline 10% annually through 2024 and an additional 3% annually after 2024. Cost projections are consistent with the U.S. Dept. of Energy's Sun Shot Solar goals and the Energy Information Administration's (EIA), most recent cost projections.[2]

The solar adoption model relates monthly residential solar adoptions to simple payback. Figure 13 shows the resulting residential solar adoption forecast.

[2] "Tracking the Sun". Lawrence Berkeley National Laboratory. September 2018.

Figure 13: Residential Solar Share Forecast



In the commercial sector, there have been too few adoptions to estimate a robust model; commercial system adoption has been low across the country. Limited commercial adoption reflects higher investment hurdle rates, building ownership issues (i.e., the entity that owns the building often does not pay the electric bill), and physical constraints as to the placement of the system. For this forecast, we assume there continues to be some commercial rooftop adoption by allowing commercial adoption to increase over time, based on the current relationship between commercial and residential adoptions rates.

Declining solar costs continue to drive solar adoption through 2022. Adoptions drop after 2023 with the change in the net metering law, but then continue to increase with declining system costs. Table 3-1 shows projected solar adoption.

Table 3-1: Solar Customer Forecast

Year	Residential Systems	Commercial Systems	Total Systems
2019	431	67	498
2020	541	84	624
2021	671	104	775
2022	814	126	939
2023	957	148	1,105
2024	1,104	170	1,274
2025	1,260	194	1,454
2026	1,424	220	1,644
2027	1,592	246	1,838
2028	1,766	273	2,038
2029	1,946	300	2,246
2030	2,126	328	2,454
2031	2,313	357	2,670
2032	2,505	387	2,892
2033	2,697	416	3,113
2034	2,897	447	3,344
2035	3,101	479	3,579
2036	3,305	510	3,815
2037	3,515	543	4,058
2038	3,731	576	4,307
2039	3,947	609	4,556
CAGR 20-39	11.0%	11.0%	11.0%

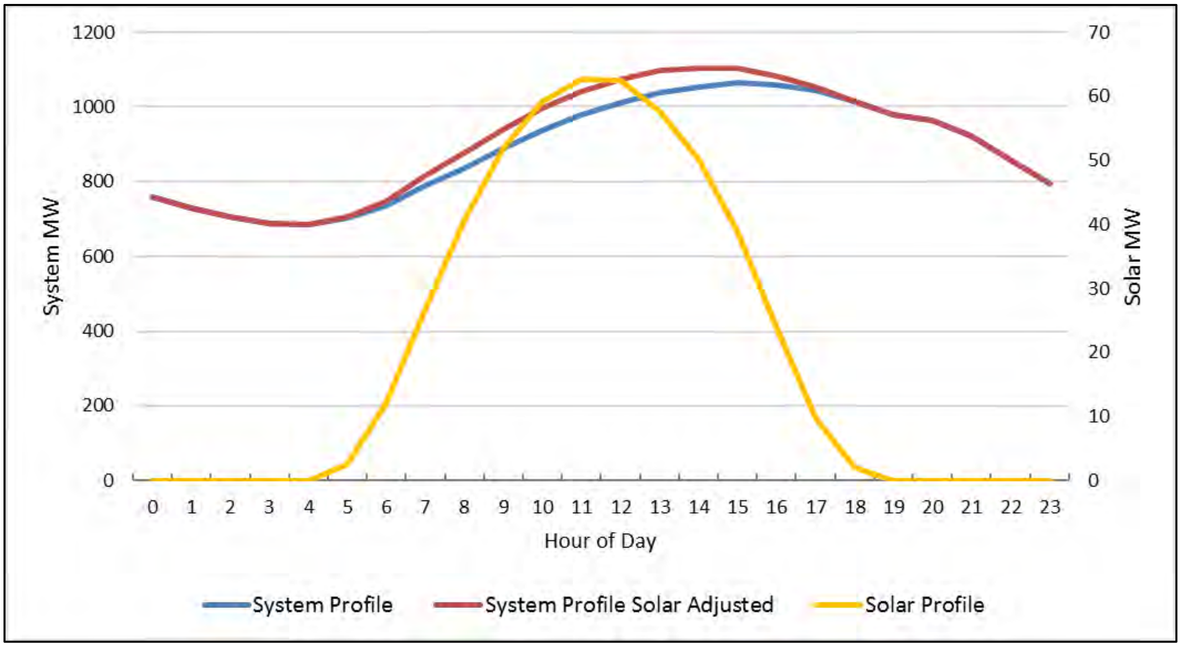
3.2 Solar Capacity and Generation

Installed solar capacity forecast is the product of the solar customer forecast and average system size (measured in kW). Based on recent solar installation data, the residential average size is 10.47 KW, and commercial average system size is 69.5 KW.

The capacity forecast (MW) is translated into system generation (MWh) forecast by applying monthly solar load factors to the capacity forecast. Monthly load factors are derived from a typical PV load profile for Evansville, IN. The PV shape is from the National Renewable Energy Laboratory (NREL) and represents a typical meteorological year (TMY).

The impact of solar generation on system peak demand is a function of the timing between solar load generation and system hourly demand. Solar output peaks during the mid-day while system peaks later in the afternoon. Figure 14 shows the system profile, solar adjusted system profile, and solar profile for a peak producing summer day.

Figure 14: Solar Hourly Load Impact



Based on system and solar load profiles, 1.0 MW of solar capacity reduces summer peak demand by approximately 0.29 MW. This adjustment factor is applied to the solar capacity forecast to yield the summer peak demand impact. Solar capacity has no impact on the winter peak demand as the winter peak is late in the evening when there is no solar generation.

Table 3-2 shows the PV capacity forecast, expected annual generation, and demand at time of peak.

Table 3-2: Solar Capacity and Generation

Year	Total Generation MWh	Installed Capacity MW (Aug)	Demand Impact MW
2019	12,084	9.3	2.7
2020	15,241	11.8	3.5
2021	18,877	14.6	4.3
2022	22,895	17.6	5.2
2023	26,943	20.7	6.1
2024	31,139	23.8	7.0
2025	35,469	27.1	8.0
2026	40,099	30.6	9.0
2027	44,835	34.2	10.1
2028	49,831	37.9	11.2
2029	54,796	41.7	12.3
2030	59,872	45.6	13.4
2031	65,153	49.6	14.6
2032	70,721	53.6	15.8
2033	75,979	57.7	17.0
2034	81,598	62.0	18.3
2035	87,349	66.3	19.5
2036	93,306	70.6	20.8
2037	99,030	75.1	22.1
2038	105,119	79.7	23.5
2039	111,208	84.3	24.8
CAGR 20-39	11.0%	10.9%	10.9%

4 Electric Vehicle Forecast

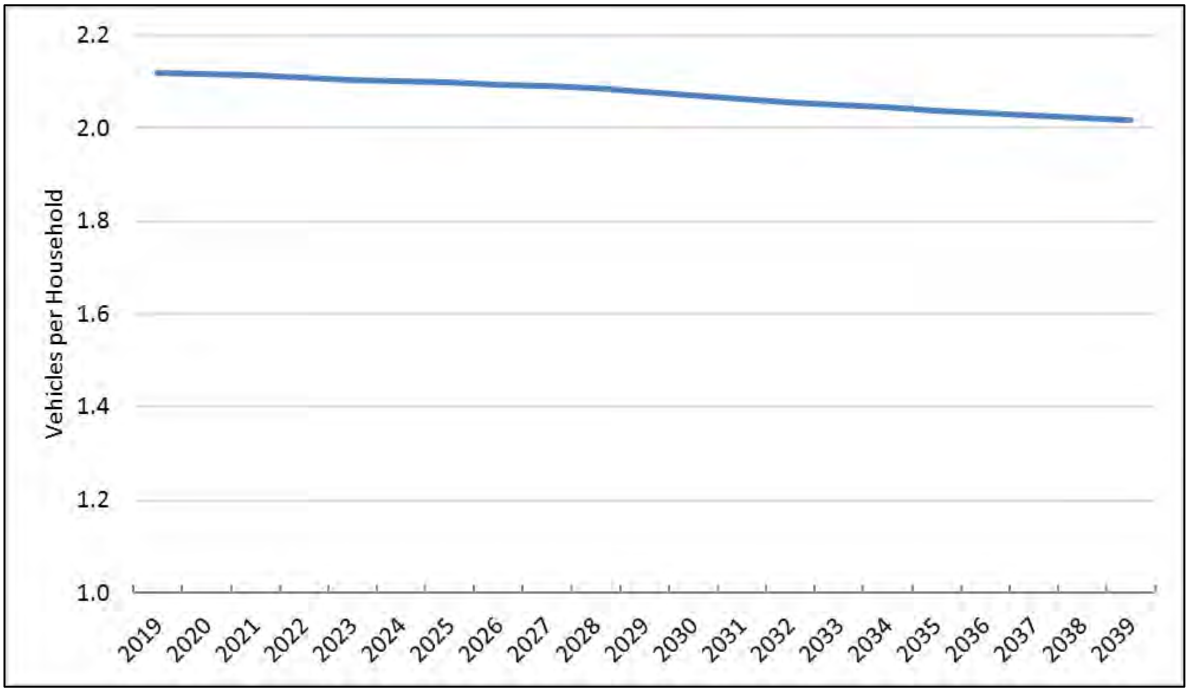
The 2019 Long-Term forecast also includes the impact of electric vehicle adoption. Currently Vectren has relatively few electric vehicles, but this is expected to increase significantly over the next twenty years with improvements in EV technology and declines in battery and vehicle costs. At the time of the forecast Vectren had 238 registered electric vehicles in the counties that Vectren serves: this included full electric (i.e., battery electric vehicles - BEV) as well as plug-in hybrid electric (PHEV) vehicles. The 238 vehicles were comprised of 105 BEVs and 133 PHEVs, with a total of 23 different make/model vehicles represented.

4.1 Methodology

The Energy Information Administration (EIA) produces a transportation forecast as part of their Annual Energy Outlook. One component of this forecast is a vehicle stock forecast by technology type, including electric vehicles. Using these data, we are able to calculate the average number of cars per household and projected electric vehicle share - BEV and PHEV.

Figure 15 shows projected number of vehicles per household. The number of vehicles declines over time as the number of persons per household declines and demand for car services such as Uber and Lyft increases.

Figure 15: EIA Vehicle Per Household

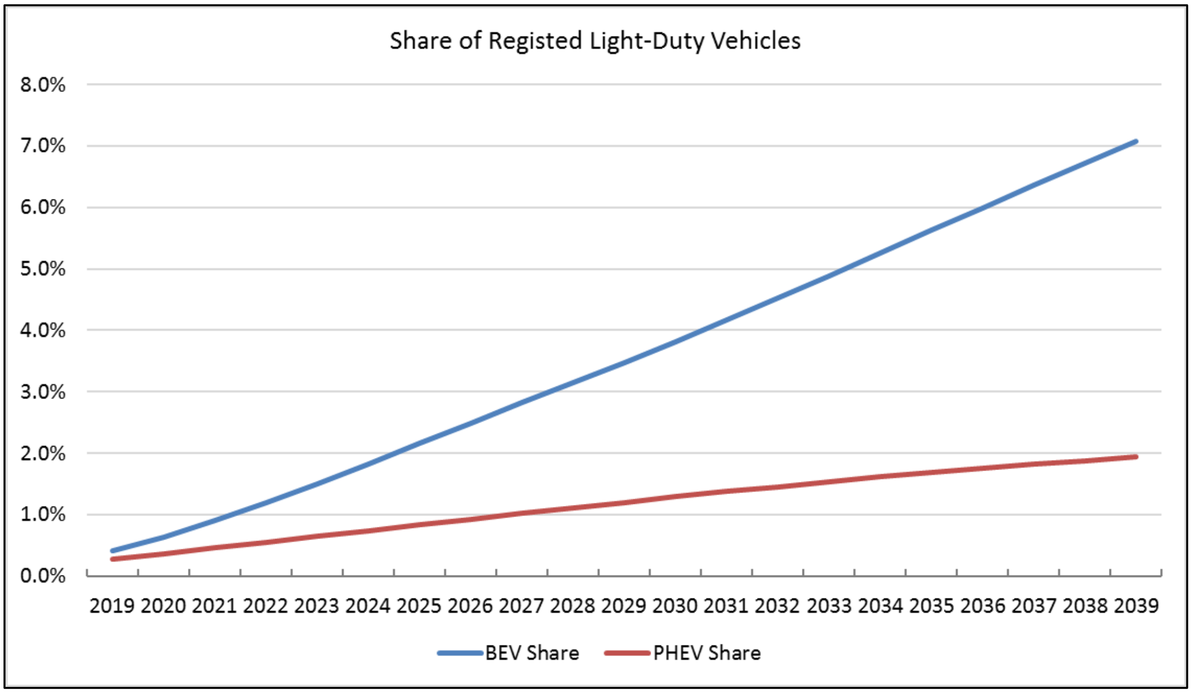


Total service area vehicles are calculated as the product of forecasted customers times EIA projected vehicles per household:

$$Ttl\ Vehicles = Custs_{yr} \times EIA\ Vehicle\ Per\ HH_{yr}$$

The number of BEV and PHEV are calculated by applying EIA's projected BEV and PHEV saturation to the service area total vehicle forecast. The share of electric vehicles are projected to increase from 0.5% to 7.1% BEV and 1.9% PHEV by 2039. The BEV and PHEV saturation forecast is shown in Figure 16.

Figure 16: EV & PHEV Market Share



The resulting electric vehicle forecast is summarized in Table 4-1:

Table 4-1: Electric Vehicle Forecast

Year	BEV Count	PHEV Count
2019	115	140
2020	283	266
2021	711	509
2022	1,783	974
2023	3,936	1,712
2024	5,112	2,065
2025	6,069	2,342
2026	7,015	2,613
2027	7,953	2,878
2028	8,884	3,136
2029	9,827	3,390
2030	10,785	3,639
2031	11,771	3,878
2032	12,772	4,109
2033	13,789	4,329
2034	14,816	4,538
2035	15,848	4,736
2036	16,875	4,926
2037	17,887	5,108
2038	18,887	5,279
2039	19,885	5,445

4.2 Electric Vehicle Energy & Load Forecast

Electric vehicles' impact on VECTREN's load forecast depends on the amount of energy a vehicle consumes annually and the timing of vehicle charging. BEVs consume more electricity than PHEVs and accounting for this distinction is important. An EV weighted annual kWh use is calculated based on the current mix of EV models. EV usage is derived from manufacturers' reported fuel efficiency to the federal government (www.fueleconomy.gov). The average annual kWh for the current mix of EVs registered in Vectren's service territory is 3,752kWh for BEV and 2,180 kWh for PHEV based on annual mileage of 12,000 miles.

Electric vehicles' impact on peak demand depends on when and where EVs are charged. Since Vectren does not have incentivized BEV/PHEV off-peak charging rates, it is assumed that the majority of charging will occur at home in the evening hours; this has a minimal impact on summer peak demand. Table 4-2 shows the electric vehicle forecast.

Table 4-2: Electric Vehicle Load Forecast

Year	BEV MWh	PHEV MWh	Total EV MWh	Demand Impact MW (Aug)
2019	432	305	737	0.1
2020	1,063	580	1,643	0.2
2021	2,667	1,110	3,777	0.4
2022	6,691	2,124	8,815	1.0
2023	14,769	3,732	18,501	2.1
2024	19,178	4,503	23,681	2.5
2025	22,770	5,106	27,876	2.9
2026	26,320	5,697	32,017	3.3
2027	29,838	6,275	36,113	3.8
2028	33,334	6,837	40,171	4.2
2029	36,869	7,392	44,261	4.6
2030	40,467	7,933	48,400	5.0
2031	44,164	8,455	52,619	5.5
2032	47,920	8,959	56,878	5.9
2033	51,735	9,438	61,173	6.3
2034	55,591	9,895	65,486	6.8
2035	59,461	10,327	69,788	7.2
2036	63,315	10,741	74,056	7.7
2037	67,111	11,137	78,248	8.1
2038	70,863	11,510	82,373	8.5
2039	74,607	11,872	86,479	8.9

5 Forecast Assumptions

5.1 Weather Data

Historical and normal HDD and CDD are derived from daily temperature data for the Evansville airport. Normal degree-days are calculated by averaging the historical daily HDD and CDD over the last twenty years. In past forecasts, we assumed normal HDD and CDD will occur in each of the forecast years. Recent analysis suggests an alternative approach. In reviewing historical weather data, we found a statistically significant positive, but slow, increase in average temperature. This translates into fewer HDD and more CDD over time. Our analysis showed HDD are decreasing 0.2% per year while CDD are increasing 0.5% per year. These trends are incorporated into the forecast. Starting normal HDD are allowed to decrease 0.2% over the forecast period while CDD increase 0.5% per year through 2039. Figure 17 and Figure 18 show historical and forecasted monthly HDD and CDD.

Figure 17: Heating Degree Days

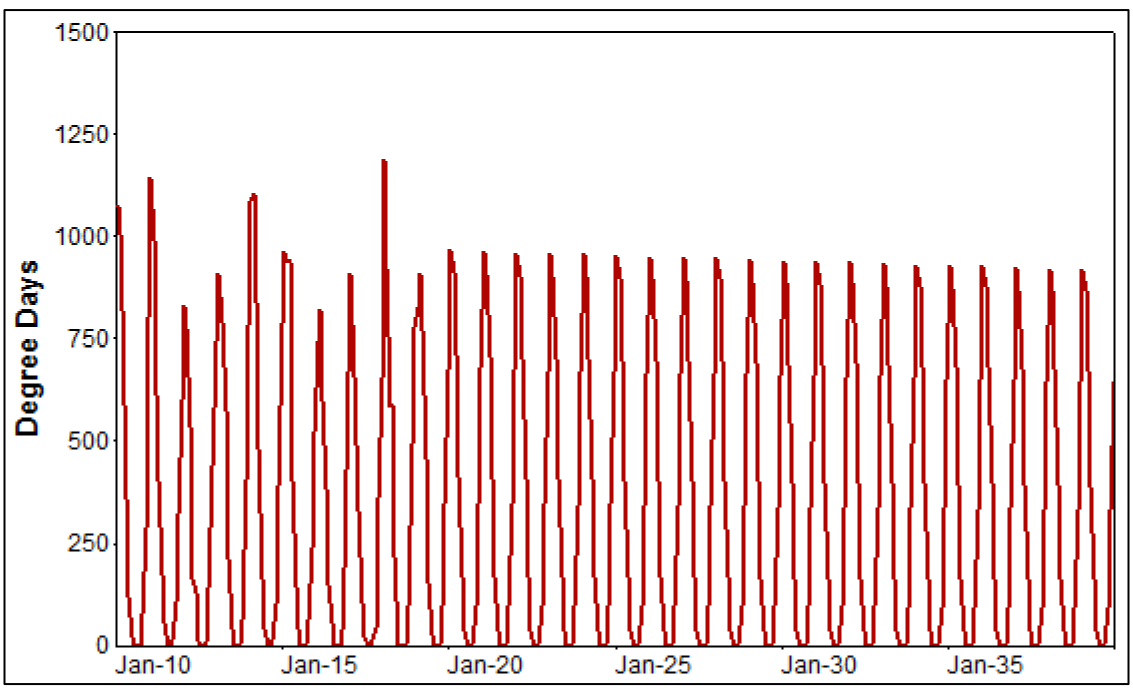
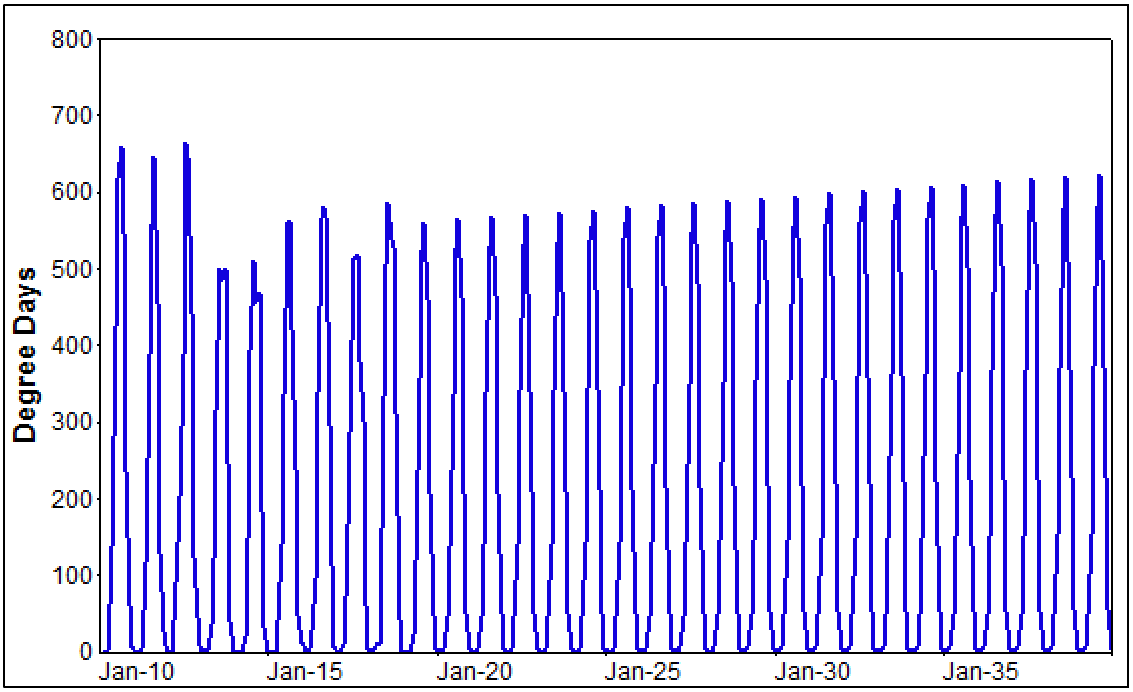


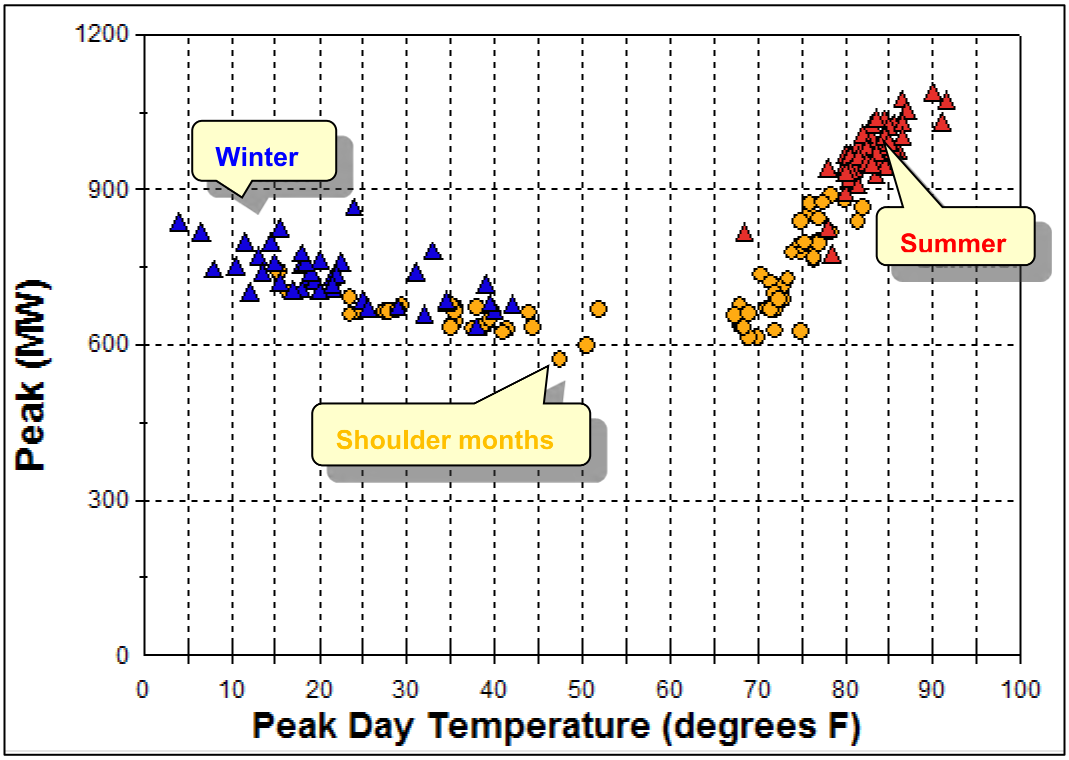
Figure 18: Cooling Degree Days



Peak-Day Weather Variables

Peak-day CDD and HDD are used in forecasting system peak demand. Peak-day HDD and CDD are derived by finding the daily HDD and CDD that occurred on the peak day in each month. The appropriate breakpoints for defining peak-day HDD and CDD are determined by evaluating the relationship between monthly peak and the peak-day average temperature, as shown in Figure 19.

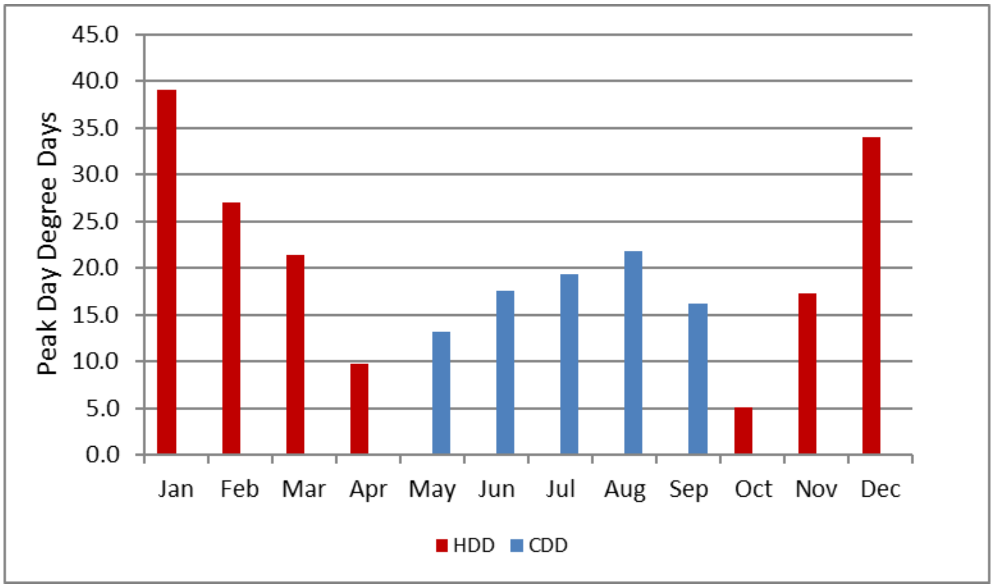
Figure 19: Monthly Peak Demand /Temperature Relationship



Peak-day cooling occurs when temperatures are above 65 degrees and peak-day heating occurs when temperatures are below 55 degrees.

Normal peak-day HDD and CDD are calculated using 20 years of historical weather data, based on a rank and average approach, these are not trended. The underlying rate class sales models incorporate trended normal weather; derived heating and cooling sales from these models are an input into the peak model. Using a trended peak weather would double count the impact of increasing temperatures. Normal peak-day HDD and CDD are based on the hottest and coldest days that occurred in each month over the historical time period. Figure 20 shows the normal peak-day HDD and CDD values used in the forecast.

Figure 20: Normal Peak-Day HDD & CDD



5.2 Economic Data

The class sales forecasts are based on *Moody's Economy.com* May 2019 economic forecast for the Evansville Metropolitan Statistical Area (MSA). The primary economic drivers in the residential sector are household income and the number of new households. Household formation is stable and increasing consistently though the forecast period with 0.4% average annual growth. Real household income growth is modest, averaging 1.6% over the forecast period.

Commercial sales are driven by nonmanufacturing output, nonmanufacturing employment, and population. Non-manufacturing output is forecasted to grow at 1.7% per year through the forecast period with non-manufacturing employment is growing 0.6% per year and population a little over 0.1% per year.

The industrial model relates sales to manufacturing output and employment. Manufacturing output is projected to increase more rapidly over the next 5 years, with output increasing 2.3% per year, over the long-term manufacturing output averages 1.8% annual growth. While output increases, associated manufacturing employment is projected to decline at a 0.5% annual rate.

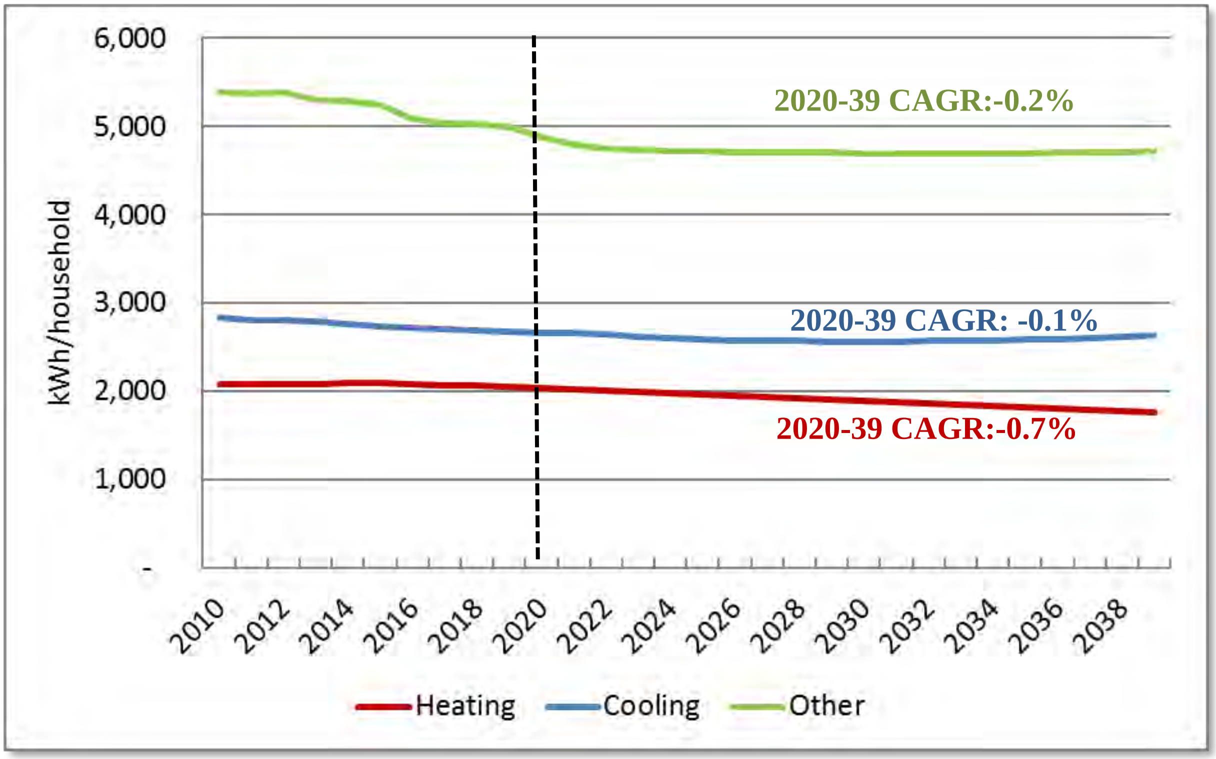
Historical electric prices (in real dollars) are derived from billed sales and revenue data. Historical prices are calculated as a 12-month moving average of the average rate (revenues divided by sales); prices are expressed in real dollars. Prices impact residential and commercial sales through imposed short-term price elasticities. Short-term price elasticities are small; residential and commercial price elasticities are set at -0.10. Price is not an input to the industrial sales model. Price projections are based on the Energy Information Administration's (EIA) long-term real growth rates. Over the forecast period, prices increase 1.5% annually.

5.3 Appliance Saturation and Efficiency Trends

Over the long-term, changes in end-use saturation and stock efficiency impact class sales, system energy, and peak demand. End-use energy intensities, expressed in kWh per household for the residential sector and kWh per square foot for the commercial sectors, are incorporated into the constructed forecast model variables. Energy intensities reflect both change in ownership (saturation) and average stock efficiency. In general, efficiency is improving faster than end-use saturation resulting in declining end-use energy use. Energy intensities are derived from Energy Information Administration's (EIA) 2019 Annual Energy Outlook and Vectren's appliance saturation surveys. The residential sector incorporates saturation and efficiency trends for seventeen end-uses. The commercial sector captures end-use intensity projections for ten end-use classifications across ten building types.

Residential end-use intensities are used in constructing the model end-use variables. Figure 21 shows the resulting aggregated end-use intensity projections.

Figure 21: Residential End-Use Energy Intensities

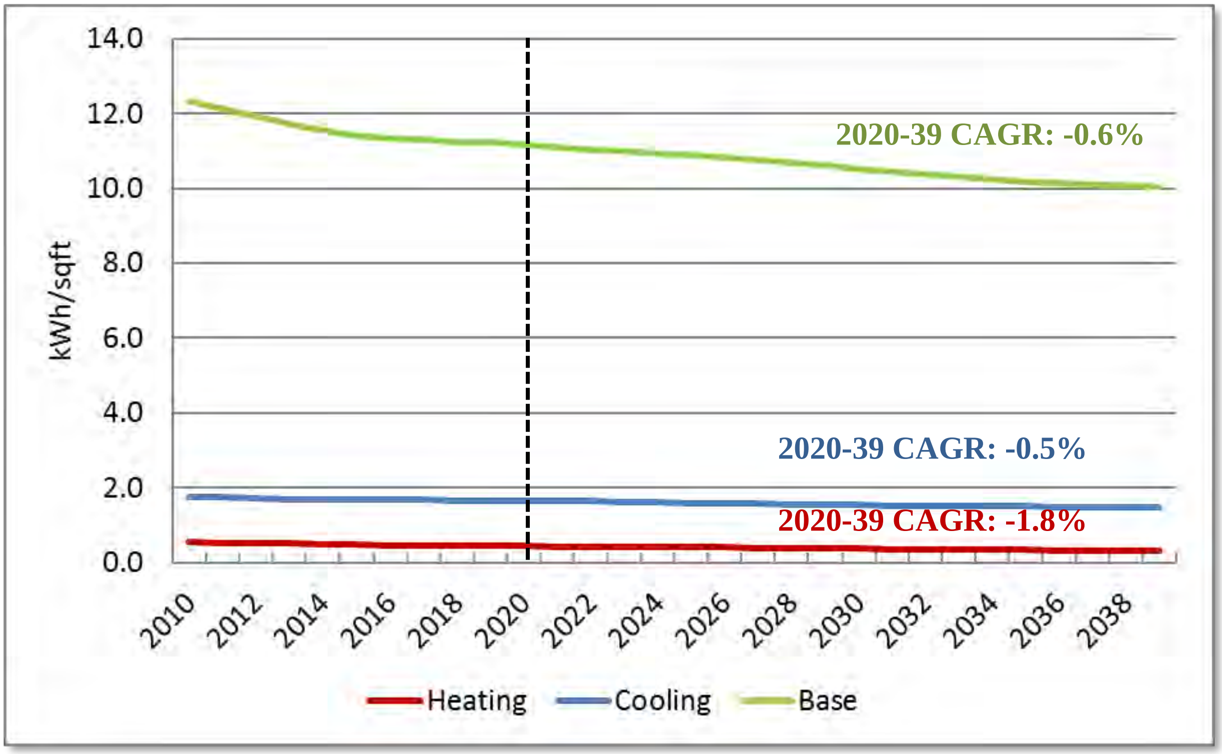


*CAGR=Compound Average Growth Rate

Heating intensity declines 0.7% annually through the forecast period, reflecting declining share in electric heat saturation. Cooling intensity declines 0.1% annually through the forecast period as overall air conditioning efficiency improvements outweigh increase in saturation. Total non-weather sensitive end-use intensity declines 0.2% annually.

Commercial end-use intensities (expressed in kWh per sqft) are based on the EIA's East South Central Census Division forecast; the starting intensity estimates are calibrated to Vectren commercial sales. As in the residential sector, end-use energy use has been declining as a result of new codes and standards and utility DSM programs. Figure 22 shows commercial end-use energy intensity forecasts for total heating, cooling, and non-weather sensitive loads.

Figure 22: Commercial End-Use Energy Intensity



Commercial usage is dominated by non-weather sensitive (Base) end-uses, which over the forecast period are projected to decline 0.6% per year. Cooling intensity declines 0.5% annually through the forecast period. Heating intensity declines even stronger at 1.8% annual rate though commercial electric heating is relatively small.

Appendix A: Model Statistics

Residential Average Use Model

Variable	Coefficient	StdErr	T-Stat	P-Value
mStructRev.XHeat	1.131	0.024	47.002	0.00%
mStructRev.XCool	1.102	0.015	72.536	0.00%
mStructRev.XOther	1.247	0.019	64.464	0.00%
mBin.Jan	41.217	10.23	4.029	0.01%
mBin.Aug	42.865	11.411	3.756	0.03%
mBin.Sep	34.721	10.421	3.332	0.12%
mBin.Oct	30.013	9.805	3.061	0.28%
mDSMF.DSM	-0.628	0.098	-6.44	0.00%

Model Statistics	
Iterations	1
Adjusted Observations	111
Deg. of Freedom for Error	103
R-Squared	0.989
Adjusted R-Squared	0.988
Model Sum of Squares	6,162,873.25
Sum of Squared Errors	70,284.55
Mean Squared Error	682.37
Std. Error of Regression	26.12
Mean Abs. Dev. (MAD)	19.03
Mean Abs. % Err. (MAPE)	1.93%
Durbin-Watson Statistic	1.81

Residential Customer Model

Variable	Coefficient	StdErr	T-Stat	P-Value
Economics.PopEV	960.574	2.859	335.981	0.00%
AR(1)	0.958	0.02	47.011	0.00%
MA(1)	0.438	0.086	5.101	0.00%

Model Statistics	
Iterations	8
Adjusted Observations	113
Deg. of Freedom for Error	110
R-Squared	0.996
Adjusted R-Squared	0.996
Model Sum of Squares	322,162,685.79
Sum of Squared Errors	1,295,103.33
Mean Squared Error	11,773.67
Std. Error of Regression	108.51
Mean Abs. Dev. (MAD)	87.12
Mean Abs. % Err. (MAPE)	0.07%
Durbin-Watson Statistic	1.91

Commercial Sales Model

Variable	Coefficient	StdErr	T-Stat	P-Value
mStructRev.XOther	9.238	1.188	7.776	0.00%
mStructRev.XCool	15.486	0.442	35.027	0.00%
mStructRev.XHeat	20.148	1.804	11.165	0.00%
mBin.Yr14	2763.076	860.831	3.21	0.18%
mBin.Feb	2174.958	1122.048	1.938	5.54%
mBin.Jun	-4324.45	995.223	-4.345	0.00%
mBin.Oct	3652.067	1025.239	3.562	0.06%
mBin.Nov	2720.101	1042.823	2.608	1.05%
mBin.Aug09Plus	29960.933	7537.599	3.975	0.01%
mDSM.DSM	-0.498	0.13	-3.826	0.02%

Model Statistics	
Iterations	1
Adjusted Observations	110
Deg. of Freedom for Error	100
R-Squared	0.964
Adjusted R-Squared	0.961
Model Sum of Squares	18,976,689,674.96
Sum of Squared Errors	712,451,460.27
Mean Squared Error	7,124,514.60
Std. Error of Regression	2,669.18
Mean Abs. Dev. (MAD)	1,974.42
Mean Abs. % Err. (MAPE)	1.82%
Durbin-Watson Statistic	1.586

Industrial Sales Model

Variable	Coefficient	StdErr	T-Stat	P-Value
mEcon.IndVar	118487.802	2254.45	52.557	0.00%
mWthrRev.CDD65	57.963	6.069	9.551	0.00%
mBin.Jul09Plus	29846.553	2190.612	13.625	0.00%
mBin.Feb	11020.029	3029.515	3.638	0.04%
mBin.Apr	7543.537	3000.036	2.514	1.32%
mBin.Sep	19778.485	3582.861	5.52	0.00%
mBin.Nov	17466.878	3505.353	4.983	0.00%
mBin.Yr09	-16514.547	3068.532	-5.382	0.00%
mBin.Yr16Plus	11358.694	1919.002	5.919	0.00%

Model Statistics	
Iterations	1
Adjusted Observations	137
Deg. of Freedom for Error	128
R-Squared	0.757
Adjusted R-Squared	0.742
Model Sum of Squares	37,889,478,247.99
Sum of Squared Errors	12,146,223,745.81
Mean Squared Error	94,892,373.01
Std. Error of Regression	9,741.27
Mean Abs. Dev. (MAD)	7,706.07
Mean Abs. % Err. (MAPE)	5.24%
Durbin-Watson Statistic	1.714

Residential Solar Adoption Model

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	23.491	11.774	1.995	5.04%
Payback.ResPayback	-1.31	0.866	-1.512	13.55%
AR(1)	0.144	0.126	1.143	25.75%

Model Statistics	
Iterations	6
Adjusted Observations	65
Deg. of Freedom for Error	62
R-Squared	0.068
Adjusted R-Squared	0.038
Model Sum of Squares	286.23
Sum of Squared Errors	3,925.31
Mean Squared Error	63.31
Std. Error of Regression	7.96
Mean Abs. Dev. (MAD)	3.71
Mean Abs. % Err. (MAPE)	91.11%
Durbin-Watson Statistic	2.009

Peak Model

Variable	Coefficient	StdErr	T-Stat	P-Value
mCPkEndUses.HeatVar	3.147	0.335	9.405	0.00%
mCPkEndUses.CoolVar	18.522	0.542	34.196	0.00%
mCPkEndUses.BaseVar	1.519	0.024	62.389	0.00%
mBin.Jan16	148.429	30.989	4.79	0.00%
mBin.Nov16	-86.871	31.195	-2.785	0.64%
mBin.Yr15	47.869	10.315	4.641	0.00%
mBin.May	-49.483	10.624	-4.658	0.00%
mBin.Oct	-48.783	11.583	-4.212	0.01%
mBin.Yr12Plus	-35.439	7.391	-4.795	0.00%

Model Statistics	
Iterations	1
Adjusted Observations	111
Deg. of Freedom for Error	102
R-Squared	0.952
Adjusted R-Squared	0.949
Model Sum of Squares	1,908,789.28
Sum of Squared Errors	95,539.47
Mean Squared Error	936.66
Std. Error of Regression	30.6
Mean Abs. Dev. (MAD)	22
Mean Abs. % Err. (MAPE)	2.81%
Durbin-Watson Statistic	1.855

Appendix B: Residential SAE Modeling Framework

The traditional approach to forecasting monthly sales for a customer class is to develop an econometric model that relates monthly sales to weather, seasonal variables, and economic conditions. From a forecasting perspective, econometric models are well suited to identify historical trends and to project these trends into the future. In contrast, the strength of the end-use modeling approach is the ability to identify the end-use factors that are drive energy use. By incorporating end-use structure into an econometric model, the statistically adjusted end-use (SAE) modeling framework exploits the strengths of both approaches.

There are several advantages to this approach.

- The equipment efficiency and saturation trends, dwelling square footage, and thermal shell integrity changes embodied in the long-run end-use forecasts are introduced explicitly into the short-term monthly sales forecast. This provides a strong bridge between the two forecasts.
- By explicitly introducing trends in equipment saturations, equipment efficiency, dwelling square footage, and thermal integrity levels, it is easier to explain changes in usage levels and changes in weather-sensitivity over time.
- Data for short-term models are often not sufficiently robust to support estimation of a full set of price, economic, and demographic effects. By bundling these factors with equipment-oriented drivers, a rich set of elasticities can be incorporated into the final model.

This section describes the SAE approach, the associated supporting SAE spreadsheets, and the *MetrixND* project files that are used in the implementation. The source for the SAE spreadsheets is the 2019 Annual Energy Outlook (AEO) database provided by the Energy Information Administration (EIA).

Residential Statistically Adjusted End-Use Modeling Framework

The statistically adjusted end-use modeling framework begins by defining energy use ($USE_{y,m}$) in year (y) and month (m) as the sum of energy used by heating equipment ($Heat_{y,m}$), cooling equipment ($Cool_{y,m}$), and other equipment ($Other_{y,m}$). Formally,

$$USE_{y,m} = Heat_{y,m} + Cool_{y,m} + Other_{y,m} \tag{1}$$

Although monthly sales are measured for individual customers, the end-use components are not. Substituting estimates for the end-use elements gives the following econometric equation.

$$USE_m = a + b_1 \times XHeat_m + b_2 \times XCool_m + b_3 \times XOther_m + \varepsilon_m \qquad (2)$$

$XHeat_m$, $XCool_m$, and $XOther_m$ are explanatory variables constructed from end-use information, dwelling data, weather data, and market data. As will be shown below, the equations used to construct these X-variables are simplified end-use models, and the X-variables are the estimated usage levels for each of the major end uses based on these models. The estimated model can then be thought of as a statistically adjusted end-use model, where the estimated slopes are the adjustment factors.

Constructing XHeat

As represented in the SAE spreadsheets, energy use by space heating systems depends on the following types of variables.

- Heating degree days
- Heating equipment saturation levels
- Heating equipment operating efficiencies
- Thermal integrity and footage of homes
- Average household size, household income, and energy prices

The heating variable is represented as the product of an annual equipment index and a monthly usage multiplier. That is,

$$XHeat_{y,m} = HeatIndex_{y,m} \times HeatUse_{y,m} \qquad (3)$$

Where:

- $XHeat_{y,m}$ is estimated heating energy use in year (y) and month (m)
- $HeatIndex_{y,m}$ is the monthly index of heating equipment
- $HeatUse_{y,m}$ is the monthly usage multiplier

The heating equipment index is defined as a weighted average across equipment types of equipment saturation levels normalized by operating efficiency levels. Given a set of fixed weights, the index will change over time with changes in equipment saturations (*Sat*), operating efficiencies (*Eff*), building structural index (*StructuralIndex*), and energy prices. Formally, the equipment index is defined as:

$$HeatIndex_y = StructuralIndex_y \times \sum_{Type} Weight^{Type} \times \frac{\left(Sat_y^{Type} \Big/ Eff_y^{Type} \right)}{\left(Sat_{2015}^{Type} \Big/ Eff_{2015}^{Type} \right)} \quad (4)$$

The *StructuralIndex* is constructed by combining the EIA's building shell efficiency index trends with surface area estimates, and then it is indexed to the 2015 value:

$$StructuralIndex_y = \frac{BuildingShellEfficiencyIndex_y \times SurfaceArea_y}{BuildingShellEfficiencyIndex_{2015} \times SurfaceArea_{2015}} \quad (5)$$

The *StructuralIndex* is defined on the *StructuralVars* tab of the SAE spreadsheets. Surface area is derived to account for roof and wall area of a standard dwelling based on the regional average square footage data obtained from EIA. The relationship between the square footage and surface area is constructed assuming an aspect ratio of 0.75 and an average of 25% two-story and 75% single-story. Given these assumptions, the approximate linear relationship for surface area is:

$$SurfaceArea_y = 892 + 1.44 \times Footage_y \quad (6)$$

For electric heating equipment, the SAE spreadsheets contain two equipment types: electric resistance furnaces/room units and electric space heating heat pumps. Examples of weights for these two equipment types for the U.S. are given in Table 1.

Table 1: Electric Space Heating Equipment Weights

Equipment Type	Weight (kWh)
Electric Resistance Furnace/Room units	767
Electric Space Heating Heat Pump	127

Data for the equipment saturation and efficiency trends are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets. The efficiency for electric space heating heat pumps are given in terms of Heating Seasonal Performance Factor [BTU/Wh], and the efficiencies for electric furnaces and room units are estimated as 100%, which is equivalent to 3.41 BTU/Wh.

Heating system usage levels are impacted on a monthly basis by several factors, including weather, household size, income levels, prices, and billing days. The estimates for space heating equipment usage levels are computed as follows:

$$HeatUse_{y,m} = \left(\frac{HDD_{y,m}}{HDD_{05}}\right) \times \left(\frac{HHSize_y}{HHSize_{05,7}}\right)^{0.25} \times \left(\frac{Income_y}{Income_{05,7}}\right)^{0.10} \times \left(\frac{Elec\,Pr\,ice_{y,m}}{Elec\,Pr\,ice_{05,7}}\right)^{-0.10} \tag{7}$$

Where:

- *HDD* is the number of heating degree days in year (*y*) and month (*m*).
- *HHSize* is average household size in a year (*y*)
- *Income* is average real income per household in year (*y*)
- *ElecPrice* is the average real price of electricity in month (*m*) and year (*y*)

By construction, the $HeatUse_{y,m}$ variable has an annual sum that is close to 1.0 in the base year (2005). The first term, which involves heating degree days, serve to allocate annual values to months of the year. The remaining terms average to 1.0 in the base year. In other years, the values will reflect changes in the economic drivers, as transformed through the end-use elasticity parameters. The price impacts captured by the Usage equation represent short-term price response.

Constructing XCool

The explanatory variable for cooling loads is constructed in a similar manner. The amount of energy used by cooling systems depends on the following types of variables.

- Cooling degree days
- Cooling equipment saturation levels
- Cooling equipment operating efficiencies
- Thermal integrity and footage of homes
- Average household size, household income, and energy prices

The cooling variable is represented as the product of an equipment-based index and monthly usage multiplier. That is,

$$XCool_{y,m} = CoolIndex_y \times CoolUse_{y,m} \tag{8}$$

Where

- $XCool_{y,m}$ is estimated cooling energy use in year (*y*) and month (*m*)

- $CoolIndex_y$ is an index of cooling equipment
- $CoolUse_{y,m}$ is the monthly usage multiplier

As with heating, the cooling equipment index is defined as a weighted average across equipment types of equipment saturation levels normalized by operating efficiency levels. Formally, the cooling equipment index is defined as:

$$CoolIndex_y = StructuralIndex_y \times \sum_{Type} Weight^{Type} \times \frac{\left(Sat_y^{Type} \Big/ Eff_y^{Type} \right)}{\left(Sat_{2015}^{Type} \Big/ Eff_{2015}^{Type} \right)} \tag{9}$$

For cooling equipment, the SAE spreadsheets contain three equipment types: central air conditioning, space cooling heat pump, and room air conditioning. Examples of weights for these three equipment types for the U.S. are given in Table 2.

Table 2: Space Cooling Equipment Weights

Equipment Type	Weight (kWh)
Central Air Conditioning	1,219
Space Cooling Heat Pump	240
Room Air Conditioning	177

The equipment saturation and efficiency trends data are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets. The efficiency for space cooling heat pumps and central air conditioning (A/C) units are given in terms of Seasonal Energy Efficiency Ratio [BTU/Wh], and room A/C units efficiencies are given in terms of Energy Efficiency Ratio [BTU/Wh].

Cooling system usage levels are impacted on a monthly basis by several factors, including weather, household size, income levels, and prices. The estimates of cooling equipment usage levels are computed as follows:

$$CoolUse_{y,m} = \left(\frac{CDD_{y,m}}{CDD_{05}}\right) \times \left(\frac{HHSize_y}{HHSize_{05,7}}\right)^{0.25} \times \left(\frac{Income_y}{Income_{05,7}}\right)^{0.10} \times \left(\frac{Elec\,Price_{y,m}}{Elec\,Price_{05,7}}\right)^{-0.10} \tag{10}$$

Where:

- CDD is the number of cooling degree days in year (y) and month (m).

- *HHSize* is average household size in a year (y)
- *Income* is average real income per household in year (y)
- *ElecPrice* is the average real price of electricity in month (m) and year (y)

By construction, the *CoolUse* variable has an annual sum that is close to 1.0 in the base year (2005). The first term, which involves cooling degree days, serve to allocate annual values to months of the year. The remaining terms average to 1.0 in the base year. In other years, the values will change to reflect changes in the economic driver changes.

Constructing XOther

Monthly estimates of non-weather sensitive sales can be derived in a similar fashion to space heating and cooling. Based on end-use concepts, other sales are driven by:

- Appliance and equipment saturation levels
- Appliance efficiency levels
- Average number of days in the billing cycle for each month
- Average household size, real income, and real prices

The explanatory variable for other uses is defined as follows:

$$XOther_{y,m} = OtherEqpIndex_{y,m} \times OtherUse_{y,m} \tag{11}$$

The first term on the right-hand side of this expression ($OtherEqpIndex_y$) embodies information about appliance saturation and efficiency levels and monthly usage multipliers. The second term (*OtherUse*) captures the impact of changes in prices, income, household size, and number of billing-days on appliance utilization.

End-use indices are constructed in the SAE models. A separate end-use index is constructed for each end-use equipment type using the following function form.

$$ApplianceIndex_{y,m} = Weight^{Type} \times \frac{\left(Sat_{y}^{Type} \Big/ \frac{1}{UEC_{y}^{Type}} \right)}{\left(Sat_{2015}^{Type} \Big/ \frac{1}{UEC_{2015}^{Type}} \right)} \times MoMult_{m}^{Type} \times \tag{12}$$

Where:

- *Weight* is the weight for each appliance type
- *Sat* represents the fraction of households, who own an appliance type
- $MoMult_m$ is a monthly multiplier for the appliance type in month (m)
- *Eff* is the average operating efficiency the appliance
- *UEC* is the unit energy consumption for appliances

This index combines information about trends in saturation levels and efficiency levels for the main appliance categories with monthly multipliers for lighting, water heating, and refrigeration.

The appliance saturation and efficiency trends data are presented on the *Shares* and *Efficiencies* tabs of the SAE spreadsheets.

Further monthly variation is introduced by multiplying by usage factors that cut across all end uses, constructed as follows:

$$ApplianceUse_{y,m} = \left(\frac{BDays_{y,m}}{30.5}\right) \times \left(\frac{HHSize_y}{HHSize_{05,7}}\right)^{0.25} \times \left(\frac{Income_y}{Income_{05,7}}\right)^{0.10} \times \left(\frac{ElecPrice_{y,m}}{ElecPrice_{05,7}}\right)^{-0.10} \quad (13)$$

The index for other uses is derived then by summing across the appliances:

$$OtherEqpIndex_{y,m} = \sum_k ApplianceIndex_{y,m} \times ApplianceUse_{y,m} \quad (14)$$

Appendix C: Commercial SAE Modeling Framework

The traditional approach to forecasting monthly sales for a customer class is to develop an econometric model that relates monthly sales to weather, seasonal variables, and economic conditions. From a forecasting perspective, the strength of econometric models is that they are well suited to identifying historical trends and to projecting these trends into the future. In contrast, the strength of the end-use modeling approach is the ability to identify the end-use factors that are driving energy use. By incorporating end-use structure into an econometric model, the statistically adjusted end-use (SAE) modeling framework exploits the strengths of both approaches.

There are several advantages to this approach.

- The equipment efficiency trends and saturation changes embodied in the long-run end-use forecasts are introduced explicitly into the short-term monthly sales forecast. This provides a strong bridge between the two forecasts.
- By explicitly introducing trends in equipment saturations and equipment efficiency levels, it is easier to explain changes in usage levels and changes in weather-sensitivity over time.
- Data for short-term models are often not sufficiently robust to support estimation of a full set of price, economic, and demographic effects. By bundling these factors with equipment-oriented drivers, a rich set of elasticities can be built into the final model.

This document describes this approach, the associated supporting Commercial SAE spreadsheets, and *MetrixND* project files that are used in the implementation. The source for the commercial SAE spreadsheets is the 2019 Annual Energy Outlook (AEO) database provided by the Energy Information Administration (EIA).

Commercial Statistically Adjusted End-Use Model Framework

The commercial statistically adjusted end-use model framework begins by defining energy use ($USE_{y,m}$) in year (y) and month (m) as the sum of energy used by heating equipment ($Heat_{y,m}$), cooling equipment ($Cool_{y,m}$) and other equipment ($Other_{y,m}$). Formally,

$$\mathrm{USE}_{y,m} = \mathrm{Heat}_{y,m} + \mathrm{Cool}_{y,m} + \mathrm{Other}_{y,m} \tag{1}$$

Although monthly sales are measured for individual customers, the end-use components are not. Substituting estimates for the end-use elements gives the following econometric equation.

$$USE_m = a + b_1 \times XHeat_m + b_2 \times XCool_m + b_3 \times XOther_m + \varepsilon_m \quad (2)$$

Here, $XHeat_m$, $XCool_m$, and $XOther_m$ are explanatory variables constructed from end-use information, weather data, and market data. As will be shown below, the equations used to construct these X-variables are simplified end-use models, and the X-variables are the estimated usage levels for each of the major end uses based on these models. The estimated model can then be thought of as a statistically adjusted end-use model, where the estimated slopes are the adjustment factors.

Constructing XHeat

As represented in the Commercial SAE spreadsheets, energy use by space heating systems depends on the following types of variables.

- Heating degree days,
- Heating equipment saturation levels,
- Heating equipment operating efficiencies,
- Commercial output, employment, population, and energy price.

The heating variable is represented as the product of an annual equipment index and a monthly usage multiplier. That is,

$$XHeat_{y,m} = HeatIndex_y \times HeatUse_{y,m} \quad (3)$$

Where:

- *$XHeat_{y,m}$ is estimated heating energy use in year (y) and month (m),*
- *$HeatIndex_y$ is the annual index of heating equipment, and*
- *$HeatUse_{y,m}$ is the monthly usage multiplier.*

The heating equipment index is composed of electric space heating equipment saturation levels normalized by operating efficiency levels. The index will change over time with changes in heating equipment saturations (*HeatShare*) and operating efficiencies (*Eff*). Formally, the equipment index is defined as:

$$HeatIndex_y = HeatSales_{2013} \times \frac{\left({HeatShare_y}/{Eff_y} \right)}{\left({HeatShare_{2013}}/{Eff_{2013}} \right)} \tag{4}$$

In this expression, 2013 is used as a base year for normalizing the index. The ratio on the right is equal to 1.0 in 2004. In other years, it will be greater than one if equipment saturation levels are above their 201
level. This will be counteracted by higher efficiency levels, which will drive the index downward. Base year space heating sales are defined as follows.

$$HeatSales_{2013} = \left(\frac{kWh}{Sqft}\right)_{Heating} \times \left(\frac{CommercialSales_{2013}}{\sum_e {kWh}/{Sqft_e}} \right) \tag{5}$$

Here, base-year sales for space heating is the product of the average space heating intensity value and the ratio of total commercial sales in the base year over the sum of the end-use intensity values. In the Commercial SAE Spreadsheets, the space heating sales value is defined on the *BaseYrInput* tab. The resulting $HeatIndex_y$ value in 2013 will be equal to the estimated annual heating sales in that year. Variations from this value in other years will be proportional to saturation and efficiency variations around their base values.

Heating system usage levels are impacted on a monthly basis by several factors, including weather, commercial level economic activity, prices and billing days. Using the COMMEND default elasticity parameters, the estimates for space heating equipment usage levels are computed as follows:

$$HeatUse_{y,m} = \left(\frac{HDD_{y,m}}{HDD_{05}} \right) \times \left(\frac{EconVar_{y,m}}{EconVar_{05,7}} \right) \times \left(\frac{Price_{y,m}}{Price_{05,7}} \right)^{-0.10} \tag{6}$$

Where:

- *HDD* is the number of heating degree days in month (m) and year (y).
- *EconVar* is the weighted commercial economic variable that blends Output, Employment, and Population in month (m), and year (y).
- *Price* is the average real price of electricity in month (m) and year (y).

By construction, the $HeatUse_{y,m}$ variable has an annual sum that is close to one in the base year (2004). The first term, which involves heating degree days, serve to allocate annual values to months of the year. The remaining terms average to one in the base year. In other years, the values will reflect changes in commercial output and prices, as transformed through the end-use elasticity parameters. For example, if the real price of electricity goes up

10% relative to the base year value, the price term will contribute a multiplier of about .98 (computed as 1.10 to the -0.18 power).

Constructing XCool

The explanatory variable for cooling loads is constructed in a similar manner. The amount of energy used by cooling systems depends on the following types of variables.

- Cooling degree days,
- Cooling equipment saturation levels,
- Cooling equipment operating efficiencies,
- Commercial output, employment, population and energy price.

The cooling variable is represented as the product of an equipment-based index and monthly usage multiplier. That is,

$$\mathrm{XCool}_{y,m} = \mathrm{CoolIndex}_{y} \times \mathrm{CoolUse}_{y,m} \tag{7}$$

Where:

- $XCool_{y,m}$ is estimated cooling energy use in year (y) and month (m),
- $CoolIndex_y$ is an index of cooling equipment, and
- $CoolUse_{y,m}$ is the monthly usage multiplier.

As with heating, the cooling equipment index depends on equipment saturation levels (*CoolShare*) normalized by operating efficiency levels (*Eff*). Formally, the cooling equipment index is defined as:

$$CoolIndex_y = CoolSales_{2013} \times \frac{\left({CoolShare_y}/{Eff_y}\right)}{\left({CoolShare_{2013}}/{Eff_{2013}}\right)} \tag{8}$$

Data values in 2013 are used as a base year for normalizing the index, and the ratio on the right is equal to 1.0 in 2013. In other years, it will be greater than one if equipment saturation levels are above their 2013 level. This will be counteracted by higher efficiency levels, which will drive the index downward. Estimates of base year cooling sales are defined as follows.

$$CoolSales_{2013} = \left(\frac{kWh}{Sqft}\right)_{Cooling} \times \left(\frac{CommercialSales_{2013}}{\sum_e {kWh}/{Sqft_e}}\right) \tag{9}$$

Here, base-year sales for space cooling is the product of the average space cooling intensity value and the ratio of total commercial sales in the base year over the sum of the end-use intensity values. In the Commercial SAE Spreadsheets, the space cooling sales value is defined on the *BaseYrInput* tab. The resulting *CoolIndex* value in 2013 will be equal to the estimated annual cooling sales in that year. Variations from this value in other years will be proportional to saturation and efficiency variations around their base values.

Cooling system usage levels are impacted on a monthly basis by several factors, including weather, economic activity levels and prices. Using the COMMEND default parameters, the estimates of cooling equipment usage levels are computed as follows:

$$CoolUse_{y,m} = \left(\frac{CDD_{y,m}}{CDD_{05}}\right) \times \left(\frac{EconVar_{y,m}}{EconVar_{05,7}}\right) \times \left(\frac{Price_{y,m}}{Price_{05,7}}\right)^{-0.10} \tag{10}$$

Where:

- *HDD* is the number of heating degree days in month (m) and year (y).
- *EconVar* is the weighted commercial economic variable that blends Output, Employment, and Population in month (m), and year (y).
- *Price* is the average real price of electricity in month (m) and year (y).

By construction, the *CoolUse* variable has an annual sum that is close to one in the base year (2004). The first term, which involves cooling degree days, serve to allocate annual values to months of the year. The remaining terms average to one in the base year. In other years, the values will change to reflect changes in commercial output and prices.

Constructing XOther

Monthly estimates of non-weather sensitive sales can be derived in a similar fashion to space heating and cooling. Based on end-use concepts, other sales are driven by:

- Equipment saturation levels,
- Equipment efficiency levels,
- Average number of days in the billing cycle for each month, and
- Real commercial output and real prices.

The explanatory variable for other uses is defined as follows:

$$\mathrm{XOther}_{y,m} = \mathrm{OtherIndex}_{y,m} \times \mathrm{OtherUse}_{y,m} \tag{11}$$

The second term on the right-hand side of this expression embodies information about equipment saturation levels and efficiency levels. The equipment index for other uses is defined as follows:

$$OtherIndex_{y,m} = \sum_{Type} Weight_{2013}^{Type} \times \left(\frac{Share_{y}^{Type} \big/ Eff_{y}^{Type}}{Share_{2013}^{Type} \big/ Eff_{2013}^{Type}} \right) \quad (12)$$

Where:

- *Weight* is the weight for each equipment type,
- *Share* represents the fraction of floor stock with an equipment type, and
- *Eff* is the average operating efficiency.

This index combines information about trends in saturation levels and efficiency levels for the main equipment categories. The weights are defined as follows.

$$Weight_{2013}^{Type} = \left(\frac{kWh}{Sqft}\right)_{Type} \times \left(\frac{CommercialSales_{04}}{\sum_e {kWh}/{Sqft}_e} \right) \quad (13)$$

Further monthly variation is introduced by multiplying by usage factors that cut across all end uses, constructed as follows:

$$OtherUse_{y,m} = \left(\frac{BDays_{y,m}}{30.5}\right) \times \left(\frac{EconVar_{y,m}}{EconVar_{05,7}}\right) \times \left(\frac{Price_{y.m}}{Price_{05,7}}\right)^{-0.10} \quad (14)$$

Attachment 4.2 Vectren Hourly System Load Data

Dt	Hour1	Hour2	Hour3	Hour4	Hour5	Hour6	Hour7	Hour8	Hour9	Hour10	Hour11	Hour12	Hour13	Hour14	Hour15	Hour16	Hour17	Hour18	Hour19	Hour20	Hour21	Hour22	Hour23	Hour24
1/1/2018	664	641	649	632	642	650	652	667	662	669	665	658	658	644	637	630	632	671	712	722	718	718	703	684
1/2/2018	673	665	667	675	680	703	772	779	790	787	770	759	724	715	695	688	695	718	749	763	770	767	744	723
1/3/2018	700	684	691	679	676	684	709	742	759	739	748	717	695	681	682	690	694	705	694	720	719	734	711	684
1/4/2018	676	676	671	682	685	710	740	789	798	795	770	747	735	728	721	703	711	725	772	754	767	750	728	706
1/5/2018	677	671	668	658	666	671	706	740	748	752	748	752	726	719	707	698	697	706	741	738	743	739	728	719
1/6/2018	698	693	697	688	703	693	718	733	742	730	717	699	679	653	631	631	620	653	688	695	685	691	683	663
1/7/2018	640	635	624	619	611	616	606	626	631	633	640	614	604	587	587	578	588	603	628	625	621	595	578	556
1/8/2018	532	525	518	512	523	540	589	706	723	716	723	716	718	713	707	705	708	711	732	728	724	714	683	657
1/9/2018	634	619	609	610	607	627	656	692	723	716	723	719	707	708	699	694	693	699	717	716	633	612	594	556
1/10/2018	528	513	509	499	504	503	539	570	585	576	583	585	577	573	567	566	572	576	586	589	576	569	553	518
1/11/2018	490	480	470	459	468	467	500	541	563	566	570	576	566	566	570	564	573	563	589	581	575	567	538	528
1/12/2018	511	508	513	532	540	568	593	631	663	672	693	702	701	694	696	681	671	680	699	687	680	660	636	606
1/13/2018	589	575	563	567	568	579	589	606	602	618	622	659	659	650	633	627	631	659	706	706	710	705	701	679
1/14/2018	673	666	667	670	673	685	691	714	719	712	694	686	666	658	651	651	662	684	718	707	701	700	679	658
1/15/2018	646	638	637	640	639	657	679	708	725	742	741	752	743	731	739	726	742	738	777	769	772	753	739	729
1/16/2018	709	715	714	718	726	743	772	809	823	825	818	808	808	799	752	746	754	772	800	797	791	780	756	730
1/17/2018	708	701	696	700	702	706	734	770	769	779	761	740	724	719	707	690	693	714	750	767	761	755	741	720
1/18/2018	698	688	690	683	683	694	729	762	767	749	730	719	686	678	673	662	658	668	710	713	719	706	691	651
1/19/2018	638	618	614	617	617	632	660	689	696	687	670	651	639	631	607	609	598	604	644	642	632	627	602	587
1/20/2018	557	552	540	538	536	545	543	550	558	555	550	538	525	526	520	516	521	531	551	552	545	535	515	496
1/21/2018	467	458	447	446	444	440	456	464	477	486	499	501	496	501	498	496	497	507	540	536	536	515	495	469
1/22/2018	439	440	431	424	429	448	489	547	563	582	582	581	596	590	582	569	564	562	589	595	597	583	571	537
1/23/2018	510	495	503	491	509	514	556	600	624	627	623	628	619	623	630	629	638	647	668	663	657	646	621	590
1/24/2018	560	549	549	540	545	554	594	629	638	645	640	624	616	603	599	586	579	600	635	648	652	645	629	600
1/25/2018	589	587	582	577	588	603	627	682	679	659	646	624	615	602	594	581	574	580	607	621	616	615	590	566
1/26/2018	539	537	528	530	530	540	572	618	632	612	606	595	579	585	568	562	556	553	577	586	583	572	562	537
1/27/2018	508	493	479	481	477	484	486	502	519	530	545	554	555	553	546	540	546	541	556	567	551	562	546	526
1/28/2018	506	494	491	492	499	505	507	525	531	531	524	510	504	496	488	478	485	495	542	552	558	549	534	509
1/29/2018	494	483	475	478	495	506	561	614	634	639	653	654	653	652	657	654	663	663	684	675	682	669	642	615
1/30/2018	589	570	568	566	576	600	631	682	686	682	666	652	633	629	610	612	606	612	658	667	671	658	643	615
1/31/2018	591	578	573	569	567	583	617	661	671	649	650	640	617	608	597	592	579	583	619	616	618	612	586	560
2/1/2018	526	513	513	507	503	524	546	583	607	612	617	616	613	628	635	652	655	664	674	692	692	695	668	636
2/2/2018	625	610	617	614	623	632	673	718	721	710	694	687	663	655	641	632	615	629	667	677	684	687	661	631
2/3/2018	615	596	599	587	595	591	589	599	604	609	619	621	598	585	567	556	561	572	596	593	591	576	550	519
2/4/2018	512	485	487	472	478	481	488	499	510	511	520	512	509	517	523	545	559	584	604	615	611	617	606	594
2/5/2018	585	568	568	563	579	601	645	709	722	704	682	683	663	650	635	629	622	647	681	686	688	672	644	598
2/6/2018	580	562	571	558	564	580	613	650	665	669	667	670	643	630	613	616	610	621	646	656	653	646	620	595
2/7/2018	571	549	555	548	559	575	614	645	663	672	682	694	676	658	656	653	649	642	671	639	657	664	638	611
2/8/2018	596	593	592	593	602	619	656	695	706	684	673	651	621	624	605	594	598	593	626	645	642	642	624	589
2/9/2018	571	559	555	550	549	560	582	623	635	623	614	605	592	576	577	560	552	554	568	576	562	564	543	525
2/10/2018	501	497	490	484	484	478	485	494	508	524	546	555	546	544	542	535	532	540	566	562	559	548	530	516
2/11/2018	495	477	476	464	471	480	486	513	524	546	559	571	578	583	591	589	598	604	625	633	626	614	598	568
2/12/2018	548	548	545	546	556	575	628	681	694	685	672	661	646	629	627	611	610	613	637	660	665	656	633	608
2/13/2018	580	578	574	578	580	590	624	673	679	679	671	657	638	626	615	599	586	584	614	622	622	605	582	558
2/14/2018	529	524	516	507	507	512	540	581	594	599	599	594	589	590	585	575	578	577	581	583	576	571	550	523
2/15/2018	497	484	474	468	469	475	501	545	557	565	574	570	570	569	575	575	568	557	577	591	586	574	555	519
2/16/2018	495	480	463	462	461	456	482	530	551	573	581	589	588	585	589	595	583	589	593	597	587	585	563	543
2/17/2018	519	508	501	507	501	512	511	519	526	540	564	580	575	578	561	561	553	560	565	570	558	544	534	520
2/18/2018	498	497	494	495	495	503	512	527	526	532	518	499	495	490	477	473	477	483	518	540	532	527	501	473
2/19/2018	459	448	441	432	435	461	488	536	543	546	560	569	559	566	566	559	551	560	567	577	582	567	537	510
2/20/2018	488	474	463	457	457	462	496	528	539	554	559	573	571	578	578	589	573	569	580	595	593	580	556	526
2/21/2018	496	475	460	447	442	454	480	530	554	563	574	581	585	590	595	586	593	599	613	618	606	599	575	548
2/22/2018	522	515	513	511	510	518	542	583	591	596	593	594	582	578	587	580	565	571	582	584	584	579	555	532
2/23/2018	506	492	492	478	482	493	519	554	561	573	569	570	571	568	567	564	565	553	558	566	561	561	544	519
2/24/2018	491	479	468	464	463	466	476	490	506	525	547	546	547	547	541	537	534	545	566	564	561	544	525	502
2/25/2018	481	457	452	452	446	446	454	452	464	484	489	495	487	483	471	476	476	493	511	546	536	535	510	486
2/26/2018	474	468	464	470	465	499	535	586	590	578	574	569	559	560	557	548	545	544	551	578	579	579	560	529
2/27/2018	515	504	504	497	506	524	556	591	595	580	564	568	551	558	551	549	539	543	557	577	566	568	539	514
2/28/2018	485	471	463	462	467	477	497	542	550	554	560	562	556	557	560	559	561	552	567	578	569	558	532	505
3/1/2018	471	465	458	449	440	445	475	522	532	542	553	555	542	553	549	551	552	542	565	574	569	571	542	527
3/2/2018	497	488	491	490	491	506	544	575	578	562	559	550	538	537	534	524	517	514	524	535	547	547	539	517
3/3/2018	499	483	479	481	483	488	507	502	508	498	493	490	479	464	460	455	445	449	464	484	490	486	478	456
3/4/2018	433	428	424	425	427	436	445	459	466	471	475	464	459	454	451	444	448	455	481	506	504	501	487	461
3/5/2018	449	445	443	442	446	466	502	547	559	572	579	572	581	577	572	577	576	579	584	591	588	563	550	523
3/6/2018	495	495	487	483	484	509	545	573	575	564	564	548	551	552	542	546	547	559	561	593	590	583	565	534

Dt	Hour1	Hour2	Hour3	Hour4	Hour5	Hour6	Hour7	Hour8	Hour9	Hour10	Hour11	Hour12	Hour13	Hour14	Hour15	Hour16	Hour17	Hour18	Hour19	Hour20	Hour21	Hour22	Hour23	Hour24
3/7/2018	515	510	500	509	517	519	550	592	608	596	598	608	605	598	591	595	593	594	603	626	614	607	593	566
3/8/2018	544	533	532	525	529	545	585	624	629	613	618	612	603	594	589	577	571	577	598	609	625	627	608	585
3/9/2018	560	558	557	561	562	580	607	643	646	636	624	611	588	576	562	570	554	556	566	583	577	574	564	539
3/10/2018	507	504	486	491	484	492	498	502	515	520	520	507	498	478	482	472	469	477	488	519	513	509	497	472
3/11/2018	447	440	429	432	430	446	460	466	482	486	490	499	503	506	517	530	547	554	569	587	575	559	518	498
3/12/2018	493	479	489	495	512	551	591	614	618	616	609	608	621	634	627	622	619	608	610	632	629	606	573	553
3/13/2018	538	542	533	538	553	587	641	655	635	623	613	596	614	595	588	577	588	585	599	624	619	607	573	554
3/14/2018	543	543	544	554	567	608	654	681	652	642	612	606	589	582	580	571	559	558	570	604	617	593	564	538
3/15/2018	538	515	512	518	526	552	599	611	596	585	577	573	564	561	545	558	544	533	542	566	562	548	521	498
3/16/2018	488	483	475	480	486	518	569	587	596	600	608	593	587	572	579	561	554	547	560	575	573	560	538	505
3/17/2018	485	474	477	477	480	491	514	514	533	547	540	529	528	519	511	498	495	505	516	529	529	522	504	489
3/18/2018	467	466	453	455	456	453	468	477	482	486	498	485	482	475	468	471	467	478	483	517	514	500	470	453
3/19/2018	446	441	445	450	473	512	564	585	585	582	577	570	571	569	578	566	580	567	585	597	588	565	528	500
3/20/2018	480	481	480	484	506	535	576	613	613	620	631	623	626	625	625	625	622	622	632	641	638	615	582	557
3/21/2018	543	538	540	532	543	573	613	633	625	630	614	616	600	595	575	567	557	552	563	594	600	578	550	527
3/22/2018	515	519	516	519	542	575	623	632	618	600	587	571	564	556	546	542	536	526	538	566	574	554	529	492
3/23/2018	488	478	471	475	492	508	572	576	591	589	583	582	571	569	549	545	533	535	547	563	555	549	527	508
3/24/2018	484	490	478	480	481	489	508	514	545	559	567	566	564	554	562	560	557	559	553	575	561	546	523	510
3/25/2018	487	473	471	471	463	484	489	505	524	536	531	520	507	497	500	495	504	510	514	534	530	522	498	471
3/26/2018	468	456	456	460	494	519	565	577	578	575	582	581	574	569	569	567	571	575	573	586	581	559	524	503
3/27/2018	486	476	478	467	478	493	532	547	557	567	572	569	573	567	570	565	570	555	563	564	570	546	519	487
3/28/2018	472	463	462	454	467	487	518	543	571	569	572	573	565	569	564	555	554	541	551	565	565	549	519	493
3/29/2018	474	472	465	455	470	491	529	542	553	565	569	576	569	561	566	556	552	545	559	570	570	549	517	482
3/30/2018	465	465	446	455	460	483	509	530	538	545	525	518	517	510	502	502	488	492	490	507	522	514	488	471
3/31/2018	459	458	452	461	468	466	470	472	481	480	478	472	467	457	459	457	465	464	476	476	478	464	454	425
4/1/2018	408	403	398	398	401	410	431	445	464	463	469	454	450	431	435	441	459	476	499	521	525	511	503	488
4/2/2018	564	560	556	554	583	623	677	692	707	710	700	700	693	691	682	679	680	672	681	702	700	665	628	607
4/3/2018	575	565	570	559	571	589	630	637	639	640	646	647	655	655	655	644	646	648	656	650	639	615	589	575
4/4/2018	556	563	570	571	593	626	677	691	697	703	692	688	684	675	664	654	653	660	663	657	664	680	652	631
4/5/2018	629	622	622	639	645	680	719	725	709	687	675	657	656	647	639	628	548	533	538	568	583	560	525	518
4/6/2018	504	486	489	480	495	523	560	564	568	551	554	544	546	538	530	536	527	521	531	558	561	558	544	515
4/7/2018	508	509	508	509	509	520	540	537	554	561	560	534	528	508	503	490	489	488	494	516	527	526	505	488
4/8/2018	481	479	475	481	481	495	507	514	524	514	506	503	497	492	484	484	504	505	526	537	539	517	496	464
4/9/2018	469	470	471	473	495	528	585	597	596	587	572	561	554	545	529	539	529	525	546	571	569	553	522	491
4/10/2018	484	478	476	479	498	536	574	587	587	580	580	573	567	572	560	561	561	552	564	579	595	579	550	521
4/11/2018	518	518	516	510	528	541	587	586	575	570	563	562	554	550	550	535	533	525	522	557	562	541	516	478
4/12/2018	468	459	453	452	461	490	528	541	546	547	556	556	558	566	564	561	555	556	545	569	569	542	509	483
4/13/2018	458	446	444	438	449	475	511	526	548	562	567	567	577	573	564	565	570	559	560	571	572	567	527	493
4/14/2018	477	462	456	445	438	442	450	462	474	492	499	503	492	494	495	492	488	492	494	499	501	476	460	438
4/15/2018	410	405	396	394	390	403	405	434	449	459	470	474	478	472	473	474	484	498	505	521	518	508	487	467
4/16/2018	462	458	459	465	486	527	582	606	622	662	674	623	632	622	620	618	616	615	610	614	620	605	571	540
4/17/2018	532	530	544	535	557	587	624	612	601	586	580	565	563	556	549	541	532	534	530	546	563	538	507	481
4/18/2018	473	462	463	469	480	513	538	555	554	558	550	561	524	567	584	572	572	548	543	550	555	525	494	466
4/19/2018	457	455	454	456	474	513	545	576	577	584	580	577	537	552	549	535	536	514	521	538	559	541	511	489
4/20/2018	484	478	475	474	492	524	557	561	561	551	545	540	532	531	523	519	512	507	497	496	518	514	479	457
4/21/2018	447	437	431	441	445	454	462	481	483	491	492	485	487	487	480	478	478	476	475	499	508	489	469	432
4/22/2018	413	414	397	393	391	385	390	405	425	427	435	442	438	448	447	447	450	469	465	480	476	467	438	415
4/23/2018	411	390	396	397	426	446	503	526	535	558	557	550	551	550	548	540	546	537	544	553	555	531	505	474
4/24/2018	454	447	437	440	446	473	502	525	532	538	541	543	547	542	539	543	539	541	544	555	543	533	494	471
4/25/2018	453	452	443	441	458	476	517	528	519	538	538	543	547	545	559	554	542	531	538	539	555	533	491	469
4/26/2018	452	437	436	432	432	467	540	511	530	532	534	533	541	540	545	541	533	531	524	530	541	520	487	445
4/27/2018	448	423	424	429	437	469	499	522	515	525	530	530	535	542	530	524	523	508	509	509	525	509	476	443
4/28/2018	429	415	407	408	407	409	419	422	435	448	447	437	444	446	435	444	443	446	442	451	464	442	427	407
4/29/2018	392	382	380	384	387	398	408	414	431	434	439	434	435	436	434	430	438	452	451	464	467	462	427	413
4/30/2018	398	402	402	407	427	458	513	518	567	612	617	611	619	622	621	630	578	547	538	541	556	538	490	457
5/1/2018	441	429	428	426	433	452	494	520	525	545	554	562	573	578	589	605	595	601	595	597	606	581	538	501
5/2/2018	471	459	452	449	449	473	516	530	561	576	602	612	637	661	662	674	677	668	659	664	676	650	597	557
5/3/2018	534	513	501	498	491	519	552	581	599	606	620	621	628	628	620	608	598	596	587	599	596	569	539	502
5/4/2018	484	477	470	464	471	497	527	556	589	603	616	633	631	639	636	639	608	595	585	591	585	564	524	490
5/5/2018	463	453	442	436	426	436	431	441	459	476	479	478	485	477	480	476	479	470	470	476	484	474	445	418
5/6/2018	399	389	378	378	370	381	373	398	421	443	454	473	495	508	516	527	540	552	541	542	546	514	477	434
5/7/2018	409	397	392	400	406	438	467	506	538	542	565	569	589	598	607	616	614	605	600	586	597	556	516	477
5/8/2018	453	438	424	426	425	453	475	502	521	537	560	563	583	593	609	620	616	619	611	596	610	568	520	476
5/9/2018	457	442	431	425	436	451	478	510	533	562	587	611	639	643	639	655	677	661	659	651	668	627	588	542
5/10/2018	516	496	476	472	461	487	515	554	581	620	645	672	702	726	758	766	775	719	684	673	665	620	582	536

Dt	Hour1	Hour2	Hour3	Hour4	Hour5	Hour6	Hour7	Hour8	Hour9	Hour10	Hour11	Hour12	Hour13	Hour14	Hour15	Hour16	Hour17	Hour18	Hour19	Hour20	Hour21	Hour22	Hour23	Hour24
5/11/2018	506	476	476	469	470	491	519	561	593	625	650	678	703	741	759	784	766	760	713	685	686	646	609	549
5/12/2018	522	496	478	470	466	454	440	480	512	557	601	629	660	652	675	693	710	692	676	658	652	617	567	526
5/13/2018	486	461	449	419	423	429	419	452	497	550	602	638	660	685	711	728	734	741	718	706	685	647	597	548
5/14/2018	517	495	479	465	480	506	553	607	651	701	747	789	822	856	882	898	900	886	860	829	813	764	697	624
5/15/2018	586	554	541	519	509	534	569	613	643	687	711	752	778	814	846	856	856	827	811	794	779	737	666	609
5/16/2018	574	547	530	524	521	548	583	604	611	628	640	644	677	717	746	762	783	787	771	748	735	699	631	582
5/17/2018	551	527	512	504	509	539	570	615	642	677	697	719	752	774	788	803	809	788	761	743	724	680	628	580
5/18/2018	539	534	519	513	510	530	564	592	611	623	630	628	629	641	651	671	661	661	646	643	637	618	576	530
5/19/2018	496	478	468	457	453	456	448	476	507	520	548	576	602	629	647	679	690	687	658	632	636	607	572	522
5/20/2018	489	456	439	428	419	415	423	458	497	548	572	602	643	679	708	732	734	718	694	665	644	618	566	525
5/21/2018	498	481	464	462	476	508	550	593	625	652	674	712	748	793	785	769	739	713	708	703	702	713	621	577
5/22/2018	546	521	514	506	508	529	568	615	647	689	722	757	794	820	843	860	861	851	821	787	766	722	662	596
5/23/2018	567	534	515	508	506	523	556	595	624	665	701	731	778	789	820	836	839	834	814	775	759	711	652	595
5/24/2018	558	532	515	501	499	514	542	584	625	664	702	738	759	796	822	835	828	830	798	769	746	698	640	591
5/25/2018	545	520	496	491	494	500	531	577	624	667	714	745	789	820	844	830	793	763	729	699	698	668	617	567
5/26/2018	537	513	497	493	483	476	477	505	529	587	619	656	689	722	745	767	773	776	758	728	710	676	629	594
5/27/2018	548	523	497	478	474	463	466	504	549	615	673	720	749	779	800	810	803	779	757	729	712	680	629	566
5/28/2018	534	500	478	463	461	466	462	494	536	604	656	701	741	762	779	799	809	779	730	688	681	645	596	558
5/29/2018	529	513	506	501	518	533	573	618	654	669	709	755	794	836	844	814	783	756	732	763	728	710	663	617
5/30/2018	591	566	559	562	559	569	610	635	664	676	711	730	748	735	795	820	827	822	809	782	775	749	686	635
5/31/2018	597	577	562	555	547	574	601	646	705	734	790	756	694	672	678	684	697	712	697	700	698	669	626	586
6/1/2018	554	534	515	507	520	576	629	671	712	768	798	847	886	920	948	959	934	902	780	742	730	703	661	604
6/2/2018	570	548	528	522	512	504	508	540	603	659	715	753	793	819	817	823	814	811	797	773	749	716	669	618
6/3/2018	582	542	512	502	492	487	490	521	559	590	608	623	643	655	660	682	692	694	673	650	633	608	552	512
6/4/2018	480	463	443	439	450	467	501	550	585	612	640	654	670	690	703	709	712	694	679	655	665	626	586	544
6/5/2018	510	496	484	476	479	493	520	565	606	634	666	686	713	748	771	794	801	802	784	753	733	692	630	573
6/6/2018	544	520	501	493	491	502	530	580	614	649	693	732	764	797	827	857	857	847	828	795	774	733	668	614
6/7/2018	575	548	528	522	516	523	561	615	657	713	766	813	857	882	914	924	927	904	891	861	838	789	734	680
6/8/2018	634	601	580	556	557	560	597	647	700	750	808	853	884	918	944	936	937	909	887	851	838	799	740	683
6/9/2018	640	605	585	557	544	528	535	569	633	683	738	787	809	825	809	751	694	659	647	628	618	603	575	538
6/10/2018	504	482	471	452	455	450	460	484	529	570	581	608	641	676	730	776	795	795	761	684	654	615	581	541
6/11/2018	501	494	485	480	495	514	552	589	635	679	704	734	758	781	818	854	875	883	867	822	794	756	690	619
6/12/2018	577	551	541	527	528	549	578	612	634	649	654	686	731	792	844	859	798	739	706	695	687	663	619	580
6/13/2018	555	533	524	518	521	531	560	611	637	671	723	761	806	840	879	890	906	900	874	841	830	788	722	661
6/14/2018	623	587	569	544	547	555	582	631	676	725	765	813	837	862	882	899	895	886	855	809	791	748	685	634
6/15/2018	596	575	555	550	551	559	580	628	654	702	770	820	863	908	933	941	937	921	903	865	839	808	749	688
6/16/2018	647	610	588	565	553	530	534	583	641	705	767	814	839	868	880	890	875	859	843	823	804	761	721	673
6/17/2018	619	587	553	532	522	512	522	564	626	691	756	804	828	864	879	885	894	891	868	849	825	801	744	692
6/18/2018	656	619	603	586	594	606	645	704	755	817	875	898	931	951	967	978	975	965	946	912	893	856	796	737
6/19/2018	687	658	632	610	610	611	650	708	762	802	855	890	914	943	962	967	967	951	930	896	876	839	787	728
6/20/2018	680	641	618	600	603	609	644	704	748	800	843	880	905	930	929	891	909	895	873	832	820	791	738	685
6/21/2018	655	625	609	589	594	599	628	649	661	685	695	722	721	751	788	799	795	773	755	734	719	697	648	603
6/22/2018	568	549	529	522	528	536	563	589	615	635	672	695	721	736	743	739	733	719	700	683	671	662	618	577
6/23/2018	544	519	509	498	486	476	473	505	549	581	619	637	656	670	674	694	720	728	724	693	675	654	610	569
6/24/2018	540	515	490	480	472	468	472	510	569	618	668	700	749	775	780	762	771	748	736	725	711	668	610	576
6/25/2018	544	531	519	512	519	555	583	617	641	665	666	659	696	735	759	785	806	797	792	774	758	729	676	633
6/26/2018	603	580	563	554	552	568	600	655	714	765	746	688	667	702	751	785	803	812	807	784	748	711	615	565
6/27/2018	550	528	519	506	517	520	553	584	615	636	683	709	754	819	859	878	921	919	913	888	867	831	784	734
6/28/2018	696	656	640	636	628	647	677	724	771	824	852	897	926	956	977	983	976	972	943	918	904	824	769	703
6/29/2018	667	633	623	607	594	609	631	689	733	788	828	878	909	955	974	988	976	979	942	924	902	857	796	741
6/30/2018	690	658	630	610	589	571	575	618	671	743	785	825	855	879	891	904	909	895	881	853	832	795	751	699
7/1/2018	659	624	591	577	564	551	562	614	678	730	788	834	855	889	895	913	915	924	909	883	856	830	767	730
7/2/2018	691	660	632	617	627	647	687	729	792	834	897	935	979	989	996	946	880	856	843	820	812	795	738	695
7/3/2018	660	643	623	618	614	622	657	710	765	814	868	904	928	905	913	919	924	877	829	799	788	759	721	676
7/4/2018	649	621	608	592	577	566	566	593	659	724	804	851	881	899	911	928	931	926	907	870	849	808	774	727
7/5/2018	688	644	626	604	604	618	659	733	796	873	925	968	1009	1029	1039	1023	1030	1025	1006	963	935	894	829	763
7/6/2018	715	685	658	639	634	640	656	699	743	792	839	880	909	927	938	936	912	888	863	824	788	752	706	644
7/7/2018	605	570	546	516	517	496	488	520	551	593	619	653	684	703	729	745	758	754	734	700	668	640	605	561
7/8/2018	525	500	489	478	480	470	473	515	553	613	672	718	761	800	827	850	865	888	861	837	803	785	730	672
7/9/2018	640	610	595	582	595	611	648	704	759	815	862	903	946	970	967	936	925	917	898	867	833	808	742	690
7/10/2018	643	612	593	581	574	582	613	669	732	798	846	876	915	937	954	972	972	967	948	922	897	854	793	733
7/11/2018	686	658	626	615	604	601	625	674	716	774	831	870	913	939	938	952	956	941	917	889	854	808	744	675
7/12/2018	626	592	560	540	540	542	569	626	664	707	750	790	829	863	884	905	920	906	884	842	818	782	716	658
7/13/2018	617	589	566	548	548	547	579	629	675	713	769	808	853	887	908	930	924	923	893	849	828	780	731	668
7/14/2018	622	586	560	540	524	517	521	551	603	669	749	794	851	891	910	922	902	852	789	762	726	700	655	604

Dt	Hour1	Hour2	Hour3	Hour4	Hour5	Hour6	Hour7	Hour8	Hour9	Hour10	Hour11	Hour12	Hour13	Hour14	Hour15	Hour16	Hour17	Hour18	Hour19	Hour20	Hour21	Hour22	Hour23	Hour24
7/15/2018	578	552	534	531	522	526	520	543	562	596	630	642	663	688	715	743	771	767	750	733	723	700	651	613
7/16/2018	571	558	543	538	537	564	595	633	659	706	758	813	851	885	918	938	941	939	914	876	849	818	746	686
7/17/2018	651	617	589	586	575	585	620	670	730	784	828	869	893	924	935	939	939	916	887	839	812	768	709	652
7/18/2018	612	586	547	549	538	547	570	611	645	685	727	763	798	835	858	869	876	865	832	793	760	717	649	596
7/19/2018	562	531	513	496	502	511	539	583	627	665	720	771	816	837	872	880	884	876	864	825	809	773	718	666
7/20/2018	625	603	571	571	558	577	608	657	709	759	821	854	886	911	945	960	966	955	927	893	864	819	747	676
7/21/2018	625	588	559	535	518	517	521	556	604	647	692	713	721	740	746	744	737	722	708	696	672	654	615	577
7/22/2018	542	523	505	491	486	491	489	509	530	548	579	587	608	630	656	669	668	674	658	631	630	616	579	549
7/23/2018	525	508	501	501	506	533	551	600	636	678	705	733	768	785	790	786	801	813	789	764	761	725	678	605
7/24/2018	595	574	561	542	545	556	581	623	677	716	775	810	841	875	887	900	903	890	864	831	807	753	690	638
7/25/2018	591	569	547	536	539	553	580	621	676	727	774	808	834	865	877	896	888	874	852	801	777	734	679	625
7/26/2018	584	558	533	524	519	531	556	608	677	737	780	807	856	890	922	927	920	881	855	824	799	764	713	654
7/27/2018	619	586	562	545	547	556	571	614	659	695	712	753	773	802	814	836	831	823	794	755	739	695	651	594
7/28/2018	554	529	505	497	482	479	473	495	531	573	614	649	671	699	724	735	741	741	724	693	676	638	595	555
7/29/2018	528	497	495	470	468	462	468	493	537	592	634	665	698	729	736	746	730	728	694	662	650	621	576	548
7/30/2018	516	505	501	496	511	538	569	609	636	663	686	694	705	709	703	698	689	679	677	672	680	666	622	585
7/31/2018	559	547	544	531	535	555	582	609	637	652	673	696	731	761	792	801	795	779	751	740	728	704	651	601
8/1/2018	564	545	534	527	523	538	566	601	635	664	714	744	770	796	821	832	839	825	809	775	765	724	664	602
8/2/2018	578	555	538	527	522	536	564	603	653	703	745	783	821	848	877	887	895	880	851	762	800	748	699	641
8/3/2018	602	565	552	537	533	543	576	615	668	716	762	798	831	877	914	934	934	924	899	856	850	799	745	688
8/4/2018	636	603	583	562	549	542	531	558	621	666	739	778	824	849	872	885	896	883	860	819	797	755	715	655
8/5/2018	610	582	557	538	528	520	520	549	599	652	719	780	827	862	884	899	895	872	823	783	781	737	686	629
8/6/2018	596	568	554	545	558	583	613	680	734	793	853	897	943	988	1004	1003	1000	976	949	927	906	869	793	736
8/7/2018	696	668	643	631	625	641	671	709	735	776	811	853	869	879	902	924	914	872	838	826	815	770	725	669
8/8/2018	638	613	598	594	584	614	648	669	702	732	754	790	832	866	884	901	917	900	887	864	853	800	745	688
8/9/2018	654	628	593	587	581	597	629	664	708	751	799	813	826	834	842	846	840	819	814	795	792	749	691	633
8/10/2018	609	587	567	562	561	584	614	647	685	727	750	771	786	809	820	835	859	859	843	807	779	745	692	645
8/11/2018	603	576	558	546	535	542	532	545	586	642	697	747	772	803	827	843	838	839	800	755	729	689	644	595
8/12/2018	554	528	512	498	488	484	481	505	556	613	658	696	737	782	801	820	833	837	809	778	746	702	640	578
8/13/2018	549	514	511	505	512	546	579	624	657	719	757	814	854	882	900	907	913	895	867	840	822	771	707	644
8/14/2018	607	577	563	539	541	559	597	625	667	721	773	814	860	887	916	930	910	877	856	836	827	774	720	662
8/15/2018	623	605	574	572	568	593	635	655	668	689	710	728	719	719	755	794	773	740	712	708	712	679	645	597
8/16/2018	580	563	559	556	557	586	625	660	679	682	737	748	763	776	793	835	857	862	853	839	825	784	730	677
8/17/2018	639	627	611	617	613	615	636	660	683	723	759	800	821	851	844	859	862	854	825	796	777	747	696	642
8/18/2018	615	600	575	570	553	556	544	570	595	631	679	725	744	756	760	789	797	788	761	730	717	673	634	589
8/19/2018	553	528	504	502	489	489	489	505	557	613	653	707	744	767	801	809	822	817	799	777	761	715	665	622
8/20/2018	595	579	553	553	568	596	645	685	706	737	772	803	814	828	839	847	860	855	835	815	808	759	707	632
8/21/2018	600	572	557	544	548	571	601	637	648	672	688	707	727	751	774	806	810	787	766	741	735	702	657	611
8/22/2018	575	549	536	531	537	554	594	614	630	650	671	679	696	716	743	757	761	734	711	686	681	638	588	538
8/23/2018	516	497	495	485	485	510	530	485	594	621	645	678	702	718	742	767	763	754	736	713	698	652	604	556
8/24/2018	518	506	496	487	490	517	535	563	578	588	608	619	622	625	620	613	605	598	603	606	611	606	576	549
8/25/2018	524	517	504	507	492	502	503	523	553	592	633	684	733	768	811	838	842	846	817	805	766	731	688	636
8/26/2018	597	570	544	534	522	521	515	543	591	652	697	753	806	841	864	892	892	889	872	831	808	754	704	656
8/27/2018	625	590	570	567	577	607	652	685	732	792	843	891	936	973	982	996	986	997	944	906	885	820	765	693
8/28/2018	661	632	609	581	595	599	651	678	725	790	842	890	934	975	990	1013	1005	990	965	929	898	836	789	715
8/29/2018	677	642	615	638	601	629	664	700	749	780	795	826	799	797	805	807	810	809	792	787	780	733	664	614
8/30/2018	592	564	549	540	542	567	616	635	660	701	749	800	841	882	900	896	893	879	851	836	806	767	715	648
8/31/2018	608	578	566	563	559	582	614	649	680	725	768	818	848	888	917	911	864	842	811	784	764	720	681	628
9/1/2018	590	572	555	542	525	514	519	531	562	608	657	714	754	778	783	802	822	818	787	750	727	688	651	611
9/2/2018	580	541	523	497	486	488	488	508	550	624	674	736	779	805	831	847	867	851	814	789	757	720	668	632
9/3/2018	585	559	531	524	516	512	506	532	576	649	714	764	808	831	854	864	874	868	841	810	788	733	681	631
9/4/2018	603	578	548	548	549	574	611	655	704	763	824	882	925	962	981	988	980	974	941	920	881	832	770	715
9/5/2018	676	654	632	617	609	627	658	681	734	775	847	889	930	967	980	970	934	906	885	863	834	791	739	683
9/6/2018	647	621	600	593	592	610	649	674	705	758	820	860	882	898	825	812	786	763	745	745	731	706	643	600
9/7/2018	570	551	535	533	532	563	611	651	662	701	744	797	852	888	904	889	831	766	737	728	708	687	662	614
9/8/2018	592	577	561	561	556	558	562	560	590	604	631	635	634	638	650	651	664	628	619	613	603	580	551	510
9/9/2018	488	473	457	456	457	454	456	474	495	508	516	525	526	534	532	532	531	537	528	545	544	514	489	465
9/10/2018	451	437	432	425	446	485	532	546	567	556	587	598	603	630	633	654	658	647	636	647	635	603	563	527
9/11/2018	503	488	483	480	483	502	536	558	586	616	635	656	674	678	685	682	683	669	655	660	651	619	589	550
9/12/2018	527	513	501	496	494	507	550	566	584	608	627	646	671	691	708	704	701	682	682	683	675	645	600	568
9/13/2018	540	520	520	507	509	530	572	596	626	673	711	745	786	827	861	888	893	881	846	824	798	746	685	632
9/14/2018	591	574	541	530	535	557	598	620	652	698	754	796	834	869	897	911	915	892	854	816	788	754	701	652
9/15/2018	612	585	557	547	536	525	517	533	578	625	689	747	803	842	868	884	879	872	832	805	767	729	681	641
9/16/2018	595	566	550	531	519	508	513	528	562	617	673	715	757	777	790	800	804	797	769	766	725	685	625	584
9/17/2018	555	534	517	518	523	559	604	629	653	683	745	786	831	863	893	905	907	901	861	836	800	751	690	635

Dt	Hour1	Hour2	Hour3	Hour4	Hour5	Hour6	Hour7	Hour8	Hour9	Hour10	Hour11	Hour12	Hour13	Hour14	Hour15	Hour16	Hour17	Hour18	Hour19	Hour20	Hour21	Hour22	Hour23	Hour24
9/18/2018	596	572	567	542	548	564	604	633	650	705	764	819	872	901	904	894	898	888	851	845	801	743	684	630
9/19/2018	603	563	538	532	527	556	601	611	661	717	779	835	888	933	950	954	943	915	879	862	820	775	713	655
9/20/2018	622	590	575	564	569	590	629	662	715	768	834	886	927	969	976	982	975	946	895	881	842	791	753	719
9/21/2018	677	653	634	624	608	629	664	691	742	787	843	886	927	929	930	935	912	872	840	812	791	743	682	626
9/22/2018	588	559	539	522	517	503	509	508	523	531	539	539	535	535	528	531	518	519	529	527	521	509	489	475
9/23/2018	460	450	434	429	429	444	444	457	467	489	475	513	530	534	537	541	544	548	551	566	555	539	511	493
9/24/2018	478	469	463	462	476	510	559	602	616	613	631	654	658	685	672	672	681	680	679	694	690	674	628	595
9/25/2018	568	561	544	541	550	578	624	647	663	689	691	690	683	683	727	744	760	762	749	761	747	714	676	617
9/26/2018	590	574	563	557	550	573	602	610	620	616	632	645	653	668	683	689	681	666	642	639	625	592	560	525
9/27/2018	512	502	492	484	497	511	549	563	569	573	581	577	578	582	583	581	578	577	569	590	580	564	529	502
9/28/2018	481	479	465	468	471	483	521	538	544	558	567	571	586	594	593	607	605	586	581	581	572	548	528	499
9/29/2018	472	461	456	446	444	438	441	450	460	482	495	505	532	541	556	572	583	579	566	561	547	522	493	468
9/30/2018	442	433	422	411	414	415	417	425	445	470	505	535	560	592	613	642	652	649	624	630	590	562	521	487
10/1/2018	460	447	437	439	447	482	534	553	581	618	644	678	704	747	759	760	749	741	730	734	709	671	623	582
10/2/2018	557	536	536	525	533	554	606	624	641	670	717	753	798	825	856	869	885	837	818	800	769	715	670	616
10/3/2018	581	570	546	545	543	566	609	629	664	696	752	795	836	853	882	881	879	853	829	816	788	749	714	661
10/4/2018	624	607	584	573	568	599	634	660	688	722	757	787	810	834	847	844	833	803	769	759	725	687	644	604
10/5/2018	564	543	528	520	521	547	600	624	652	706	774	812	848	879	881	898	881	852	822	792	753	719	681	633
10/6/2018	606	568	548	537	525	521	524	525	572	628	667	705	750	773	797	804	793	768	744	712	688	652	604	565
10/7/2018	534	498	482	464	458	457	467	477	515	566	618	664	718	741	765	782	786	769	744	723	698	652	606	574
10/8/2018	538	524	503	508	517	537	582	607	641	695	744	793	826	846	866	877	872	844	819	802	777	732	687	639
10/9/2018	605	587	565	552	553	571	602	621	654	694	730	763	799	839	844	852	842	821	794	782	750	705	665	608
10/10/2018	579	569	548	556	542	561	620	632	637	645	657	678	689	697	712	750	747	724	723	720	701	667	615	559
10/11/2018	529	509	493	486	484	493	543	557	557	568	582	584	589	593	592	595	588	584	587	589	576	551	518	481
10/12/2018	477	465	468	458	466	483	533	542	545	541	546	550	549	547	551	540	531	535	538	545	528	529	501	470
10/13/2018	459	455	455	449	445	449	460	466	486	492	502	494	482	483	471	474	476	480	498	500	492	475	454	437
10/14/2018	417	416	402	403	404	413	427	439	455	467	475	476	480	478	481	483	492	502	511	505	500	479	454	430
10/15/2018	421	416	410	418	431	459	499	533	537	549	552	561	563	566	571	566	562	564	586	582	573	561	525	501
10/16/2018	490	481	467	474	481	508	556	566	574	566	566	563	566	561	562	555	563	556	577	590	581	561	527	514
10/17/2018	501	501	491	493	496	524	569	574	556	563	566	557	551	556	552	551	551	539	562	570	565	545	520	493
10/18/2018	482	468	457	467	465	502	544	554	555	557	549	548	552	553	549	554	546	544	566	566	567	548	527	491
10/19/2018	492	488	476	493	492	510	556	573	562	561	564	557	558	568	551	557	545	548	556	554	547	530	512	480
10/20/2018	464	457	453	442	441	438	454	447	463	474	478	477	473	477	473	465	466	463	483	483	482	474	457	446
10/21/2018	431	429	426	425	433	447	463	475	486	488	479	479	472	465	469	464	468	489	512	527	525	508	493	479
10/22/2018	464	458	462	470	485	515	574	587	585	572	569	558	562	557	551	546	544	544	564	572	561	544	515	487
10/23/2018	484	477	468	473	480	499	552	561	558	558	557	550	558	545	550	541	538	536	560	566	557	540	508	488
10/24/2018	479	469	470	476	483	507	556	540	541	554	538	553	558	553	552	551	546	548	567	567	567	545	517	498
10/25/2018	485	474	474	476	486	500	548	567	569	568	571	566	569	566	555	557	555	555	578	569	559	538	511	493
10/26/2018	469	462	460	460	462	488	531	551	550	552	558	567	558	552	550	549	542	540	549	549	543	532	506	481
10/27/2018	453	454	455	447	451	454	460	467	484	487	496	478	473	471	469	462	459	474	489	488	480	480	457	437
10/28/2018	428	424	420	416	414	423	435	442	452	469	463	468	464	468	468	468	476	483	503	506	499	477	452	439
10/29/2018	422	411	420	430	450	482	546	568	572	561	558	560	551	557	559	551	556	546	571	558	561	532	514	486
10/30/2018	473	469	467	459	469	497	543	557	562	550	561	552	567	566	572	576	560	560	570	568	563	547	516	497
10/31/2018	478	465	457	461	466	482	525	548	553	569	570	571	583	585	573	579	563	568	569	567	556	551	498	480
11/1/2018	463	463	458	449	460	486	530	562	560	578	570	567	576	578	570	571	560	576	583	590	572	562	544	505
11/2/2018	491	485	479	475	483	511	559	566	569	571	563	561	556	552	542	534	527	527	556	555	555	527	512	487
11/3/2018	481	467	468	469	476	481	493	491	498	493	488	481	472	476	465	472	474	485	504	494	497	488	467	450
11/4/2018	433	429	419	472	422	426	436	448	453	477	480	482	487	485	493	492	497	513	528	526	525	500	488	468
11/5/2018	448	438	436	443	434	455	482	521	549	560	561	561	554	559	570	573	575	591	602	595	587	579	559	535
11/6/2018	502	491	488	484	489	495	511	555	557	569	575	582	575	587	577	573	573	566	580	588	595	578	557	534
11/7/2018	506	498	492	492	504	500	527	573	579	588	579	582	582	571	568	570	564	571	593	589	593	588	569	547
11/8/2018	518	518	513	513	514	529	551	593	608	620	617	616	614	619	607	602	612	606	632	621	614	606	580	562
11/9/2018	533	530	511	514	512	523	551	582	593	609	611	617	617	619	624	624	636	637	641	638	638	634	622	598
11/10/2018	586	579	579	579	582	591	598	598	602	590	587	578	557	552	534	536	540	556	591	593	590	596	589	571
11/11/2018	556	555	557	551	566	561	564	564	574	592	575	556	539	486	532	531	540	559	584	577	574	567	549	539
11/12/2018	526	510	515	504	513	525	552	591	613	620	625	636	635	645	637	633	637	655	661	665	658	652	619	600
11/13/2018	577	569	562	568	573	590	626	666	676	683	695	700	700	699	691	700	696	715	733	725	728	712	694	660
11/14/2018	635	644	630	627	634	644	673	712	725	717	727	715	722	703	699	678	674	673	687	676	668	667	641	604
11/15/2018	587	553	551	544	540	563	574	615	627	633	622	629	630	635	602	630	628	635	635	656	639	629	606	581
11/16/2018	559	557	549	550	552	563	587	629	623	609	593	585	573	564	560	549	547	559	587	580	593	584	569	556
11/17/2018	530	526	529	521	524	532	541	539	547	545	530	512	502	480	481	476	478	485	513	510	498	501	489	472
11/18/2018	465	446	453	439	444	447	462	479	479	498	481	477	463	461	471	456	468	498	519	525	524	519	490	475
11/19/2018	460	442	437	437	442	457	493	545	554	573	575	578	577	577	579	580	584	599	603	597	593	588	565	542
11/20/2018	521	508	503	505	499	504	539	582	602	610	618	626	618	619	620	630	634	628	644	638	631	628	607	593
11/21/2018	571	567	555	563	564	576	604	633	635	621	610	588	569	561	553	546	535	544	578	581	578	572	554	510

Dt	Hour1	Hour2	Hour3	Hour4	Hour5	Hour6	Hour7	Hour8	Hour9	Hour10	Hour11	Hour12	Hour13	Hour14	Hour15	Hour16	Hour17	Hour18	Hour19	Hour20	Hour21	Hour22	Hour23	Hour24
11/22/2018	480	473	463	455	442	451	458	464	475	464	470	453	438	403	384	373	376	385	405	414	416	418	414	406
11/23/2018	397	391	391	387	394	399	411	421	437	443	454	459	452	447	445	443	454	462	472	472	464	459	451	432
11/24/2018	414	404	388	390	391	394	400	424	437	456	464	466	462	452	450	443	445	456	483	488	482	476	478	458
11/25/2018	441	425	422	421	419	429	435	447	459	459	461	461	465	462	464	476	478	498	532	519	515	508	487	467
11/26/2018	458	450	459	460	479	501	541	602	616	625	629	636	644	638	640	641	648	664	671	673	672	653	633	608
11/27/2018	581	570	572	561	575	592	613	660	663	668	663	670	674	671	673	675	682	695	709	706	701	690	663	637
11/28/2018	608	609	604	598	611	624	667	708	692	687	676	662	631	628	625	613	625	643	662	665	656	640	622	590
11/29/2018	559	561	540	537	538	550	561	601	620	598	600	593	579	581	582	569	566	587	596	588	579	572	550	519
11/30/2018	491	472	470	469	460	472	499	529	542	563	555	564	554	550	555	551	546	556	578	563	560	549	546	514
12/1/2018	476	446	459	456	450	448	453	465	463	480	497	509	503	491	498	497	501	521	526	530	510	501	486	465
12/2/2018	446	426	407	409	416	424	427	444	450	455	465	468	465	466	469	469	483	509	537	541	533	530	504	478
12/3/2018	459	444	436	440	446	466	498	557	573	588	599	621	616	613	616	615	619	633	642	641	633	630	609	577
12/4/2018	560	540	538	530	541	551	564	612	626	637	641	637	628	624	620	619	627	644	660	654	651	643	625	588
12/5/2018	587	569	572	576	571	589	606	644	659	646	639	644	624	629	622	605	595	624	649	648	649	643	627	596
12/6/2018	572	556	543	550	545	564	585	631	631	628	623	625	603	601	606	602	606	616	622	621	625	610	604	566
12/7/2018	546	537	532	527	525	549	578	605	628	635	616	605	594	585	588	578	583	598	620	611	621	621	608	590
12/8/2018	564	542	542	537	543	536	544	568	580	595	608	610	603	607	598	594	600	619	626	612	608	592	581	559
12/9/2018	536	524	519	507	515	516	519	532	543	554	547	541	527	524	517	521	526	563	591	594	588	592	565	542
12/10/2018	529	519	517	522	537	562	600	641	650	642	630	615	595	576	576	579	568	608	640	641	642	654	637	615
12/11/2018	596	596	599	602	603	614	645	682	674	645	615	619	603	588	618	571	579	597	633	630	640	631	608	586
12/12/2018	551	542	547	538	543	553	575	622	619	614	604	590	570	569	555	555	551	575	597	586	588	582	566	531
12/13/2018	507	488	484	481	479	490	517	564	577	581	586	586	574	584	562	570	571	588	585	584	590	574	559	527
12/14/2018	492	479	473	469	474	487	504	550	566	571	577	572	571	572	569	565	569	581	583	574	574	566	551	524
12/15/2018	499	479	480	468	467	467	468	474	487	490	509	507	509	504	492	500	504	529	530	531	523	510	503	484
12/16/2018	456	448	433	427	435	432	441	462	467	470	473	464	470	453	458	451	455	482	520	530	529	528	511	496
12/17/2018	475	467	467	464	480	494	531	590	593	588	569	560	549	533	546	528	539	552	579	587	584	586	573	544
12/18/2018	516	509	503	508	520	529	558	611	614	603	581	567	560	543	540	535	540	554	582	595	598	598	593	557
12/19/2018	535	520	515	512	521	525	540	581	590	575	569	550	547	536	530	528	528	552	580	572	566	563	546	521
12/20/2018	489	479	471	467	461	472	494	531	543	548	556	554	548	542	546	551	546	567	572	573	566	559	547	512
12/21/2018	477	462	453	454	454	468	482	524	532	552	569	566	566	564	568	566	557	574	583	577	567	554	539	502
12/22/2018	486	463	462	444	451	442	460	466	481	478	483	479	464	462	457	441	444	468	498	499	499	494	484	479
12/23/2018	454	450	432	429	440	440	452	467	473	493	510	504	506	506	500	486	484	510	527	521	519	519	500	485
12/24/2018	458	438	432	429	427	436	452	469	468	476	462	451	440	423	410	402	405	420	444	436	430	439	432	415
12/25/2018	403	384	375	371	376	382	388	403	415	425	430	429	403	390	369	367	374	387	423	425	435	434	431	417
12/26/2018	404	396	388	400	401	418	448	477	495	498	492	484	480	469	472	462	475	490	515	517	506	497	479	458
12/27/2018	441	427	413	416	412	427	435	471	488	496	512	506	509	506	507	512	514	512	529	521	512	500	479	456
12/28/2018	430	418	408	405	392	403	423	457	472	480	486	497	499	496	495	490	493	510	536	537	528	518	518	496
12/29/2018	475	458	455	443	451	455	469	489	491	508	516	519	522	519	517	508	507	523	550	541	524	528	513	493
12/30/2018	476	461	443	448	445	451	471	482	498	498	501	485	468	468	441	451	451	483	515	516	509	501	486	459
12/31/2018	447	422	413	411	412	420	418	446	462	473	487	491	495	502	490	478	482	483	493	485	469	458	445	429

Attachment 4.3 2019 MISO LOLE Study Report

Planning Year 2019-2020 Loss of Load Expectation Study Report

Loss of Load Expectation Working Group

MISO

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Revision History

Reason for Revision	Revised by:	Date:
Draft Posted	MISO	10/03/2018
Final Posted	MISO	10/17/2018

1 Executive Summary

Midcontinent Independent System Operator (MISO) conducts an annual Loss of Load Expectation (LOLE) study to determine a Planning Reserve Margin Unforced Capacity (PRM UCAP), zonal per-unit Local Reliability Requirements (LRR), Zonal Import Ability (ZIA), Zonal Export Ability (ZEA), Capacity Import Limits (CIL) and Capacity Export Limits (CEL). The results of the study and its deliverables supply inputs to the MISO Planning Resource Auction (PRA).

The 2019-2020 Planning Year LOLE Study:

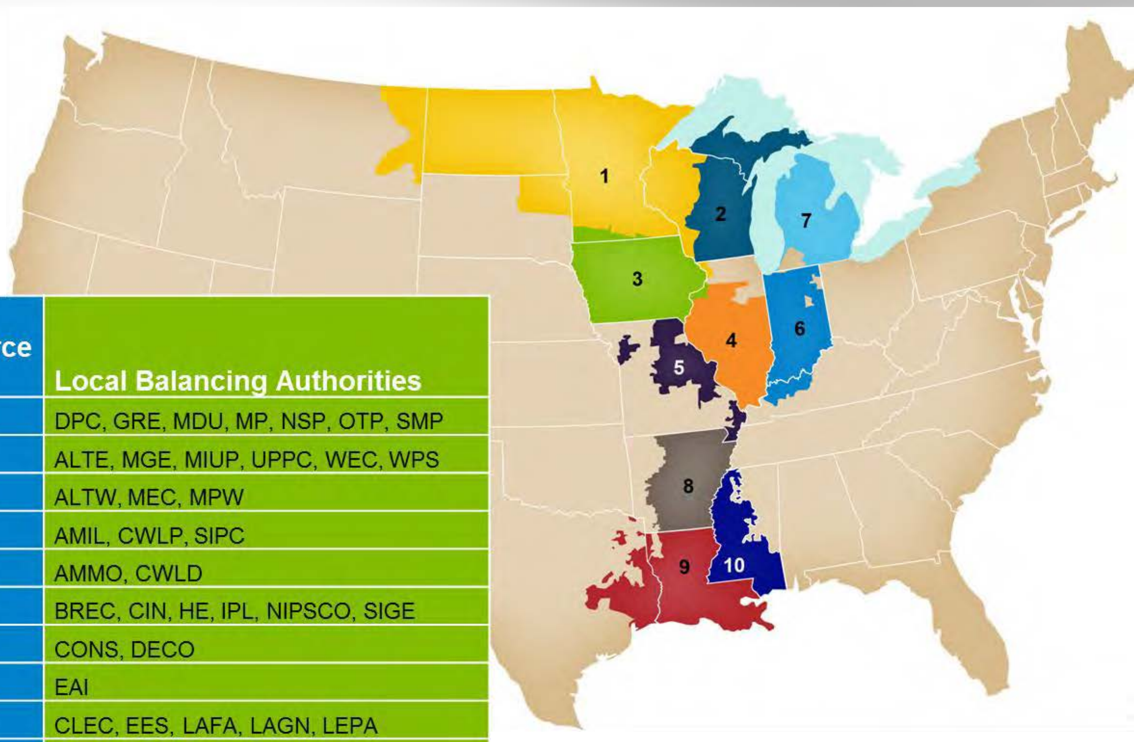
- Establishes a PRM UCAP of 7.9 percent to be applied to the Load Serving Entity (LSE) coincident peaks for the planning year starting June 2019 and ending May 2020
- Uses the Strategic Energy Risk Valuation Model (SERVM) software for Loss of Load analysis to provide results applicable across the MISO market footprint
- Provides initial zonal ZIA, ZEA, CIL and CEL for each Local Resource Zone (LRZ) (Figure 1-1). These values may be adjusted in March 2019 based on changes to MISO units with firm capacity commitments to non-MISO load, and equipment rating changes since the LOLE analysis. The Simultaneous Feasibility Test (SFT) process can further adjust CIL and CEL to assure the resources cleared in the auction are simultaneously reliable.
- Determines a minimum planning reserve margin that would result in the MISO system experiencing a less than one-day loss of load event every 10 years, as per the MISO Tariff.[1] The MISO analysis shows that the system would achieve this reliability level when the amount of installed capacity available is 1.168 times that of the MISO system coincident peak.
- Sets forth initial zonal-based (Table 1-1) PRA deliverables in the LOLE charter.

The stakeholder review process played an integral role in this study. The MISO staff would like to thank the Loss of Load Expectation Working Group (LOLEWG) for its help. Stakeholder advice led to revisions in LOLE results, including updated transfer limits due to improved redispatch, use of existing Op Guides, and constraint invalidation.

PRA and LOLE Metrics	LRZ 1	LRZ 2	LRZ 3	LRZ 4	LRZ 5	LRZ 6	LRZ 7	LRZ 8	LRZ 9	LRZ 10
PRM UCAP	7.90%	7.90%	7.90%	7.90%	7.90%	7.90%	7.90%	7.90%	7.90%	7.90%
LRR UCAP per-unit of LRZ Peak Demand	1.151	1.161	1.156	1.244	1.251	1.152	1.172	1.358	1.127	1.472
Capacity Import Limit (CIL) (MW)	4,078	1,713	3,037	6,845	5,013	7,066	3,211	4,424	3,950	3,906
Capacity Export Limit (CEL) (MW)	3,048	979	4,440	3,693	2,122	1,435	1,358	5,089	1,905	1,607
Zonal Import Ability (ZIA) (MW)	3,747	1,713	2,813	5,210	5,013	6,924	3,211	4,185	3,631	3,792
Zonal Export Ability (ZEA) (MW)	3,379	979	4,664	5,332	2,122	1,577	1,358	5,328	2,224	1,721

Table 1-1: Initial Planning Resource Auction Deliverables

[1] A one-day loss of load in 10 years (0.1 day/year) is not necessarily equal to 24 hours loss of load in 10 years (2.4 hours/year).



Local Resource Zone	Local Balancing Authorities
1	DPC, GRE, MDU, MP, NSP, OTP, SMP
2	ALTE, MGE, MIUP, UPPC, WEC, WPS
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, CIN, HE, IPL, NIPSCO, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	EMBA, SME

Figure 1-1: Local Resource Zones (LRZ)

2 LOLE Study Process Overview

In compliance with Module E-1 of the MISO Tariff, MISO performed its annual LOLE study to determine the 2019-2020 PY MISO system unforced capacity (UCAP) Planning Reserve Margin (PRM) and the per-unit Local Reliability Requirements (LRR) of Local Resource Zone (LRZ) Peak Demand.

In addition to the LOLE analysis, MISO performed transfer analysis to determine initial Zonal Import Ability (ZIA), Zonal Export Ability (ZEA), Capacity Import Limits (CIL) and Capacity Export Limits (CEL). CIL,CEL, and ZIA are used, in conjunction with the LOLE analysis results, in the Planning Resource Auction (PRA). ZEA is informational and not used in the PRA.

The 2019-2020 per-unit LRR UCAP multiplied by the updated LRZ Peak Demand forecasts submitted for the 2019-2020 PRA determines each LRZ's LRR. Once the LRR is determined, the ZIA values and non-pseudo tied exports are subtracted from the LRR to determine each LRZ's Local Clearing Requirement (LCR) consistent with Section 68A.6[2] of Module E-1. An example calculation pursuant to Section 68A.6 of the current effective Module E-1[3] shows how these values are reached (Table 2-1).

The actual effective PRM Requirement (PRMR) will be determined after the updated LRZ Peak Demand forecasts are submitted by November 1, 2018, for the 2019-2020 PRA. The ZIA, ZEA, CIL and CEL values are subject to updates in March 2019 based on changes to exports of MISO resources to non-

[2] https://www.misoenergy.org/Library/Tariff/Pages/Tariff.aspx#
[3] Effective Date: September 21, 2015

MISO load, changes to pseudo tied commitments, and updates to facility ratings since completion of the LOLE.

Finally, the simultaneous feasibility test (SFT) is performed as part of the PRA to ensure reliability and is maintained by adjusting CIL and CEL values as needed.

Local Resource Zone (LRZ) EXAMPLE	Example LRZ	Formula Key
Installed Capacity (ICAP)	17,442	[A]
Unforced Capacity (UCAP)	16,326	[B]
Adjustment to UCAP (1d in 10yr)	50	[C]
Local Reliability Requirement (LRR) (UCAP)	16,376	[D]=[B]+[C]
LRZ Peak Demand	14,270	[E]
LRR UCAP per-unit of LRZ Peak Demand	114.8%	[F]=[D]/[E]
Zonal Import Ability (ZIA)	3,469	[G]
Zonal Export Ability (ZEA)	2,317	[H]
Proposed PRA (UCAP) EXAMPLE	**Example LRZ**	**Formula Key**
Forecasted LRZ Peak Demand	14,270	[I]
Forecasted LRZ Coincident Peak Demand	13,939	[J]
Non-Pseudo Tied Exports UCAP	150	[K]
Local Reliability Requirement (LRR) UCAP	16,376	[L]=[F]x[I]
Local Clearing Requirement (LCR)	12,757	[M]=[L]-[G]-[K]
Zone's System Wide PRMR	15,040	[N]=[1.079]X[J]
PRMR	15,040	[O] = Higher of [M] or [N]
Planning Reserve Margin (PRM)	7.9%	[P]=[O]/[J]-1

Table 2-1: Example LRZ Calculation

2.1 Locational Tariff LOLE Study Enhancements

The Tariff filing referred to as the “Locational” filing resulted in several changes to the LOLE study process for the 2019-2020 Planning Year. The filing aligned CILs and CELs with the Zones where resources are accredited in the Planning Resource Auction (PRA). It also adjusted these limits to represent the share of transfers which can clear in the PRA. Below are more details regarding the filing’s effect on the LOLE study:

- Updates to match how resources are accredited in the PRA
    - Resources outside the MISO boundary (External Resources) will continue to be modeled at their physical location
    - External Resources which meet physical and operational criteria to obtain credit within a MISO LRZ will be included as generation within that Zone for LRR and transfer analysis
- Adjusted limits to represent the share of transfer which can clear in the PRA
    - Two new values, Zonal Import Ability (ZIA) and Zonal Export Ability (ZEA) represent the transfer ability prior to making adjustments for exports to non-MISO load
    - Exports to non-MISO load are removed from these values to determine the transfer limits available for the PRA
    - Adjustment applied to both CEL and CIL; previously only applied to CIL

- Updates to the Local Clearing Requirement calculation aligned with the above changes
  - ZIA replaces CIL
  - Non-pseudo tied exports expanded to reference ‘controllable exports’

2.2 Future Study Improvement Considerations

In response to stakeholder feedback received through the LOLEWG, MISO has committed to reviewing two aspects of the transfer analysis process. MISO will examine the redispatch process for external constraints and the Generation Limited Transfer methodology with stakeholders early next year. MISO and stakeholders will consider any identified improvement for the next LOLE study.

3 Transfer Analysis

3.1 Calculation Methodology and Process Description

Transfer analyses determined initial ZIA, ZEA, CIL and CEL for LRZs for the 2019-2020 Planning Year. The objective of transfer analysis is to determine constraints caused by the transfer of capacity between zones and the associated transfer capability. Multiple factors impacted the analysis when compared to previous studies, including:

- Completion of MTEP transmission projects
- Generation retirements and commissioning of new units
- External system dispatch changes

3.1.1 Generation pools

To determine an LRZ’s import or export limit, a transfer is modeled by ramping generation up in a source subsystem and ramping generation down in a sink subsystem. The source and sink definitions depend on the limit being tested. The LRZ studied for import limits is the sink subsystem and the adjacent MISO areas are the source subsystem. The LRZ studied for export limits is the source subsystem and the rest of MISO is the sink subsystem.

Transfers can cause potential issues, which are addressed through the study assumptions. First, an abundantly large source pool spreads the impact of the transfer widely, which potentially masks constraints. Second, ramping up generation from remote areas could cause electrically distant constraints for any given LRZ, which should not determine a zone’s limit. For example, export constraints due to dispatch of LRZ 1 generation in the northwest portion of the footprint should not limit the import capability of LRZ 10, which covers the MISO portion of Mississippi.

To address these potential issues, the transfer studies limit the source pool for the import studies to the areas adjacent to the study zone. Since export study subsystems are defined by the LRZ, these issues only apply to import studies. Generation within the zone studied for an export limit is ramped up and constraints are expected to be near the zone because the ramped-up generation concentrates in a particular area.

3.1.2 Redispatch

Limited redispatch is applied after performing transfer analyses to mitigate constraints. Redispatch ensures constraints are not caused by the base dispatch and aligns with potential actions that can be implemented for the constraint in MISO operations. Redispatch scenarios can be designed to address multiple constraints as required and may be used for constraints that are electrically close to each other or to further optimize transfer limits for several constraints requiring only minor redispatch. The redispatch assumptions include:

- The use of no more than 10 conventional fuel units or wind plants
- Redispatch limit at 2,000 MW total (1,000 MW up and 1,000 MW down)
- No adjustments to nuclear units
- No adjustments to the portions of pseudo-tied units committed to non-MISO load

3.1.3 Generation Limited Transfer for CIL/CEL and ZIA/ZEA

When conducting transfer analysis to determine import or export limits, the source subsystem might run out of generation to dispatch before identifying a constraint caused by a transmission limit. MISO developed a Generation Limited Transfer (GLT) process to identify transmission constraints in these situations, when possible, for both imports and exports.

After running the First Contingency Incremental Transfer Capability (FCITC) analysis to determine limits for each LRZ, MISO will determine whether a zone is experiencing a GLT (e.g. whether the first constraint would only occur after all the generation is dispatched at its maximum amount). If the LRZ experiences a GLT, MISO will adjust the base model based on whether it is an import or export analysis and re-run the transfer analysis.

For an export study, when a transmission constraint has not been identified after dispatching all generation within the exporting system (LRZ under study) MISO will decrease load and generation dispatch in the study zone. The adjustment creates additional capacity to export from the zone. After the adjustments are complete, MISO will rerun the transfer analysis. If a GLT reappears, MISO will make further adjustments to the load and generation of the study zone.

For an import study, when a transmission constraint has not been identified after dispatching all generation within the source subsystem, MISO will adjust load and generation in the source subsystem. This increases the import capacity for the study zone. After the adjustments are complete, MISO will run the transfer analysis again. If a GLT reappears, MISO will make further adjustments to the model's load and generation in the source subsystem.

FCITC could indicate the transmission system can support larger thermal transfers than would be available based on installed generation for some zones. However, large variations in load and generation for any zone may lead to unreliable limits and constraints. Therefore, MISO limits load scaling for both import and export studies to 50 percent of the zone's load.

Upon further review of LRZ-5 export GLT by the LOLEWG, it was determined that the ZEA value would be set at last year's value of 2,122 MWs.

3.1.4 Voltage Limited Transfer for CIL/CEL and ZIA/ZEA

Zonal imports may be limited by voltage constraints due to a decrease in the generation in the zone prior to the thermal limits determined by linear FCITC. LOLE studies may evaluate Power-Voltage curves for LRZs with known voltage-based transfer limitations identified through prior MISO or Transmission Owner studies. Such evaluation may also happen if an LRZ's import reaches a level where the majority of the zone's load would be served using imports from resources outside of the zone. MISO will coordinate with stakeholders as it encounters these scenarios.

3.2 Powerflow Models and Assumptions

3.2.1 Tools used

MISO used the Siemens PTI Power System Simulator for Engineering (PSS E) and Transmission Adequacy and Reliability Assessment (TARA) as transfer analysis tools.

3.2.2 Inputs required

Thermal transfer analysis requires powerflow models and input files. MISO used contingency files from MTEP[4] reliability assessment studies. Single-element contingencies in MISO/seam areas were also evaluated.

MISO developed a subsystem file to monitor its footprint and seam areas. LRZ definitions were developed as sources and sinks in the study. See Appendix B for maps containing adjacent area definitions (Tiers 1 and 2) used for this study. The monitored file includes all facilities under MISO functional control and single elements in the seam areas of 100 kV and above.

3.2.3 Powerflow Modeling

The summer peak 2019 study model was built using MISO's Model on Demand (MOD) model data repository, with the following base assumptions (Table 3-1).

Scenario	Effective Date	Projects Applied	External Modeling	Load and Generation Profile
2019	6/1/2019	MTEP18 Appendix A and Target A	2017 Series 2019 Summer ERAG MMWG	Summer Peak

Table 3-1: Model assumptions

MISO excluded several types of units from the transfer analysis dispatch; these units' base dispatch remained fixed.

- Nuclear dispatch does not change for any transfer
- Intermittent resources can be ramped down, but not up
- Pseudo-tied resources were modeled at their expected commitments to non-MISO load, although portions of these units committed to MISO could participate in transfer analyses

System conditions such as load, dispatch, topology and interchange have an impact on transfer capability. The model was reviewed as part of the base model build for MTEP18 analyses, with study files made available on the MTEP ftp site. MISO worked closely with transmission owners and stakeholders in order to model the transmission system accurately, as well as to validate constraints and redispatch. Like other planning studies, transmission outage schedules were not included in the analysis. This is driven partly by limited availability of outage information as well as by current standard requirements. Although no outage schedules were evaluated, all single element contingencies were evaluated. This includes BES lines, transformers, and generators. Contingency coverage covers most of category P1 and some of category P2.

3.2.4 General Assumptions

MISO uses TARA to process the powerflow model and associated input files to determine the import and export limits of each LRZ by determining the transfer capability. Transfer capability measures the ability of interconnected power systems to reliably transfer power from one area to another under specified system conditions. The incremental amount of power that can be transferred will be determined through FCITC analysis. FCITC analysis and base power transfers provide the information required to calculate the First Contingency Total Transfer Capability (FCTTC), which indicates the total amount of transferrable power before a constraint is identified. FCTTC is the base power transfer plus the incremental transfer capability (Equation 3-1). All published limits are based on the zone's FCTTC and may be adjusted for capacity exports.

[4] Refer to the Transmission Planning BPM for more information regarding MTEP input files. https://www.misoenergy.org/_layouts/MISO/ECM/Redirect.aspx?ID=19215

$$First\ Contingency\ Total\ Transfer\ Capability\ (FCTTC) = FCITC + Base\ Power\ Transfer$$

Equation 3-1: Total Transfer Capability

Facilities were flagged as potential constraints for loadings of 100 percent or more in two scenarios: the normal rating for system intact conditions and the emergency rating for single event contingencies. Linear FCITC analysis identifies the limiting constraints using a minimum transfer Distribution Factor (DF) cutoff of 3 percent, meaning the transfer and contingency must increase the loading on the overloaded element by 3 percent or more.

A pro-rata dispatch is used, which ensures all available generators will reach their maximum dispatch level at the same time. The pro-rata dispatch is based on the MW reserve available for each unit and the cumulative MW reserve available in the subsystem. The MW reserve is found by subtracting a unit's base model generation dispatch from its maximum dispatch, which reflects the available capacity of the unit.

Table 3-2 and Equation 3-2 show an example of how one unit's dispatch is set, given all machine data for the source subsystem.

Machine	Base Model Unit Dispatch (MW)	Minimum Unit Dispatch (MW)	Maximum Unit Dispatch (MW)	Reserve MW (Unit Dispatch Max – Unit Dispatch Min)
1	20	20	100	80
2	50	10	150	100
3	20	20	100	80
4	450	0	500	50
5	500	100	500	0
			Total Reserve	**310**

Table 3-2: Example subsystem

$$\boldsymbol{Machine\ 1\ Incremental\ Post\ Transfer\ Dispatch = \frac{Machine\ 1\ Reserve\ MW}{Source\ Subsystem\ Reserve\ MW} \times Transfer\ Level\ MW}$$

$$Machine\ 1\ Incremental\ Post\ Transfer\ Dispatch = \frac{80}{310} \times 100 = 25.8$$

$$Machine\ 1\ Incremental\ Post\ Transfer\ Dispatch = 25.8$$

Equation 3-2: Machine 1 dispatch calculation for 100 MW transfer

3.3 Results for CIL/CEL and ZIA/ZEA

Constraints limiting transfers and the associated ZIA, ZEA, CIL, and CEL for each LRZ were presented and reviewed through the LOLEWG. Preliminary results for Planning Year 2019/20 were presented in the September 2018 meeting and updates were presented in an October 2018 WebEx/conference call.

Detailed constraint and redispatch information for all limits is found in the Transfer Analysis section of this report. Table 3-3 presents a summary of the Planning Year 2019-20 Capacity Import Limits.

LRZ	Tier	19-20 CIL (MW)[5]	19-20 ZIA (MW)	Monitored Element	Contingent Element	Figure 3.3-1 Map ID	GLT applied	Generation Redispatch (MW)	18-19 CIL (MW)[6]
1	1&2	4,078	3,747	Sherman Street to Sunnyvale 115 kV	Arpin to Rocky Run 115 kV	1	No	1,992	4,546
2	1&2	1,713	1,713	University Park to East Frankfort 345 kV	Dumont to Wilton 765 kV	2	No	2,000	2,317
3	1&2	3,037	2,813	Sub 3458 to Sub 3456 345 kV	Sub 3455 to Sub 3740 345 kV	3	No	2,000	2,812
4	N/A	6,845	5,210	Hallock Bus 138 kV voltage	Clinton Generation	4	No	N/A	6,278
5	1&2	5,013	5,013	Joppa 345/161 kV	Shawnee 500/345 kV	5	No	1,820	3,580
6	1&2	7,066	6,924	Paradise to BRTAP 161 kV	Phipps Bend to Volunteer 500 kV	6	No	2,000	7,375
7	N/A	3,211	3,211	Pioneer 120 kV bus voltage	Wayne – Monroe 345 kV	7	No	N/A	3,785
8	1&2	4,424	4,185	Moon Lake-Ritchie 230 kV	Cordova TN to Benton MS500 kV	8	No	2,000	4,778
9	1&2	3,950	3,631	Sterlington to Downsville 115 kV	Mt. Olive to El Dorado 500 kV	9	No	2,000	3,679
10	1	3,906	3,792	Freeport to Twinkletown 230 kV	Freeport to Horn Lake 230 kV	10	No	2,000	2,618

Table 3-3: Planning Year 2019–2020 Import Limits

[5] Results after applying redispatch and adjusted for exports to non-MISO load per the FERC locational filing.
[6] Results after applying redispatch and shift factor adjustments for the Dec. 31, 2015, FERC order.

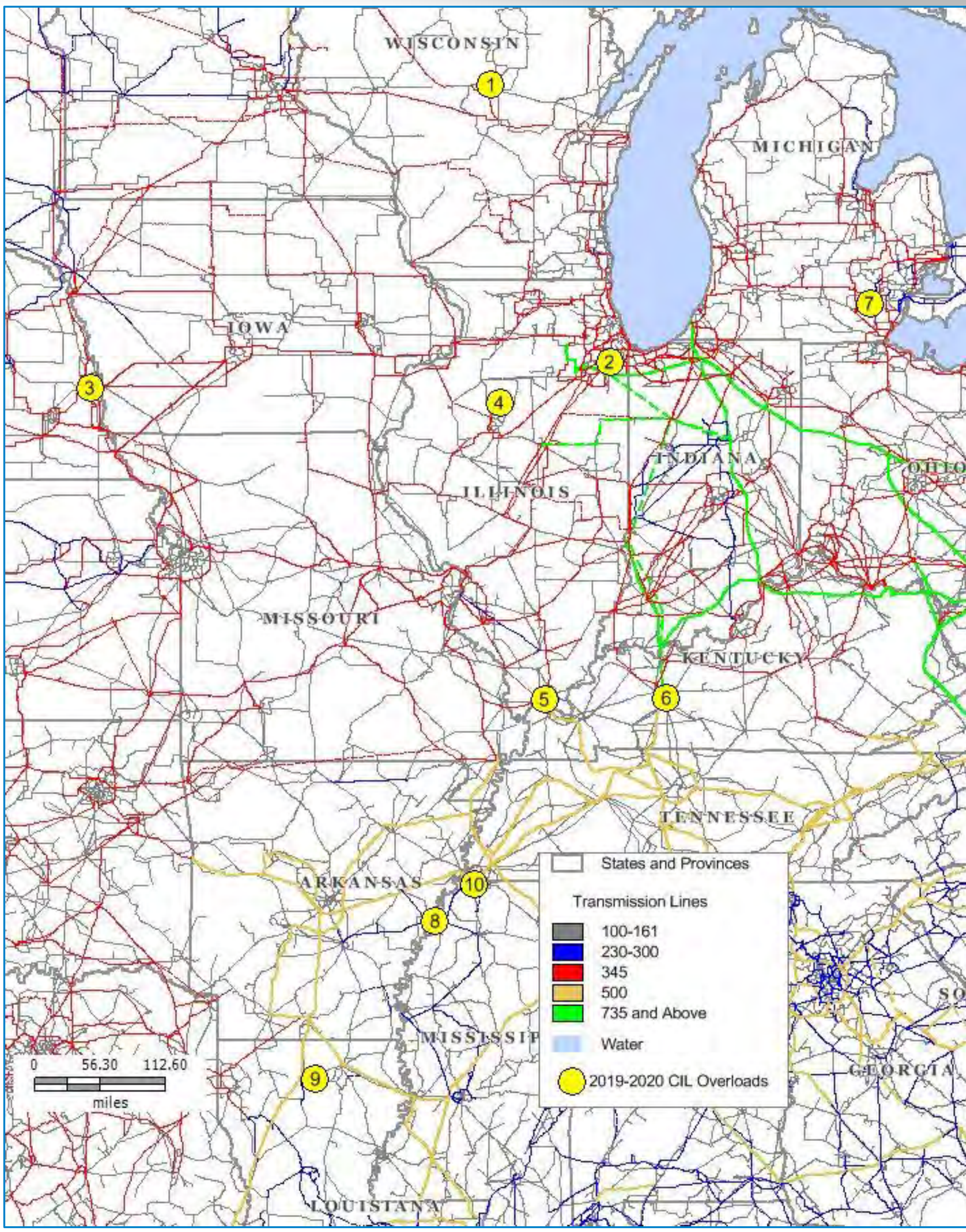


Figure 3-1: Planning Year 2019-20 Import Constraint Map

Capacity Exports Limits were found by increasing generation in the zone being studied and decreasing generation in the rest of the MISO footprint. Table 3-4 summarizes Planning Year 2019-20 Capacity Export Limits.

LRZ	19-20 CEL (MW)	19-20 ZEA (MW)	Monitored Element	Contingent Element	Figure 3.3-2 Map ID	Generation Redispatch (MW)	GLT applied	18-19 CEL (MW)
1	3,048	3,379	Seneca to Gran Grae 161 kV	Arpin to Eau Claire 345 kV	1	400	Yes	516
2	979	979	Wempleton 345/138 kV	Cherry Valley 345/138 kV	2	1,208	Yes	2,017
3	4,440	4,664	Fargo 345/138 kV	Mapleridge to Tazwell 345 kV	3	350	Yes	5,430
4	3,693	5,332	Pontiac to Brokaw 345 kV	Pontiac to Bluemond 345 kV	4	350	Yes	4,280
5	2,122	2,122	No Constraint found	System Intact	5	0	Yes	2,122
6	1,435	1,577	University Park to East Frankfort 345 kV	Dumont to Wilton 765 kV	7	0	Yes	3,249
7	1,358	1,358	University Park to East Frankfort 345 kV	Dumont to Wilton 765 kV	6	1400	No	2,578
8	5,089	5,328	Russelville South to Dardanelle 161 kV	Arkansas Nuclear to Fort Smith 500 kV	8	0	Yes	2,424
9	1,905	2,224	Addis to Tiger 230 kV	Dow meter to Chenango 230 kV	9	800	No	2,149
10	1,607	1,721	Batesville to Tallahachie 161 kV	Choctaw to Clay 500 kV	10	100	Yes	1,824

Table 3-4: Planning Year 2019–2020 Export Limits

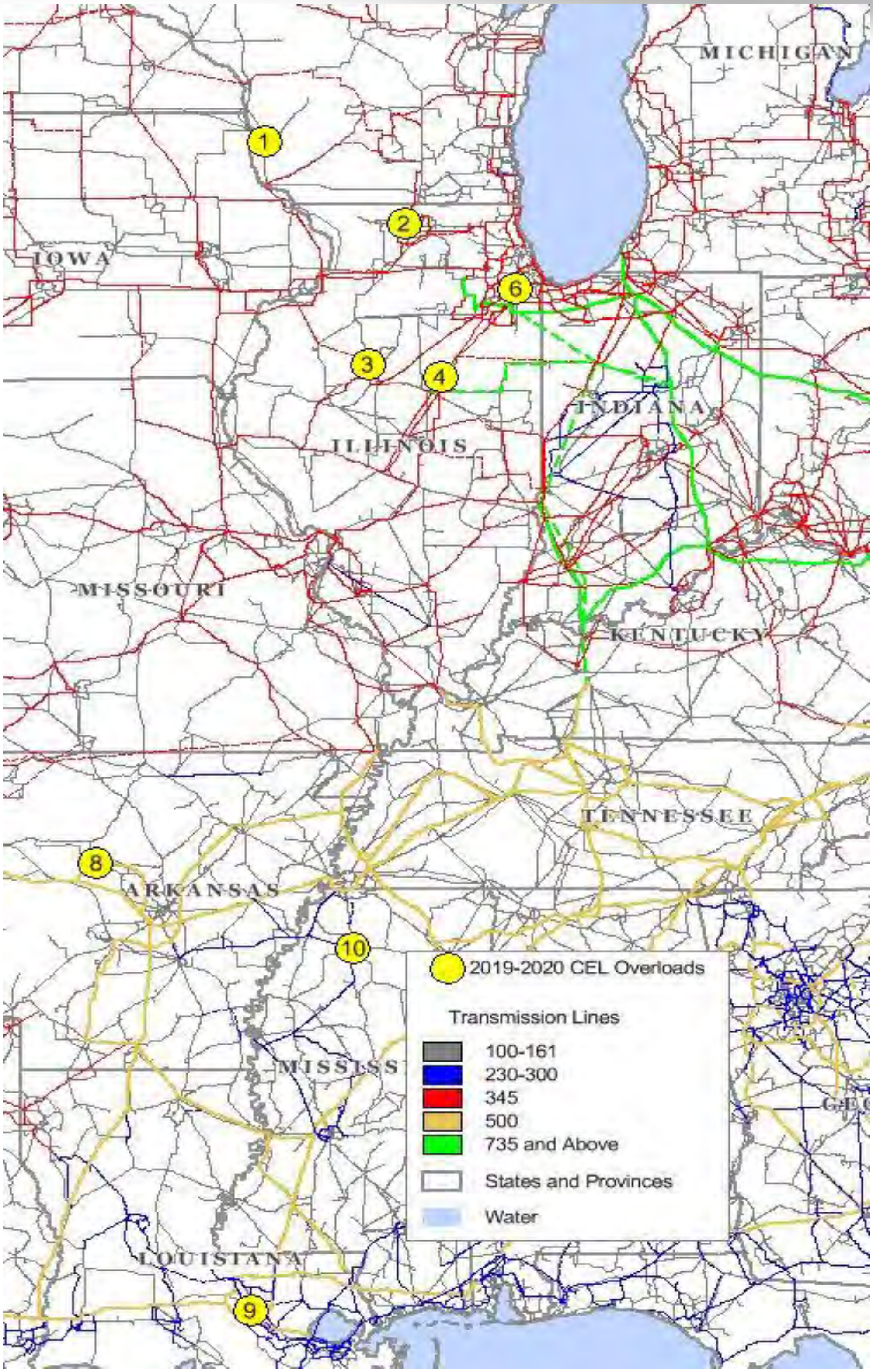


Figure 3-2: Planning Year 2019-20 Export Constraint Map

3.3.1 Out-Year Analysis

In 2018, MISO and its stakeholders redesigned the out-year LOLE transfer analysis process through the LOLEWG and Resource Adequacy Subcommittee (RASC). The out-year analysis will now be performed after the near-term analyses are complete. The out-year results will be documented outside of the LOLE report and recorded in LOLEWG meeting materials.

4 Loss of Load Expectation Analysis

4.1 LOLE Modeling Input Data and Assumptions

MISO uses a program managed by Astrapé Consulting called SERVM to calculate the LOLE for the applicable planning year. SERVM uses a sequential Monte Carlo simulation to model a generation system and to assess the system's reliability based on any number of interconnected areas. SERVM calculates the annual LOLE for the MISO system and each LRZ by stepping through the year chronologically and taking into account generation, load, load modifying and energy efficiency resources, equipment forced outages, planned and maintenance outages, weather and economic uncertainty, and external support.

Building the SERVM model is the most time-consuming task of the PRM study. Many scenarios are built in order to determine how certain variables impact the results. The base case models determine the MISO PRM Installed Capacity (ICAP), PRM UCAP and the LRRs for each LRZ for years one, four and six.

4.2 MISO Generation

4.2.1 Thermal Units

The 2019-2020 planning year LOLE study used the 2018 PRA converted capacity as a starting point for which resources to include in the study. This ensured that only resources eligible as a Planning Resources were included in the LOLE study. An exception was made for resources with a signed GIA with an anticipated in-service date for the 2019-2020 PY. These resources were also included. All internal Planning Resources were modeled in the LRZ in which they are physically located. Additionally, Coordinating Owners and Border External Resources were modeled as being internal to the LRZ in which they are committed to serving load.

Forced outage rates and planned maintenance factors were calculated over a five-year period (January 2013 to December 2017) and modeled as one value for each unit. Some units did not have five years of historical data in MISO's Generator Availability Data System (PowerGADS). However, if they had at least 12 consecutive months of data then unit-specific information was used to calculate their forced outage rates and maintenance factors. Units with fewer than 12 consecutive months of unit-specific data were assigned the corresponding MISO class average forced outage rate and planned maintenance factor based on their fuel type. Any MISO class with fewer than 30 units were assigned the overall MISO weighted class average forced outage rate of 9.28 percent.

Nuclear units have a fixed maintenance schedule, which was pulled from publicly available information and was modeled for each of the study years.

The historical class average outage rates as well as the MISO fleet wide weighted average forced outage rate are in Table 4-1.

Pooled EFORd GADS Years	2013-2017 (%)	2012-2016 (%)	2011-2015 (%)	2010-2014 (%)	2009-2013 (%)	2008-2012 (%)
LOLE Study Planning Year	2019-2020 PY LOLE Study	2018-2019 PY LOLE Study	2017-2018 PY LOLE Study	2016-2017 PY LOLE Study	2015-2016 PY LOLE Study	2014-2015 PY LOLE Study
Combined Cycle	5.37	4.62	3.56	3.78	3.92	4.74
Combustion Turbine (0-20 MW)	23.18	29.02	24.2	23.58	18.39	27.22
Combustion Turbine (20-50 MW)	15.76	13.48	13.94	16.03	53.12	25.27
Combustion Turbine (50+ MW)	5.18	6.19	5.94	5.69	5.61	5.76
Diesel Engines	10.26	10.42	13.12	12.51	14.00	9.83
Fluidized Bed Combustion	*	*	*	*	**	**
HYDRO (0-30MW)	*	*	*	*	**	**
HYDRO (30+ MW)	*	*	*	*	**	**
Nuclear	*	*	*	*	**	**
Pumped Storage	*	*	*	*	**	**
Steam - Coal (0-100 MW)	4.60	5.14	5.99	7.12	8.45	8.82
Steam - Coal (100-200 MW)	*	*	*	*	6.39	6.85
Steam - Coal (200-400 MW)	9.82	9.77	8.64	8.46	8.44	8.33
Steam - Coal (400-600 MW)	*	*	*	7.04	6.99	6.98
Steam - Coal (600-800 MW)	8.22	7.90	7.42	7.58	7.36	**
Steam - Coal (800-1000 MW)	*	*	*	*	**	**
Steam - Gas	11.56	11.94	11.68	10.18	8.79	**
Steam - Oil	*	*	*	*	**	**
Steam - Waste Heat	*	*	*	*	**	**
Steam - Wood	*	*	*	*	**	**
MISO System Wide Weighted	9.28	9.16	8.21	7.98	7.67	7.55

*MISO system-wide weighted forced outage rate used in place of class data for those with less than 30 units reporting 12 or more months of data

**Prior to 2015-2016PY the NERC class average outage rate was used for units with less than 30 units reporting 12 or more months of data

Table 4-1: Historical Class Average Forced Outage Rates

4.2.2 Behind-the-Meter Generation

Behind-the-Meter generation data came from the Module E Capacity Tracking (MECT) tool. These resources were explicitly modeled just as any other thermal generator with a monthly capacity and forced outage rate. Performance data was pulled from PowerGADS.

4.2.3 Sales

This year's LOLE analysis incorporated firm sales to neighboring capacity markets as well as firm transactions off system where information was available. For units with capacity sold off-system, the monthly capacities were reduced by the megawatt amount sold. This totaled 3,195 MW UCAP for Planning Year 2019-2020. See Section 4.4 for a more detailed breakdown. These values came from PJM's Reliability Pricing Model (RPM) as well as exports to other external areas taken from the Independent Market Monitor (IMM) exclusion list.

4.2.4 Attachment Y

For the 2019-2020 planning year, generating units with approved suspensions or retirements (as of June 1, 2018) through MISO's Attachment Y process were removed from the LOLE analysis. Any unit retiring, suspending, or coming back online at any point during the planning year was excluded from the year-one analysis. This same methodology is used for the four- and six-year analyses.

4.2.5 Future Generation

Future thermal generation and upgrades were added to the LOLE model based on unit information in the MISO Generator Interconnection Queue. The LOLE model included units with a signed interconnection agreement (as of June 1, 2018). These new units were assigned class-average forced outage rates and planned maintenance factors based on their particular unit class. Units upgraded during the study period reflect the megawatt increase for each month, beginning the month the upgrade was finished. The LOLE analysis also included future wind and solar generation at the MISO capacity accreditation amount (wind at 15.2 percent and solar at 50 percent).

4.2.6 Intermittent Resources

Intermittent resources such as run-of-river hydro, biomass and wind were explicitly modeled as demand-side resources. Non-wind intermittent resources, such as run-of-river hydro and biomass, provide MISO with up to 15 years of historical summer output data for the hours ending 15:00 EST through 17:00 EST. This data is averaged and modeled in the LOLE analysis as UCAP for all months. Each individual unit is modeled and put in the corresponding LRZ.

Each wind-generator Commercial Pricing Node (CPNode) received a capacity credit based on its historical output from MISO's top eight peak days in each of the past years for which data were available. The megawatt value corresponding to each CPNode's wind capacity credit was used for each month of the year. Units new to the commercial model without a wind capacity credit as part of the 2018 Wind Capacity Credit analysis received the MISO-wide wind capacity credit of 15.2 percent as established by the 2018 Wind Capacity Credit Effective Load Carrying Capability (ELCC) study. The capacity credit established by the ELCC analysis determines the maximum percent of the wind unit that can receive credit in the PRA while the actual amount could be less due to other factors such as transmission limitations. Each wind CPNode receives its actual wind capacity credit based on the capacity eligible to participate in the PRA. Only Network Resource Interconnection Service or Energy Resource Interconnection Service with firm point-to-point is considered an eligible capacity resource. The final value from the 2018 PRA for each wind unit was modeled at a flat capacity profile for the planning year. The detailed methodology for establishing the MISO-wide and individual CPNode Wind Capacity Credits can be found in the 2018 Wind Capacity Credit Report.

4.2.7 Demand Response

Demand response data came from the MECT tool. These resources were explicitly modeled as dispatch-limited resources. Each demand response program was modeled individually with a monthly capacity, limited to the number of times each program can be called upon, and limited by duration.

4.3 MISO Load Data

The 2019-2020 LOLE analysis used a load training process with neural net software to create a neural-net relationship between historical weather and load data. This relationship was then applied to 30 years of hourly historical weather data to create 30 different load shapes for each LRZ in order to capture both load diversity and seasonal variations. The average monthly loads of the predicted load shapes were adjusted to match each LRZ's Module E 50/50 monthly zonal peak load forecasts for each study year. The results of this process are shown as the MISO System Peak Demand (Table 5-1) and LRZ Peak Demands (Table 6-1).

Direct Control Load Management and Interruptible Demand types of demand response were explicitly included in the LOLE model as resources. These demand resources are implemented in the LOLE simulation before accumulating LOLE or shedding of firm load.

4.3.1 Weather Uncertainty

MISO has adopted a six-step load training process in order to capture the weather uncertainty associated with the 50/50 load forecasts. The first step of this process requires the collection of five years of historical real-time load modifying resource (LMR) performance and load data, as well as the collection of 30 years of historical weather data. Both the LMR and load data are taken from the MISO market for each LBA, while the historical weather data is collected from the National Oceanic and Atmospheric Administration (NOAA) for each LRZ. After collecting the data the hourly gross load for each LRZ is calculated using the five years of historical data.

The second step of the process is to normalize the five years of load data to consistent economics. With the load growth due to economics removed from 5 years of historical LRZ load, the third step of the process utilizes neural network software to establish functional relationships between the five years of historical weather and load data. In the fourth step of the process the neural network relationships are applied to the 30 years of historical weather data in order to predict/create 30 years' worth of load shapes for each LRZ.

In the fifth step of the load training process, MISO undertakes extreme temperature verification on the 30 years of load shapes to ensure that the hourly load data is accurate at extremely hot or cold temperatures. This is required since there are fewer data points available at the temperature extremes when determining the neural network functional relationships. This lack of data at the extremes can result in inaccurate predictions when creating load shapes, which will need to be corrected before moving forward.

The sixth and final step of the load training process is to average the monthly peak loads of the predicted load shapes and adjust them to match each LRZ's Module E 50/50 monthly zonal peak load forecasts for each study year. In order to calculate this adjustment, the ratio of the first year's non-coincident peak forecast to the zonal coincident peak forecast is applied to future year's non-coincident peak forecast.

By adopting this new methodology for capturing weather uncertainty MISO is able to model multiple load shapes based off a functional relationship with weather. This modeling approach provides a variance in load shapes, as well as the peak loads observed in each load shape. This approach also provides the ability to capture the frequency and duration of severe weather patterns.

4.3.2 Economic Load Uncertainty

To account for economic load uncertainty in the 2019-2020 planning year LOLE model MISO utilized a normal distribution of electric utility forecast error accounting for projected and actual Gross Domestic Product (GDP), as well as electricity usage. The historic projections for GDP growth were taken from the Congressional Budget Office (CBO), the actual GDP growth was taken from the Bureau of Economic Analysis (BEA), and the electric use was taken from the U.S. Energy Information Administration (EIA). Due to lack of statewide projected GDP data MISO relied on United States aggregate level data when calculating the economic uncertainty.

In order to calculate the electric utility forecast error, MISO first calculated the forecast error of GDP between the projected and actual values. The resulting GDP forecast error was then translated into electric utility forecast error by multiply by the rate at which electric load grows in comparison to the GDP. Finally, a standard deviation is calculated from the electric utility forecast error and used to create a normal distribution representing the probabilities of the load forecast errors (LFE) as shown in Table 4-2.

	LFE Levels				
	-2.0%	-1.0%	0.0%	1.0%	2.0%
Standard Deviation in LFE	Probability assigned to each LFE				
1.19%	10.4%	23.3%	32.6%	23.3%	10.4%

Table 4-2: Economic Uncertainty

As a result of stakeholder feedback MISO is exploring possible alternative methods for determining economic uncertainty to be used in the LOLE process.

4.4 External System

Within the LOLE study, a 1 MW increase of non-firm support from external areas leads to a 1 MW decrease in the reserve margin calculation. It is important to account for the benefit of being part of the eastern interconnection while also providing a stable result. In order to provide a more stable result and remove the false sense of precision, the external non-firm support was set at an ICAP of 2,987 MW and a UCAP of 2,331 MW.

Firm imports from external areas to MISO are modeled at the individual unit level. The specific external units were modeled with their specific installed capacity amount and their corresponding Equivalent Forced Outage Rate demand (EFORd). This better captures the probabilistic reliability impact of firm external imports. These units are only modeled within the MISO PRM analysis and are not modeled when calculating the LRZ LRRs. Due to the locational Tariff filing, Border External Resources and Coordinating Owners are no longer considered firm imports. Instead, these resources are modeled as internal MISO units and are included in the PRM and LRR analysis. The external resources to include for firm imports were based on the amount offered into the 2018-19 planning year PRA. This is a historically accurate indicator of future imports. For 2018-19 planning year this amount was 1,883 MW ICAP.

Firm exports from MISO to external areas were modeled the same as previous years. As stated in Section 4.2.3, capacity ineligible as MISO capacity due to transactions with external areas is removed from the model. Table 4-3 shows the amount of firm imports and exports in this year's study.

Contracts	ICAP (MW)	UCAP (MW)
Imports (MW)	1,883	1,809
Exports (MW)	3,526	3,195
Net	**-1,643**	**-1,386**

Table 4-3: 2018 Planning Year Firm Imports and Exports

4.5 Loss of Load Expectation Analysis and Metric Calculations

Upon completion of the SERVM database, MISO determined the appropriate PRM ICAP and PRM UCAP for the 2019-2020 planning year as well as the appropriate Local Reliability Requirement for each of the 10 LRZ's. These metrics were determined by a probabilistic LOLE analysis such that the LOLE for the planning year was one day in 10 years, or 0.1 day per year.

4.5.1 MISO-Wide LOLE Analysis and PRM Calculation

For the MISO-wide analysis, generating units were modeled as part of their appropriate LRZ as a subset of a larger MISO pool. The MISO system was modeled with no internal transmission limitations. In order to meet the reliability criteria of 0.1 day per year LOLE, capacity is either added or removed from the MISO pool. The minimum amount of capacity above the 50/50 net internal MISO Coincident Peak Demand required to meet the reliability criteria was used to establish the PRM values.

The minimum PRM requirement is determined using the LOLE analysis by either adding or removing capacity until the LOLE reaches 0.1 day per year. If the LOLE is less than 0.1 day per year, a perfect negative unit with zero forced outage rate is added until the LOLE reaches 0.1 day per year. The perfect negative unit adjustment is akin to adding load to the model. If the LOLE is greater than 0.1 day per year, proxy units based on a unit of typical size and forced outage rate will be added to the model until the LOLE reaches 0.1 day per year.

For the 2019-2020 planning year, the MISO PRM analysis removed capacity (6,250 MW) using the perfect unit adjustment.

The formulas for the PRM values for the MISO system are:

PRM ICAP = ((Installed Capacity + Firm External Support ICAP + ICAP Adjustment to meet a LOLE of 0.1 days per year) – MISO Coincident Peak Demand)/MISO Coincident Peak Demand

PRM UCAP = (Unforced Capacity + Firm External Support UCAP + UCAP Adjustment to meet a LOLE of 0.1 days per year) – MISO Coincident Peak Demand)/MISO Coincident Peak Demand

Where Unforced Capacity (UCAP) = Installed Capacity (ICAP) x (1 – XEFORd)

4.5.2 LRZ LOLE Analysis and Local Reliability Requirement Calculation

For the LRZ analysis, each LRZ included only the generating units within the LRZ (including Coordinating Owners and Border External Resources) and was modeled without consideration of the benefit of the LRZ's import capability. Much like the MISO analysis, unforced capacity is either added or removed in each LRZ such that a LOLE of 0.1 day per year is achieved. The minimum amount of unforced capacity above each LRZ's Peak Demand that was required to meet the reliability criteria was used to establish each LRZ's LRR.

The 2019-2020 LRR is determined using the LOLE analysis by either adding or removing capacity until the LOLE reaches 0.1 day per year for the LRZ. If the LOLE is less than 0.1 day per year, a perfect negative unit with zero forced outage rate will be added until the LOLE reaches 0.1 day per year. If the LOLE is greater than 0.1 day per year, proxy units based on a unit of typical size and forced outage rate will be added to the model until the LOLE reaches 0.1 day per year.

For the 2019-2020 planning year, only LRZ-3 and LRZ-8 had sufficient capacity, internal to the LRZ to achieve the LOLE of 0.1 day per year as an island. In the eight zones without sufficient capacity as an island, proxy units of typical size (160 MW) and class-average EFORd (5.17 percent) were added to the LRZ. When needed, a fraction of the final proxy unit was added to achieve the exact LOLE of 0.1 day per year for the LRZ.

5 MISO System Planning Reserve Margin Results

5.1 Planning Year 2019-2020 MISO Planning Reserve Margin Results

For the 2019-2020 planning year, the ratio of MISO capacity to forecasted MISO system peak demand yielded a planning ICAP reserve margin of 16.8 percent and a planning UCAP reserve margin of 7.9 percent. These PRM values assume 1,809 MW UCAP of firm and 2,331 MW UCAP of non-firm external support. Numerous values and calculations went into determining the MISO system PRM ICAP and PRM UCAP (Table 5-1).

MISO Planning Reserve Margin (PRM)	**2019/2020 PY** (June 2019 - May 2020)	**Formula Key**
MISO System Peak Demand (MW)	125,501	[A]
Installed Capacity (ICAP) (MW)	153,896	[B]
Unforced Capacity (UCAP) (MW)	142,132	[C]
Firm External Support (ICAP) (MW)	1,883	[D]
Firm External Support (UCAP) (MW)	1,809	[E]
Adjustment to ICAP {1d in 10yr} (MW)	-6,250	[F]
Adjustment to UCAP {1d in 10yr} (MW)	-6,250	[G]
Non-Firm External Support (ICAP) (MW)	2,987	[H]
Non-Firm External Support (UCAP) (MW)	2,331	[I]
ICAP PRM Requirement (PRMR) (MW)	146,543	[J]=[B]+[D]+[F]-[H]
UCAP PRM Requirement (PRMR) (MW)	135,360	[K]=[C]+[E]+[G]-[I]
MISO PRM ICAP	**16.8%**	[L]=([J]-[A])/[A]
MISO PRM UCAP	**7.9%**	[M]=([K]-[A])/[A]

Table 5-1: Planning Year 2019-2020 MISO System Planning Reserve Margins

5.1.1 LOLE Results Statistics

In addition to the LOLE results SERVM has the ability to calculate several other probabilistic metrics (Table 5-2). These values are given when MISO is at its PRM UCAP of 7.9 percent. The LOLE of 0.1 day/year is what the model is driven to and how the PRM is calculated. The loss of load hours is defined as the number of hours during a given time period where system demand will exceed the generating capacity during a given period. Expected Unserved Energy (EUE) is energy-centric and analyzes all hours of a particular planning year. Results are calculated in megawatt-hours (MWh). EUE is the summation of the expected number of MWh of load that will not be served in a given planning year as a result of demand exceeding the available capacity across all hours.

MISO LOLE Statistics	
Loss of Load Expectation - LOLE [Days/Yr]	0.100
Loss of Load Hours - LOLH [hrs/yr]	0.339
Expected Unserved Energy - EUE [MWh/yr]	732.9

Table 5-2: MISO Probabilistic Model Statistics

5.2 Comparison of PRM Targets Across Eight Years

Figure 5-1 compares the PRM UCAP values over the last nine planning years. The last endpoint of the blue line shows the Planning Year 2019-2020 PRM value.

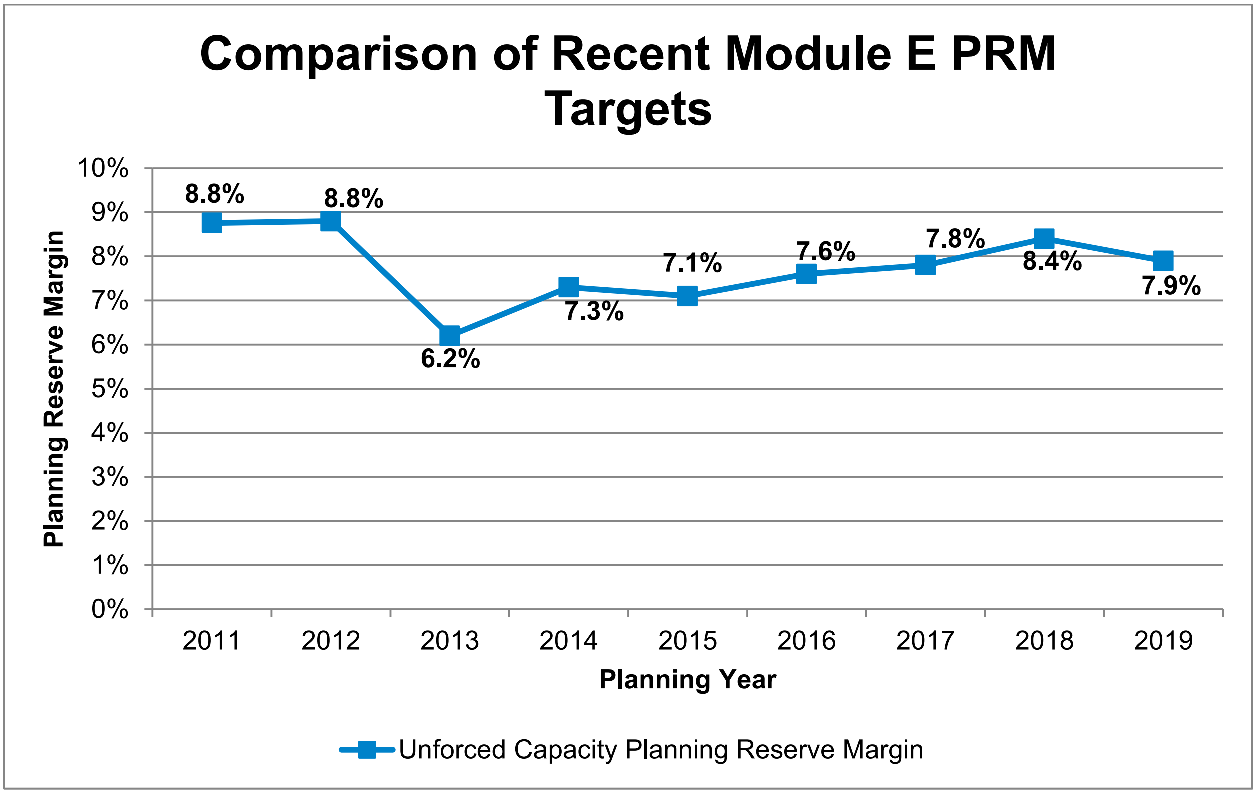


Figure 5-1: Comparison of PRM targets across eight years

5.3 Future Years 2019 through 2028 Planning Reserve Margins

Beyond the planning year 2019-2020 LOLE study analysis, an LOLE analysis was performed for the four-year-out planning year of 2022-2023, and the six-year-out planning year of 2024-2025. Table 5-3 shows all the values and calculations that went into determining the MISO system PRM ICAP and PRM UCAP values for those years. Those results are shown as the underlined values of Table 5-4. The values from the intervening years result from interpolating the 2019, 2022, and 2024 results. Note that the MISO system PRM results assume no limitations on transfers within MISO.

The 2022-2023 planning year PRM increased slightly from the 2019-2020 planning year driven mainly by new unit additions and retirements. The forecasts for the 2024-2025 Planning Year PRM decreased primarily because of LSE load forecasts.

MISO Planning Reserve Margin (PRM)	**2022/2023 PY** (June 2022 - May 2023)	**2024/2025 PY** (June 2024 - May 2025)	**Formula Key**
MISO System Peak Demand (MW)	126,768	127,259	[A]
Installed Capacity (ICAP) (MW)	156,422	156,686	[B]
Unforced Capacity (UCAP) (MW)	144,815	145,037	[C]
Firm External Support (ICAP) (MW)	1,883	1,883	[D]
Firm External Support (UCAP) (MW)	1,809	1,809	[E]
Adjustment to ICAP {1d in 10yr} (MW)	-7,225	-7,615	[F]
Adjustment to UCAP {1d in 10yr} (MW)	-7,225	-7,615	[G]
Non-Firm External Support (ICAP) (MW)	2,987	2,987	[H]
Non-Firm External Support (UCAP) (MW)	2,331	2,331	[I]
ICAP PRM Requirement (PRMR) (MW)	148,093	147,967	[J]=[B]+[D]+[F]-[H]
UCAP PRM Requirement (PRMR) (MW)	137,068	136,900	[K]=[C]+[E]+[G]-[I]
MISO PRM ICAP	16.8%	16.3%	[L]=([J]-[A])/[A]
MISO PRM UCAP	8.1%	7.6%	[M]=([K]-[A])/[A]

Table 5-3: Future Planning Year MISO System Planning Reserve Margins

Metric	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PRM ICAP	**16.8%**	**16.8%**	**16.8%**	**16.8%**	**16.8%**	**16.3%**	**16.3%**	**16.2%**	**16.1%**	**16.1%**
PRM UCAP	**7.9%**	**8.0%**	**8.0%**	**8.1%**	**8.1%**	**7.6%**	**7.7%**	**7.7%**	**7.6%**	**7.6%**

Table 5-4: MISO System Planning Reserve Margins 2019 through 2028
(Years without underlined results indicate values that were calculated through interpolation)

6 Local Resource Zone Analysis – LRR Results

6.1 Planning Year 2019-2020 Local Resource Zone Analysis

MISO calculated the per-unit LRR of LRZ Peak Demand for years one, four and six (Table 6-1, Table 6-2, and Table 6-3). The UCAP values in Table 6-1 reflect the UCAP within each LRZ, including Border External Resources and Coordinating Owners. The adjustment to UCAP values are the megawatt adjustments needed in each LRZ so that the reliability criterion of 0.1 days per year LOLE is met. The LRR is the summation of the UCAP and adjustment to UCAP megawatts. The LRR is then divided by each LRZ's Peak Demand to determine the per-unit LRR UCAP. The 2019-2020 per unit LRR UCAP values will be multiplied by the updated demand forecasts submitted for the 2019-2020 PRA to determine each LRZ's LRR.

Local Resource Zone (LRZ)	LRZ-1 MN/ND	LRZ-2 WI	LRZ-3 IA	LRZ-4 IL	LRZ-5 MO	LRZ-6 IN	LRZ-7 MI	LRZ-8 AR	LRZ-9 LA/TX	LRZ-10 MS	Formula Key
2019-2020 Planning Reserve Margin (PRM) Study											
Installed Capacity (ICAP) (MW)	20,794	14,439	11,394	12,382	8,699	19,835	24,228	11,529	24,492	6,096	[A]
Unforced Capacity (UCAP) (MW)	19,762	13,629	10,863	11,012	7,766	18,529	22,171	10,823	22,509	5,061	[B]
Adjustment to UCAP {1d in 10yr} (MW)	702	1,038	-12	702	2,342	1,731	2,674	-273	811	2,025	[C]
LRR (UCAP) (MW)	20,464	14,667	10,851	11,713	10,108	20,259	24,845	10,550	23,320	7,086	[D]=[B]+[C]
Peak Demand (MW)	17,780	12,629	9,391	9,415	8,079	17,584	21,208	7,770	20,693	4,814	[E]
LRR UCAP per-unit of LRZ Peak Demand	**115.1%**	**116.1%**	**115.6%**	**124.4%**	**125.1%**	**115.2%**	**117.2%**	**135.8%**	**112.7%**	**147.2%**	[F]=[D]/[E]

Table 6-1: Planning Year 2019-2020 LRZ Local Reliability Requirements

Local Resource Zone (LRZ)	LRZ-1 MN/ND	LRZ-2 WI	LRZ-3 IA	LRZ-4 IL	LRZ-5 MO	LRZ-6 IN	LRZ-7 MI	LRZ-8 AR	LRZ-9 LA/TX	LRZ-10 MS	Formula Key
2022-2023 Planning Reserve Margin (PRM) Study											
Installed Capacity (ICAP) (MW)	20,976	15,211	11,600	13,115	8,721	20,540	22,924	11,617	25,612	6,096	[A]
Unforced Capacity (UCAP) (MW)	19,942	14,364	11,064	11,717	7,787	19,196	21,224	10,910	23,542	5,061	[B]
Adjustment to UCAP {1d in 10yr} (MW)	1,091	479	90	223	2,380	1,348	3,177	-195	391	1,974	[C]
LRR (UCAP) (MW)	21,032	14,843	11,154	11,940	10,167	20,544	24,401	10,715	23,933	7,036	[D]=[B]+[C]
Peak Demand (MW)	18,303	12,761	9,648	9,394	8,119	17,827	21,038	7,990	20,763	4,839	[E]
LRR UCAP per-unit of LRZ Peak Demand	**114.9%**	**116.3%**	**115.6%**	**127.1%**	**125.2%**	**115.2%**	**116.0%**	**134.1%**	**115.3%**	**145.4%**	[F]=[D]/[E]

Table 6-2: Planning Year 2022-2023 LRZ Local Reliability Requirements

Local Resource Zone (LRZ)	LRZ-1 MN/ND	LRZ-2 WI	LRZ-3 IA	LRZ-4 IL	LRZ-5 MO	LRZ-6 IN	LRZ-7 MI	LRZ-8 AR	LRZ-9 LA/TX	LRZ-10 MS	Formula Key
2024-2025 Planning Reserve Margin (PRM) Study											
Installed Capacity (ICAP) (MW)	20,976	15,211	11,600	13,115	8,721	20,540	23,188	11,617	25,612	6,096	[A]
Unforced Capacity (UCAP) (MW)	19,942	14,364	11,064	11,717	7,787	19,196	21,446	10,910	23,542	5,061	[B]
Adjustment to UCAP {1d in 10yr} (MW)	1,313	578	261	114	2,487	1,181	2,323	-220	711	2,010	[C]
LRR (UCAP) (MW)	21,255	14,942	11,324	11,831	10,274	20,377	23,769	10,690	24,253	7,072	[D]=[B]+[C]
Peak Demand (MW)	18,519	12,837	9,809	9,287	8,173	17,663	20,982	8,055	20,999	4,875	[E]
LRR UCAP per-unit of LRZ Peak Demand	**114.8%**	**116.4%**	**115.5%**	**127.4%**	**125.7%**	**115.4%**	**113.3%**	**132.7%**	**115.5%**	**145.1%**	[F]=[D]/[E]

Table 6-3: Planning Year 2024-2025 LRZ Local Reliability Requirements

Weather Year Time of Peak Demand (ESTHE)	MISO	LRZ-1 MN/ND	LRZ-2 WI	LRZ-3 IA	LRZ-4 IL	LRZ-5 MO	LRZ-6 IN	LRZ-7 MI	LRZ-8 AR	LRZ-9 LA/TX	LRZ-10 MS
1988	8/1/88 16:00	8/1/88 16:00	8/1/88 16:00	7/31/88 16:00	8/16/88 16:00	8/15/88 17:00	7/9/88 17:00	7/6/88 18:00	7/19/88 15:00	8/15/88 15:00	7/2/88 18:00
1989	7/10/89 16:00	7/9/89 18:00	7/9/89 18:00	7/10/89 19:00	7/10/89 17:00	7/10/89 19:00	7/10/89 16:00	6/26/89 16:00	8/27/89 16:00	12/24/89 9:00	8/27/89 16:00
1990	7/3/90 17:00	7/3/90 18:00	8/27/90 16:00	7/3/90 16:00	9/6/90 16:00	9/6/90 16:00	7/9/90 17:00	8/28/90 15:00	7/10/90 16:00	8/6/90 16:00	8/27/90 18:00
1991	7/19/91 16:00	7/18/91 17:00	7/18/91 15:00	7/17/91 18:00	7/6/91 18:00	8/2/91 17:00	8/2/91 17:00	7/19/91 16:00	7/24/91 16:00	8/20/91 18:00	8/2/91 16:00
1992	8/10/92 16:00	8/9/92 17:00	8/10/92 18:00	7/8/92 16:00	7/2/92 15:00	7/2/92 16:00	7/14/92 16:00	8/27/92 15:00	7/16/92 17:00	8/10/92 16:00	7/11/92 17:00
1993	8/27/93 15:00	8/11/93 16:00	8/24/93 16:00	8/22/93 19:00	7/17/93 17:00	7/27/93 16:00	7/25/93 16:00	8/27/93 15:00	7/28/93 15:00	8/19/93 16:00	8/20/93 17:00
1994	7/6/94 14:00	6/14/94 19:00	6/15/94 16:00	7/19/94 18:00	7/5/94 18:00	7/5/94 17:00	7/20/94 15:00	6/18/94 18:00	8/14/94 16:00	8/14/94 16:00	1/19/94 9:00
1995	7/13/95 17:00	7/13/95 17:00	7/13/95 17:00	7/12/95 16:00	7/13/95 17:00	7/13/95 16:00	7/13/95 16:00	7/13/95 17:00	7/14/95 16:00	8/16/95 16:00	8/31/95 16:00
1996	8/6/96 17:00	8/6/96 17:00	6/29/96 17:00	7/18/96 17:00	7/18/96 18:00	7/18/96 17:00	7/19/96 17:00	8/7/96 15:00	7/1/96 15:00	2/5/96 7:00	7/3/96 16:00
1997	7/16/97 16:00	7/16/97 18:00	7/16/97 17:00	7/26/97 20:00	7/27/97 17:00	7/26/97 17:00	7/27/97 15:00	7/16/97 16:00	7/22/97 15:00	8/31/97 17:00	7/25/97 16:00
1998	7/20/98 16:00	7/13/98 18:00	6/25/98 16:00	7/20/98 18:00	7/20/98 16:00	7/20/98 17:00	7/19/98 17:00	6/25/98 16:00	7/7/98 15:00	8/28/98 17:00	8/28/98 17:00

1999	7/30/99 15:00	7/25/99 15:00	7/30/99 15:00	7/25/99 17:00	7/19/99 0:00	7/26/99 19:00	7/30/99 15:00	7/30/99 14:00	7/28/99 15:00	8/5/99 16:00	8/20/99 18:00
2000	8/15/00 16:00	8/14/00 19:00	7/17/00 17:00	8/31/00 19:00	8/29/00 16:00	8/17/00 18:00	9/2/00 16:00	8/9/00 15:00	8/29/00 18:00	8/30/00 16:00	8/30/00 17:00
2001	8/9/01 15:00	8/7/01 16:00	8/9/01 17:00	7/31/01 18:00	7/23/01 17:00	7/23/01 17:00	8/7/01 16:00	8/8/01 16:00	7/12/01 15:00	1/4/01 8:00	7/20/01 17:00
2002	7/2/02 16:00	7/6/02 18:00	8/1/02 15:00	7/20/02 19:00	7/9/02 17:00	8/1/02 16:00	8/3/02 15:00	7/3/02 16:00	7/30/02 16:00	8/7/02 17:00	7/10/02 16:00
2003	8/21/03 16:00	8/24/03 17:00	8/21/03 16:00	7/26/03 18:00	8/21/03 16:00	8/21/03 18:00	8/27/03 17:00	8/21/03 16:00	7/29/03 16:00	1/24/03 7:00	7/17/03 17:00
2004	7/13/04 16:00	6/7/04 18:00	6/8/04 17:00	7/20/04 17:00	7/13/04 16:00	7/13/04 16:00	1/31/04 4:00	7/22/04 15:00	7/14/04 15:00	8/1/04 17:00	7/24/04 16:00
2005	7/24/05 17:00	7/17/05 17:00	7/24/05 16:00	7/25/05 17:00	7/24/05 17:00	7/24/05 17:00	7/25/05 16:00	7/24/05 18:00	7/27/05 15:00	8/20/05 17:00	8/21/05 15:00
2006	7/31/06 17:00	7/31/88 17:00	7/31/06 15:00	7/19/06 18:00	7/31/06 18:00	8/2/06 17:00	7/31/06 16:00	8/3/06 15:00	8/10/06 18:00	8/15/06 18:00	8/15/06 17:00
2007	8/1/07 17:00	8/10/07 17:00	8/2/07 16:00	7/17/07 15:00	8/15/07 18:00	8/15/07 17:00	8/7/07 16:00	7/31/07 18:00	8/14/07 16:00	8/21/07 15:00	8/14/07 18:00
2008	7/17/08 15:00	7/11/08 18:00	7/7/08 17:00	8/3/08 16:00	7/20/08 16:00	7/20/08 17:00	8/23/08 15:00	8/24/08 12:00	7/22/08 15:00	8/6/08 18:00	7/22/08 16:00
2009	6/25/09 16:00	6/22/09 19:00	6/25/09 16:00	7/24/09 18:00	8/9/09 17:00	8/9/09 16:00	1/16/09 4:00	6/25/09 16:00	7/11/09 19:00	7/2/09 16:00	7/11/09 17:00
2010	8/3/10 18:00	8/8/10 18:00	8/20/10 14:00	7/17/10 18:00	8/10/10 17:00	8/3/10 16:00	8/13/10 16:00	9/1/10 15:00	7/21/10 15:00	8/1/10 17:00	8/2/10 16:00
2011	7/20/11 16:00	7/18/11 17:00	7/20/11 16:00	7/20/11 16:00	9/1/11 16:00	8/2/11 18:00	7/20/11 16:00	7/2/11 16:00	8/3/11 16:00	8/18/11 16:00	8/31/11 17:00
2012	7/6/12 17:00	7/31/88 17:00	7/13/95 17:00	7/25/12 17:00	7/6/12 18:00	7/24/12 18:00	7/5/12 17:00	7/6/12 17:00	7/30/12 17:00	8/16/12 17:00	7/3/12 16:00
2013	7/17/13 17:00	8/27/13 15:00	8/27/13 17:00	7/18/13 17:00	9/10/13 16:00	8/31/13 17:00	8/31/13 15:00	7/19/13 14:00	7/18/13 16:00	8/7/13 16:00	8/9/13 16:00
2014	7/22/14 16:00	7/21/14 17:00	7/7/14 16:00	7/22/14 16:00	8/24/14 16:00	7/26/14 15:00	1/24/14 9:00	7/22/14 16:00	7/14/14 16:00	1/8/14 3:00	8/24/14 17:00
2015	7/29/15 16:00	8/14/15 16:00	8/14/15 17:00	7/13/15 16:00	9/2/15 16:00	9/9/15 16:00	7/29/15 16:00	7/29/15 16:00	7/28/15 15:00	8/12/15 16:00	7/21/15 15:00
2016	7/20/16 15:00	6/25/16 15:00	8/11/16 14:00	7/20/16 14:00	9/7/16 15:00	9/7/16 16:00	9/8/16 16:00	9/7/16 14:00	7/22/16 15:00	8/23/16 15:00	8/3/16 15:00
2017	7/20/17 16:00	7/6/17 17:00	9/25/17 15:00	7/20/17 16:00	7/12/17 14:00	7/20/17 14:00	9/22/17 15:00	9/25/17 15:00	7/21/17 16:00	8/20/17 15:00	7/20/17 16:00

Table 6-4: Time of Peak Demand for all 30 weather years

Appendix A: Comparison of Planning Year 2018 to 2019

Multiple study sensitivity analyses were performed to compute changes in the PRM target on an UCAP basis, from the 2018-2019 planning year to the 2019-2020 planning year. These sensitivities included one-off incremental changes of input parameters to quantify how each change affected the PRM result independently. Note the impact of the incremental PRM changes from 2018 to 2019 in the waterfall chart of Figure A-1; see Section A.1 Waterfall Chart Details for an explanation.

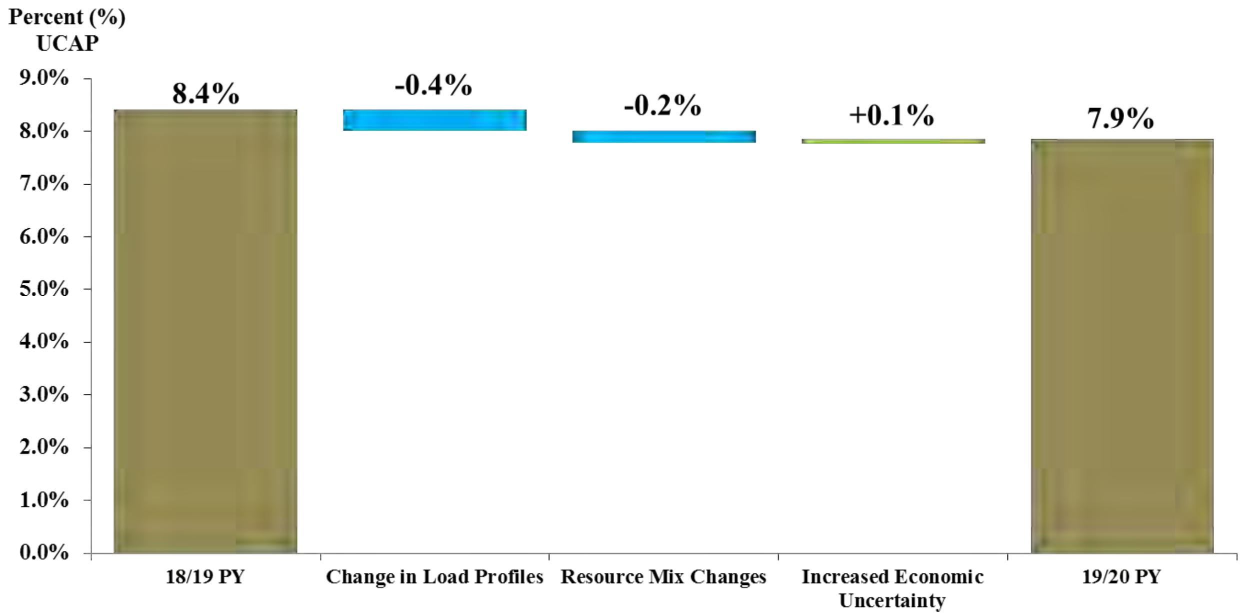


Figure A-1: Waterfall Chart of 2018 PRM UCAP to 2019 PRM UCAP

A.1 Waterfall Chart Details

A.1.1 Load

The MISO Coincident Peak Demand decreased from the 2018-2019 planning year, which was driven by the updated actual load forecasts submitted by the LSEs. The reduction was mainly driven by reduction in anticipated load growth and changes in diversity. The monthly load profiles submitted by LSE's resulted in more peaked load shapes compared to the 2018-2019 PY. This caused a 0.4 percentage point decrease to the PRM.

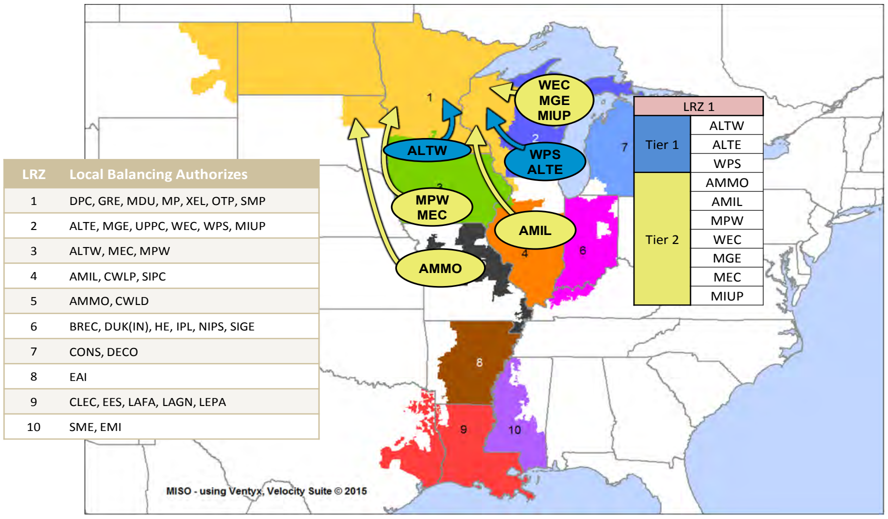
An increase of economic load uncertainty, detailed in Section 4.3.2, in the 2019-2020 planning year resulted in a 0.1 percentage point increase in the PRM UCAP. The modeling of economic load uncertainty effectively increases the risk associated with high peak loads, thus resulting in larger adjustment to UCAP for the same MISO peak load. Upon incorporating the increased adjustment into the equations of Section 4.5.1 of the report, the mathematical calculations result in a higher PRM in percentage.

A.1.2 Units

Changes from 2018-2019 planning year values are due to changes in Generation Verification Test Capacity (GVTC); EFORd or equivalent forced outage rate demand with adjustment to exclude events outside management control (XEFORd); new units; retirements; suspensions; and changes in the resource mix. The MISO fleet weighted average forced outage rate increased from 9.16 percent to 9.28 percent from the previous study to this study. An increase in unit outage rates will generally lead to an increase in reserve margin in order to cover the increased risk of loss of load. Although the MISO-wide average EFORd increased slightly for the 2019-2020 PY, new units and retirements led to a resource mix that improved reliability overall.

Appendix B: Capacity Import Limit source subsystem definitions (Tiers 1 & 2)

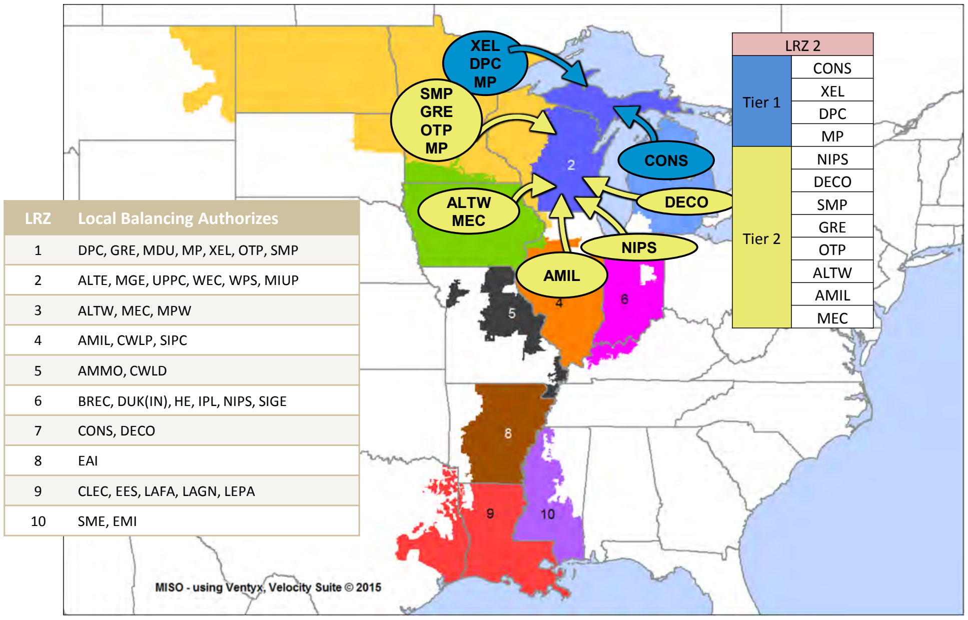
MISO Local Resource Zone 1



LRZ	Local Balancing Authorizes
1	DPC, GRE, MDU, MP, XEL, OTP, SMP
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	SME, EMI

LRZ 1	
Tier 1	ALTW
	ALTE
	WPS
Tier 2	AMMO
	AMIL
	MPW
	WEC
	MGE
	MEC
	MIUP

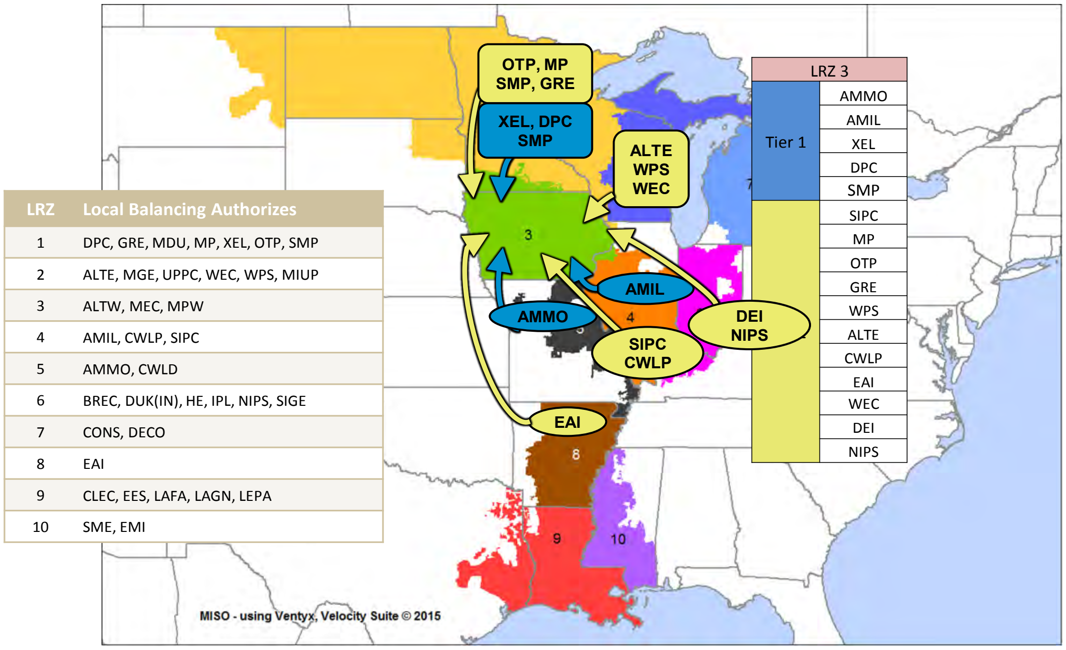
MISO Local Resource Zone 2



LRZ	Local Balancing Authorizes
1	DPC, GRE, MDU, MP, XEL, OTP, SMP
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	SME, EMI

LRZ 2	
Tier 1	CONS
	XEL
	DPC
	MP
Tier 2	NIPS
	DECO
	SMP
	GRE
	OTP
	ALTW
	AMIL
	MEC

MISO Local Resource Zone 3



LRZ	Local Balancing Authorizes
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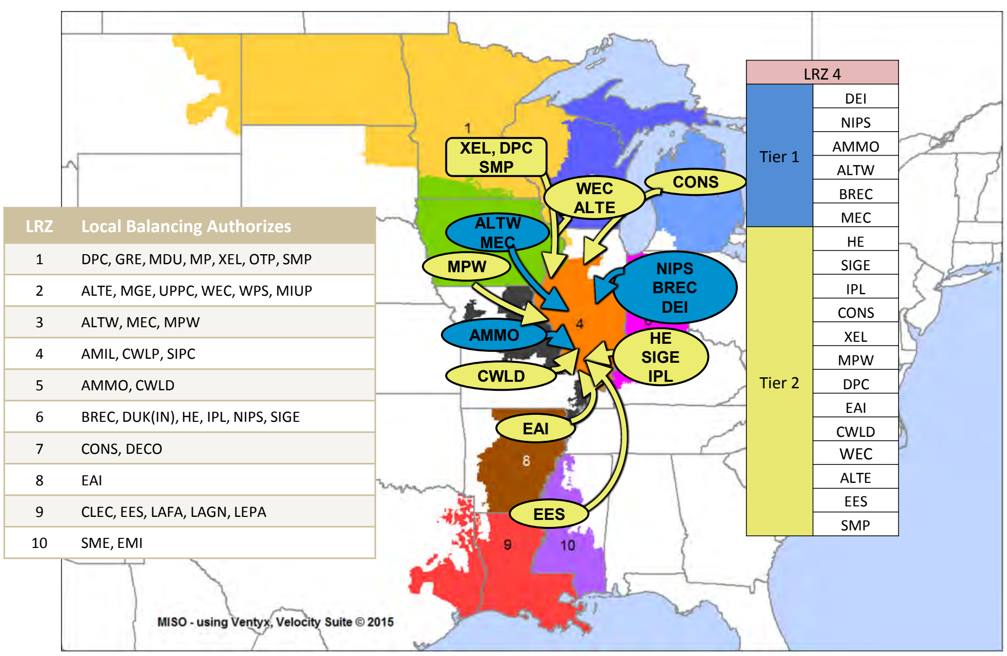
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	SME, EMI

LRZ 3	
Tier 1	AMMO
	AMIL
	XEL
	DPC
	SMP
	SIPC
	MP
	OTP
	GRE
	WPS
	ALTE
	CWLP
	EAI
	WEC
	DEI
	NIPS

MISO Local Resource Zone 4



LRZ	Local Balancing Authorizes
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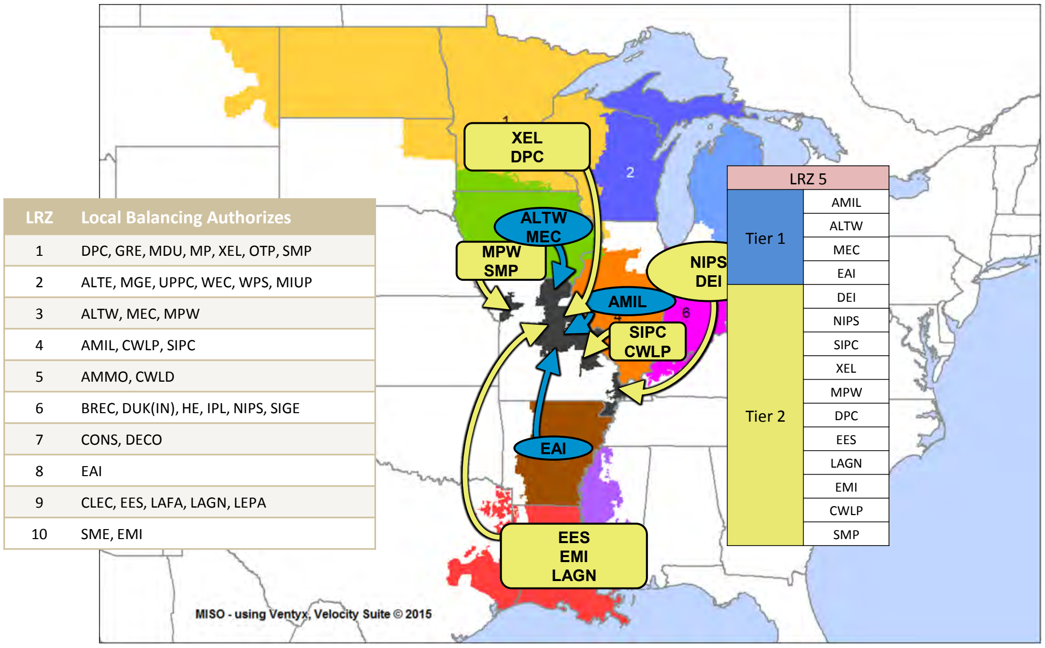
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	SME, EMI

LRZ 4	
Tier 1	DEI
	NIPS
	AMMO
	ALTW
	BREC
	MEC
Tier 2	HE
	SIGE
	IPL
	CONS
	XEL
	MPW
	DPC
	EAI
	CWLD
	WEC
	ALTE
	EES
	SMP

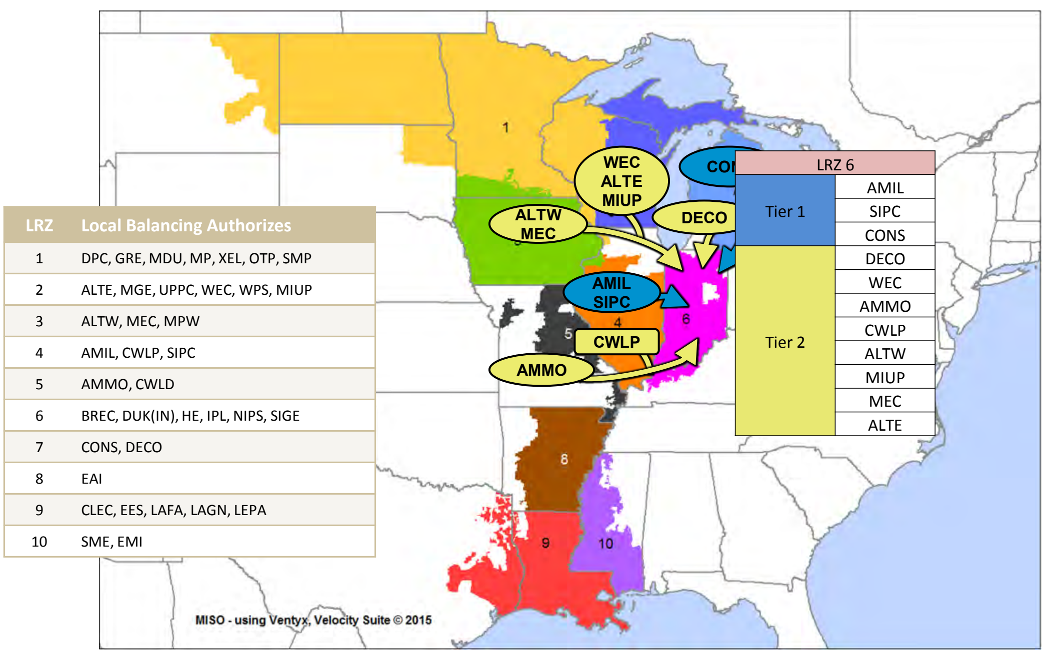
MISO Local Resource Zone 5



LRZ	Local Balancing Authorizes
1	DPC, GRE, MDU, MP, XEL, OTP, SMP
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	SME, EMI

LRZ 5	
Tier 1	AMIL
	ALTW
	MEC
	EAI
Tier 2	DEI
	NIPS
	SIPC
	XEL
	MPW
	DPC
	EES
	LAGN
	EMI
	CWLP
	SMP

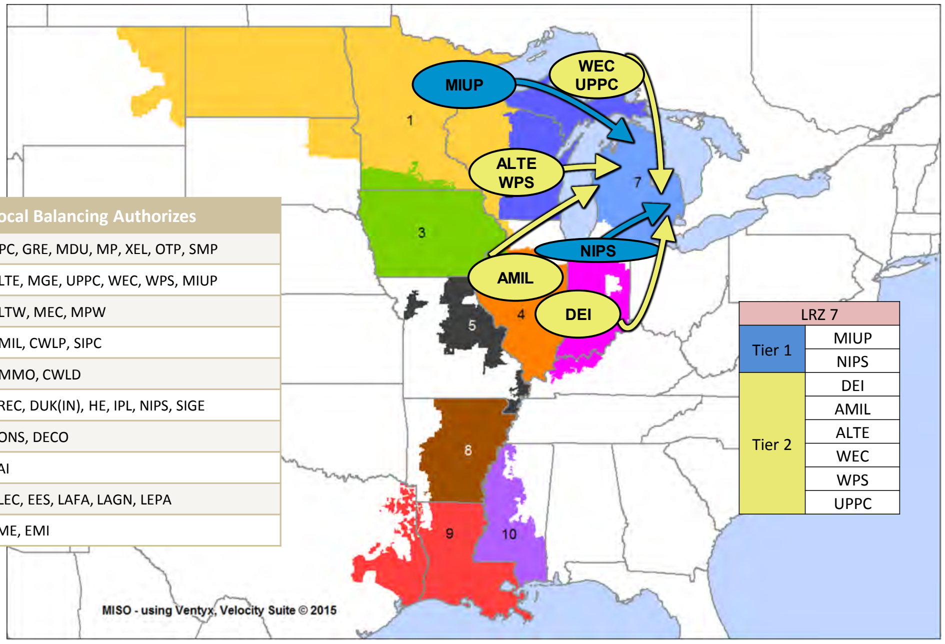
MISO Local Resource Zone 6



LRZ	Local Balancing Authorizes
1	DPC, GRE, MDU, MP, XEL, OTP, SMP
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	SME, EMI

LRZ 6	
Tier 1	AMIL
	SIPC
	CONS
Tier 2	DECO
	WEC
	AMMO
	CWLP
	ALTW
	MIUP
	MEC
	ALTE

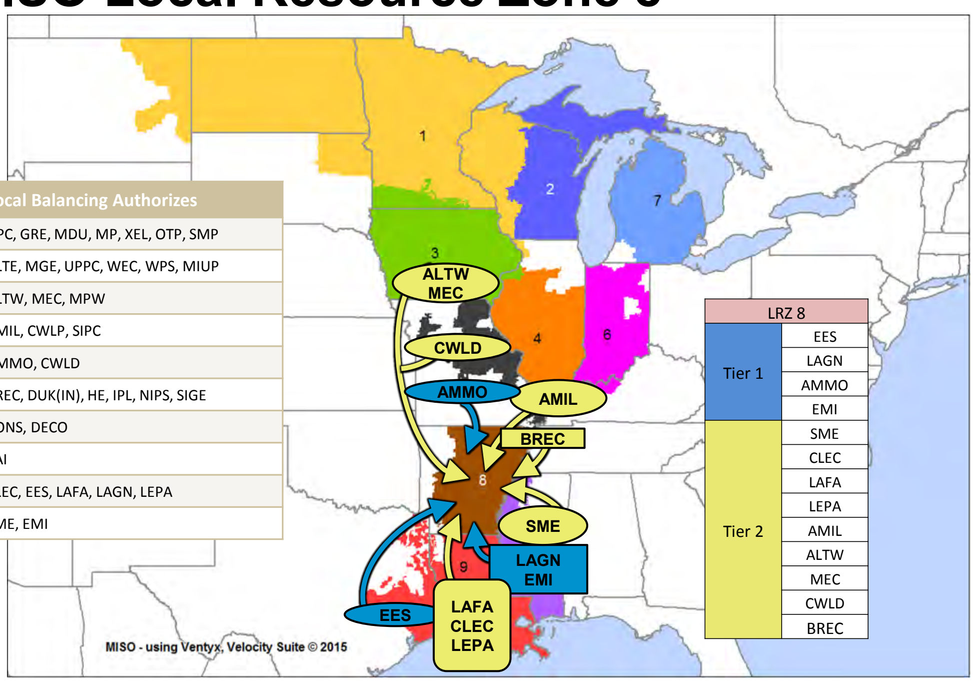
MISO Local Resource Zone 7



LRZ	Local Balancing Authorizes
1	DPC, GRE, MDU, MP, XEL, OTP, SMP
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	SME, EMI

LRZ 7	
Tier 1	MIUP
	NIPS
Tier 2	DEI
	AMIL
	ALTE
	WEC
	WPS
	UPPC

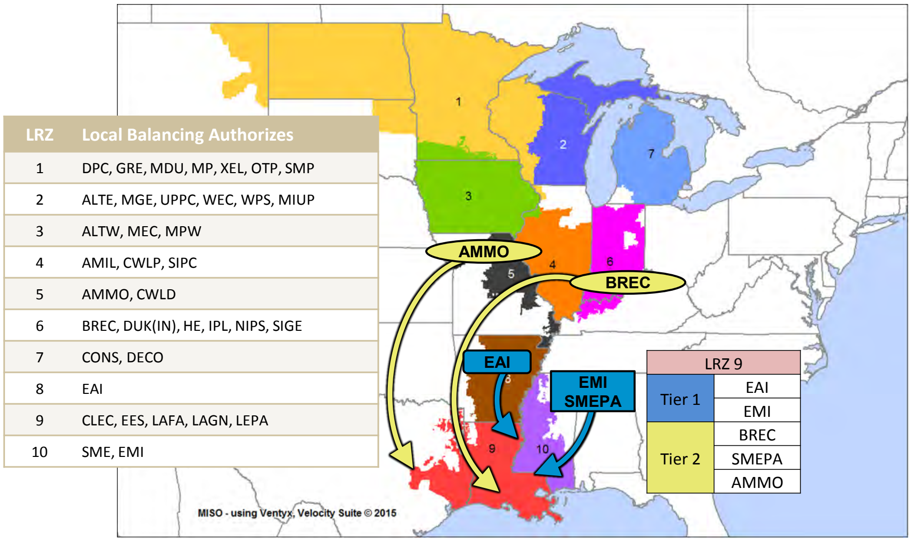
MISO Local Resource Zone 8



LRZ	Local Balancing Authorizes
1	DPC, GRE, MDU, MP, XEL, OTP, SMP
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	SME, EMI

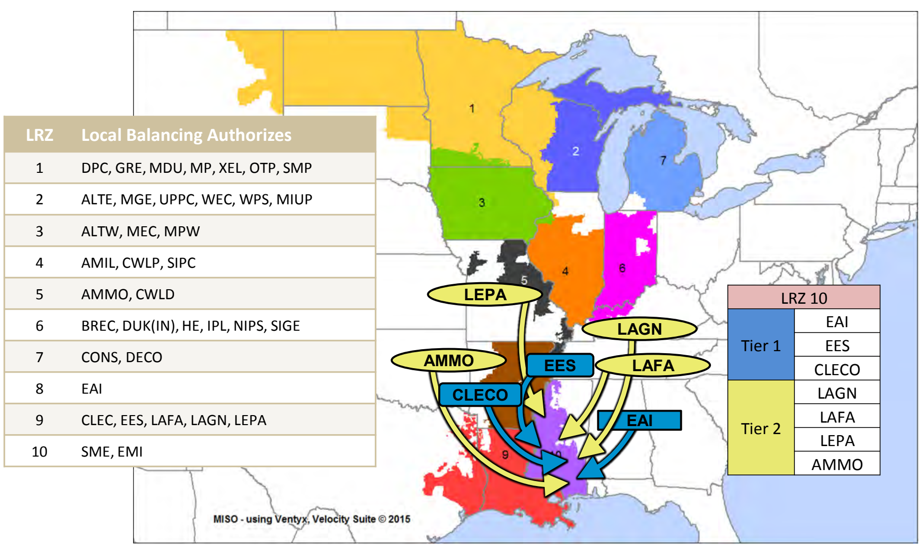
LRZ 8	
Tier 1	EES
	LAGN
	AMMO
	EMI
Tier 2	SME
	CLEC
	LAFA
	LEPA
	AMIL
	ALTW
	MEC
	CWLD
	BREC

MISO Local Resource Zone 9



* BRAZ, DERS, EES-EMI, and BCA now modeled in EES power flow area

MISO Local Resource Zone 10



Appendix C: Compliance Conformance Table

Requirements under: Standard BAL-502-RF-03	Response
R1 The Planning Coordinator shall perform and document a Resource Adequacy analysis annually. The Resource Adequacy analysis shall:	The Planning Year 2019 LOLE Study Report is the annual Resource Adequacy Analysis for the peak season of June 2019 through May 2020 and beyond. Analysis of Planning Year 2019 is in Sections 5.1 and 6.1 Analysis of Future Years 2020-2028 is in Sections 5.3 and 6.1
R1.1 Calculate a planning reserve margin that will result in the sum of the probabilities for loss of Load for the integrated peak hour for all days of each planning year[1] analyzed (per R1.2) being equal to 0.1. (This is comparable to a “one day in 10 year” criterion).	Section 4.5 of this report outlines the utilization of LOLE in the reserve margin determination. “These metrics were determined by a probabilistic LOLE analysis such that the LOLE for the planning year was one day in 10 years, or 0.1 day per year.”
R1.1.1 The utilization of Direct Control Load Management or curtailment of Interruptible Demand shall not contribute to the loss of Load probability.	Section 4.3 of this report. “Direct Control Load Management and Interruptible Demand types of demand response were explicitly included in the LOLE model as resources. These demand resources are implemented in the LOLE simulation before accumulating LOLE or shedding of firm load.”
R1.1.2 The planning reserve margin developed from R1.1 shall be expressed as a percentage of the median forecast peak Net Internal Demand (planning reserve margin).	Section 4.5.1 of this report. “The minimum amount of capacity above the 50/50 net internal MISO Coincident Peak Demand required to meet the reliability criteria was used to establish the PRM values.”
R1.2 Be performed or verified separately for each of the following planning years.	Covered in the segmented R1.2 responses below.
R1.2.1 Perform an analysis for Year One.	In Sections 5.1 and 6.1, a full analysis was performed for planning year 2019.
R1.2.2 Perform an analysis or verification at a minimum for one year in the 2 through 5 year period and at a minimum one year in the 6 though 10 year period.	Sections 5.3 and 6.1 show a full analysis was performed for future planning years 2022 and 2024.
R1.2.2.1 If the analysis is verified, the verification must be supported by current or past studies for the same planning year.	Analysis was performed.
R1.3 Include the following subject matter and documentation of its use:	Covered in the segmented R1.3 responses below.

R1.3.1 Load forecast characteristics: • Median (50:50) forecast peak load • Load forecast uncertainty (reflects variability in the Load forecast due to weather and regional economic forecasts). • Load diversity. • Seasonal Load variations. • Daily demand modeling assumptions (firm, interruptible). • Contractual arrangements concerning curtailable/Interruptible Demand.	Median forecasted load – In Section 4.3 of this report: "The average monthly loads of the predicted load shapes were adjusted to match each LRZ's Module E 50/50 monthly zonal peak load forecasts for each study year." Load Forecast Uncertainty – A detailed explanation of the weather and economic uncertainties are given in Sections 4.3.1 and 4.3.2. Load Diversity/Seasonal Load Variations — In Section 4.3 of this report: "For the 2019-2020 LOLE analysis, a load training process utilizing neural net software was used to create a neural-net relationship between historical weather and load data. This relationship was then applied to 30 years of hourly historical weather data in order to create 30 different load shapes for each LRZ in order to capture both load diversity and seasonal variations." Demand Modeling Assumptions/Curtailable and Interruptible Demand — All Load Modifying Resources must first meet registration requirements through Module E. As stated in Section 4.2.7: "Each demand response program was modeled individually with a monthly capacity and was limited to the number of times each program can be called upon as well as limited by duration."
R1.3.2 Resource characteristics: • Historic resource performance and any projected changes • Seasonal resource ratings • Modeling assumptions of firm capacity purchases from and sales to entities outside the Planning Coordinator area. • Resource planned outage schedules, deratings, and retirements. • Modeling assumptions of intermittent and energy limited resource such as wind and cogeneration. • Criteria for including planned resource additions in the analysis.	Section 4.2 details how historic performance data and seasonal ratings are gathered, and includes discussion of future units and the modeling assumptions for intermittent capacity resources. A more detailed explanation of firm capacity purchases and sales is in Section 4.4.
R1.3.3 Transmission limitations that prevent the delivery of generation reserves	Annual MTEP deliverability analysis identifies transmission limitations preventing delivery of generation reserves. Additionally, Section 3 of this report details the transfer analysis to capture transmission constraints limiting capacity transfers.
R1.3.3.1 Criteria for including planned Transmission Facility additions in the analysis	Inclusion of the planned transmission addition assumptions is detailed in Section 3.2.3.
R1.3.4 Assistance from other interconnected systems including multi-area assessment considering Transmission limitations into the study area.	Section 4.4 provides the analysis on the treatment of external support assistance and limitations.

R1.4 Consider the following resource availability characteristics and document how and why they were included in the analysis or why they were not included: • Availability and deliverability of fuel. • Common mode outages that affect resource availability. • Environmental or regulatory restrictions of resource availability. • Any other demand (Load) response programs not included in R1.3.1. • Sensitivity to resource outage rates. • Impacts of extreme weather/drought conditions that affect unit availability. • Modeling assumptions for emergency operation procedures used to make reserves available. • Market resources not committed to serving Load (uncommitted resources) within the Planning Coordinator area.	Fuel availability, environmental restrictions, common mode outage and extreme weather conditions are all part of the historical availability performance data that goes into the unit's EFORd statistic. The use of the EFORd values is covered in Section 4.2. The use of demand response programs are mentioned in Section 4.2. The effects of resource outage characteristics on the reserve margin are outlined in Section 4.5.2 by examining the difference between PRM ICAP and PRM UCAP values.
R1.5 Consider Transmission maintenance outage schedules and document how and why they were included in the Resource Adequacy analysis or why they were not included	Transmission maintenance schedules were not included in the analysis of the transmission system due to the limited availability of reliable long-term maintenance schedules and minimal impact to the results of the analysis. However, Section 3 treats worst-case theoretical outages by Perform First Contingency Total Transfer Capability (FCTTC) analysis for each LRZ, by modeling NERC Category P0 (system intact) and Category P1 (N-1) contingencies.
R1.6 Document that capacity resources are appropriately accounted for in its Resource Adequacy analysis	MISO internal resources are among the quantities documented in the tables provided in Sections 5 and 6.
R1.7 Document that all Load in the Planning Coordinator area is accounted for in its Resource Adequacy analysis	MISO load is among the quantities documented in the tables provided in Sections 5 and 6.
R2 The Planning Coordinator shall annually document the projected Load and resource capability, for each area or Transmission constrained sub-area identified in the Resource Adequacy analysis.	In Sections 5 and 6, the peak load and estimated amount of resources for planning years 2019, 2022, and 2024 are shown. This includes the detail for each transmission constrained sub-area.
R2.1 This documentation shall cover each of the years in Year One through ten.	Section 5.3 and Table 5-4 shows the three calculated years, and in-between years estimated by interpolation. Estimated transmission limitations may be determined through a review of the 2019 LOLE study transfer analysis shown in Section 3 of this report, along with the results from previous LOLE studies.
R2.2 This documentation shall include the Planning Reserve margin calculated per requirement R1.1 for each of the three years in the analysis.	Section 5.3 and Table 5-4 shows the three calculated years underlined.
R2.3 The documentation as specified per requirement R2.1 and R2.2 shall be publicly posted no later than 30 calendar days prior to the beginning of Year One.	The 2019 LOLE Study Report documentation is posted on November 1 prior to the planning year.

R3 The Planning Coordinator shall identify any gaps between the needed amount of planning reserves defined in Requirement R1, Part 1.1 and the projected planning reserves documented in Requirement R2.	In Sections 5 and 6, the difference between the needed amount and the projected planning reserves for planning years 2019, 2022, and 2024 are shown the adjustments to ICAP and UCAP in Table 5-1, Table 5-3, Table 6-1, Table 6-2, and Table 6-3.

Appendix D: Acronyms List Table

CEL	Capacity Export Limit
CIL	Capacity Import Limit
CPNode	Commercial Pricing Node
DF	Distribution Factor
EFORd	Equivalent Forced Outage Rate demand
ELCC	Effective Load Carrying Capability
ERZ	External Resource Zone
EUE	Expected Unserved Energy
FERC	Federal Energy Regulatory Commission
FCITC	First Contingency Incremental Transfer Capability
FCTTC	First Contingency Total Transfer Capability
GADS	Generator Availability Data System
GLT	Generation Limited Transfer
GVTC	Generation Verification Test Capacity
ICAP	Installed Capacity
LBA	Local Balancing Authority
LCR	Local Clearing Requirement
LFE	Load Forecast Error
LFU	Load Forecast Uncertainty
LOLE	Loss of Load Expectation
LOLEWG	Loss of Load Expectation Working Group
LRR	Local Reliability Requirement
LRZ	Local Resource Zones
LSE	Load Serving Entity
MARS	Multi-Area Reliability Simulation
MECT	Module E Capacity Tracking
MISO	Midcontinent Independent System Operator
MOD	Model on Demand
MTEP	MISO Transmission Expansion Plan
MW	Megawatt
MWh	Megawatt hours
NERC	North American Electric Reliability Corp.
PRA	Planning Resource Auction
PRM	Planning Reserve Margin
PRM ICAP	PRM Installed Capacity

PRM UCAP	PRM Unforced Capacity
PRMR	Planning Reserve Margin Requirement
PSS E	Power System Simulator for Engineering
RCF	Reciprocal Coordinating Flowgate
RPM	Reliability Pricing Model
SERVM	Strategic Energy & Risk Valuation Model
SPS	Special Protection Scheme
TARA	Transmission Adequacy and Reliability Assessment
UCAP	Unforced Capacity
XEFORd	Equivalent forced outage rate demand with adjustment to exclude events outside management control
ZIA	Zonal Import Ability
ZEA	Zonal Export Ability

Attachment 6.1 Vectren Electric 2018-2020 DSM Plan

Vectren South 2018-2020 Electric Energy Efficiency Plan

Prepared by:
Southern Indiana Gas & Electric Company d/b/a Vectren Energy Delivery of Indiana Inc. (Vectren South)

4/7/2017

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List of Acronyms & Abbreviations

Acronym	Description
AEG	Applied Energy Group
ARCA	Appliance Recycling Centers of America Inc.
BAS	Building Automation System
BTU	Building Tune-Up
BYOT	Bring Your Own Thermostat
C&I	Commercial and Industrial
CAC	Central Air Conditioning
CFL	Compact Fluorescent Lamp
CVR	Conservation Voltage Reduction
DLC	Direct Load Control
DR	Demand Response
DSM	Demand Side Management
EAD	Energy Design Assistance
EAP	Energy Assistance Program
ECM	Electronically Commutated Motors
EE	Energy Efficiency
EISA	Energy Independence and Security Act
EM&V	Evaluation, Measurement and Verification
ES	ENERGY STAR
HEA	Home Energy Assessment & Weatherization
HERS	Home Efficiency Rating System
HVAC	Heating, Ventilation and Air Conditioning
IQW	Income Qualified & Weatherization
IRP	Integrated Resource Plan
IURC	Indiana Utility Regulatory Commission
kW/kWh	Kilowatt, Kilowatt hour
LED	Light Emitting Diode
MISO	Midcontinent Independent Transmission System Operator, Inc.
MPS	Market Potential Study
MW,MWh	Megawatt, Megawatt hour
NEF	National Energy Foundation
NPV	Net Present Value
O&M	Operations and Maintenance
PCT	Participant Cost Test
RFQ	Request for Qualification
RIM	Ratepayer Impact Measure
RNC	Residential New Construction
TRM	Technical Reference Manual
UCT	Utility Cost Test

1. Introduction

Southern Indiana Gas and Electric Company d/b/a Vectren Energy Delivery of Indiana, Inc. ("Vectren South") provides energy delivery services to approximately 144,000 electric customers and 111,000 natural gas customers located in Southwestern Indiana. Vectren South is a direct, wholly owned subsidiary of Vectren Utility Holdings, Inc. and an indirect subsidiary of Vectren Corporation ("Vectren"), headquartered in Evansville, IN. This Vectren South 2018-2020 Electric Demand Side Management (DSM) Plan ("2018-2020 Plan" or "Plan") describes the details of the electric Energy Efficiency (EE) and Demand Response (DR) programs Vectren South plans to offer in its service territory in 2018-2020.

Vectren South is proposing a 2018-2020 Plan designed to cost effectively reduce energy use by approximately 1% of eligible retail sales each year over the three-year plan. The EE savings goals are consistent with Vectren South's 2016 Integrated Resource Plan ("2016 IRP"), reasonably achievable and cost effective. The Plan includes program budgets, including the direct and indirect costs of energy efficiency programs. The 2018-2020 Plan recommends electric EE and DR programs for the residential and commercial & industrial (C&I) sectors in Vectren South's service territory. Where appropriate, it also describes opportunities for coordination with some of Vectren South's gas EE programs to leverage the best total EE and DR opportunities for customers and to share costs of delivery. Vectren South utilizes a portfolio of DSM programs to achieve demand reductions and energy savings, thereby providing reliable electric service to its customers. Vectren's DSM programs have been approved by the Indiana Utility Regulatory Commission ("Commission" or "IURC") and implemented pursuant to various IURC orders over the years.

2. Vectren South DSM Strategy

Energy efficiency remains at the core of Vectren's culture as the utility strives to partner with customers to help them use energy wisely. The company's tagline, Live Smart, originated from Vectren's turn toward energy efficiency in 2006 with the emergence natural gas energy efficiency programs, and then that effort was bolstered when electric energy efficiency programs were launched in 2010. Vectren employees receive regular communication on the progress toward the company's annual energy efficiency goals and rely on their workforce to serve as ambassadors in driving participation in its energy efficiency programs. One of the utility's goals is to "Be a leader in customer conservation and energy efficiency," and Vectren proactively works with its oversight boards in each state it serves to assemble progressive, cost-effective programs that work toward achieving that objective.

The preferred portfolio of Vectren South's recently filed 2016 Integrated Resource Plan ("2016 IRP") includes EE programs for all customer classes and sets an annual savings target of 1% of retail sales for 2018-2020. The framework for the 2018 - 2020 Plan was modeled at a savings level of 1% of retail sales adjusted for an opt-out rate of 73% eligible load, as provided for in Indiana Code § 8-1-8.5-10 ("Section 10"). The load forecast also includes an ongoing level of EE related to codes and standards embedded in the load forecast projections. Ongoing EE and DR programs are also important given the integration of Vectren South's natural gas and electric EE and DR programs.

A. Integration with Vectren South Gas

Opportunities exist to gain both natural gas and electric savings from some EE programs and measures. In these instances, energy savings will be captured by the respective utility. For the programs where integration opportunities exist, Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric. Below is a list of programs that Vectren South has identified as integrated:

- Residential Prescriptive
- Residential New Construction
- Home Energy Assessment & Weatherization
- Income Qualified Weatherization
- Energy Efficient Schools
- Residential Behavioral Savings
- Commercial and Industrial (C&I) Custom
- Small Business Direct Install
- C&I New Construction
- Building Tune-up
- Multi-Family Retrofit

B. Vectren Oversight Board

The Vectren Oversight Board (VOB) provides input into the planning and evaluation of Vectren South's EE programs. The VOB was formed in 2010 pursuant to the Final Order issued in Cause No. 43427 and included the Indiana Office of the Utility Consumer Counselor (OUCC) and Vectren South as voting members. The Citizens Action Coalition (CAC) was added as a voting member of the VOB in 2013 pursuant to the Final Order issued in Cause No. 44318. In 2014, the Vectren South Electric Oversight Board merged with the Vectren South Gas Oversight Board and Vectren North Gas Oversight to form one governing body, the VOB. Vectren and the VOB have worked collaboratively over the last several years and Vectren requests to continue the current voting structure.

3. Vectren South Planning Process

Vectren South has offered a variety of EE programs since April 2010 and has engaged in a similar planning process each time a new portfolio is presented to the Commission for approval.

The 2018-2020 Plan was developed in conjunction with the 2016 IRP planning process and therefore the 2016 IRP served as a key input into the 2018-2020 Plan. As such, this process aligns with Indiana Code § 8-1-8.5-10 ("Section 10"), which requires that EE goals be consistent with an electricity supplier's IRP.

Consistent with the 2016 IRP preferred portfolio, the framework for the 2018 - 2020 Plan was modeled at a savings level of 1% of retail sales with opt-out assumptions incorporated. Once the level of EE programs to be offered from 2018 through 2020 was established, Vectren South engaged in a process to develop the 2018-2020 Plan. The objective of the planning process was to develop a plan based upon market-specific information for Vectren South's territory, which could be successfully implemented utilizing realistic assessments of achievable market potential.

The program design used an Electric Market Potential Study (MPS) for guidance to validate that the plan estimates were reasonable. While building from the bottom up with estimates from program implementers to help determine participation, this comparison to the MPS allowed the planning team to determine if the results were reasonable.

In 2013, Vectren South engaged EnerNOC, Inc., to conduct an MPS and Action Plan. For this effort, EnerNOC evaluated electric energy efficiency resources in the residential, commercial, and industrial sectors for the years 2015-2019. The study included a detailed, bottom-up assessment of the Vectren South market in the Evansville metropolitan area to deliver a projection of baseline electric energy use, forecasts of the energy savings achievable through efficiency measures, and program designs and strategies to optimally deliver those savings. The study assessed various tiers of technical, economic and achievable potential by sector, customer type and measure.

Given this Plan 2018 through 2020, and the most recent MPS ended in 2019, Vectren South, with VOB approval, engaged Applied Energy Group (AEG), previously EnerNOC, to refresh the MPS for 2018 and 2019 and to extend the analysis to include 2020. Several key data elements of the analysis were updated as part of this effort, specifically:

- Load forecast, which is approximately 4% lower in 2018-2020 than the load forecast used for those years in the original analysis
- The impact of large customer opt-outs on the market potential for the commercial and industrial (C&I) sectors, where 73% of eligible C&I load has elected to opt out of energy efficiency programs and the accompanying surcharge that would otherwise appear on their bill
- LED lighting measures cost and performance data
- Vectren South EE Program performance and budgets
- Projections of avoided energy, capacity, and transmission and distribution (T&D) infrastructure costs
- Vectren South retail rates, discount rates, and line losses

In addition, vendors and other implementation partners who operate the current programs were involved in the planning process by providing suggestions for program changes and enhancements. The vendors and partners also provided technical information about measures to include recommended incentives, estimated participation and estimated implementation costs. This data provided a foundation for the 2018-2020 Plan based on actual experience within Vectren South's territory. These companies also bring their experience operating programs for other utilities. Once the draft version of the 2018-2020 Plan was developed, Vectren South solicited feedback from the VOB for consideration in the final design.

Other sources of program information were also considered. Current evaluations and the Indiana Technical Resource Manual (TRM) were used for adjustments to inputs. In addition, best practices were researched and reviewed to gain insights into the program design of successful EE and DR programs implemented by other utility companies.

VOB feedback was incorporated into the planning process, as applicable.

4. Cost Effectiveness Analysis

Vectren South's last step of the planning process was the cost benefit analysis. Vectren South retained Dr. Richard Stevie, Vice President of Forecasting with Integral Analytics, to complete the cost benefit modeling. Utilizing DSMore, the measures and programs were analyzed for cost effectiveness. The DSMore tool is nationally recognized and used in many states across the country to determine cost-effectiveness. Developed and licensed by Integral Analytics based in Cincinnati, OH, the DSMore cost-effectiveness modeling tool takes hourly prices and hourly energy savings from the specific measures/technologies being considered for the EE program, and then correlates both to weather. This tool looks at more than 30 years of historic weather variability to get the full weather variances appropriately modeled. In turn, this allows the model to capture the low probability, but high consequence weather events and apply appropriate value to them. Thus, a more accurate view of the value of the efficiency measure can be captured in comparison to other alternative supply options.

The outputs of DSMore include all the California Standard Practice Manual results including Total Resource Cost (TRC), Utility Cost Test (UCT), Participant Cost Test (PCT) and Ratepayer Impact Measure (RIM) tests. Inputs into the model include the following: participation rates, incentives paid, energy savings of the measure, life of the measure, implementation costs, and administrative costs, incremental costs to the participant of the high efficiency measure, and escalation rates and discount rates. Vectren South considers the results of each test and ensures that the portfolio passes the TRC test as it includes the total costs and benefits to both the utility and the consumer. The model includes a full range of economic perspectives typically used in EE and DSM analytics. The perspectives include:

- Total Resource Cost Test - shows the combined perspective of the utility and the participating customers. This test compares the level of benefits associated with the reduced energy supply costs to utility programs and participant costs.
- Utility Cost Test - shows the value of the program considering only avoided utility supply cost (based on the next unit of generation) in comparison to program costs.
- Participant Cost Test - shows the value of the program from the perspective of the utility's customer participating in the program. The test compares the participant's bill savings over the life of the EE/DR program to the participant's cost of participation.
- Ratepayer Impact Measure Test - shows the impact of a program on all utility customers through impacts in average rates. This perspective also includes the estimates of revenue losses, which may be experienced by the utility as a result of the program.

The cost effectiveness analysis produces two types of resulting metrics:

- Net Benefits (dollars) = NPV $\sum$ benefits – NPV $\sum$ costs
- Benefit Cost Ratio = NPV $\sum$ benefits ÷ NPV $\sum$ costs

Cost effectiveness analysis is performed using each of the four primary tests. The results of each test reflect a distinct perspective and have a separate set of inputs demonstrating the treatment of costs and benefits. A summary of benefits and costs included in each cost effectiveness test can be found in Appendix A.

5. 2018 - 2020 Plan Objectives and Impact

The framework for the 2018-2020 Plan aligns with the preferred portfolio as filed in the 2016 IRP and was designed to reach a reduction in sales of approximately 1% of eligible retail sales with opt-out assumptions incorporated. Table 1 below provides an overview of energy savings and demand impacts, participation and budget by the residential and C&I sectors and for the total portfolio. Table 2 provides an overview of budget and energy savings by program and by year.

Table 1: 2018-2020 Portfolio Summary of Participation, Impacts & Budget

Residential

Program Year	Participants/ Measures	Annual Energy Savings kWh	Annual Demand Savings kW	Direct Program Budget	First Year Cost/Kwh*
2018	327,374	21,520,612	5,782	$4,663,152	$0.22
2019	347,909	22,025,627	6,021	$4,865,148	$0.22
2020	217,427	19,294,127	5,977	$4,649,484	$0.24

Commercial & Industrial

Program Year	Participants/ Measures	Annual Energy Savings kWh	Annual Demand Savings kW	Direct Program Budget	First Year Cost/Kwh*
2018	7,252	15,135,729	1,648	$3,387,238	$0.22
2019	6,211	16,043,561	1,585	$3,568,128	$0.22
2020	7,638	17,053,515	1,773	$3,720,882	$0.22

Portfolio Participation, Impacts & Budget

Program Year	Participants/ Measures	Annual Energy Savings kWh	Annual Demand Savings kW	Res & C&I Direct Program Budget	Indirect Portfolio Level Budget	Other Costs Budget	Portfolio Total Budget Including Indirect & Other	First Year Cost/Kwh*
2018	334,626	36,656,341	7,430	$8,050,391	$937,436	$500,000	$9,487,827	$0.23
2019	354,120	38,069,188	7,607	$8,433,276	$960,110	$200,000	$9,593,386	$0.23
2020	225,065	36,347,642	7,750	$8,370,366	$960,225	$200,000	$9,530,591	$0.24

*Cost per kWh includes program and indirect costs for budget. First year costs are calculated by dividing total cost by total savings and do not include carry forward costs related to smart thermostat, BYOT and CVR programs.

Table 2: Vectren South 2018 - 2020 Plan Overview by Program

	Total Budget ($)			Total Savings (kWh)			Total Demand (kW)		
Residential Programs	**2018**	**2019**	**2020**	**2018**	**2019**	**2020**	**2018**	**2019**	**2020**
Residential Lighting	$ 942,125	$ 930,451	$ 691,256	7,610,617	8,340,595	6,075,005	942	1,029	791
Residential Prescriptive	$ 635,925	$ 681,609	$ 694,362	1,747,547	1,918,174	1,979,280	1,558	1,775	1,910
Residential New Construction	$ 85,345	$ 87,132	$ 88,940	187,038	187,038	187,038	118	118	118
Home Energy Assessment & Weatherization	$ 526,473	$ 533,934	$ 541,669	863,991	863,991	863,991	192	192	192
Income Qualified Weatherization	$ 841,848	$ 899,806	$ 958,593	959,988	1,046,148	1,130,945	459	499	540
Food Bank - LED Bulb Distribution	$ 174,141	$ 175,308	$ -	1,401,264	1,401,264	-	149	149	0
Energy Efficient Schools	$ 131,696	$ 136,805	$ 119,995	899,706	937,194	645,216	53	53	53
Residential Behavioral Savings	$ 305,622	$ 285,585	$ 286,545	6,470,000	5,970,000	5,600,000	1,351	1,248	1,153
Appliance Recycling	$ 174,759	$ 180,648	$ 186,532	913,771	894,534	884,915	121	118	117
Smart Thermostat Program	$ 97,639	$ 98,222	$ 98,798	-	-	-	-	-	-
CVR Residential	$ 118,786	$ 114,907	$ 230,134	-	-	1,461,047	-	-	263
SmartDLC - Wifi DR/DLC Change-out	$ 517,759	$ 562,148	$ 606,532	466,690	466,690	466,690	600	600	600
BYOT (Bring Your Own Thermostat)	$ 111,036	$ 178,592	$ 146,128	-	-	-	240	240	240
Residential Subtotal	**$ 4,663,152**	**$4,865,148**	**$4,649,484**	**21,520,612**	**22,025,627**	**19,294,127**	**5,782**	**6,021**	**5,977**
C&I Programs	**2018**	**2019**	**2020**	**2018**	**2019**	**2020**	**2018**	**2019**	**2020**
Commercial Prescriptive	$ 729,398	$ 655,370	$ 731,330	4,999,125	4,501,186	5,002,621	378	325	369
Commercial Custom	$ 1,019,072	$ 1,022,184	$ 1,160,256	5,000,000	5,000,000	5,500,000	476	476	524
Small Business Direct Install	$ 1,149,640	$ 1,182,037	$ 1,173,133	4,032,934	3,905,372	3,900,306	667	645	567
Commercial New Construction	$ 214,536	$ 386,092	$ 222,628	502,080	1,835,413	502,080	108	120	108
Building Tune-up	$ 130,880	$ 182,074	$ 261,266	500,000	700,000	1,000,000	1	1	1
Multi-Family Retrofit	$ 34,880	$ 35,074	$ 35,266	101,590	101,590	115,853	18	18	18
CVR Commercial	$ 108,834	$ 105,297	$ 137,003	-	-	1,032,655	-	-	186
Commercial Subtotal	**$ 3,387,238**	**$3,568,128**	**$3,720,882**	**15,135,729**	**16,043,561**	**17,053,515**	**1,648**	**1,585**	**1,773**
Residential & Commercial Subtotal	**$ 8,050,391**	**$8,433,276**	**$8,370,366**	**36,656,341**	**38,069,188**	**36,347,642**	**7,430**	**7,607**	**7,750**
Portfolio Level Costs Subtotal*	$ 937,436	$ 960,110	$ 960,225						
Other Costs Subtotal**	$ 500,000	$ 200,000	$ 200,000						
DSM Portfolio Total including Other Costs	**$ 9,487,827**	**$9,593,386**	**$9,530,591**	**36,656,341**	**38,069,188**	**36,347,642**	**7,430**	**7,607**	**7,750**

*Portfolio level costs include: Contact Center, Online Audit, Outreach & Education, and Evaluation.

**Other Costs include Market Potential Study and Emerging Markets.

A. Plan Savings

The planned savings goal for 2018-2020 was calculated based on a percentage of forecasted weather normalized electric sales for 2018 to 2020 with a target of 1% of eligible retail sales. The forecast is consistent with Vectren South's 2016 IRP sales forecast. Goals are based on gross energy savings with opt-out assumptions incorporated. Table 3 demonstrates the portfolio, residential and C&I energy savings targets at the 1% eligible retail sales level. Table 4 demonstrates the portfolio energy and demand savings by program and by year.

Table 3: Vectren South 2018 - 2020 Plan Portfolio Summary Planned Energy Savings

Portfolio Summary	kWh Savings			kW Savings		
	2018	**2019**	**2020**	**2018**	**2019**	**2020**
Residential Total	21,520,612	22,025,627	19,294,127	5,782	6,021	5,977
Commercial & Industrial Total	15,135,729	16,043,561	17,053,515	1,648	1,585	1,773
Portfolio Total	36,656,341	38,069,188	36,347,642	7,430	7,607	7,750

Table 4: Vectren South 2018 - 2020 Plan Portfolio Planned Energy Savings

Residential	2018 kWh	2018 kW	2019 kWh	2019 kW	2020 kWh	2020 kW
Residential Lighting	7,610,617	942	8,340,595	1,029	6,075,005	791
Residential Prescriptive	1,747,547	1,558	1,918,174	1,775	1,979,280	1,910
Residential New Construction	187,038	118	187,038	118	187,038	118
Home Energy Assessment & Weatherization	863,991	192	863,991	192	863,991	192
Income Qualified Weatherization	959,988	459	1,046,148	499	1,130,945	540
Food Bank - LED Bulb Distribution	1,401,264	149	1,401,264	149	0	0
Energy Efficient Schools	899,706	53	937,194	53	645,216	53
Residential Behavioral Savings	6,470,000	1,351	5,970,000	1,248	5,600,000	1,153
Appliance Recycling	913,771	121	894,534	118	884,915	117
Smart Thermostat Program	-	-	-	-	-	-
CVR Residential	-	-	-	-	1,461,047	263
SmartDLC - Wifi DR/DLC Change-out	466,690	600	466,690	600	466,690	600
BYOT (Bring Your Own Thermostat)	-	240	-	240	-	240
Residential Total	**21,520,612**	**5,782**	**22,025,627**	**6,021**	**19,294,127**	**5,977**

Commercial & Industrial	2018 kWh	2018 kW	2019 kWh	2019 kW	2020 kWh	2020 kW
Commercial Prescriptive	4,999,125	378	4,501,186	325	5,002,621	369
Commercial Custom	5,000,000	476	5,000,000	476	5,500,000	524
Small Business Direct Install	4,032,934	667	3,905,372	645	3,900,306	567
Commercial New Construction	502,080	108	1,835,413	120	502,080	108
Building Tune-up	500,000	1	700,000	1	1,000,000	1
Multi-Family Retrofit	101,590	18	101,590	18	115,853	18
CVR Commercial	-	-	-	-	1,032,655	186
Commercial & Industrial Total	**15,135,729**	**1,648**	**16,043,561**	**1,585**	**17,053,515**	**1,773**
Portfolio Total	**36,656,341**	**7,430**	**38,069,188**	**7,607**	**36,347,642**	**7,750**

B. Plan Budget

The total planned program budget includes the direct and indirect costs of implementing Vectren South's electric energy efficiency programs. In addition, a budget for other costs are being requested as described below.

Direct program costs include three main categories: vendor implementation, program incentives and administration costs. The program budgets were built based upon multiple resources. Program budgets were discussed with program implementers as a basis for the development of this plan. Vendor implementation budgets were estimated using historical data and estimates provided by the current vendors. This helps to assure that the estimates are realistic for successful delivery. Program incentives were calculated by assigning measures with appropriate incentive values based upon existing program incentives, evaluation results and vendor recommendations. Lastly, administrative costs are comprised of internal costs for Vectren South's management and oversight of the programs. Administrative costs were allocated back to programs based on the percent of savings these programs represent as well as estimated staff time spent on programs.

Indirect costs are costs that are not directly tied to a single program, but rather support multiple programs or the entire portfolio. These include: Contact Center, Online Audit, Outreach & Education, and Evaluation, Measurement and Verification (EM&V). These costs are budgeted at the portfolio level.

Other costs are also being requested in the 2018-2020 filed plan. Vectren South requests approval of a budget to include a Market Potential Study for 2020 and beyond and funding for Emerging Markets, which is discussed later in the Plan. Emerging Markets funding allows Vectren's EE portfolio to offer leading-edge program designs for next-generation technologies, services, and engagement strategies to growing markets in the Vectren South territory. This funding will not be used to support existing measures or programs, but rather support new program development or new measures within an existing program. Tables 5 through 8 below list the summary budgets by year, program and category.

Table 5: Vectren South 2018 – 2020 Summary Budgets by Year

Residential	2018	2019	2020	Total Budget
Residential Lighting	$942,125	$930,451	$691,256	$2,563,832
Residential Prescriptive	$635,925	$681,609	$694,362	$2,011,896
Residential New Construction	$85,345	$87,132	$88,940	$261,417
Home Energy Assessment & Weatherization	$526,473	$533,934	$541,669	$1,602,076
Income Qualified Weatherization	$841,848	$899,806	$958,593	$2,700,247
Food Bank - LED Bulb Distribution	$174,141	$175,308	$0	$349,449
Energy Efficient Schools	$131,696	$136,805	$119,995	$388,496
Residential Behavioral Savings	$305,622	$285,585	$286,545	$877,752
Appliance Recycling	$174,759	$180,648	$186,532	$541,939
Smart Thermostat Program	$97,639	$98,222	$98,798	$294,659
CVR Residential	$118,786	$114,907	$230,134	$463,827
SmartDLC - Wifi DR/DLC Change-out	$517,759	$562,148	$606,532	$1,686,439
BYOT (Bring Your Own Thermostat)	$111,036	$178,592	$146,128	$435,756
Residential Total	**$4,663,152**	**$4,865,148**	**$4,649,484**	**$14,177,784**
Commercial & Industrial	**2018**	**2019**	**2020**	**Total Budget**
Commercial Prescriptive	$729,398	$655,370	$731,330	$2,116,098
Commercial Custom	$1,019,072	$1,022,184	$1,160,256	$3,201,512
Small Business Direct Install	$1,149,640	$1,182,037	$1,173,133	$3,504,810
Commercial New Construction	$214,536	$386,092	$222,628	$823,256
Building Tune-up	$130,880	$182,074	$261,266	$574,220
Multi-Family Retrofit	$34,880	$35,074	$35,266	$105,220
CVR Commercial	$108,834	$105,297	$137,003	$351,134
Commercial & Industrial Total	**$3,387,238**	**$3,568,128**	**$3,720,882**	**$10,676,248**
Total Direct Program Costs	**$8,050,391**	**$8,433,276**	**$8,370,366**	**$24,854,032**
Indirect Portfolio Level Costs	**2018**	**2019**	**2020**	**Total Budget**
Contact Center	$63,000	$63,000	$63,000	$189,000
Online Audit	$36,444	$39,806	$42,911	$119,161
Outreach & Education	$410,000	$410,000	$410,000	$1,230,000
Evaluation	$427,992	$447,304	$444,314	$1,319,610
Indirect Portfolio Level Costs Subtotal	**$937,436**	**$960,110**	**$960,225**	**$2,857,771**
Total Portfolio	**$8,987,827**	**$9,393,386**	**$9,330,591**	**$27,711,803**
Other Costs	**2018**	**2019**	**2020**	**Total Budget**
Emerging Markets	$200,000	$200,000	$200,000	$600,000
Market Potential Study	$300,000	$0	$0	$300,000
Other Costs Subtotal	**$500,000**	**$200,000**	**$200,000**	**$900,000**
DSM Portfolio Total including Other Costs	**$9,487,827**	**$9,593,386**	**$9,530,591**	**$28,611,803**

Table 6: Vectren South 2018 Summary Budgets by Category

Residential	Administrative	Implementation	Incentives	Total Budget
Residential Lighting	$ 94,072	$ 225,000	$ 623,053	$ 942,125
Residential Prescriptive	$ 5,880	$ 219,860	$ 410,185	$ 635,925
Residential New Construction	$ 17,639	$ 39,856	$ 27,850	$ 85,345
Home Energy Assessment & Weatherization	$ 47,036	$ 479,437	$ -	$ 526,473
Income Qualified Weatherization	$ 35,277	$ 806,571	$ -	$ 841,848
Food Bank - LED Bulb Distribution	$ 35,277	$ 138,864	$ -	$ 174,141
Energy Efficient Schools	$ 44,096	$ 87,600	$ -	$ 131,696
Residential Behavioral Savings	$ 29,398	$ 276,224	$ -	$ 305,622
Appliance Recycling	$ 11,759	$ 115,500	$ 47,500	$ 174,759
Smart Thermostat Program	$ 17,639	$ 40,000	$ 40,000	$ 97,639
CVR Residential	$ 2,940	$ 115,846	$ -	$ 118,786
SmartDLC - Wifi DR/DLC Change-out	$ 11,759	$ 484,000	$ 22,000	$ 517,759
BYOT (Bring Your Own Thermostat)	$ 47,036	$ 26,000	$ 38,000	$ 111,036
Residential Subtotal	**$ 399,806**	**$ 3,054,758**	**$1,208,588**	**$ 4,663,152**

Commercial & Industrial	Administrative	Implementation	Incentives	Total Budget
Commercial Prescriptive	$ 29,398	$ 200,000	$ 500,000	$ 729,398
Commercial Custom	$ 94,072	$ 325,000	$ 600,000	$ 1,019,072
Small Business Direct Install	$ 2,940	$ 321,700	$ 825,000	$ 1,149,640
Commercial New Construction	$ 47,036	$ 102,500	$ 65,000	$ 214,536
Building Tune-up	$ 5,880	$ 100,000	$ 25,000	$ 130,880
Multi-Family Retrofit	$ 5,880	$ 10,000	$ 19,000	$ 34,880
CVR Commercial	$ 2,940	$ 105,894	$ -	$ 108,834
Commercial Subtotal	**$ 188,144**	**$ 1,165,094**	**$2,034,000**	**$ 3,387,238**
Residential & Commercial Subtotal	**$ 587,950**	**$ 4,219,853**	**$3,242,588**	**$ 8,050,391**

Indirect Costs		Total Budget
Contact Center		$ 63,000
Online Audit		$ 36,444
Outreach & Education		$ 410,000
Evaluation		$ 427,992
DSM Portfolio Total		**$ 8,987,827**

Other Costs		Total Budget
Emerging Markets		$ 200,000
Market Potential Study		$ 300,000
Other Costs Subtotal		**$ 500,000**
DSM Portfolio Total including Other Costs		**$ 9,487,827**

Table 7: Vectren South 2019 Summary Budgets by Category

Residential	Administrative	Implementation	Incentives	Total Budget
Residential Lighting	$ 97,184	$ 225,000	$ 608,267	$ 930,451
Residential Prescriptive	$ 6,074	$ 226,800	$ 448,735	$ 681,609
Residential New Construction	$ 18,222	$ 41,060	$ 27,850	$ 87,132
Home Energy Assessment & Weatherization	$ 48,592	$ 485,342	$ -	$ 533,934
Income Qualified Weatherization	$ 36,444	$ 863,362	$ -	$ 899,806
Food Bank - LED Bulb Distribution	$ 36,444	$ 138,864	$ -	$ 175,308
Energy Efficient Schools	$ 45,555	$ 91,250	$ -	$ 136,805
Residential Behavioral Savings	$ 30,370	$ 255,215	$ -	$ 285,585
Appliance Recycling	$ 12,148	$ 122,000	$ 46,500	$ 180,648
Smart Thermostat Program	$ 18,222	$ 40,000	$ 40,000	$ 98,222
CVR Residential	$ 3,037	$ 111,870	$ -	$ 114,907
SmartDLC - Wifi DR/DLC Change-out	$ 12,148	$ 506,000	$ 44,000	$ 562,148
BYOT (Bring Your Own Thermostat)	$ 48,592	$ 84,000	$ 46,000	$ 178,592
Residential Subtotal	**$ 413,032**	**$ 3,190,764**	**$1,261,352**	**$ 4,865,148**

Commercial & Industrial	Administrative	Implementation	Incentives	Total Budget
Commercial Prescriptive	$ 30,370	$ 200,000	$ 425,000	$ 655,370
Commercial Custom	$ 97,184	$ 325,000	$ 600,000	$ 1,022,184
Small Business Direct Install	$ 3,037	$ 319,000	$ 860,000	$ 1,182,037
Commercial New Construction	$ 48,592	$ 112,500	$ 225,000	$ 386,092
Building Tune-up	$ 6,074	$ 141,000	$ 35,000	$ 182,074
Multi-Family Retrofit	$ 6,074	$ 10,000	$ 19,000	$ 35,074
CVR Commercial	$ 3,037	$ 102,260	$ -	$ 105,297
Commercial Subtotal	**$ 194,368**	**$ 1,209,760**	**$2,164,000**	**$ 3,568,128**
Residential & Commercial Subtotal	**$ 607,400**	**$ 4,400,524**	**$3,425,352**	**$ 8,433,276**

Indirect Costs		Total Budget
Contact Center		$ 63,000
Online Audit		$ 39,806
Outreach & Education		$ 410,000
Evaluation		$ 447,304
DSM Portfolio Total		**$ 9,393,386**

Other Costs		Total Budget
Emerging Markets		$ 200,000
Market Potential Study		$ -
Other Costs Subtotal		**$ 200,000**
DSM Portfolio Total including Other Costs		**$ 9,593,386**

Table 8: Vectren South 2020 Summary Budgets by Category

Residential	Administrative	Implementation	Incentives	Total Budget
Residential Lighting	$ 100,256	$ 150,000	$ 441,000	$ 691,256
Residential Prescriptive	$ 6,266	$ 234,111	$ 453,985	$ 694,362
Residential New Construction	$ 18,798	$ 42,292	$ 27,850	$ 88,940
Home Energy Assessment & Weatherization	$ 50,128	$ 491,541	$ -	$ 541,669
Income Qualified Weatherization	$ 37,596	$ 920,997	$ -	$ 958,593
Food Bank - LED Bulb Distribution	$ -	$ -	$ -	$ -
Energy Efficient Schools	$ 46,995	$ 73,000	$ -	$ 119,995
Residential Behavioral Savings	$ 31,330	$ 255,215	$ -	$ 286,545
Appliance Recycling	$ 12,532	$ 128,000	$ 46,000	$ 186,532
Smart Thermostat Program	$ 18,798	$ 40,000	$ 40,000	$ 98,798
CVR Residential	$ 40,729	$ 189,405	$ -	$ 230,134
SmartDLC - Wifi DR/DLC Change-out	$ 12,532	$ 528,000	$ 66,000	$ 606,532
BYOT (Bring Your Own Thermostat)	$ 50,128	$ 42,000	$ 54,000	$ 146,128
Residential Subtotal	**$ 426,088**	**$ 3,094,561**	**$1,128,835**	**$ 4,649,484**
Commercial & Industrial	**Administrative**	**Implementation**	**Incentives**	**Total Budget**
Commercial Prescriptive	$ 31,330	$ 250,000	$ 450,000	$ 731,330
Commercial Custom	$ 100,256	$ 400,000	$ 660,000	$ 1,160,256
Small Business Direct Install	$ 3,133	$ 345,000	$ 825,000	$ 1,173,133
Commercial New Construction	$ 50,128	$ 107,500	$ 65,000	$ 222,628
Building Tune-up	$ 6,266	$ 205,000	$ 50,000	$ 261,266
Multi-Family Retrofit	$ 6,266	$ 10,000	$ 19,000	$ 35,266
CVR Commercial	$ 3,133	$ 133,870	$ -	$ 137,003
Commercial Subtotal	**$ 200,512**	**$ 1,451,370**	**$2,069,000**	**$ 3,720,882**
Residential & Commercial Subtotal	**$ 626,600**	**$ 4,545,931**	**$3,197,835**	**$ 8,370,366**
Indirect Costs				**Total Budget**
Contact Center				$ 63,000
Online Audit				$ 42,911
Outreach & Education				$ 410,000
Evaluation				$ 444,314
DSM Portfolio Total				**$ 9,330,591**
Other Costs				**Total Budget**
Emerging Markets				$ 200,000
Market Potential Study				$ -
Other Costs Subtotal				**$ 200,000**
DSM Portfolio Total including Other Costs				**$ 9,530,591**

C. Cost Effectiveness Results

The total portfolio for the Vectren South programs passes the TRC and UCT test for both the Residential and Commercial & Industrial sectors. Table 9 below confirms that all programs pass the TRC at greater than one. In completing the cost effectiveness testing, Vectren South used 7.29% as the weighted average cost of capital (WACC) as approved by the Commission on April 27, 2011 in Cause No. 43839. For the 2018 - 2020 Plan, Vectren South utilized the avoided costs from the 2016 IRP.

Table 9: Vectren South 2018-2020 Plan Cost Effectiveness Results without Performance Incentive

Residential	**TRC**	**UCT**	**RIM**	**Participant**	**TRC NPV $**	**UCT NPV $**	**Lifetime Cost/kWh**	**1st Year Cost/kWh**
Residential Lighting	4.20	6.19	0.86	5.18	$ 11,354,267	$ 12,498,117	$0.01	$0.12
Residential Prescriptive	1.28	2.68	0.99	1.04	$ 1,113,799	$ 3,153,088	$0.05	$0.36
Residential New Construction	1.25	2.02	0.79	1.39	$ 98,697	$ 248,511	$0.06	$0.47
Home Energy Assessment & Weatherization	1.19	1.19	0.48	n/a	$ 277,622	$ 277,622	$0.06	$0.62
Income Qualified Weatherization	1.30	1.30	0.59	n/a	$ 752,131	$ 752,131	$0.08	$0.86
Food Bank - LED Bulb Distribution	8.42	8.42	0.88	n/a	$ 2,503,138	$ 2,503,138	$0.01	$0.12
Energy Efficient Schools	3.28	3.28	0.53	n/a	$ 829,622	$ 829,622	$0.02	$0.16
Residential Behavioral Savings	1.54	1.54	0.50	n/a	$ 440,606	$ 440,606	$0.04	$0.05
Appliance Recycling	1.19	1.02	0.36	n/a	$ 83,146	$ 12,513	$0.05	$0.20
Smart Thermostat Program	-	-	-	n/a	$ (162,984)	$ (275,015)	n/a	n/a
CVR Residential	1.59	1.59	0.66	n/a	$ 580,613	$ 580,613	$0.07	$0.16
SmartDLC - Wifi DR/DLC Change-out	1.90	1.75	0.92	n/a	$ 1,301,580	$ 1,181,234	$0.10	$1.11
BYOT (Bring Your Own Thermostat)	2.80	1.92	1.92	n/a	$ 498,223	$ 370,438	n/a	n/a
Residential Portfolio	**2.18**	**2.64**	**0.76**	**4.06**	**$19,670,459**	**$22,572,616**	**$0.04**	**$0.21**
Commercial & Industrial	**TRC**	**UCT**	**RIM**	**Participant**	**TRC NPV $**	**UCT NPV $**	**Lifetime Cost/kWh**	**1st Year Cost/kWh**
Commercial Prescriptive	1.63	3.68	0.51	2.70	$ 2,811,420	$ 5,291,462	$0.02	$0.15
Commercial Custom	2.05	3.27	0.52	3.59	$ 5,003,931	$ 6,772,616	$0.02	$0.21
Small Business Direct Install	5.34	2.38	0.53	24.51	$ 6,333,499	$ 4,520,941	$0.03	$0.30
Commercial New Construction	2.01	1.69	0.45	9.55	$ 652,266	$ 530,199	$0.03	$0.29
Building Tune-up	1.09	1.13	0.34	9.35	$ 46,816	$ 67,027	$0.04	$0.26
Multi-Family Retrofit	3.99	2.28	0.53	24.86	$ 167,808	$ 125,751	$0.03	$0.33
CVR Commercial	1.30	1.30	0.55	n/a	$ 219,929	$ 219,929	$0.07	$0.13
Commercial & Industrial Total	**2.21**	**2.69**	**0.51**	**4.57**	**$15,235,668**	**$17,527,926**	**$0.02**	**$0.22**
Indirect Portfolio Level Costs					$ (2,666,479)	$ (2,666,479)		
Total Portfolio	**2.01**	**2.40**	**0.61**	**4.31**	**$32,239,647**	**$37,434,062**	**$0.03**	**$0.24**

First year costs are calculated by diving total cost by total savings and do not include carry forward costs related to smart thermostat, BYOT and CVR programs.

Table 9.1: Vectren South 2018-2020 Plan Cost Effectiveness Results including Performance Incentive

Including Performance Incentive	**TRC**	**UCT**	**RIM**	**Participant**	**TRC NPV $**	**UCT NPV $**	**Lifetime Cost/kWh**	**1st Year Cost/kWh**
Total Portfolio	**1.80**	**2.11**	**0.59**	**4.31**	**$28,624,007**	**$33,818,421**	**$0.04**	**$0.27**

*Utility Performance Incentive does not include IQW, 2016 Smart Tstat, or CVR.

6. New or Modified Program Initiatives

Vectren South's 2018-2020 filing largely extends the existing momentum of the portfolio of programs from 2016-2017 while applying the lessons learned from Vectren's program experience and evaluations as well as making refinements to key data and assumptions as described in this document.

Below is a summary which outlines notable changes for the 2018-2020 Plan from previous filings. More in depth details on the following topics can be found within the Program Descriptions portion of this document.

A. Residential Lighting

All programs within this filing will utilize light emitting diode (LED) lighting technologies per evaluation recommendations. This shift began in 2016 and the 2017 portfolio, as a whole, shifted focus from Compact Fluorescent Lamp (CFL) lamps to LED bulbs where performance, price and market readiness have all improved dramatically in recent years.

Additionally, new light bulbs standards are proposed to go into effect in 2020 due to the Energy Independence and Security Act (EISA). As proposed, this legislation would change the baseline and available savings for general service bulbs. The future of the 2020 EISA legislation is uncertain, thus Vectren will include LED bulbs in the plan for all three years. The incorporation of LED bulbs in 2020 is with the understanding that the measure's inclusion is pending regulatory outcomes.

There is still significant opportunity in the residential lighting market and thus Vectren plans to continue this offering as long as the market and legislation will allow. Lighting programs are consistently highly cost-effective and critical to the advancement of increased efficiency.

B. LED Food Bank

The LED Food Bank program was first offered in 2016 to help meet goals and serve the IQW population. This program will be part of the standard portfolio offering in 2018-2019 (2020 is not included due to EISA uncertainty). The program has been well received by food banks and pantries and Vectren South expects to see continued participation in 2018 and 2019.

C. Residential Prescriptive

Starting in 2018, duct sealing measure within the residential prescriptive program will require a small co-pay of $50 by the customer. The purpose of the duct sealing measure change is to increase participation and promotion of deeper retrofit measures in homes.

D. Smart Thermostat Program Expansion

In 2016, Vectren South conducted a field study designed to analyze the EE and DR benefits associated with smart thermostats. Between the months of April and May 2016, Vectren South installed approximately 2,000 smart thermostats (1,000 Honeywell and 1,000 Nest) in customer homes. The program is currently under evaluation to measure effectiveness. Vectren South anticipates continuing to pay incentives to these 2,000 customers, who are currently enrolled in Vectren South's Summer Cycler program. In addition, and as a result of the field study, Vectren South anticipates expanding its Smart Thermostat program by offering the following two new programs during 2018 through 2020: (1) DLC Change-out program and (2) Bring Your Own Thermostat (BYOT) program. A description of these new programs is included.

E. Commercial & Industrial Prescriptive

Based upon input from the VOB during the planning process, Vectren South added several agricultural measures to the prescriptive measure offering list including:

- Livestock Waterer
- Agriculture - Poultry Farm LED Lighting
- VSD Milk Pump
- High Volume Low Speed Fans
- High Speed Fans (Ventilation and Circulation)
- Dairy Plate Cooler
- Heat Mat (Single, ~14x60")
- Automatic Milker Take Off
- HE Diary Scroll Compressor
- Heat Reclaimer (No Pre-cooler Installed)

F. Commercial & Industrial Targeted Outreach

Vectren South's Commercial & Industrial Programs will seek out higher participation levels from schools, civic/government buildings and non-profit organizations and through a concentrated outreach approach. The concerted outreach will directly engage these segments to inform them of energy-saving opportunities and the available rebates through existing programs. Additional consideration can be provided to align program engagement with peak times to undertake energy efficiency projects: for schools, this means helping them schedule projects to be completed during summer vacations; for government institutions, this means planning around their fiscal cycles.

With this targeted outreach approach, Vectren South plans to assist 30 schools, 15 governmental buildings and 60 non-profit organizations in 2018-2020. Schools will likely receive support through the Prescriptive and Custom programs, while civic/government buildings and non-profit organizations may qualify for the Small Business Energy Savings program benefits.

G. Multi-Family Retrofit

The Multi-Family Retrofit program was offered as a small pilot starting in 2017 and will continue to be available to the Commercial & Industrial sector in 2018-2020. This program was initiated to continue to serve the multi-family sector as the integrated Multi-Family Direct Install program was discontinued in 2017 due to market saturation.

H. Emerging Markets

The Emerging Markets funding allows Vectren South's DSM portfolio to offer leading-edge program designs for next-generation technologies, services, and engagement strategies to growing markets in the Vectren South territory. Incentives promoted through this program may range from innovative rebate offerings to engineering and trade ally assistance to demand-control services that encourage early adoption of new, efficient technologies in high-impact market sectors. Depending on the development of certain technologies and growth areas in the service territory, a wide variety of projects and services are eligible. Because this program will focus on innovative new approaches and leading the DSM market, the exact list of measures cannot be set at this time. However, potential measures and services include: new technologies, such as Advanced Lighting Controls; new strategies for achieving significant energy savings, such as midstream incentives, contractor bids to provide energy efficiency projects, and targeting high-impact market sectors; and integrated DSM (iDSM) approaches, such as demand response, combined energy efficiency and demand response measures, and load shifting. This funding will not be used to support existing measures or programs, but rather support new program development or new measures within an existing program

7. Program Descriptions

A. Residential Lighting

The Residential Lighting Program is a market-based residential EE program designed to reach residential customers through retail outlets. The program consists of a buy-down strategy that provides incentives to consumers to facilitate the purchase of EE lighting products. The overall program goal is to increase the penetration of ENERGY STAR qualified lighting products based on the most up-to-date standards. As of 2017, the Residential Lighting program shifted 100% to LED bulbs.

There is still significant opportunity in the residential lighting market and thus Vectren plans to continue this offering as long as the market and legislation will allow. Lighting programs are consistently highly cost-effective and critical to the advancement of increased efficiency.

The future of the 2020 EISA legislation is uncertain, thus Vectren will include LED bulbs in the plan for all three years. The incorporation of LED bulbs in 2020 is with the understanding that the measure's inclusion is pending regulatory outcomes and uses conservative estimates.

Table 11: Residential Lighting Program Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Residential Lighting**				
	Number of Measures	222,863	246,086	163,416	632,365
	Energy Savings kWh	7,610,617	8,340,595	6,075,005	22,026,217
	Peak Demand kW	942.2	1,028.9	791.4	2,762.4
	Total Program Budget $	942,125	930,451	691,256	2,563,832
	Per Participant Avg Energy Savings (kWh)*	34.1	33.9	37.2	34.8
	Per Participant Avg Demand Savings (kW)*				0.004
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				67%

Eligible Customers

Any customer of a participating retailer in Vectren South's electric territory.

Marketing Plan

The program is designed to reach residential customers through retail outlets. Proposed marketing efforts include point of purchase promotional activities, the use of utility bill inserts and customer emails, utility web site and social media promotions and coordinated advertising with selected manufacturers and retail outlets.

Barriers/Theory

The program addresses the market barriers by empowering customers to take advantage of new lighting technologies through education and availability in the marketplace; accelerating the adoption of proven energy efficient technologies through incentives to lower price; and working with retailers to allow them to sell more high efficient products.

Initial Measures, Products and Services

The measures will include a variety of ENERGY STAR qualified lighting products currently available at retailers in Indiana, including LED bulbs, fixtures and ceiling fans.

Program Delivery

Vectren South will oversee the program and partner with Ecova to deliver the program.

Evaluation, Measurement and Verification

The implementation contractor will verify the paperwork of the participating retail stores. They will also spot check stores to assure that the program guidelines are being followed. A third party evaluator will evaluate the program using standard EM&V protocols.

B. Residential Prescriptive

Program Description

The program, also called Residential Efficient Products, is designed to incent customers to purchase energy efficient equipment by covering part of the incremental cost. The program also offers home weatherization rebates to residential customers for attic insulation, wall insulation and duct sealing. If a product vendor or contractor chooses to do so, the rebates can be presented as an "instant discount" to Vectren South residential customers on their invoice.

Table 12: Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Residential Prescriptive**				
	Number of Measures	4,093	6,445	6,595	17,133
	Energy Savings kWh	1,747,547	1,918,174	1,979,280	5,645,001
	Peak Demand kW	1,558.1	1,775.2	1,910.2	5,243.5
	Total Program Budget $	635,925	681,609	694,362	4,037
	Per Participant Avg Energy Savings (kWh)*				329.5
	Per Participant Avg Demand Savings (kW)*				0.306
	Weighted Avg Measure Life*				17
	Net To Gross Ratio				52%

Eligible Customers

Any residential customer located in the Vectren South electric service territory. For the equipment rebates, the applicant must reside in a single-family home or multi-family complex with up to 12 units. Only single-family homes are eligible for insulation and duct sealing remediation measures.

Marketing Plan

The marketing plan includes program specific materials that will target contractors, trade allies, distributors, manufacturers, industry organizations and appropriate retail outlets in the Heating, Ventilation and Air Conditioning (HVAC) industry. Marketing outreach medium include targeted direct marketing, direct contact by vendor personnel, trade shows and trade associations. Vectren will also use web banners, bill inserts, customer emails, social media outreach, press releases and mass market advertising. Program marketing will direct customers and contractors to the Vectren South website or call center for additional information.

Barriers/Theory

The initial cost is one of the key barriers. Customers do not always understand the long-term benefits of the energy savings from efficient alternatives. Trade allies are also often reluctant to sell the higher cost items as they do not want to be the high cost bidder. Incentives help address the initial cost issue and provide a good reason for Trade Allies to promote these higher efficient options.

Initial Measures, Products and Services

Details of the measures, savings, and incentives can be found in Appendix B. Measures included in the program will change over time as baselines change, new technologies become available and customer needs are identified.

Program Delivery

Vectren South will oversee the program and will partner with CLEAResult to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas/electric EE program in its combined natural gas and electric service territory. Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric.

Evaluation, Measurement and Verification

As part of the Quality Assurance/Quality Control process, the vendor will provide 100% paper verification that the equipment/products purchased meet the program efficiency standards and a field verification of 5% of the measures installed. A third party evaluator will review the program using appropriate EM&V protocols.

C. Residential New Construction

Program Description

The Residential New Construction (RNC) program produces long-term energy savings by encouraging the construction of single-family homes, duplexes, or end-unit townhomes with only one shared wall that are inspected and evaluated through the Home Efficiency Rating System (HERS). Builders can select from two rebate tiers for participation. Gold Star homes must achieve a HERS rating of 61 to 65. Platinum Star homes must meet a HERS rating of 60 or less.

The RNC Program provides incentives and encourages home builders to construct homes that are more efficient than current building codes and address the lost opportunities in this customer segment by promoting EE at the time the initial decisions are being made. The Residential New Construction Program will work closely with builders, educating them on the benefits of energy efficient new homes. Homes may feature additional insulation, better windows, and higher efficiency appliances. The homes should also be more efficient and comfortable than standard homes constructed to current building codes.

Table 13: Program Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Residential New Construction**				
	Number of Homes	139	139	139	417
	Energy Savings kWh	187,038	187,038	187,038	561,114
	Peak Demand kW	118.0	118.0	118.0	354.0
	Total Program Budget $	85,345	87,132	88,940	261,417
	Per Participant Avg Energy Savings (kWh)*				1345.6
	Per Participant Avg Demand Savings (kW)*				0.849
	Weighted Avg Measure Life*				25
	Net To Gross Ratio				50%

Eligible Customers

Any customer or home builder constructing an eligible home in the Vectren South service territory.

Marketing Plan

In order to move the market toward an improved home building standard, education will be required for home builders, architects and designers as well as customers buying new homes. A combination of in-person meetings with these market participants as well as other educational methods will be necessary.

Barriers/Theory

The Residential New Construction program addresses the primary barriers of first cost as well as builder and customer knowledge. First cost is addressed by program incentives to help reduce the cost of the EE upgrades. The program provides opportunities for builders and developers to gain knowledge and skills concerning EE building practices and coaches them on application of these skills. The HERS rating system allows customers to understand building design and construction improvements through a rating system completed by professionals.

Incentive Strategy

Program incentives are designed to be paid to both all-electric and combination homes that have natural gas heating. It is important to note that the program is structured such that an incentive will not be paid for an all-electric home that has natural gas available to the home site. Incentives can be paid to either the home builder or the customer/account holder. Incentives will be based on the rating tier qualification. For all-electric homes, where Vectren South natural gas service is not available, the initial incentives will be:

Tier	HERS Rating	Total Incentive
Platinum	60 or less	$800
Gold	61 to 65	$700

For homes with central air conditioning and Vectren South natural gas space heating, the electric portion of the incentive will be:

Tier	HERS Rating	Total Incentive	Gas Portion	Electric Portion
Platinum	60 or less	$800	$600	$200
Gold	61 to 65	$700	$525	$175

Program Delivery

Vectren South will oversee the program and will partner with CLEAResult to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas/electric EE program in its combined natural gas and electric service territory.

Evaluation, Measurement and Verification

Field inspections will occur at least once during construction and upon completion by a certified HERS Rater. As part of the Quality Assurance/Quality Control process, the vendor will provide 100% paper verification that the equipment/products purchased meet the program efficiency standards. A third party evaluator will evaluate the program using standard EM&V protocols.

D. Home Energy Assessments & Weatherization

Program Description

The Home Energy Assessment and Weatherization Program will be offered jointly by Vectren South Gas and Electric. This program targets a hybrid phased approach that combines helping customers analyze and understand their energy use via an on-site energy assessment, providing direct installation of energy efficient measures including low-flow water fixtures, LED bulbs and thermostats, as well as provide deeper retrofit measures.

- Phase 1 - Assessors will perform a walk-through assessment of the home, collecting data for use in identifying cost-effective energy efficient improvements and appropriate direct install measures. Audit report provided to customer onsite will showcase deeper retrofit measure opportunities within the home.

- Phase 2 - If the home is eligible for air sealing and/or duct sealing, the Assessor will provide the information to the customer for scheduling the Phase 2 appointment via the online scheduling portal for a co-pay of $50. Customers who choose to install attic insulation will be referred to the Residential Energy Efficient Rebate Program.

Customers can schedule an assessment appointment in one of the following two ways: (1) by visiting vectren.com/saveenergy to schedule an appointment through self-booking tool; or (2) calling the call center to speak with a program representative. Customers who opt to receive email notifications will receive confirmation and appointment reminders prior to the assessment.

Table 14: Home Energy Assessments & Weatherization Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Home Energy Assessment & Weatherization**				
	Number of Homes	1,210	1,210	1,210	3,630
	Energy Savings kWh	863,991	863,991	863,991	2,591,973
	Peak Demand kW	191.6	192.0	192.0	575.6
	Total Program Budget $	526,473	533,934	541,669	1,602,076
	Per Participant Avg Energy Savings (kWh)*				714.0
	Per Participant Avg Demand Savings (kW)*				0.159
	Weighted Avg Measure Life*				12
	Net To Gross Ratio				98%

Eligible Customers

Vectren South residential customers with electric service at a single-family residence, provided the home was not built within the past five years and has not had an audit within the last three years. Additionally, the home should be owner-occupied (or renter where occupants have the electric service in their name).

Marketing Plan

Proposed marketing efforts include utilizing direct mailers, email blasts, Vectren South online audit tools, bill inserts, social media outreach, as well as other outreach and education efforts and promotional campaigns throughout the year to ensure participation levels are maintained.

Barriers/Theory

The primary barrier addressed through this program is customer education and awareness. Often customers do not understand what opportunities exist to reduce their home energy use. This program not only informs the customer but helps them start down the path of energy savings by directly installing low-cost measures. The program is also a “gateway” to other Vectren South gas and electric programs.

Initial Measures, Products and Services

The direct install measures available for installation at no cost include:

- Kitchen & Bathroom Aerators
- Filter Whistle
- LED bulbs
- Low Flow Showerhead
- Pipe Wrap
- Water Heater Temperature Setback
- Wi-fi Thermostat

For customers who elect to move forward with Phase 2, Duct Sealing and Air Sealing are available for a $50 co-pay.

Program Delivery

Vectren South will oversee the program and will partner with CLEAResult to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas/electric EE program in its combined natural gas and electric service territory. Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric.

Evaluation, Measurement and Verification

To assure compliance with program guidelines, field visits with auditors will occur as well as spot check verifications of measure installations. A third party evaluator will evaluate the program using standard EM&V protocols.

E. Income Qualified Weatherization

Program Description

The Income Qualified Weatherization program is designed to produce long-term energy and demand savings in the residential market. The program is designed to provide weatherization upgrades to low-income homes that otherwise would not have been able to afford the energy saving measures. The program provides direct installation of energy-saving measures and educates consumers on ways to reduce energy consumption. Customers eligible through the Income Qualified Weatherization Program will have opportunity to receive deeper retrofit measures including refrigerators, attic insulation, duct sealing, and air infiltration reduction. This year, we will engage with the manufactured homes population and offer the same measures offered to single family homes.

Collaboration and coordination between gas and electric low-income programs along with state and federal funding is recommended to provide the greatest efficiencies among all programs. The challenge of meeting the goals set for this program have centered on health and safety as well as customer cancellations and scheduling. Vectren South is committed to finding innovative solutions to these areas. A health and safety budget has been established, and we continue to work on improving methods of customer engagement with various confirmations via phone and email reminders prior to the appointment.

Table 15: Income Qualified Weatherization Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Income Qualified Weatherization**				
	Number of Homes	475	500	525	1,500
	Energy Savings kWh	959,988	1,046,148	1,130,945	3,137,081
	Peak Demand kW	458.8	499.4	540.2	1,498.4
	Total Program Budget $	841,848	899,806	958,593	2,700,247
	Per Participant Avg Energy Savings (kWh)*				2091.4
	Per Participant Avg Demand Savings (kW)*				0.999
	Weighted Avg Measure Life*				14
	Net To Gross Ratio				100%

Eligible Customers

The Residential Low Income Weatherization Program targets single-family and manufactured homeowners and tenants who have electric service in their name with Vectren South and a total household income up to 200% of the federally-established poverty level.

Marketing Plan

Vectren South will provide a list to the implementation contractor of high consumption customers who have received Energy Assistance Program (EAP) funds within the past 12 months to help prioritize those customers who will benefit most from the program. This will also help in any direct marketing activities to specifically target those customers.

Barriers/Theory

Lower-income homeowners do not have the money to make even simple improvements to lower their energy usage and often live in homes with the most need for EE improvements. They may also lack the knowledge, experience, or capability to do the work. Health and safety can also be at risk for low-income homeowners, as their homes typically are not as "tight", and indoor air quality can be compromised. In order to increase participation and eligibility, Vectren South has incorporated a Health and Safety budget of $250 per home. This program provides those customers with basic improvements to help them start saving energy without needing to make the investment themselves.

Initial Measures, Products and Services

Measures available for installation will vary based on the home and include:

- LED bulbs/lamps
- Low flow kitchen and bath aerators
- Low flow showerheads
- Pipe wrap
- Filter whistles
- Infiltration reduction
- Attic insulation
- Duct repair, seal and insulation
- Refrigerator replacement
- Programmable/Smart thermostat
- Smart power strips

Program Delivery

Vectren South will oversee the program and will partner with CLEAResult to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas/electric EE program in its combined natural gas and electric service territory. Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric.

Evaluation, Measurement and Verification

To assure quality installations, 5% of the installations will be field inspected. A third party evaluator will evaluate the program using standard EM&V protocols.

F. LED Food Bank

Program Description

The food bank program provides LED bulbs to food pantries in Vectren South's electric service territory. This program targets hard to reach, low income customers in the Vectren South electric territory. All food pantry recipients must provide proof of income qualification to receive the food baskets.

The program implementer purchases bulbs from a manufacturer and bulbs are shipped in bulk to the partner food bank. Food banks then distribute the bulbs to the respective food pantries in its network. Pantries include bulbs when assembling food packages and bulbs are provided to food recipients.

Table 16: LED Food Bank Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Food Bank - LED Bulb Distribution**				
	Number of Measures	50,496	50,496	0	100,992
	Energy Savings kWh	1,401,264	1,401,264	0	2,802,528
	Peak Demand kW	148.8	148.8	0.0	297.6
	Total Program Budget $				349,449
	Per Participant Avg Energy Savings (kWh)*				27.8
	Per Participant Avg Demand Savings (kW)*				0.003
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				100%

Eligible Customers

Any participant visiting a food pantry in Vectren South's electric territory.

Marketing Plan

The program will be marketed directly to food banks in the Vectren South electric service territory as well as other channels identified by the implementation contractor.

Barriers/Theory

Lower-income homeowners do not have the money to make even simple improvements to lower their energy usage and often live in homes with the most need for EE improvements. They may also lack the knowledge, experience, or capability to do the work. This program also addresses the barrier of education and awareness of EE opportunities. Working through food banks, participants receive LED bulbs and are educated about opportunities to save energy.

Initial Measures, Products and Services

Each participating food pantry will place a bundle of four (4) LED bulbs in food packages.

Program Delivery

Vectren South will oversee the program and will partner with CLEAResult and the Tri-State Area Food Bank to deliver the program.

Evaluation, Measurement and Verification

A third party evaluator will evaluate the program using standard EM&V protocols. A postcard will be provided to each participant to help acquire necessary information for EM&V. The postcard will be a postage paid reply card and 'drop box' will also be provided for customers to voluntarily supply their information for verification.

G. Energy Efficient Schools

Program Description

The Energy Efficient Schools Program is designed to impact students by teaching them how to conserve energy and to produce cost effective electric savings by influencing students and their families to focus on the efficient use of electricity.

The program consists of a school education program for 5th grade students attending schools served by Vectren South. To help in this effort, each child that participates will receive a take-home energy kit with various energy saving measures for their parents to install in the home. The kits, along with the in-school teaching materials, are designed to make a lasting impression on the students and help them learn ways to conserve energy.

Table 17: Energy Efficient Schools Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Energy Efficient Schools**				
	Number of Kits	2,400	2,500	2,600	7,500
	Energy Savings kWh	899,706	937,194	645,216	2,482,115
	Peak Demand kW	52.8	52.8	52.8	158.4
	Total Program Budget $	131,696	136,805	119,995	388,496
	Per Participant Avg Energy Savings (kWh)*				330.9
	Per Participant Avg Demand Savings (kW)*				0.021
	Weighted Avg Measure Life*				10
	Net To Gross Ratio				100%

Eligible Customers

The program will be available to selected 5th grade students/schools in the Vectren South electric service territory.

Marketing Plan

The program will be marketed directly to elementary schools in Vectren South electric service territory as well as other channels identified by the implementation contractor. A list of the eligible schools will be provided by Vectren South to the implementation contractor for direct marketing to the schools via email, phone, and mail (if necessary) to obtain desired participation levels in the program.

Barriers/Theory

This program addresses the barrier of education and awareness of EE opportunities. Working through schools, both students and families are educated about opportunities to save. As well, the families receive energy savings devices they can install to begin their savings.

Initial Measures, Products and Services

The kits for students will include:

- Low flow showerhead
- Low flow kitchen aerator
- Low flow bathroom aerator (2)
- LED bulbs (2)
- LED nightlight
- Filter whistle

Program Delivery

Vectren South will oversee the program and will partner with National Energy Foundation (NEF) to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas/electric EE program in its combined natural gas and electric service territory. Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric.

Evaluation, Measurement and Verification

Classroom participation will be tracked. A third party evaluator will evaluate the program using standard EM&V protocols.

H. Residential Behavior Savings

Program Description

The Residential Behavioral Savings Program motivates behavior change and provides relevant, targeted information to the consumer through regularly scheduled direct contact via mailed and emailed home energy reports. The report and web portal include a comparison against a group of similarly sized and equipped homes in the area, usage history comparisons, goal setting tools, and progress trackers. The Home Energy Report program anonymously compares customers' energy use with that of other customers with similar home size and demographics. Customers can view the past 12 months of their energy usage and compare and contrast their energy consumption and costs with others in the same neighborhood. Once a consumer understands better how they use energy, they can then start conserving energy.

Program data and design was provided by OPower, the implementation vendor for the program. OPower provides energy usage insight that drives customers to take action by selecting the most relevant information for each particular household, which ensures maximum relevancy and high response rate to recommendations.

Table 18: Residential Behavior Savings Program Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Residential Behavioral Savings**				
	Number of Participants	41,348	38,203	35,298	114,849
	Energy Savings kWh	6,470,000	5,970,000	5,600,000	18,040,000
	Peak Demand kW	1,351	1,248	1,153	3,752
	Total Program Budget $	305,622	285,585	286,545	877,752
	Per Participant Avg Energy Savings (kWh)*				157.1
	Per Participant Avg Demand Savings (kW)*				0.033
	Weighted Avg Measure Life*				1
	Net To Gross Ratio				100%

Eligible Customers

Residential customers who receive electric service from Vectren South are eligible to participate in this integrated natural gas and electric EE program.

Barriers/Theory

The Residential Behavioral Savings program provides residential customers with better energy information through personalized reports delivered by mail, email and an integrated web portal to help them put their energy usage in context and make better energy usage decisions. Behavioral science research has demonstrated that peer-based comparisons are highly motivating ways to present information. The program will leverage a dynamically created comparison group for each residence and compare it to other similarly sized and located households.

Implementation & Delivery Strategy

The program will be delivered by OPower and include energy reports and a web portal. Customers typically receive between 4 to 6 reports annually and monthly emailed reports. These reports provide updates on energy consumption patterns compared to similar homes and provide energy savings strategies to reduce energy use. They also promote other Vectren South programs to interested customers. The web portal is an interactive system for customers to perform a self-audit, monitor energy usage over time, access energy savings tips and be connected to other Vectren South gas and electric programs.

Program Delivery

Vectren South will oversee the program and partner with OPower to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas/electric EE program in its combined natural gas and electric service territory. Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric.

Evaluation, Measurement and Verification

A third party evaluator will complete the evaluation of this program and work with Vectren South to select the participant and non-participant groups.

I. Appliance Recycling

Program Description

The Residential Appliance Recycling program encourages customers to recycle their old inefficient refrigerators and freezers in an environmentally safe manner. The program recycles operable refrigerators and freezers so the appliance no longer uses electricity, and keeps 95% of the appliance out of landfills. An older refrigerator can use up to three times the amount of energy as new efficient refrigerators. An incentive of $50 will be provided to the customer for each operational unit picked up.

Table 19: Appliance Recycling Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Appliance Recycling**				
	Number of Measures	950	930	920	2,800
	Energy Savings kWh	913,771	894,534	884,915	2,693,219
	Peak Demand kW	120.7	118.1	116.8	355.6
	Total Program Budget $	174,759	180,648	186,532	541,939
	Per Participant Avg Energy Savings (kWh)*				961.9
	Per Participant Avg Demand Savings (kW)*				0.127
	Weighted Avg Measure Life*				8
	Net To Gross Ratio				54%

Eligible Customers

Any residential customer with an operable secondary refrigerator or freezer receiving electric service from Vectren South.

Marketing Plan

The program will be marketed through a variety of mediums, including the use of utility bill inserts and customer emails, press releases, retail campaigns coordinated with appliance sales outlets as well as the potential for direct mail, web and social and mass media promotional campaigns.

Barriers/Theory

Many homes have second refrigerators and freezers that are very inefficient. Customers are not aware of the high energy consumption of these units. Customers also often have no way to move and dispose of the units, so they are kept in homes past their usefulness. This program educates customers about the waste of these units and provides a simple way for customers to dispose of the units.

Program Delivery

Vectren South will work directly with Appliance Recycling Centers of America Inc. (ARCA), to implement this program.

Evaluation, Measurement and Verification

Recycled units will be logged and tracked to assure proper handling and disposal. The utility will monitor the activity for disposal. Customer satisfaction surveys will also be used to understand the customer experience with the program. A third party evaluator will evaluate the program using standard EM&V protocols.

J. Smart Thermostat Program

Program Description

In 2016, Vectren South conducted a field study designed, in part, to analyze the different approaches to DR that are available through smart thermostats. Between the months of April and May, Vectren South installed approximately 2,000 smart thermostats (1,000 Honeywell and 1,000 Nest) in customer homes. Vectren South leveraged these thermostats to manage DR events during the summer in an effort to evaluate the reduction in peak system loads. These smart devices are connected to Wi-Fi and reside on the customer's side of the electric meter and are used to communicate with customer's air conditioning systems. The program provides Vectren South with increased customer contact opportunities and the ability to facilitate customers' shift of their energy usage to reduce peak system loads. Vectren South will not install additional thermostats pursuant to this program; however, incentives will continue to be paid to participating customers.

Table 20: Smart Thermostat Program Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**Smart Thermostat Program**				
	Number of Measures	0	0	0	0
	Energy Savings kWh				
	Peak Demand kW	0	0	0	0
	Total Program Budget $	97,639	98,222	98,798	294,659
	Per Participant Avg Energy Savings (kWh)*				0.0
	Per Participant Avg Demand Savings (kW)*				0.000
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				100%

*No additional kWh or demand savings will be recorded.

Incentive Strategy

The program budget is for incentives for existing customers to participate in the Demand Response events for 2018-2020.

Program Delivery

Vectren South will oversee the program.

Evaluation, Measurement and Verification

A third party evaluator will evaluate the program using standard EM&V protocols.

K. Smart DLC – Wi-Fi/DLC Switchout Program

Program Description

Since 1992, Vectren South has operated a Direct Load Control (DLC) program called Summer Cycler that reduces residential and small commercial air-conditioning and water heating electricity loads during summer peak hours. While this technology still helps lower peak load demand for electricity, this aging technology will be phased out over time. Vectren's Summer Cycler program has served Vectren and its customers well for more than two decades, but emerging technology is now making the program obsolete.

By installing connected devices in customer homes rather than using one-way signal switches, Vectren will be able to provide its customer base deeper energy savings opportunities and shift future energy focus to customer engagement rather than traditional program goals and rules. The most recent Vectren electric DSM evaluation has demonstrated that smart thermostats outperform standard programmable thermostats and are a practical option to transition into future customer engagement strategies.

Smart thermostat installations are also a feasible solution to multiple utility and customer quandaries. Past Vectren evaluations have discovered that its customers program less than half of all programmable thermostats installed, hindering potential savings and acting a disincentive for customers to become involved in how their home uses energy. This issue is coupled with the uncertainty of whether standard DLC switches in the field are in working order and the fact that the switches cannot record or yield any savings data. With these issues mitigated, utility management burden is reduced, customer engagement and satisfaction is increased, and Vectren will be able to obtain better home usage data for creation and implementation of future DSM programs.

If approved by the Commission, Vectren South anticipates replacing DLC switches with smart thermostats over time, as the benefits associated with this emerging technology far outweigh the benefits associated with DLC switches. In 2018, Vectren South will begin its phase out of the Summer Cycler program by removing approximately 1,000 Sumer Cycler devices and replacing them with Wi-Fi thermostats that utilize demand response technology. Customers will receive a professionally installed Wi-Fi thermostat at no additional cost and a monthly bill credit of $5 during the months of June to September. The current monthly credit for Summer Cycler is also $5; therefore the annual bill credit by customer does not change.

By replacing the Summer Cycler devices, Vectren South will eliminate the annual inspection and maintenance ("I&M costs") for the Summer Cycler program, and thus offer a more reliable DR program. Long-term, Vectren South will almost eliminate the annual ongoing inspection and maintenance cost. By replacing 1,000 switches each year, Vectren continues to have resources to manage peak demand for electricity during the summer months.

Table 22: SmartDLC – Wi-Fi/DLC Switchout Program& Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**SmartDLC - Wifi DR/DLC Changeout**				
	Number of Participants	1,000	1,000	1,000	3,000
	Energy Savings kWh	466,690	466,690	466,690	1,400,070
	Peak Demand kW	600.0	600.0	600.0	1,800.0
	Total Program Budget $	517,759	562,148	606,532	1,686,439
	Per Participant Avg Energy Savings (kWh)*				466.7
	Per Participant Avg Demand Savings (kW)*				0.600
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				100%

Eligible Customers

Customers in the Vectren South territory who currently participate in the DLC Summer Cycler program and have access to Wi-Fi.

Marketing Plan

Proposed marketing efforts include utilizing direct mailers, email blasts, Vectren South online audit tools, bill inserts as well as other outreach and education efforts and promotional campaigns throughout the year to ensure participation levels are maintained.

Incentive Strategy

Customers will receive a professionally installed Wi-Fi thermostat at no additional cost and a monthly bill credit of $5 during the months of June to September.

Program Delivery

Vectren South will oversee the program.

Evaluation, Measurement and Verification

A third party evaluator will evaluate the program using standard EM&V protocols.

L. Bring Your Own Thermostat (BYOT)

Program Description

The Bring Your Own Thermostat ("BYOT") program is a further expansion of the residential smart thermostat initiative. BYOT allows customers to purchase their own device from multiple vendors and participate in DR with Vectren South and other load curtailing programs managed through the utility. Taking advantage of two-way communicating smart thermostats, the BYOT program can help reduce acquisition costs for load curtailment programs and improve customer satisfaction.

Table 23: BYOT Program Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**BYOT (Bring Your Own Thermostat)**				
	Number of Participants	400	400	400	1,200
	Energy Savings kWh				
	Peak Demand kW	240.0	240.0	240.0	720.0
	Total Program Budget $	111,036	178,592	146,128	435,756
	Per Participant Avg Energy Savings (kWh)*				0.0
	Per Participant Avg Demand Savings (kW)*				0.600
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				100%

Eligible Customers

Residential single or multi-family customers in the Vectren South territory with access to Wi-Fi and who own a qualifying compatible Wi-Fi thermostat that operates the central air-conditioning cooling system.

Marketing Plan

Proposed marketing efforts include utilizing direct mailers, email blasts, Vectren South online audit tools, bill inserts as well as other outreach and education efforts and promotional campaigns throughout the year to ensure participation levels are maintained.

Incentive Strategy

Customers will receive a one-time enrollment incentive of $75 and a bill credit of $5 during the months of June to September. The enrollment incentive will be provided in the first year to new enrollees only.

Program Delivery

Vectren South will oversee the program.

Evaluation, Measurement and Verification

A third party evaluator will evaluate the program using standard EM&V protocols.

M. Conservation Voltage Reduction - Residential and Commercial and Industrial

Program Description

Conservation Voltage Reduction (CVR) is a technology that reduces energy usage and peak demand through automated monitoring and control of voltage levels provided on distribution circuits. End use customers realize lower energy and demand consumption when CVR is applied to the distribution circuit from which they are served.

A distribution circuit facilitates electric power transfer from an electric substation to utility meters located at electric customer premises. Electric power customers employ end-use electric devices (loads) that consume electrical power. At any point along a single distribution circuit, voltage levels vary based upon several parameters, mainly including, but not exclusive of, the actual electrical conductors that comprise the distribution circuit, the size and location of electric loads along the circuit, the type of end-use loads being served, the distance of loads from the power source, and losses incurred inherent to the distribution circuit itself. All end-use loads require certain voltage levels to operate and standards exist to regulate the levels of voltage delivered by utilities. In Indiana, Vectren South is required to maintain a steady state +/-5% of the respective baseline level as specified by ANSI C84.1 (120 volt baseline yields acceptable voltage range of 114 volts to 126 volts).

Historically, utilities including Vectren South have set voltage levels near the upper limit at the distribution circuit source (substation) and have applied voltage support devices such as voltage regulators and capacitors along the circuit to assure that all customers are provided voltages within the required range. This basic design economically met the requirements by utilizing the full range (+/- 5%) of allowable voltages while only applying independent voltage support where needed. This basic design has worked well for many years. However, in the 1980's, utilities recognized that loads on the circuits would actually consume less energy if voltages in the lower portion of the acceptable range were provided. In fact, many utilities, including Vectren South, established emergency operating procedures to lower voltage at distribution substations by 5% during power shortage conditions.

The recent focus on EE and the availability of technology that allows monitoring and tighter control of circuit voltage conditions has led to development of automated voltage control schemes which coordinate the operation of voltage support devices and allow more customers on the circuit to be served at voltages in the lower portion of the acceptable range.

Once applied, a step change in energy and demand consumption by customers is realized, dependent upon where customer loads are located within the voltage zones, the load characteristics of the circuit, and how end-use loads respond to the voltage reduction. The resultant energy and demand consumption reduction persist at the new levels as long as tighter voltage bandwidth operation is applied. As a result, ongoing energy and demand savings persists for the duration of the life of the CVR equipment and as long as the equipment is maintained and operated in the voltage bandwidth mode.

With Commission approval, Vectren South will capitalize the costs to implement the CVR program and seek to recover through the annual Demand Side Management Adjustment (DSMA) mechanism the carrying costs and depreciation expense associated with the implementation along with annual, ongoing Operation and Maintenance (O&M) expense, a representative share of Vectren South's DSM support staff and administration costs and related EM&V cost. The budget below is reflective of this request.

Table 21: Conservation Voltage Reduction Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Residential	**CVR Residential**				
	Number of Participants			5,324	5,324
	Energy Savings kWh			1,461,047	1,461,047
	Peak Demand kW			263	263
	Total Program Budget $	118,786	114,907	230,134	463,827
	Per Participant Avg Energy Savings (kWh)*				274.4
	Per Participant Avg Demand Savings (kW)*				0.049
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				100%

Market	Program	2018	2019	2020	Total Program
Commercial & Industrial	**CVR Commercial**				
	Number of Participants			558	558
	Energy Savings kWh			1,032,655	1,032,655
	Peak Demand kW			185.9	185.9
	Total Program Budget $	108,834	105,297	137,003	351,134
	Per Participant Avg Energy Savings (kWh)*				1850.6
	Per Participant Avg Demand Savings (kW)*				0.333
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				100%

Program Delivery

Vectren South will oversee the program and will partner with an implementer to deliver the program. One unit installation will be completed in 2017, and as an expansion of this program, one additional unit will be installed in 2020.

Eligible Customers

Vectren South has identified substations that will benefit from the CVR program. For this program, one substation will be installed in 2020.

Barriers/Theory

CVR is both a DR and an EE program. First, it seeks to cost effectively deploy new technology to targeted distribution circuits, in part to reduce the peak demand experienced on Vectren South's electrical power supply system. The voltage reduction stemming from the CVR program operates to effectively reduce consumption during the times in which system peaks are set and as a result directly reduces peak demand. CVR also cost effectively reduces the level of ongoing energy consumption by end-use devices located on the customer side of the utility meter as many end-use devices consume less energy with lower voltages consistently applied. Like an equipment maintenance service program, the voltage optimization allows the customer’s equipment to operate at optimum levels which saves energy without requiring direct customer intervention or change.

Initial Measures, Products and Services

Vectren South will install the required communication and control equipment on the appropriate circuits from the substation. No action is required of the customers.

N. Commercial and Industrial Prescriptive

Program Description

The Commercial & Industrial (C&I) Prescriptive Program is designed to provide financial incentives on qualifying products to produce greater energy savings in the C&I market. The rebates are designed to promote lower electric energy consumption, assist customers in managing their energy costs, and build a sustainable market around EE.

Program participation is achieved by offering incentives structured to cover a portion of the customer's incremental cost of installing prescriptive efficiency measures.

Table 24: Commercial & Industrial Prescriptive Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Commercial & Industrial	**Commercial Prescriptive**				
	Number of Measures	7,024	5,981	6,856	19,861
	Energy Savings kWh	4,999,125	4,501,186	5,002,621	14,502,932
	Peak Demand kW	378.2	325.4	369.0	1,072.6
	Total Program Budget $	729,398	655,370	731,330	2,116,098
	Per Participant Avg Energy Savings (kWh)*				730.2
	Per Participant Avg Demand Savings (kW)*				0.054
	Weighted Avg Measure Life*				14
	Net To Gross Ratio				87%

Eligible Customers

Any eligible participating commercial or industrial customer receiving Vectren South electric service.

Marketing Plan

Proposed marketing efforts include trade ally outreach, trade ally meetings, direct mail, face-to-face meetings with customers, marketing campaigns and bonuses, web-based marketing, and coordination with key account executives.

Barriers/Theory

Customers often have the barrier of higher first cost for EE measures, which precludes them from purchasing the more expensive EE alternative. They also lack information on high-efficiency alternatives. Trade allies often run into the barrier of not being able to promote more EE alternatives because of first cost or lack of knowledge. Trade allies also gain credibility with customers for their EE claims when a measure is included in a utility prescriptive program. Through the program the Trade allies can promote EE measures directly to their customers encouraging them to purchase more efficient equipment while helping customers get over the initial cost barrier.

Initial Measures, Products and Services

Measures will include high efficient lighting and lighting controls, HVAC equipment including variable frequency drives, commercial kitchen equipment including electronically commutated motors (ECMs), and miscellaneous items including compressed air equipment.

Note that measures included in the program will change over time as baselines change, new technologies become available and customer needs are identified. Detailed measure listings, participation and incentives are in Appendix B.

Implementation & Delivery Strategy

The program will be delivered primarily through the trade allies working with their customers. Vectren South and its implementation partners will work with the trade allies to make them aware of the offerings and help them promote the program to their customers. The implementation partner will provide training and technical support to the trade allies to become familiar with the EE technologies offered through the program. The program will be managed by the same implementation provider as the Commercial & Industrial Custom program so that customers can seamlessly receive assistance and all incentives can be efficiently processed through a single procedure.

Incentive Strategy

Incentives are provided to customers to reduce the difference in first cost between the lower efficient technology and the high efficient option. There is no fixed incentive percentage amount based on the difference in price because some technologies are newer and need higher amounts. Others have been available in the marketplace longer and do not need as much to motivate customers. Incentives will be adjusted to respond to market activity and bonuses may be available for limited time, if required, to meet goals.

Program Delivery

Vectren South will oversee the program partner Nexant to deliver the program.

Evaluation, Measurement and Verification

Site visits will be made on 5% of the installations, as well as all projects receiving incentive greater than $20,000, to verify the correct equipment was installed. Standard EM&V protocols will be used for the third party evaluation of the program.

O. Commercial and Industrial Custom

Program Description

The Commercial & Industrial (C&I) Custom Program promotes the implementation of customized energy saving measures at qualifying customer facilities. Incentives promoted through this program serve to reduce the cost of implementing energy saving projects and upgrading to high-efficiency equipment. Due to the nature of a custom EE program, a wide variety of projects are eligible.

Table 25: Commercial & Industrial Custom Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Commercial & Industrial	**Commercial Custom**				
	Number of Measures	50	50	55	155
	Energy Savings kWh	5,000,000	5,000,000	5,500,000	15,500,000
	Peak Demand kW	476.0	476.0	524.0	1,476.0
	Total Program Budget $	1,019,072	1,022,184	1,160,256	3,201,512
	Per Participant Avg Energy Savings (kWh)*				100000.0
	Per Participant Avg Demand Savings (kW)*				9.523
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				100%

Eligible Customers

Any participating commercial or industrial customer receiving electric service from Vectren South.

Marketing Plan

Proposed marketing efforts include coordination with key account representatives to leverage the contacts and relationships they have with the customers. Direct mail, media outreach, trade shows, marketing campaigns and bonuses, trade ally meetings, and educational seminars could also be used to promote the program.

Barriers/Theory

Applications of some specific EE technologies are unique to that customer's application or process. The energy savings estimates for these measures are highly variable and cannot be assessed without an engineering estimation of that application; however, they offer a large opportunity for energy savings. To promote the installation of these high efficient technologies or measures, the Commercial & Industrial Custom program will provide incentives based on the kWh saved as calculated by the engineering analysis. To assure savings, these projects will require program engineering reviews and pre approvals. The custom energy assessments offered will help remove customer barriers regarding opportunity identification and determining energy savings potential.

Initial Measures, Products and Services

All technologies or measures that save kWh qualify for the program. Facility energy assessments will be offered to customers who are eligible and encouraged to implement multiple EE measures. Detailed measure listings, participation and incentives are in Appendix B.

Implementation & Delivery Strategy

The implementation partner will work collaboratively with Vectren South staff to recruit and screen customers for receiving facility energy assessments. The implementation partner will also provide engineering field support to customers and trade allies to calculate the energy savings. Customers or trade allies with a proposed project will complete an application form with the energy savings calculations for the project. The implementation team will review all calculations and where appropriate complete site visits to assess and document pre-installation conditions. Customers will be informed and funds will be reserved for the project. Implementation engineering staff will review the final project information as installed and verify the energy savings. Incentives are then paid on the verified savings.

The implementation partner will work collaboratively with Vectren South staff to recruit and screen customers for receiving facility energy assessments, technical assistance and energy management education. The program will seek to gain customer commitment towards setting up an energy management process and implementing multiple EE improvements. The implementation partner will help customers achieve agreed upon milestones in support for their commitment.

Incentive Strategy

Incentives will be calculated on a per kWh basis. The initial kWh rate will be $0.12/kWh and is paid based on the first year annual savings reduction. Rates may change over time and vary with some of the special initiatives. Incentives will not pay more than 50% of the project cost nor provide incentives for projects with paybacks less than 12 months. Vectren South will offer a cost share on facility energy assessments that will cover up to 100% of the assessment cost.

Program Delivery

Vectren South will oversee the program partner Nexant to deliver the program.

Evaluation, Measurement and Verification

Given the variability and uniqueness of each project, all projects will be pre-approved. Pre and post visits to the site to verify installation and savings will be performed as defined by the program implementation partner. Monitoring and verification may occur on the largest projects. A third party evaluator will be used for this project and use standard EM&V protocols.

P. Small Business Direct Install

Program Description

The Small Business Direct Install Program provides value by directly installing EE products such as high efficiency lighting, pre-rinse sprayers, refrigeration controls, electrically-commutated motors, smart thermostats and vending machine controls. The program helps businesses identify and install cost effective energy saving measures by providing an on-site energy assessment customized for their business.

Table 26: Small Business Direct Install Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Commercial & Industrial	**Small Business Direct Install**				
	Number of Projects	146	142	127	415
	Energy Savings kWh	4,032,934	3,905,372	3,900,306	11,838,612
	Peak Demand kW	667.0	645.0	567.0	1,879.0
	Total Program Budget $	1,149,640	1,182,037	1,173,133	3,504,810
	Per Participant Avg Energy Savings (kWh)*				28526.8
	Per Participant Avg Demand Savings (kW)*				4.528
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				95%

Eligible Customers

Any participating Vectren South business customer with a maximum peak energy demand of less than 400 kW.

Marketing Plan

The Small Business Direct Install Program will be marketed primarily through in-network trade ally outreach. The program implementer will provide trade ally-specific marketing collateral to support trade allies as they connect with customers.

The program will provide targeted marketing efforts as needed to individual customer segments (e.g., hospitality, grocery stores, and retail) to increase participation in under-performing segments, including direct customer outreach and enhanced incentive campaigns. Additional program marketing may occur through direct mail, trade associations, local business organizations, marketing campaigns and bonuses, educational seminars, and direct personal communication from Vectren South staff and third-party contractors.

Barriers/Theory

Small business customers generally do not have the knowledge, time or money to invest in EE upgrades. This program assists these small businesses with direct installation and turn-key services to get measures installed at no or low out-of-pocket cost.

There is an implementation contractor in place providing suggested additions and changes to the program based on results and local economics.

Implementation & Delivery Strategy

Trade Ally Network: Trained trade ally energy advisors will provide energy assessments to business customers with less than 400 kW of annual peak demand. The program implementer will issue an annual Request for Qualification (RFQ) to select the trade allies with the best ability to provide high-quality and cost-effective service to small businesses, and provide training to Small Business Energy Solutions trade allies on the program process, with an emphasis on improving energy efficiency sales.

Energy Assessment: Trade allies will walk through small businesses and record site characteristics and energy efficiency opportunities at no cost to the customer. They will provide an energy assessment report that will detail customer-specific opportunities, costs, energy savings, incentives, and simple payback periods. The trade ally will then review the report with the customer, presenting the program benefits and process, while addressing any questions.

Initial Measures, Products and Services

Details of the measures, savings, and incentives can be found in Appendix B. The program will have two types of measures provided. The first are measures that will be installed at no cost to the customer. Some available measures will include, but are not limited to the following:

- LEDs: 8-12W
- LEDs: MR16 track light
- LEDs: > 12 W flood light
- Wifi-enabled thermostats
- Programmable thermostats
- Pre-rinse sprayers
- Faucet aerators

The second types of measures require the customer to pay a portion of the labor and materials. Some available measures will include, but are not limited to the following:

- Interior LED lighting (replacing incandescent, high bays and linear fluorescents)
- High-efficiency linear fluorescent lighting
- Linear fluorescent delamping
- LED exit signs
- Exterior LED lighting
- ECMs in refrigeration equipment

- Anti-sweat heater controls
- LED lighting for display cases

Incentive Strategy

In addition to the no-cost measures identified during the audit, the program will also pay a cash incentive on every recommended improvement identified through the assessment. Incentive rates may change over time and vary with special initiatives.

Program Delivery

Vectren South will oversee the program partner Nexant to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas and electric EE program in its combined natural gas and electric service territory.

Evaluation, Measurement and Verification

On-site verification will be provided for the first three projects completed by each trade ally, in addition to the program standard 5% of all completed projects and all projects receiving incentives greater than $20,000. These verifications allow the program to validate energy savings, in addition to providing an opportunity to ensure the trade allies are providing high-quality customer services and the incentivized equipment satisfies program requirements. A third party evaluator will evaluate the program using standard EM&V protocols.

Q. Commercial & Industrial New Construction

Program Description

The Commercial and Industrial New Construction Program provides value by promoting EE designs with the goal of developing projects that are more energy efficient than current Indiana building code. This program applies to new construction and major renovation projects. Major renovation is defined as the replacement of at least two systems within an existing space (e.g. lighting, HVAC, controls, building envelope). The program provides incentives as part of the facility design process to explore opportunities in modeling EE options to craft an optimal package of investments. The program also offers customers the opportunity to receive prescriptive or custom rebates toward eligible equipment in order to reduce the higher capital cost for the EE solutions.

Table 27: Commercial & Industrial New Construction Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Commercial & Industrial	**Commercial New Construction**				
	Number of Projects	18	20	18	56
	Energy Savings kWh	502,080	1,835,413	502,080	2,839,573
	Peak Demand kW	108.0	120.0	108.0	336.0
	Total Program Budget $	214,536	386,092	222,628	823,256
	Per Participant Avg Energy Savings (kWh)*				50706.7
	Per Participant Avg Demand Savings (kW)*				6.000
	Weighted Avg Measure Life*				10
	Net To Gross Ratio				100%

Eligible Customers

Any commercial or industrial customer who receives or intends to receive electric service from Vectren South.

Marketing Plan

The Commercial & Industrial New Construction Program will be marketed through trade ally meetings, trade association training, marketing campaigns and bonuses, educational seminars, and direct personal communication from Vectren South staff and third party contractors.

Barriers/Theory

There are three primary barriers addressed by the C&I New Construction program. The first is knowledge. For commercial and industrial buildings it is the knowledge and experience of the design team including the owner, architect, lighting and HVAC engineers, general contractor and others. This team may not understand new technologies and EE options that could be considered. The second barrier is cost. There is a cost during the design phase of the project in modeling EE options to see what can cost-effectively work within the building. The program provides design team incentives to help reduce the design cost for the consideration of EE upgrades. The third barrier is the first cost of the high efficiency upgrades in equipment and materials. The program provides prescriptive or custom rebates toward eligible equipment to help reduce this first cost.

Implementation & Delivery Strategy

The new construction program is designed as a proactive, cost-effective way to achieve energy efficiency savings and foster economic growth. Typically, program participants face time and cost constraints throughout the project that make it difficult to invest in sustainable building practices. Participants need streamlined and informed solutions that are specific to their projects and locations. This scenario is particularly true for small to medium-sized new construction projects, where design fees and schedules provide for a very limited window of opportunity.

To help overcome the financial challenge for small-medium size projects, we offer a Standard Energy Design Assistance (EDA). EDA targets buildings that are less than 100,000 square feet, but is also available for larger new buildings that are beyond the schematic design phase or are on an accelerated schedule. Commercial and industrial projects for buildings greater than 100,000 square feet still in the conceptual design phase qualify for Vectren South's Enhanced EDA incentives. The Vectren South implementation partner staff expert will work with the design team through the conceptual design, schematic design and design development processes providing advice and counsel on measures that should be considered and EE modeling issues. Incentives will be paid after the design team submits completed construction documents for review to verify that the facility design reflects the minimum energy savings requirements.

For those projects that are past the phase where EDA can be of benefit, the C&I New Construction program offers the opportunity to receive prescriptive or custom rebates towards eligible equipment.

Incentive Strategy

Incentives are provided to help offset some of the expenses for the design team's participation in the EDA process with the design team incentive. The design team incentive is a fixed amount based on the new/renovated conditioned square footage and is paid when the proposed EE projects associated with the construction documents exceed a minimum energy savings threshold. The program also offers customers the opportunity to receive prescriptive or custom rebates toward eligible equipment in order to reduce the higher capital cost for the EE solutions. Program specific savings and incentive include:

Facility Size – Square Feet	Design Team Incentives	Minimum Savings
Small <25,000	$750	25,000 kWh
Medium 25,000 - 100,000	$2,250	75,000 kWh
Large >100,000	$3,750	150,000 kWh
Enhance Large >100,000	$5,000	10% beyond code

Program Delivery

Vectren South will oversee the program and partner with Nexant to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas and electric EE program in its combined natural gas and electric service territory. Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric.

Evaluation, Measurement and Verification

All construction documents will be reviewed and archived. A third party evaluator will evaluate the program using standard EM&V protocols.

R. Commercial Building Tune-Up

Program Description

The Building Tune-Up (BTU) program provides a targeted, turnkey, and cost-effective retrocommissioning solution for small- to mid-sized customer facilities.

It is designed as a comprehensive customer solution that will identify, validate, quantify, and encourage the installation of both operational and capital measures. The majority of these measures will be no- or low-cost with low payback periods and will capture energy savings from a previously untapped source: building automation systems.

Table 28: Building Tune-Up Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Commercial & Industrial	**Building Tune-up**				
	Number of Projects	10	14	20	44
	Energy Savings kWh	500,000	700,000	1,000,000	2,200,000
	Peak Demand kW	1.0	1.0	1.0	3.0
	Total Program Budget $	130,880	182,074	261,266	574,220
	Per Participant Avg Energy Savings (kWh)*				50000.0
	Per Participant Avg Demand Savings (kW)*				0.068
	Weighted Avg Measure Life*				7
	Net To Gross Ratio				100%

Eligible Customers

Applicants must be both an active Vectren South electric customer on a qualifying commercial rate and an active natural gas General Service customer on Rate 120 or 125. The program will target customers with buildings between 50,000 square feet and 150,000 square feet.

Marketing Plan

The BTU Program will be marketed primarily through in-network service provider outreach and direct personal communication from Vectren South staff and third-party contractors. The program implementer will provide service provider specific-marketing collateral to support these companies as they connect with customers.

The program will provide targeted marketing efforts to recruit quality participants. Additional program marketing may occur through direct mailing, trade associations, marketing campaigns and bonuses, local business organizations, and educational seminars.

Barriers/Theory

The program will typically target customers with buildings between 50,000 square feet and 150,000 square feet. Customers in this size range face unique barriers to energy efficiency. For example, although they are large enough to have a Building Automation System (BAS), they are usually too small to have a dedicated facility manager or staff with experience achieving operational efficiency. Also, most retrocommissioning service companies prefer larger projects and their services often are too expensive for small-to-midsized customers. We have specifically tailored the incentive structure and program design to eliminate these barriers. The BTU program is designed as a comprehensive customer solution that will identify, validate, quantify, and encourage the installation of both operational and capital measures eligible for incentive offerings.

Implementation & Delivery Strategy

The BTU program is designed to encourage high levels of implementation by customers seeking to optimize the operation of their existing HVAC system. Key elements of the program approach are:

- Service Provider Network: Service providers play a key role in program marketing and outreach. Their existing relationships with building owners and knowledge of customer facilities give them an easy starting point to begin program marketing efforts. For this reason, recruiting quality providers, training them on program processes, and making the BTU program profitable for them are key strategies that drive program participation. The program implementer will issue an annual RFQ to select those service providers with the best ability to provide high-quality and cost-effective services.

- Fully Funded Service Offering: The BTU program fully funds the investigation of opportunities by the program implementer and service providers. The program also provides a cash incentive on implemented improvements.

- Customer Commitment: BTU program participants are required to commit to a spending minimum to implement a group, or “bundle,” of agreed-upon energy saving measures. This bundle of measures will have a collective estimated simple payback of 1.5 years or less based upon energy savings identified, which ensures that it benefits customers as well as the program.

- Technical Services: The program will provide the following technical services to successfully implement each BTU project:

Application Phase: Each application will be screened to verify that the customer's facility has enough energy savings potential for the BTU study. After being accepted into the program, the customer will sign the Customer Agreement to spend the minimum amount of money on a bundle of measures with a simple payback of 1.5 years or less. This agreement ensures that both the customer and Vectren South will achieve energy savings from the project.

Investigation and Implementation Phase: During the investigation and implementation phase, the program implementer and the customers' preferred in-network service provider will perform a BTU study to identify and install measures for the customer. They will generate a study report to summarize findings from the investigation and present the results to the customer. The customer will select the bundle of measures to install that meet the program minimum and payback requirements, and work with their service provider to install the selected measures.

Verification Phase: The program implementer revisits the customer's facility as needed. If any of the measures were incorrectly installed, the service provider works with the customer to fix it. The implementer and service provider calculate the final estimated energy savings from the BTU project and share those results with both the customer and Vectren South, thus ensuring that the most accurate energy savings estimate is reported.

Initial Measures, Products and Services

The BTU program will specifically target measures that provide no- and low-cost operational savings. Customized measures will be identified for each building, these could include:

- Scheduling air handling units
- Optimizing economizer and outdoor air control
- Reducing/resetting duct static pressure
- Resetting chilled water temperature

Most measures involve optimizing the building automation system (BAS) settings but the program will also investigate related capital measures, like controls, operations, processes, and HVAC.

Incentive Strategy

The BTU program fully funds the investigation of opportunities by the program implementer and service provider. The program also provides a cash incentive on implemented improvements.

Program Delivery

Vectren South will oversee the program and partner with Nexant to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas and electric EE program in its combined natural gas and electric service territory. Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric.

Evaluation, Measurement and Verification

A third party evaluator will evaluate the program using standard EM&V protocols.

S. Multi-Family Retrofit

Program Description

The Multi-Family Retrofit Program provides value by directly installing EE products such as high efficiency lighting, water-saving measures, thermostats, and vending machine controls into multi-family common areas. The program helps multi-family facilities identify and install cost-effective energy-saving measures by providing an on-site energy assessment customized for their business.

Table 29: Multi-Family Retrofit Budget & Energy Savings Targets

Market	Program	2018	2019	2020	Total Program
Commercial & Industrial	**Multi-Family Retrofit**				
	Number of Projects	4	4	4	12
	Energy Savings kWh	101,590	101,590	115,853	319,033
	Peak Demand kW	18.0	18.0	18.0	54.0
	Total Program Budget $	34,880	35,074	35,266	105,220
	Per Participant Avg Energy Savings (kWh)*				26586.1
	Per Participant Avg Demand Savings (kW)*				4.500
	Weighted Avg Measure Life*				15
	Net To Gross Ratio				100%

Eligible Customers

Applicants must be both an active Vectren South electric customer on a qualifying commercial rate and an active natural gas General Service customer on Rate 120 or 125.

Marketing Plan

The Multi-Family Retrofit Program will be marketed primarily through in-network trade ally outreach. The program implementer will provide trade ally-specific marketing collateral to support trade allies as they connect with customers.

The program will provide targeted marketing efforts as needed to increase participation, including direct customer outreach and enhanced incentive campaigns.

Additional program marketing may occur through direct mail, trade associations, local business organizations, marketing campaigns and bonuses, educational seminars, and direct personal communication from Vectren South staff and third-party contractors.

Barriers/Theory

Multi-family landlords generally do not have the knowledge, time or money to invest in EE upgrades. This program assists these customers with direct installation and turn-key services to get measures installed at no or low out-of-pocket cost.

There is an implementation contractor in place providing suggested additions and changes to the program based on results and local economics.

Implementation & Delivery Strategy

Trade Ally Network: Trained trade ally energy advisors will provide energy assessments to customers. The program implementer will issue an annual RFQ to select the trade allies with the best ability to provide high-quality and cost-effective service to customers, and provide training to trade allies on the program process, with an emphasis on improving energy efficiency sales.

Energy Assessments: Trade allies will walk through the multi-family common areas and record site characteristics and energy efficiency opportunities at no cost to the customer. They will provide an energy assessment report that will detail customer-specific opportunities, costs, energy savings, incentives, and simple payback periods. The trade ally will then review the report with the customer, presenting the program benefits and process, while addressing any questions.

Initial Measures, Products and Services

The program will have two types of measures provided. The first are measures that will be installed at no cost to the customer. They will include but are not limited to the following:

- LEDs: 8-12W
- LEDs: MR16 track light
- LEDs: > 12 W flood light
- Wi-fi enabled thermostats
- Programmable thermostats
- Pre-rinse sprayers
- Faucet aerators

The second types of measures require the customer to pay a portion of the labor and materials. These measures include:

- Interior LED lighting (replacing incandescent, high bays and linear fluorescents)
- High-efficiency linear fluorescent lighting
- Linear fluorescent delamping
- Electronically commutated motors (ECM)
- Anti-sweat heater controls
- LED exit signs
- Exterior LED lighting

Incentive Strategy

In addition to the no-cost measures identified during the audit, the program will also pay a cash incentive for all recommended improvements identified through the assessment.

Program Delivery

Vectren South will oversee the program and will partner with Nexant to deliver the program.

Integration with Vectren South Gas

Vectren South will offer this integrated natural gas and electric EE program in its combined natural gas and electric service territory. Vectren South has allocated implementation costs based on the net benefits split between natural gas and electric.

Evaluation, Measurement and Verification

On-site verification will be provided for the first three projects completed by each trade ally, in addition to the program standard 5% of all completed projects and all projects receiving incentives greater than $20,000. These verifications allow the program to validate energy savings, in addition to providing an opportunity to ensure the trade allies are providing high-quality customer services and the incentivized equipment satisfies program requirements. A third party evaluator will evaluate the program using standard EM&V protocols.

8. Program Administration

As in previous years, Vectren South will continue to serve as the program administrator for the 2018-2020 Plan. Vectren South will utilize third party program implementers to deliver specific programs or program components where specialty expertise is required. Contracting directly with specialty vendors avoids an unnecessary layer of management, oversight and expense that occurs when utilizing a third-party administration approach.

Program administration costs are allocated at the program level and include costs associated with program support and internal labor. Program support includes costs associated with outside consulting and annual license and maintenance fees for DSMore, Data Management, and Esource. Based upon the EE and DR programs proposed in the 2018 - 2020 Plan, Vectren South is proposing to maintain the staffing levels that were previously approved to support the portfolio. The major responsibilities associated with these FTEs are as follows:

- **Portfolio Management and Implementation -** Oversees the overall portfolio and staff necessary to support program administration. Serves as primary contact for regulatory and oversight of programs.
- **Reporting and Analysis -** Responsible for all aspects of program reporting including, budget analysis/reporting, scorecards and filings.
- **Outreach and Education -** Serves as contact to trade allies regarding program awareness. Also serves as point of contact for residential and commercial/industrial customers to assist with responding to program inquiries.
- **Research and Evaluation -** Works with the selected EM&V Administrator and facilitates measurement and verification efforts, assists with program reporting/tracking.

9. Support Services

Support services are considered indirect costs which support the entire portfolio and include: Contact Center, Online Audit, Outreach & Education, and Evaluation, Measurement and Verification (EM&V). These costs are budgeted at the portfolio level.

Table 30: Portfolio Level Costs by Year

Indirect Portfolio Level Costs	2018	2019	2020
Contact Center	$63,000	$63,000	$63,000
Online Audit	$36,444	$39,806	$42,911
Outreach & Education	$410,000	$410,000	$410,000
Evaluation	$427,992	$447,304	$444,314
Total Indirect Portfolio Level Costs	**$937,436**	**$960,110**	**$960,225**

A. Contact Center

The Vectren Contact Center, called the Energy Efficiency Advisory Team, fields referrals from the company's general call center and serves as a resource for interested customers. A toll-free number is provided on all outreach and education materials. Direct calls are initial contacts from customers or market providers coming through the dedicated toll free number printed on all Vectren South's energy efficiency materials. Transferred calls are customers that have spoken with a Vectren Contact Center representative and have either asked or been offered a transfer to an Energy Efficiency Advisor who is trained to respond to energy efficiency questions or conduct the on-line energy audit.

These customer communication channels provide support mechanisms for Vectren South customers to receive the following services:

- Provide general guidance on energy saving behaviors and investments using customer specific billing data via the on-line tool (bill analyzer and energy audit).
- Respond to questions about the residential and general service programs.
- Facilitate the completion of and provide a hard copy report from the online audit tool for customers without internet access or who have difficulty understanding how to use the tool.
- Respond to inquiries about rebate fulfillment status.

B. Online Audit

The Online Energy Audit tool is a customer engagement and messaging tool that uses actual billing data from a customer's energy bills to pinpoint ways to save energy in their home. Data collected drives account messaging through providing tips and rebates relevant to that customer's situation. Additionally, data collected from the online energy audit is used to validate neighbor comparison data, which illustrates how the customer's monthly energy use compares to their neighbors and is designed to inspire customers to try and save more energy than their efficient neighbors. This tool provides the online ability and means to communicate, cross promote, and educate customers about energy efficiency and Vectren's energy efficiency programs. The Online Energy Audit tool provides tools and messaging to educate customers and provide suggestions, tips, and advice on energy usage.

C. Outreach & Education

Vectren South's Customer Outreach and Education program serves to raise awareness and drive customer participation as well as educate customers on how to manage their energy bills. The program includes the following goals as objectives:

- Build awareness;
- Educate consumers on how to conserve energy and reduce demand;
- Educate customers on how to manage their energy costs and reduce their bill;
- Communicate support of customer EE needs; and
- Drive participation in the EE and DR programs.

The marketing approach includes paid media as well as web-based tools to help analyze bills, energy audit tools, EE and DSM program education and information. Informational guides and sales promotion materials for specific programs are included in this budget.

This effort is the key to achieving greater energy savings by convincing the families and businesses making housing/facility, appliance and equipment investments to opt for greater EE. The first step in convincing the public and businesses to invest in EE is to raise their awareness.

It is essential that a broad public education and outreach campaign not only raise awareness of what consumers can do to save energy and control their energy bills, but also prime them for participation in the various EE and DR programs.

Vectren South will oversee outreach and education for the programs and work closely with implementation partners to provide consistent messaging across different program outreach and education efforts. Vectren South will utilize the services of communication and EE experts to deliver the EE and DR message.

The Outreach budget also includes funds for program development and staff training. Examples of these costs include memberships to EE related organizations, outreach for home/trade shows and travel and training related to EE associated staff development.

D. Evaluation

Vectren South will work with an independent third party evaluator, selected by the VOB, to conduct an evaluation of DSM programs approved as part of its 2018-2020 Plan. The evaluation will include standard EM&V analyses, such as a process, impact, and/or market effects evaluation of Vectren South's portfolio of DSM programs. Gas impacts will be calculated for all of Vectren South's integrated gas programs. EM&V costs are based on 5% of the budget and allocated at the portfolio level.

10. Other Costs

Other costs being requested in the 2018-2020 filed plan include a Market Potential Study and funding for Emerging Markets.

Table 31: Other Costs by Year

Other Costs	2018	2019	2020
Emerging Markets	$200,000	$200,000	$200,000
Market Potential Study	$300,000	$0	$0
Total	**$500,000**	**$200,000**	**$200,000**

A. Emerging Markets

The Emerging Markets funding allows Vectren's DSM portfolio to offer leading-edge program designs for next-generation technologies, services, and engagement strategies to growing markets in the Vectren territory. The budget will be $200,000 each year for 2018-2020 and will not be used to support existing programs, but rather support new program development or new measures within an existing program.

Incentives promoted through this program may range from innovative rebate offerings to engineering and trade ally assistance to demand-control services that encourage early adoption of new, efficient technologies in high-impact market sectors. Depending on the development of certain technologies and growth areas in the service territory, a wide variety of projects and services are eligible.

To offset the risks of oversaturation of common prescriptive measures and redefined prescriptive baselines, this program will bring to market next generation technologies and energy-saving strategies that have significant savings and cost-effectiveness potential. As new technologies develop towards lower costs and higher efficiency, their market penetration and energy-savings potential will increase. This program will allow Vectren to be on the forefront of emerging technologies to understand the market disruption a new product may cause, test strategies for capturing their energy-saving opportunities, and plan for future program savings growth. This offering will supplement the other DSM programs that do not easily fit into other program offerings. Additionally, growing segments of Vectren South electric customers may require tailored offerings to accommodate their needs in order to participate.

Because this program will focus on innovative new approaches and leading the DSM market, the exact list of measures cannot be set at this time. However, potential measures and services include: new technologies, such as Advanced Lighting Controls; new strategies for achieving significant energy savings, such as midstream incentives, contractor bids to provide energy efficiency projects, and targeting high-impact market sectors; and integrated DSM (iDSM) approaches, such as demand response, combined energy efficiency and demand response measures, and load shifting.

Emerging technologies and measures will be reviewed and may be offered using this funding as long as they do not fall into a current program offering. Innovative engagement and incentivizing approaches may also be used as a tool to provide reduced costs to new systems, equipment and/or services to help reduce peak demand and electric usage. This program also allows Vectren to take steps toward an integrated Demand Side Management approach to address both energy efficiency and demand response together.

B. Market Potential Study

Vectren South is requesting $300,000 to complete a full blown Market Potential Study (MPS) for the years of 2020 and beyond, which is scheduled for 2018. Vectren will issue a Request for Quote to select a consultant to perform this work.

11. Conclusion

Vectren South has developed a 2018-2020 Electric Energy Efficiency Plan that is aligned with the 2016 Integrated Resource Plan and is reasonably achievable and cost effective. The cost effectiveness analysis was performed for 2018-2020 using the DSMore model – a nationally recognized economic analysis tool that is specifically designed to evaluate the cost effectiveness of implementing energy efficiency and demand response programs.

Program costs were determined by referencing 2016 program delivery costs, based on prior contracts and performance in the field and consultation with the program vendors that will deliver the DSM Plan. Energy and demand savings were primarily determined by using recent EM&V results and the IN TRM version 2.2. For measures that were not addressed in the IN TRM or EM&V, Vectren South used Technical Resource Manual resources from nearby states or vendor input. Vectren South utilized the avoided costs from Figure 10.13 in the 2016 IRP.

Based on this information, Vectren South requests IURC approval of this 2018-2020 DSM Plan as well as the costs associated with Emerging Markets and the Market Potential study for 2020 and beyond.

12. Appendix A: Cost Effectiveness Tests Benefits & Costs Summary

Test	Benefits	Costs
Participant Cost Test	• Incentive payments • Annual bill savings • Applicable tax credits	• Incremental technology/equipment costs • Incremental installation costs
Utility Cost Test (Program Administrator Cost Test)	• Avoided energy costs • Avoided capacity costs	• All program costs (startup, marketing, labor, evaluation, promotion, etc.) • Utility/Administrator incentive costs
Rate Impact Measure Test	• Avoided energy costs • Avoided capacity costs	• All program costs (startup, marketing, labor, evaluation, promotion, etc.) • Utility/Administrator incentive costs • Lost revenue due to reduced energy bills
Total Resource Cost Test	• Avoided energy costs • Avoided capacity costs • Applicable participant tax credits	• All program costs (not including incentive costs) • Incremental technology/equipment costs (whether paid by the participant or the utility)

13. Appendix B: Program Measure Detail

Program	Measure	Measure Life	Average Savings per Unit (kWh	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
Residential Programs												
Residential Lighting	Standard Units		27.75	0.00	146,465	164,424	80,000		$ 3	4,064,403	4,562,766	2,220,000
Residential Lighting	Specialty Units		44.00	0.01	62,698	67,962	69,716		$ 4	2,758,712	2,990,328	3,067,504
Residential Lighting	LED Fixtures		57.48	0.01	13,700	13,700	13,700		$ 20	787,501	787,501	787,501
Total Residential Lighting					**222,863**	**246,086**	**163,416**			**7,610,617**	**8,340,595**	**6,075,005**
Residential Prescriptive	Air Source Heat Pump 16 SEER	18	1,154.92	0.30	52	52	52	$ 300	$ 870	60,056	60,056	60,056
Residential Prescriptive	Air Source Heat Pump 18 SEER	18	1,625.77	0.35	9	9	9	$ 500	$ 870	14,632	14,632	14,632
Residential Prescriptive	Attic Insulation - Elec Heated	25	3,382.75	0.30	13	13	13	$ 450	$ 500	43,976	43,976	43,976
Residential Prescriptive	Attic Insulation - Gas Heated South (Electric)	25	339.71	0.30	36	36	36	$ 450	$ 500	12,229	12,229	12,229
Residential Prescriptive	Central Air Conditioner 16 SEER	18	294.63	0.35	644	644	644	$ 200	$ 400	189,745	189,745	189,745
Residential Prescriptive	Central Air Conditioner 18 SEER	18	573.88	0.33	76	76	76	$ 400	$ 800	43,615	43,615	43,615
Residential Prescriptive	Dual Fuel Air Source Heat Pump 16 SEER	18	767.06	0.34	0	0	0	$ 300	$ 1,000	0	0	0
Residential Prescriptive	Duct Sealing Electric Heat Pump - South	20	829.21	0.44	7	7	7	$ 350	$ 400	5,804	5,804	5,804
Residential Prescriptive	Duct Sealing Electric Resistive Furnace - South	20	1,351.93	0.40	0	0	0	$ 350	$ 400	0	0	0
Residential Prescriptive	Duct Sealing Gas Heating with A/C - South (Electric)	20	228.61	0.40	77	77	77	$ 175	$ 200	17,603	17,603	17,603
Residential Prescriptive	Ductless Heat Pump 17 SEER 9.5 HSPF	18	3,847.40	0.29	2	2	2	$ 500	$ 1,667	7,695	7,695	7,695
Residential Prescriptive	Ductless Heat Pump 19 SEER 9.5 HSPF	18	3,919.89	0.40	7	7	7	$ 500	$ 2,333	27,439	27,439	27,439
Residential Prescriptive	Ductless Heat Pump 21 SEER 10.0 HSPF	18	3,924.75	0.29	2	2	2	$ 500	$ 2,833	7,850	7,850	7,850
Residential Prescriptive	Ductless Heat Pump 23 SEER 10.0 HSPF	18	4,032.45	0.31	11	11	11	$ 500	$ 3,333	44,357	44,357	44,357
Residential Prescriptive	Duel Fuel Air Source Heat Pump 18 SEER	18	1,498.67	0.13	0	0	0	$ 500	$ 1,667	0	0	0
Residential Prescriptive	ECM HVAC Motor	20	384.72	0.10	1,107	1,107	1,107	$ 100	$ 97	425,884	425,884	425,884
Residential Prescriptive	Heat Pump Water Heater	10	2,291.38	0.31	2	2	2	$ 300	$ 1,000	4,583	4,583	4,583
Residential Prescriptive	Nest On-Line Store (Electric)	15	466.69	0.90	300	350	400	$ 75	$ 39	140,007	163,342	186,676
Residential Prescriptive	Nest On-Line Store (Dual)	15	377.71	0.90	900	1,000	1,100	$ 15	$ 175	339,939	377,710	415,481
Residential Prescriptive	Pool Heater	10	666.87	0.00	1	1	1	$ 1,000	$ 3,333	667	667	667
Residential Prescriptive	Wifi Thermostat - South (Electric)	15	405.09	0.00	264	264	264	$ 10	$ 21	106,944	106,944	106,944
Residential Prescriptive	Smart Programmable Thermostat - South (Electric)	15	412.19	0.00	428	428	428	$ 15	$ 39	176,417	176,417	176,417
Residential Prescriptive	Variable Speed Pool Pump	15	1,173.00	1.72	18	18	18	$ 300	$ 750	21,114	21,114	21,114
Residential Prescriptive	Wall Insulation - Elec Heated	25	1,158.34	0.04	5	5	5	$ 450	$ 500	5,792	5,792	5,792
Residential Prescriptive	Wall Insulation - Gas Heated - South (Electric)	25	60.29	0.04	32	32	32	$ 450	$ 500	1,929	1,929	1,929
Residential Prescriptive	AC Tune Up	5	75.64	0.12	0	644	644	$ 50	$ 64	0	48,710	48,710
Residential Prescriptive	ASHP Tune Up	5	284.99	0.12	0	22	22	$ 50	$ 64	0	6,270	6,270
Residential Prescriptive	Air Purifier	9	492.70	0.06	100	100	100	$ 25	$ 70	49,270	49,270	49,270
Residential Prescriptive	Furnace Tune Up	2	35.51	0.00	0	1,536	1,536	$ -	$ -	0	54,543	54,543
Total Residential Prescriptive					**4,093**	**6,445**	**6,595**			**1,747,547**	**1,918,174**	**1,979,280**
Residential New Construction	Gold Star: HERS Index Score ≤ 65 - EH	25	954.15	0.64	0	0	0	$ 700	$ 2,504	0	0	0
Residential New Construction	Gold Star: HERS Index Score ≤ 65 - Gas Heated	25	954.15	0.64	22	22	22	$ 175	$ 1,573	20,991	20,991	20,991
Residential New Construction	Platinum Star: HERS Index Score ≤ 60 - EH	25	1,419.20	0.89	1	1	1	$ 800	$ 3,079	1,419	1,419	1,419
Residential New Construction	Platinum Star: HERS Index Score ≤ 60-Gas Heated	25	1,419.20	0.89	116	116	116	$ 200	$ 1,778	164,627	164,627	164,627
Total Residential New Construction					**139**	**139**	**139**			**187,038**	**187,038**	**187,038**

Program	Measure	Measure Life	Average Savings per Unit (kWh	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
HEA & Weatherization	Water Heater Temperature Setback - Elec DHW	4	86.40	0.01	15	15	15		$ 7	1,296	1,296	1,296
HEA & Weatherization	Wifi Thermostat - South (Electric)	15	405.09	0.00	399	399	399		$ 21	161,631	161,631	161,631
HEA & Weatherization	Exterior LED Lamp	15	91.98	0.00	1,210	1,210	1,210		$ 8	111,296	111,296	111,296
HEA & Weatherization	Duct Sealing Gas Heating with A/C	15	228.61	0.40	64	64	64		$ 200	14,631	14,631	14,631
HEA & Weatherization	Duct Sealing Electric Heat Pump	15	829.21	0.44	8	8	8		$ 400	6,634	6,634	6,634
HEA & Weatherization	Duct Sealing Electric Resistive Furnace	15	1,351.93	0.40	4	4	4		$ 400	5,408	5,408	5,408
HEA & Weatherization	Air Sealing Gas Furnace w/ CAC	15	140.27	0.39	258	258	258		$ 100	36,190	36,190	36,190
HEA & Weatherization	Air Sealing Heat Pump	15	1,501.47	0.28	30	30	30		$ 200	45,044	45,044	45,044
HEA & Weatherization	Air Sealing Electric Furnace w/ CAC	15	4,687.85	0.92	15	15	15		$ 200	70,318	70,318	70,318
HEA & Weatherization	AC Tune Up	5	75.64	0.12	0	0	0		$ 175	0	0	0
HEA & Weatherization	ASHP Tune Up	5	284.99	0.12	0	0	0		$ 350	0	0	0
HEA & Weatherization	Furnace Tune Up	2	35.51	0.00	0	0	0		$ -	0	0	0
Total HEA & Weatherization					**15,158**	**15,158**	**15,158**			**863,991**	**863,991**	**863,991**
	Number of Homes				1,210	1,210	1,210					
Income Qualified Weatherization	Water Heater Temperature Setback - Gas DHW	4	-34.20	0.00	0	0	0		$ 7	0	0	0
Income Qualified Weatherization	Attic Insulation - Electric Resistance Heated	25	828.28	0.03	24	25	26		$ 1,413	19,879	20,707	21,535
Income Qualified Weatherization	Attic Insulation - Gas Heated (Electric)	25	138.64	0.14	238	250	263		$ 706	32,997	34,661	36,463
Income Qualified Weatherization	Audit Recommendations - dual (Electric)	1	67.87	0.01	475	500	525		$ 26	32,239	33,936	35,633
Income Qualified Weatherization	Audit Recommendations - Electric Only	1	67.87	0.01	0	0	0		$ 106	0	0	0
Income Qualified Weatherization	Bathroom Aerator 1.0 gpm - Elec DHW	10	12.03	0.00	145	153	160		$ 1	1,744	1,841	1,925
Income Qualified Weatherization	9W LED	15	18.66	0.00	2,170	2,284	2,399		$ 3	40,501	42,628	44,775
Income Qualified Weatherization	LED 5W Globe	15	10.37	0.00	93	98	102		$ 9	964	1,016	1,058
Income Qualified Weatherization	LED R30 Dimmable	15	52.98	0.01	365	385	404		$ 12	19,337	20,396	21,403
Income Qualified Weatherization	Exterior LED Lamps	15	91.98	0.00	285	300	315		$ 7	26,214	27,594	28,974
Income Qualified Weatherization	Filter Whistle	15	54.72	0.00	190	200	210		$ 2	10,397	10,944	11,491
Income Qualified Weatherization	Kitchen Flip Aerator 1.5 gpm - Elec DHW	10	120.03	0.01	42	44	47		$ 1	5,041	5,281	5,641
Income Qualified Weatherization	LED Nightlight	16	13.64	0.00	887	933	980		$ 3	12,095	12,723	13,364
Income Qualified Weatherization	Low Flow Showerhead 1.5 gpm - Elec DHW	5	299.86	0.01	89	93	98		$ 3	26,688	27,887	29,386
Income Qualified Weatherization	Pipe Wrap - Elec DHW (per home)	15	148.16	0.02	42	44	47		$ 2	6,223	6,519	6,964
Income Qualified Weatherization	Wifi Thermostat - South (Electric)	15	405.19	0.00	262	276	290		$ 25	106,160	111,832	117,505
Income Qualified Weatherization	Refrigerator Replacement	8	441.56	0.07	63	67	70		$ 580	27,818	29,584	30,909
Income Qualified Weatherization	Smart Power Strips	4	23.00	0.00	570	600	630		$ 35	13,110	13,800	14,490
Income Qualified Weatherization	Smart Thermostat (Electric)	15	412.19	0.00	47	49	52		$ 125	19,373	20,197	21,434
Income Qualified Weatherization	Water Heater Temperature Setback - Elec DHW	4	86.40	0.01	135	142	150		$ 7	11,664	12,269	12,960
Income Qualified Weatherization	Duct Sealing Gas Heating with A/C	15	228.61	0.40	303	319	335		$ 225	69,270	72,928	76,585
Income Qualified Weatherization	Duct Sealing Electric Heat Pump	15	829.21	0.44	36	38	39		$ 450	29,852	31,510	32,339
Income Qualified Weatherization	Duct Sealing Electric Resistive Furnace	15	1,351.93	0.40	18	19	20		$ 450	24,335	25,687	27,039
Income Qualified Weatherization	Air Sealing Gas Furnace w/ CAC	15	140.27	0.39	303	319	335		$ 100	42,502	44,746	46,990
Income Qualified Weatherization	Air Sealing Heat Pump	15	1,501.47	0.28	36	38	39		$ 200	54,053	57,056	58,557
Income Qualified Weatherization	Air Sealing Electric Furnace w/ CAC	15	4,687.85	0.92	18	19	20		$ 200	84,381	89,069	93,757
Income Qualified Weatherization	AC Tune Up	5	75.64	0.12	0	0	0		$ 200	0	0	0
Income Qualified Weatherization	ASHP Tune Up	5	284.99	0.12	0	0	0		$ 400	0	0	0
Income Qualified Weatherization	9W LED	15	18.66	0.00	766	919	1,072		$ 3	14,297	17,152	20,008
Income Qualified Weatherization	LED 5W Globe	15	10.37	0.00	45	54	64		$ 9	467	560	664
Income Qualified Weatherization	LED R30 Dimmable	15	52.98	0.01	179	215	251		$ 12	9,483	11,390	13,297
Income Qualified Weatherization	Wifi Thermostat - South (Electric)	15	405.19	0.00	29	35	40		$ 25	11,751	14,182	16,208
Income Qualified Weatherization	Site Visit and DI - dual (Electric)	1	0.00	0.00	100	120	140		$ 23	0	0	0
Income Qualified Weatherization	9W LED	15	18.66	0.00	1,250	1,500	1,750		$ 3	23,330	27,996	32,662
Income Qualified Weatherization	LED 5W Globe	15	10.37	0.00	114	136	159		$ 9	1,182	1,410	1,649
Income Qualified Weatherization	LED R30 Dimmable	15	52.98	0.01	250	300	350		$ 12	13,244	15,893	18,542
Income Qualified Weatherization	Bathroom Aerator 1.0 gpm - Electric DHW	10	12.03	0.00	23	28	32		$ 1	277	337	385
Income Qualified Weatherization	Kitchen Flip Aerator 1.5 gpm - Electric DHW	10	120.03	0.01	11	13	15		$ 1	1,320	1,560	1,800
Income Qualified Weatherization	Low Flow Showerhead 1.5 gpm - Electric DHW	5	299.86	0.01	29	35	40		$ 3	8,696	10,495	11,994
Income Qualified Weatherization	Wifi Thermostat - South (Electric)	15	405.19	0.00	72	87	101		$ 25	29,174	35,252	40,924
Income Qualified Weatherization	Duct Sealing Gas Heating with A/C	15	114.31	0.20	213	255	298		$ 225	24,347	29,148	34,063
Income Qualified Weatherization	Duct Sealing Electric Heat Pump	15	414.61	0.22	13	15	18		$ 450	5,390	6,219	7,463
Income Qualified Weatherization	Duct Sealing Electric Resistive Furnace	15	675.96	0.20	25	30	35		$ 450	16,899	20,279	23,659
Income Qualified Weatherization	Air Sealing Gas Furnace w/ CAC	15	70.14	0.19	213	255	298		$ 100	14,939	17,884	20,900

Program	Measure	Measure Life	Average Savings per Unit (kWh)	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
Income Qualified Weatherization	Air Sealing Heat Pump	15	1,501.47	0.28	36	38	39		$ 200	54,053	57,056	58,557
Income Qualified Weatherization	Air Sealing Electric Furnace w/ CAC	15	4,687.85	0.92	18	19	20		$ 200	84,381	89,069	93,757
Income Qualified Weatherization	AC Tune Up	5	75.64	0.12	0	0	0		$ 200	0	0	0
Income Qualified Weatherization	ASHP Tune Up	5	284.99	0.12	0	0	0		$ 400	0	0	0
Income Qualified Weatherization	9W LED	15	18.66	0.00	766	919	1,072		$ 3	14,297	17,152	20,008
Income Qualified Weatherization	LED 5W Globe	15	10.37	0.00	45	54	64		$ 9	467	560	664
Income Qualified Weatherization	LED R30 Dimmable	15	52.98	0.01	179	215	251		$ 12	9,483	11,390	13,297
Income Qualified Weatherization	Wifi Thermostat - South (Electric)	15	405.19	0.00	29	35	40		$ 25	11,751	14,182	16,208
Income Qualified Weatherization	Site Visit and DI - dual (Electric)	1	0.00	0.00	100	120	140		$ 23	0	0	0
Income Qualified Weatherization	9W LED	15	18.66	0.00	1,250	1,500	1,750		$ 3	23,330	27,996	32,662
Income Qualified Weatherization	LED 5W Globe	15	10.37	0.00	114	136	159		$ 9	1,182	1,410	1,649
Income Qualified Weatherization	LED R30 Dimmable	15	52.98	0.01	250	300	350		$ 12	13,244	15,893	18,542
Income Qualified Weatherization	Bathroom Aerator 1.0 gpm - Electric DHW	10	12.03	0.00	23	28	32		$ 1	277	337	385
Income Qualified Weatherization	Kitchen Flip Aerator 1.5 gpm - Electric DHW	10	120.03	0.01	11	13	15		$ 1	1,320	1,560	1,800
Income Qualified Weatherization	Low Flow Showerhead 1.5 gpm - Electric DHW	5	299.86	0.01	29	35	40		$ 3	8,696	10,495	11,994
Income Qualified Weatherization	Wifi Thermostat - South (Electric)	15	405.19	0.00	72	87	101		$ 25	29,174	35,252	40,924
Income Qualified Weatherization	Duct Sealing Gas Heating with A/C	15	114.31	0.20	213	255	298		$ 225	24,347	29,148	34,063
Income Qualified Weatherization	Duct Sealing Electric Heat Pump	15	414.61	0.22	13	15	18		$ 450	5,390	6,219	7,463
Income Qualified Weatherization	Duct Sealing Electric Resistive Furnace	15	675.96	0.20	25	30	35		$ 450	16,899	20,279	23,659
Income Qualified Weatherization	Air Sealing Gas Furnace w/ CAC	15	70.14	0.19	213	255	298		$ 100	14,939	17,884	20,900
Income Qualified Weatherization	Air Sealing Heat Pump	15	750.74	0.14	13	15	18		$ 200	9,760	11,261	13,513
Income Qualified Weatherization	Air Sealing Electric Furnace w/ CAC	15	2,343.93	0.46	25	30	35		$ 200	58,598	70,318	82,037
Income Qualified Weatherization	Mobile Home Audit (Dual)	1	0.00	0.00	213	255	298		$ 26	0	0	0
Income Qualified Weatherization	Mobile Home Audit (Electric)	1	0.00	0.00	38	45	53		$ 106	0	0	0
Total Income Qualified Weatherization					**10,457**	**11,537**	**12,623**			**959,988**	**1,046,148**	**1,130,945**
	Number of Homes				475	500	525					
Foodbank	**9W LED**	**15**	**27.75**	**0.00**	**50,496**	**50,496**	**0**		**$ 3**	**1,401,264**	**1,401,264**	**0**
Energy Efficient Schools	15-watt LED x1	15	39.33		2,400	2,500				94,403	98,336	0
Energy Efficient Schools	11-watt LED	15	43.69		2,400	2,500				104,863	109,232	0
Energy Efficient Schools	11-watt LED	15	43.69		2,400	2,500				104,863	109,232	0
Energy Efficient Schools	Showerheads	5	122.64		2,400	2,500	2,600			294,330	306,594	318,864
Energy Efficient Schools	Kitchen aerators	10	55.83		2,400	2,500	2,600			133,987	139,569	145,152
Energy Efficient Schools	Bathroom aerators	10	20.04		2,400	2,500	2,600			48,094	50,098	52,102
Energy Efficient Schools	Bathroom aerators	10	20.04		2,400	2,500	2,600			48,094	50,098	52,102
Energy Efficient Schools	Filter Whistle	5	22.60		2,400	2,500	2,600			54,240	56,500	58,760
Energy Efficient Schools	LED Night Light	16	7.01		2,400	2,500	2,600			16,833	17,534	18,236
Total Energy Efficient Schools					**2,400**	**2,500**	**2,600**			**899,706**	**937,194**	**645,216**
Residential Behavorial Savings		**1**	**157.08**		**41,348**	**38,203**	**35,298**			**6,470,000**	**5,970,000**	**5,600,000**
Appliance Recycling	Refrigerator Recycling	8	1,000.09	0.14	760	744	736	$ 50		760,068	744,067	736,066
Appliance Recycling	Freezer Recycling	8	808.96	0.10	190	186	184	$ 50		153,702	150,467	148,849
Total Appliance Recycling					**950**	**930**	**920**			**913,771**	**894,534**	**884,915**
Smart Thermostat Program (Incentive)		15			2,000	2,000	2,000	$ 20				
												Savings
Conservation Voltage Reduction - Residential		**15**										**1,461,047**
Smart DLC - Wifi DR/DLC Changeout		**15**	**466.69**	**0.90**	**1,000**	**1,000**		**$ 20**		**466,690**	**466,690**	**466,690**
BYOT (Bring Your Own Thermostat)		**15**		**0.90**	**300**	**300**	**300**	**$ 20**				
Sub-Total Residential										**21,520,612**	**22,025,627**	**19,294,126**

Program	Measure	Measure Life	Average Savings per Unit (kWh	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
C&I Prescriptive	Lighting Power Density Reduction	15	0.9	0.0002	4	3	4	15754.5	-	4	3	4
C&I Prescriptive	LED Decoratives	10	147.0	0.0460	2231	1892	2170	10	20.62	327,957	278,124	318,990
C&I Prescriptive	T12/T8 4 Lamp 4' To LED Panel	15	288.0	0.0755	1069	907	1040	40	91.64	307,872	261,216	299,520
C&I Prescriptive	T12/T8 3 Lamp 4' To LED Panel	15	261.0	0.0485	578	491	563	40	81.80	150,858	128,151	146,943
C&I Prescriptive	T12/T8 2 Lamp 4' To LED Panel	15	226.0	0.0350	513	435	499	40	37.41	115,938	98,310	112,774
C&I Prescriptive	T12/T8 Lamp 4' to LED Tube (includes U-tube)	15	105.0	0.0174	398	338	388	5	22.85	41,790	35,490	40,740
C&I Prescriptive	Fixture Mounted Occupancy Sensor	8	150.1	0.0182	360	305	350	15	125.00	54,035	45,780	52,534
C&I Prescriptive	High Bay HID to LED 175W+	16	780.2	0.2351	293	249	285	90	340.61	228,610	194,279	222,368
C&I Prescriptive	Bonus Incentive - Electric	0	-	-	259	750	0	50	-	-	-	-
C&I Prescriptive	1000W HID to Exterior LED	15	3,143.7	-	250	212	244	200	330.07	785,916	666,457	767,054
C&I Prescriptive	T12/T8 48” 1 Lamp To Delamp (includes U-tubes)	11	116.0	0.0460	202	171	196	5	15.02	23,439	19,842	22,743
C&I Prescriptive	251-400W Post Fixture LED	15	1,122.0	-	148	126	144	120	543.96	166,063	141,378	161,574
C&I Prescriptive	<= 175W Parking Garage or Canopy Fixture to LED	15	524.6	0.0194	94	80	91	50	240.34	49,314	41,970	47,740
C&I Prescriptive	251-400W Parking Garage or Canopy Fixture to LED	15	1,360.7	0.0693	90	76	87	120	257.23	122,466	103,416	118,384
C&I Prescriptive	<= 175W Wallpack to LED	15	583.4	0.0148	86	73	84	50	227.82	50,170	42,586	49,004
C&I Prescriptive	176-250W Wallpack to LED	15	873.6	-	67	57	65	65	316.05	58,534	49,798	56,787
C&I Prescriptive	Occupancy Sensor - Wall Mounted <500W	8	420.4	0.0114	65	55	63	20	42.00	27,324	23,120	26,483
C&I Prescriptive	251-400W Wallpack to LED 75W+	15	1,438.2	-	56	48	55	120	354.13	80,538	69,033	79,100
C&I Prescriptive	T12 or T8 2-Lamp 8-Foot to LED Panel or Kit	15	217.5	0.0457	46	39	45	40	175.56	10,005	8,483	9,788
C&I Prescriptive	T12 96" 4 Lamp To T8 96" 4 Lamp	15	348.4	0.1018	34	29	33	12	202.04	11,846	10,104	11,497
C&I Prescriptive	<= 175W Post Fixture LED	16	556.7	-	33	28	32	50	278.89	18,371	15,588	17,814
C&I Prescriptive	2 Lamp 4ft T12 to 2 Lamp 4ft HPT8	15	46.1	0.0228	28	24	28	6	47.68	1,290	1,105	1,290
C&I Prescriptive	176-250W Post Fixture LED	15	988.8	-	28	24	27	65	398.61	27,686	23,731	26,697
C&I Prescriptive	T12 6' To Refrigerated Display Case Lighting 6' LED - Cooler	8.1	496.9	0.0494	27	23	26	30	137.14	13,418	11,430	12,921
C&I Prescriptive	Fluorescent Exit Sign To LED Exit Sign	16	92.3	0.0106	23	19	22	30	24.91	2,124	1,754	2,031
C&I Prescriptive	176-250W Parking Garage or Canopy Fixture to LED	15	916.1	-	19	16	19	65	295.80	17,405	14,657	17,405
C&I Prescriptive	T8 5' To Refrigerated Display Case Lighting 5' LED - Cooler	8.1	332.5	0.0500	17	15	17	15	150.00	5,652	4,987	5,652
C&I Prescriptive	Cooler - Walk-In Electronically Commutated (EC) Motor	15	357.0	0.0500	13	11	13	35	50.00	4,641	3,927	4,641
C&I Prescriptive	Occupancy Sensor - Ceiling Mounted <500w	8	604.2	0.0144	10	8	9	20	66.00	6,042	4,834	5,438
C&I Prescriptive	Split System Unitary Air Conditioner <65,000 BtuH	15	638.9	0.0682	10	8	9	120	282.11	6,389	5,111	5,750
C&I Prescriptive	T12/T8 U-Tube 2 Lamp 2' To LED Panel	15	185.0	0.0267	8	7	8	30	179.14	1,480	1,295	1,480
C&I Prescriptive	T12 48" 4 Lamp To T8 48" 28W 4 Lamp	15	240.1	0.0440	8	7	8	14	36.19	1,921	1,681	1,921
C&I Prescriptive	Wifi Thermostat - Electric Only	15	4,720.3	-	8	7	16	100	200.00	37,763	33,042	75,526
C&I Prescriptive	Programmable Thermostat - Electric Only	15	4,720.3	-	8	7	16	100	200.00	37,763	33,042	75,526
C&I Prescriptive	Occupancy Sensor - Ceiling Mounted 500W+	8	176.7	0.0617	7	6	7	40	66.00	1,237	1,060	1,237
C&I Prescriptive	T12/T8 1 Lamp 4' To LED Panel	15	129.4	0.0436	7	6	7	30	83.42	906	776	906
C&I Prescriptive	2 Lamp 8ft T12 to 4 Lamp 4ft HPT8	15	41.1	0.0110	7	6	7	25	132.19	288	247	288
C&I Prescriptive	ENERGY STAR Commercial Ice Machine < 500 lb/day harvest rate	9	230.4	0.0338	5	5	5	100	296.00	1,152	1,152	1,152
C&I Prescriptive	Delamp 2' T12	11	36.4	0.0200	5	4	5	2.5	-	182	146	182
C&I Prescriptive	VFD Supply Fan <100hp	15	35,640.0	0.0149	4	3	4	900	10,915.00	142,560	106,920	142,560
C&I Prescriptive	Interior 1000W HID to LED	16	898.6	0.0199	4	3	4	110	-	3,594	2,696	3,594
C&I Prescriptive	2x2 Panel	15	144.0	0.0377	4	3	4	20	45.82	576	432	576
C&I Prescriptive	Split System Unitary Air Conditioner 65,000-135,000 BtuH	15	1,689.3	0.0424	3	2	3	240	666.67	5,068	3,379	5,068
C&I Prescriptive	ENERGY STAR Commercial Hot Holding Cabinets Full Size	12	5,256.0	0.8100	3	2	3	420	1,110.00	15,768	10,512	15,768
C&I Prescriptive	Split System Unitary Air Conditioner 135,000-240,000 BtuH	15	4,865.3	0.0442	2	2	2	600	1,100.00	9,731	9,731	9,731
C&I Prescriptive	ENERGY STAR CEE Tier 2 Window\Sleeve\Room AC < 14,000 BTUH	15	232.2	0.2248	1	1	1	20	-	232	232	232
C&I Prescriptive	ENERGY STAR CEE Tier 2 Window\Sleeve\Room AC >= 14,000 BTUH	15	363.3	0.4430	1	1	1	22	-	363	363	363
C&I Prescriptive	Split System Unitary Air Conditioner 240,000-760,000 BtuH	15	27,827.4	0.2015	1	1	1	1200	2,000.00	27,827	27,827	27,827
C&I Prescriptive	Split System Unitary Air Conditioner >760,000 BtuH	15	81,970.0	2.8190	1	1	1	1050	-	81,970	81,970	81,970
C&I Prescriptive	ENERGY STAR Window\Sleeve\Room AC < 14,000 BTUH	15	189.8	0.1628	1	1	1	12	-	190	190	190
C&I Prescriptive	ENERGY STAR Window\Sleeve\Room AC >= 14,000 BTUH	15	293.3	0.3208	1	1	1	14	-	293	293	293
C&I Prescriptive	ENERGY STAR CEE Tier 1 Window\Sleeve\Room AC < 14,000 BTUH	15	189.8	0.1135	1	1	1	16	-	190	190	190
C&I Prescriptive	ENERGY STAR CEE Tier 1 Window\Sleeve\Room AC >= 14,000 BTUH	15	293.3	0.2237	1	1	1	18	-	293	293	293
C&I Prescriptive	Electric Chiller - Air cooled, with condenser	20	9,606.6	0.0031	1	1	1	1500	-	9,607	9,607	9,607
C&I Prescriptive	Electric Chiller Tune-up - Air cooled, without condenser	5	8,153.0	0.0013	1	1	1	400	-	8,153	8,153	8,153

Program	Measure	Measure Life	Average Savings per Unit (kWh	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
C&I Prescriptive	Electric Chiller Tune-up - Water Cooled, Centrifugal	5	21,430.9	0.0002	1	1	1	1600	-	21,431	21,431	21,431
C&I Prescriptive	Electric Chiller Tune-up - Water Cooled, Rotary Screw	5	5,073.1	0.0425	1	1	1	1600	1,790.00	5,073	5,073	5,073
C&I Prescriptive	Chilled Water Reset Control	10	173.0	0.0133	1	1	1	1.5	-	173	173	173
C&I Prescriptive	Electric Chiller - Air cooled, without condenser	20	2,923.7	0.0013	1	1	1	500	-	2,924	2,924	2,924
C&I Prescriptive	Electric Chiller - Water Cooled, Rotary Screw <150 tons	20	5,814.1	0.0011	1	1	1	1500	-	5,814	5,814	5,814
C&I Prescriptive	Electric Chiller - Water Cooled, Rotary Screw 150-300 tons	20	17,632.9	0.0000	1	1	1	4500	-	17,633	17,633	17,633
C&I Prescriptive	Electric Chiller - Water Cooled, Rotary Screw >300 tons	20	33,449.4	0.0003	1	1	1	9000	-	33,449	33,449	33,449
C&I Prescriptive	Electric Chiller - Water Cooled, Centrifugal <150 tons	20	6,969.9	0.0033	1	1	1	1500	-	6,970	6,970	6,970
C&I Prescriptive	Electric Chiller - Water Cooled, Centrifugal 150-300 tons	20	17,438.9	0.0006	1	1	1	4500	-	17,439	17,439	17,439
C&I Prescriptive	Electric Chiller - Water Cooled, Centrifugal >300 tons	20	18,656.4	0.0416	1	1	1	9000	13,833.00	18,656	18,656	18,656
C&I Prescriptive	Electric Chiller Tune-up - Air cooled, with condenser	5	9,222.3	0.0015	1	1	1	400	-	9,222	9,222	9,222
C&I Prescriptive	Central Lighting Control	8	224.7	0.0270	1	1	1	30	-	225	225	225
C&I Prescriptive	Daylight Dimming Control <500w	8	337.1	0.0135	1	1	1	20	-	337	337	337
C&I Prescriptive	Occupancy Sensor - Wall Mounted 500W+	8	344.9	0.0270	1	1	1	40	-	345	345	345
C&I Prescriptive	Daylight Dimming Control 500W+	8	674.2	0.0270	1	1	1	40	-	674	674	674
C&I Prescriptive	Fixture Mounted daylight dimming control	8	168.6	0.0068	1	1	1	15	-	169	169	169
C&I Prescriptive	Switching Control for Multi-Level Lighting 500W+	8	168.6	0.0068	1	1	1	30	-	169	169	169
C&I Prescriptive	ENERGY STAR Griddles	12	6,995.7	1.3416	1	1	1	550	-	6,996	6,996	6,996
C&I Prescriptive	ENERGY STAR Combination Oven	12	18,431.7	3.5348	1	1	1	1000	-	18,432	18,432	18,432
C&I Prescriptive	ENERGY STAR Convection Oven	12	3,234.8	0.6204	1	1	1	350	-	3,235	3,235	3,235
C&I Prescriptive	ENERGY STAR Commercial Dishwasher - Door Type, High Temp	15	14,143.0	0.6889	1	1	1	1100	-	14,143	14,143	14,143
C&I Prescriptive	ENERGY STAR Commercial Dishwasher - Door Type, Low Temp	15	12,135.0	0.5911	1	1	1	1000	-	12,135	12,135	12,135
C&I Prescriptive	ENERGY STAR Commercial Dishwasher - Multi-Tank Conveyor, High Temp	20	34,153.0	1.6635	1	1	1	2700	-	34,153	34,153	34,153
C&I Prescriptive	ENERGY STAR Commercial Dishwasher - Multi-Tank Conveyor, Low Temp	20	17,465.0	0.8507	1	1	1	1400	-	17,465	17,465	17,465
C&I Prescriptive	ENERGY STAR Commercial Dishwasher - Single Tank Conveyor, High Temp	20	19,235.0	0.9369	1	1	1	1500	-	19,235	19,235	19,235
C&I Prescriptive	ENERGY STAR Commercial Ice Machine >=500 and <1000 lb/day harvest rate	9	702.4	0.1100	1	1	1	175	1,485.00	702	702	702
C&I Prescriptive	ENERGY STAR Commercial Dishwasher - Single Tank Conveyor, Low Temp	20	11,384.0	0.5545	1	1	1	900	-	11,384	11,384	11,384
C&I Prescriptive	ENERGY STAR Commercial Dishwasher - Under Counter, High Temp	10	7,471.0	0.3639	1	1	1	600	-	7,471	7,471	7,471
C&I Prescriptive	ENERGY STAR Commercial Dishwasher - Under Counter, Low Temp	10	1,213.0	0.0591	1	1	1	100	-	1,213	1,213	1,213
C&I Prescriptive	ENERGY STAR Commercial Ice Machine >=1000 lb/day harvest rate	9	1,227.5	0.1898	1	1	1	250	-	1,227	1,227	1,227
C&I Prescriptive	ENERGY STAR Commercial Hot Holding Cabinets Half Size	12	1,795.8	0.2755	1	1	1	150	-	1,796	1,796	1,796
C&I Prescriptive	ENERGY STAR Commercial Hot Holding Cabinets Three Quarter Size	12	2,825.1	0.4334	1	1	1	230	-	2,825	2,825	2,825
C&I Prescriptive	ENERGY STAR Commercial Fryer	12	1,526.2	0.2195	1	1	1	80	-	1,526	1,526	1,526
C&I Prescriptive	ENERGY STAR Commercial Steam Cookers	12	2,200.0	0.4400	1	1	1	200	-	2,200	2,200	2,200
C&I Prescriptive	Air Source Heat Pump <65,000 BtuH	15	555.3	0.0136	1	1	1	120	221.67	555	555	555
C&I Prescriptive	Air Source Heat Pump≥65,000 Btu/h and <135,000 Btu/h	15	492.0	-	1	1	1	240	-	492	492	492
C&I Prescriptive	Air Source Heat Pump≥135,000 Btu/h and <240,000 Btu/h	15	1,350.0	-	1	1	1	600	-	1,350	1,350	1,350
C&I Prescriptive	Air Source Heat Pump≥240,000 Btu/h and <760,000 Btu/h	15	6,949.0	-	1	1	1	1200	-	6,949	6,949	6,949
C&I Prescriptive	Water Source Heat Pump <17,000Btu/hr	15	160.0	0.0500	1	1	1	30	-	160	160	160
C&I Prescriptive	Water Source Heat Pump >=17,000Btu/hr - 65,000Btu/hr	15	596.6	0.0475	1	1	1	120	-	597	597	597
C&I Prescriptive	Water Source Heat Pump >65,000Btu/hr and <135,000Btu/hr	15	1,193.2	0.0463	1	1	1	240	-	1,193	1,193	1,193
C&I Prescriptive	Ground Source Heat Pump <135,000 Btu/hr	15	1,322.4	-	1	1	1	30	-	1,322	1,322	1,322
C&I Prescriptive	Ground Water Source Heat Pump <135,000 Btu/hr	15	41,712.0	0.0350	1	1	1	240	-	41,712	41,712	41,712
C&I Prescriptive	High Bay HID to LED <175W	16	303.5	0.0067	1	1	1	35	-	303	303	303
C&I Prescriptive	T12 or T8 1-Lamp 8-Foot to LED Panel or Kit	15	118.0	0.0228	1	1	1	40	-	118	118	118
C&I Prescriptive	T12/T8 Lamp 8' to LED Tube	15	210.0	-	1	1	1	10	-	210	210	210
C&I Prescriptive	Clothes Washer ENERGY STAR/CEE Tier 1	11	541.5	-	1	1	1	50	-	542	542	542
C&I Prescriptive	Pellet Dryers duct insulation	5	297.7	0.0450	1	1	1	30	-	298	298	298
C&I Prescriptive	Clothes Washer CEE Tier 2	11	541.5	-	1	1	1	60	-	542	542	542
C&I Prescriptive	Clothes Washer CEE Tier 3	11	541.5	-	1	1	1	70	-	542	542	542
C&I Prescriptive	Smart Strip Plug Outlet	8	23.6	-	1	1	1	8	-	24	24	24
C&I Prescriptive	Plug Load Occupancy sensor with Smart Strip	8	169.0	-	1	1	1	20	-	169	169	169
C&I Prescriptive	Compressed Air Engineered Nozzles (1/8")	15	429.8	0.1631	1	1	1	5	-	430	430	430
C&I Prescriptive	Compressed Air Engineered Nozzles (1/4")	15	1,346.6	0.5111	1	1	1	8	-	1,347	1,347	1,347
C&I Prescriptive	VFD compressor	15	31,875.0	0.0011	1	1	1	5625	-	31,875	31,875	31,875
C&I Prescriptive	Barrel Wraps (Inj Mold Only)	5	983.3	0.0306	1	1	1	30	-	983	983	983

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C&I Prescriptive	Electric Chiller Tune-up - Water Cooled, Centrifugal	5	21,430.9	0.0002	1	1	1	1600	-	21,431	21,431	21,431
C&I Prescriptive	T12/T8 96" 1 Lamp To Delamp	11	157.2	0.0684	1	1	1	10	-	157	157	157
C&I Prescriptive	Incandescent Traffic Signal To LED Traffic Signal Round 8" Red	10	298.7	0.0341	1	1	1	30	-	299	299	299
C&I Prescriptive	Incandescent Traffic Signal To LED Traffic Signal Pedestrian 12"	10	946.1	0.1080	1	1	1	50	-	946	946	946
C&I Prescriptive	Packaged Terminal Air Conditioner (PTAC) <7000 BtuH	15	138.0	0.2284	1	1	1	35	-	138	138	138
C&I Prescriptive	Packaged Terminal Air Conditioner (PTAC) 7,000-15,000 BtuH	15	1,702.4	0.9600	1	1	1	70	35.00	1,702	1,702	1,702
C&I Prescriptive	Packaged Terminal Air Conditioner (PTAC) >15,000 BtuH	15	506.0	0.7715	1	1	1	105	-	506	506	506
C&I Prescriptive	Packaged Terminal Heat Pump (PTHP) <7,000 BtuH	15	395.4	0.3945	1	1	1	35	48.97	395	395	395
C&I Prescriptive	Packaged Terminal Heat Pump (PTHP) 7,000 - 15,000 BtuH	15	385.0	0.1000	1	1	1	70	-	385	385	385
C&I Prescriptive	Packaged Terminal Heat Pump (PTHP) > 15,000 BtuH	15	639.8	0.1133	1	1	1	105	-	640	640	640
C&I Prescriptive	Cooler <15 vol	12	3,671.3	0.0593	1	1	1	375	-	3,671	3,671	3,671
C&I Prescriptive	T12 6' To Refrigerated Display Case Lighting 6' LED - Cooler With Connected Motion Sensor	8.1	825.7	0.0856	1	1	1	45	-	826	826	826
C&I Prescriptive	T12 6' To Refrigerated Display Case Lighting 6' LED - Freezer	8.1	622.5	0.0923	1	1	1	30	-	622	622	622
C&I Prescriptive	T12 6' To Refrigerated Display Case Lighting 6' LED - Freezer With Connected Motion Sensor	8.1	890.2	0.0923	1	1	1	45	-	890	890	890
C&I Prescriptive	T8 5' To Refrigerated Display Case Lighting 5' LED - Cooler With Connected Motion Sensor	8.1	475.4	0.0493	1	1	1	25	-	475	475	475
C&I Prescriptive	T8 5' To Refrigerated Display Case Lighting 5' LED - Freezer	8.1	358.4	0.0531	1	1	1	15	-	358	358	358
C&I Prescriptive	T8 5' To Refrigerated Display Case Lighting 5' LED - Freezer With Connected Motion Sensor	8.1	512.5	0.0531	1	1	1	25	-	513	513	513
C&I Prescriptive	Cooler - Reach-In Electronically Commutated (EC) Motor	15	328.0	0.0330	1	1	1	35	-	328	328	328
C&I Prescriptive	Freezer - Reach-In Electronically Commutated (EC) Motor	15	411.0	0.0350	1	1	1	45	-	411	411	411
C&I Prescriptive	Cooler 15-30 vol	12	14,411.1	0.0500	1	1	1	1650	164.00	14,411	14,411	14,411
C&I Prescriptive	Freezer - Walk-In Electronically Commutated (EC) Motor	15	532.0	0.0360	1	1	1	45	-	532	532	532
C&I Prescriptive	Cooler Anti-Sweat Heater Controls	12	614.5	-	1	1	1	50	-	615	615	615
C&I Prescriptive	Freezer Anti-Sweat Heater Controls	12	1,302.5	-	1	1	1	100	-	1,303	1,303	1,303
C&I Prescriptive	Refrigerated Case Covers	5	157.5	-	1	1	1	10	-	158	158	158
C&I Prescriptive	Cooler - Glass Door 30-50 vol	12	38,943.5	0.0800	1	1	1	3000	164.00	38,944	38,944	38,944
C&I Prescriptive	Cooler - Glass Door >50 vol	12	91,487.5	0.1000	1	1	1	7000	249.00	91,488	91,488	91,488
C&I Prescriptive	Freezer - Glass Door <15 vol	12	5,837.7	0.0800	1	1	1	750	142.00	5,838	5,838	5,838
C&I Prescriptive	Freezer - Glass Door 15-30 vol	12	26,061.0	0.0900	1	1	1	4500	166.00	26,061	26,061	26,061
C&I Prescriptive	Freezer - Glass Door 30-50 vol	12	164,834.0	0.4400	1	1	1	8000	166.00	164,834	164,834	164,834
C&I Prescriptive	Freezer - Glass Door >50 vol	12	715,400.0	0.7667	1	1	1	35000	407.00	715,400	715,400	715,400
C&I Prescriptive	T12 48" 1 Lamp To T5 46" 1 Lamp	15	25.3	0.0100	1	1	1	4	-	25	25	25
C&I Prescriptive	175 - 250W HID To T5 46" 2 Lamp HO	15	377.7	0.1049	1	1	1	45	-	378	378	378
C&I Prescriptive	175 - 250W HID To T5 46" 3 Lamp HO	15	167.5	0.0465	1	1	1	40	-	168	168	168
C&I Prescriptive	400W HID To T5 46" 4 Lamp HO	15	702.9	0.1952	1	1	1	85	-	703	703	703
C&I Prescriptive	400W HID To T5 46" 6 Lamp HO	15	318.6	0.0885	1	1	1	50	-	319	319	319
C&I Prescriptive	1000W HID To T5 46" 10 Lamp HO	15	1,652.2	0.4587	1	1	1	115	-	1,652	1,652	1,652
C&I Prescriptive	1000W HID To T5 46" 12 Lamp HO	15	1,215.3	0.3374	1	1	1	105	-	1,215	1,215	1,215
C&I Prescriptive	T12 48" 2 Lamp To T5 46" 2 Lamp	15	18.4	0.0073	1	1	1	6	-	18	18	18
C&I Prescriptive	T12 48" 3 Lamp To T5 46" 3 Lamp	15	43.7	0.0173	1	1	1	8	-	44	44	44
C&I Prescriptive	T12 48" 4 Lamp To T5 46" 4 Lamp	15	36.8	0.0146	1	1	1	12	-	37	37	37
C&I Prescriptive	HID 75W-100W To T5 Garage 1 Lamp	15	301.7	0.1104	1	1	1	8	-	302	302	302
C&I Prescriptive	HID 101W-175W To T5 Garage 2 Lamp	15	275.4	0.1008	1	1	1	12	-	275	275	275
C&I Prescriptive	HID 176W+ To T5 Garage 3 Lamp	15	367.2	0.1344	1	1	1	16	-	367	367	367
C&I Prescriptive	Up to 175W HID To T5 46" 2 Lamp HO	15	239.8	0.0666	1	1	1	35	-	240	240	240
C&I Prescriptive	Up to 175W HID To T5 46" 3 Lamp HO	15	88.7	0.0246	1	1	1	30	-	89	89	89
C&I Prescriptive	Up to 175W HID to T8VHO 48" 3 Lamp	15	197.1	0.0547	1	1	1	35	-	197	197	197
C&I Prescriptive	T12 48" 1 Lamp To T8 48" 25W 1 Lamp	15	48.3	0.0192	1	1	1	8	-	48	48	48
C&I Prescriptive	T12 48" 2 Lamp To T8 48" 25W 2 Lamp	15	71.3	0.0283	1	1	1	10	-	71	71	71
C&I Prescriptive	T12 48" 3 Lamp To T8 48" 25W 3 Lamp	15	123.5	0.0490	1	1	1	12	-	123	123	123
C&I Prescriptive	T12 48" 4 Lamp To T8 48" 25W 4 Lamp	15	146.0	0.0579	1	1	1	16	-	146	146	146
C&I Prescriptive	1 Lamp 4ft T12 to 1 Lamp 4ft HPT8	15	41.4	0.0164	1	1	1	4	-	41	41	41
C&I Prescriptive	3 Lamp 4ft T12 to 3 Lamp 4ft HPT8	15	96.6	0.0383	1	1	1	8	-	97	97	97
C&I Prescriptive	4 Lamp 4ft T12 to 4 Lamp 4ft HPT8	15	110.4	0.0438	1	1	1	12	-	110	110	110
C&I Prescriptive	T12 96" 1 Lamp To T8 96" 1 Lamp	15	39.1	0.0155	1	1	1	6	-	39	39	39
C&I Prescriptive	T12 96" 2 Lamp To T8 96" 2 Lamp	15	32.2	0.0128	1	1	1	8	-	32	32	32
C&I Prescriptive	176-250W HID to T8VHO 48" 4 Lamp	15	266.1	0.0739	1	1	1	50	-	266	266	266
C&I Prescriptive	1 Lamp 8ft T12 to 2 Lamp 4ft HPT8	15	62.1	0.0246	1	1	1	20	-	62	62	62

Program	Measure	Measure Life	Average Savings per Unit (kWh)	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
C&I Prescriptive	Electric Chiller Tune-up - Water Cooled, Centrifugal	5	21,430.9	0.0002	1	1	1	1600	-	21,431	21,431	21,431
C&I Prescriptive	T12/T8 96" 1 Lamp To Delamp	11	157.2	0.0684	1	1	1	10	-	157	157	157
C&I Prescriptive	400W HID to T8VHO 4ft 6 Lamp	15	762.0	0.2116	1	1	1	85	-	762	762	762
C&I Prescriptive	400W HID to T8VHO 4ft 8 Lamp	15	558.4	0.1550	1	1	1	60	-	558	558	558
C&I Prescriptive	MH 1000W To T8VHO 48" 8 Lamp (2 fixtures)	15	1,655.5	0.4596	1	1	1	125	-	1,655	1,655	1,655
C&I Prescriptive	T12 48" 1 Lamp To T8 48" 28W 1 Lamp	15	45.3	0.0180	1	1	1	6	-	45	45	45
C&I Prescriptive	T12 48" 2 Lamp To T8 48" 28W 2 Lamp	15	57.5	0.0228	1	1	1	8	-	57	57	57
C&I Prescriptive	T12 48" 3 Lamp To T8 48" 28W 3 Lamp	15	103.7	0.0411	1	1	1	10	-	104	104	104
C&I Prescriptive	Vending Machine Occ Sensor - Refrigerated Beverage	5	1,611.8	-	1	1	1	50	-	1,612	1,612	1,612
C&I Prescriptive	Snack Machine Controller (Non-refrigerated vending)	5	342.5	-	1	1	1	25	-	343	343	343
C&I Prescriptive	Vending Machine Occ Sensor - Refrigerated Glass Front Cooler	5	1,208.9	-	1	1	1	50	-	1,209	1,209	1,209
C&I Prescriptive	VFD Return Fan <100hp	15	60,000.0	-	1	1	1	900	-	60,000	60,000	60,000
C&I Prescriptive	VFD Tower Fan <100hp	15	19,220.0	-	1	1	1	900	-	19,220	19,220	19,220
C&I Prescriptive	VFD CW Pump <100hp	15	26,800.0	-	1	1	1	900	-	26,800	26,800	26,800
C&I Prescriptive	VFD HW Pump <100hp	15	88,620.0	0.9790	1	1	1	900	-	88,620	88,620	88,620
C&I Prescriptive	VFD CHW Pump <100hp	15	74,020.0	0.3900	1	1	1	900	-	74,020	74,020	74,020
C&I Prescriptive	Heat Pump Water Heater 10-50 MBH	10	3,534.0	0.5000	1	1	1	500	-	3,534	3,534	3,534
C&I Prescriptive	Window Film	10	3.7	0.0010	1	1	1	1	-	4	4	4
C&I Prescriptive	Pre-Rinse Sprayer - Electric	5	3,727.2	-	1	1	1	50	-	3,727	3,727	3,727
C&I Prescriptive	Livestock Waterer	10	266.1	0.5250	1	1	1	110	787.50	266	266	266
C&I Prescriptive	Agriculture - Poultry Farm LED Lighting	7	292.0	0.0500	1	1	1	10	30.00	292	292	292
C&I Prescriptive	VSD Milk Pump	15	33.9	0.0116	1	1	1	5	4,000.00	34	34	34
C&I Prescriptive	High Volume Low Speed Fans	10	8,543.0	3.1000	1	1	1	1000	4,180.00	8,543	8,543	8,543
C&I Prescriptive	High Speed Fans (Ventilation and Ciculation)	7	625.0	0.1980	1	1	1	50	150.00	625	625	625
C&I Prescriptive	Dairy Plate Cooler	15	76.2	0.0163	1	1	1	8	-	76	76	76
C&I Prescriptive	Heat Mat (Single, ~14x60")	5	657.0	-	1	1	1	65	225.00	657	657	657
C&I Prescriptive	Automatic Milker Take Off	15	556.0	0.1165	1	1	1	5	-	556	556	556
C&I Prescriptive	HE Diary Scroll Compressor	12	279.5	0.0689	1	1	1	250	-	279	279	279
C&I Prescriptive	Heat Reclaimer (No Precooler Installed)	14	152.7	-	1	1	1	5	-	153	153	153
C&I Prescriptive	Prescriptive Other	15								132,109	99,082	132,110
Total C&I Prescriptive					**7,024**	**5,981**	**6,856**			**4,999,125**	**4,501,186**	**5,002,621**
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 1-Lamp 4' T12 to HP, 28W or 25W T8	15	64.0	0.0171	80	77	68	12	51	5,122	4,930	4,353
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 2-Lamp 4' T12 to HP, 28W or 25W T8	15	85.4	0.0228	119	116	102	15	56	10,158	9,902	8,707
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 3-Lamp 4' T12 to HP, 28W or 25W T8	15	104.1	0.0383	2	2	1	20	70	208	208	104
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 4-Lamp 4' T12 to HP, 28W or 25W T8	15	116.5	0.0390	159	154	136	24	78	18,523	17,940	15,843
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 1-Lamp 8' T12 to 2-Lamp 4' or 1-Lamp 8' HP, 28W or 25W T8 w/ reflector	15	153.9	0.0246	2	2	1	20	93	308	308	154
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 2-Lamp 8' T12 to 4-Lamp 4' or 2-Lamp 8' HP, 28W or 25W T8 w/ reflector	15	59.3	0.0230	192	185	164	25	108	11,381	10,966	9,721
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 1-Lamp 8' T12 to 2-Lamp 4' or 1-Lamp 8' HP, 28W or 25W T8	15	110.7	0.0246	2	2	1	22	88	221	221	111
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 2-Lamp 8' T12 to 4-Lamp 4' or 2-Lamp 8' HP, 28W or 25W T8	15	41.6	0.0208	256	248	218	27	103	10,653	10,320	9,072
Small Business Direct Install (SBDI)	400W HID to High Bay Fluorescent 6-Lamp 4' HP, 28W or 25W T8	7	703.4	0.2116	2	2	1	125	300	1,407	1,407	703
Small Business Direct Install (SBDI)	250W HID to High Bay Fluorescent 4-Lamp 4' HP, 28W or 25W T8	7	519.9	0.1778	2	2	1	90	255	1,040	1,040	520
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 4-Lamp 4' T12 to 3-Lamp 4' HP, 28W or 25W T8	15	211.2	0.0648	2	2	1	35	75	422	422	211
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 4-Lamp 4' T12 to 2-Lamp 4' HP, 28W or 25W T8	15	264.9	0.0876	2	2	1	45	75	530	530	265
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 3-Lamp 4' T12 to 2-Lamp 4' HP, 28W or 25W T8	15	199.8	0.0611	2	2	1	35	57	400	400	200
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 2-Lamp 4' T12 to 1-Lamp 4' HP, 28W or 25W T8	15	137.3	0.0246	2	2	1	25	50	275	275	137
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 4-Lamp 8' T12 to 4-Lamp 4' or 2-Lamp 8' HP, 28W or 25W T8	15	360.0	0.1368	2	2	1	60	105	720	720	360
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit w/Reflector: 4-Lamp 4' T12 to 3-Lamp 4' HP, 28W or 25W T8	15	247.1	0.0716	2	2	1	35	90	494	494	247
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit w/Reflector: 4-Lamp 4' T12 to 2-Lamp 4' HP, 28W or 25W T8	15	341.5	0.0910	1152	1115	984	60	58.51	393,353	380,719	335,989
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit w/Reflector: 3-Lamp 4' T12 to 2-Lamp 4' HP, 28W or 25W T8	15	225.7	0.0675	2	2	1	40	88	451	451	226
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit w/Reflector: 2-Lamp 4' T12 to 1-Lamp 4' HP, 28W or 25W T8	15	149.2	0.0404	2	2	1	25	57	298	298	149
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit w/Reflector: 2-Lamp 8' T12 to 2-Lamp 4' or 1-Lamp 8' HP, 28W or 25W T8	15	275.9	0.0631	2	2	1	50	110	552	552	276
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit w/Reflector: 4-Lamp 8' T12 to 4-Lamp 4' or 2-Lamp 8' HP, 28W or 25W T8	15	505.3	0.1368	2	2	1	90	140	1,011	1,011	505
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 1-Lamp 4' T12/T8 to 4' LED Tube	15	112.9	0.0232	80	77	68	18	80	9,036	8,697	7,680
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 2-Lamp 4' T12/T8 to 4' LED Tube	15	74.4	-	2	2	1	25	100	149	149	74
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 3-Lamp 4' T12/T8 to 4' LED Tube	15	81.8	-	2	2	1	25	120	164	164	82
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 4-Lamp 4' T12/T8 to 4' LED Tube	15	314.3	0.0645	437	423	374	50	140	137,340	132,940	117,541
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 1-Lamp 8' T12/T8 to 2-Lamp 4' or 1-Lamp 8' LED Tube	15	171.9	0.0353	675	654	577	30	132	116,013	112,404	99,170
Small Business Direct Install (SBDI)	Lamp & Ballast Retrofit: 2-Lamp 8' T12/T8 to 4-Lamp 4' or 2-Lamp 8' LED Tube	15	214.5	0.0433	40	39	34	40	175	8,580	8,366	7,293

Program	Measure	Measure Life	Average Savings per Unit (kWh	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 4-Lamp 4' T12/T8 to 3-Lamp 4' LED Tube	15	190.4	-	2	2	1	30	130	381	381	190
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 4-Lamp 4' T12/T8 to 2-Lamp 4' LED Tube	15	353.6	0.0726	80	77	68	60	120	28,285	27,225	24,042
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 3-Lamp 4' T12/T8 to 2-Lamp 4' LED Tube	15	158.1	-	2	2	1	30	100	316	316	158
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 2-Lamp 4' T12/T8 to 1-Lamp 4' LED Tube	15	213.5	-	2	2	1	40	75	427	427	214
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit: 4-Lamp 8' T12/T8 to 4-Lamp 4' or 2-Lamp 8' LED Tube	15	364.8	-	2	2	1	65	250	730	730	365
Small Business Direct Install (SBDI)	Delamping with Lamp & Ballast Retrofit w/Reflector: 2-Lamp 2' T12 U-tube to 2-Lamp 2' HP, 28W or 25W T8	15	108.0	0.0329	2	2	1	19	89	216	216	108
Small Business Direct Install (SBDI)	400W HID to High Bay LED ≤250W	15	589.9	0.1797	172	166	147	220	480	101,461	97,921	86,714
Small Business Direct Install (SBDI)	250W HID to High Bay LED ≤100W	15	716.6	0.1778	2	2	1	160	460	1,433	1,433	717
Small Business Direct Install (SBDI)	LED Exit Sign Fixture with Battery Backup	16	87.2	0.0077	641	621	548	60	88	55,923	54,178	47,810
Small Business Direct Install (SBDI)	4-Lamp 4' T12/T8 to LED Panel	15	286.6	-	2	2	1	50	155	573	573	287
Small Business Direct Install (SBDI)	3-Lamp 4' T12/T8 to LED Panel	15	214.9	-	2	2	1	40	145	430	430	215
Small Business Direct Install (SBDI)	2-Lamp 4' T12/T8 to LED Panel	15	93.3	-	2	2	1	40	135	187	187	93
Small Business Direct Install (SBDI)	ENERGY STAR® LED lamps 40W Equivalent	15	64.3	0.0293	279	270	238	12	33	17,951	17,372	15,313
Small Business Direct Install (SBDI)	ENERGY STAR® LED lamps 60W Equivalent	15	120.8	0.0337	913	884	780	22	7.38	110,272	106,769	94,208
Small Business Direct Install (SBDI)	ENERGY STAR® LED lamps 75W+ Equivalent	15	179.2	0.0536	2	2	1	32	35	358	358	179
Small Business Direct Install (SBDI)	ENERGY STAR® LED downlights - 40W Equivalent	15	94.3	0.0285	2	2	1	18	52	189	189	94
Small Business Direct Install (SBDI)	ENERGY STAR® LED downlights - 60W Equivalent	15	132.3	0.0371	5	5	4	27	57	661	661	529
Small Business Direct Install (SBDI)	ENERGY STAR® LED downlights - 75W+ Equivalent	15	205.3	0.0412	398	385	340	35	39	81,698	79,029	69,792
Small Business Direct Install (SBDI)	Delamp 1 lamp 8ft T12 lamp and ballast	10	278.1	-	2	2	1	50	34	556	556	278
Small Business Direct Install (SBDI)	Delamp 2 lamp 8ft T12 lamp and ballast	10	417.2	-	2	2	1	75	36	834	834	417
Small Business Direct Install (SBDI)	Delamp 4 lamp 8ft T12 lamp and ballast	10	834.3	-	2	2	1	75	38	1,669	1,669	834
Small Business Direct Install (SBDI)	Vending Machine Occ Sensor - Refrigerated Glass Front Cooler	5	1,208.9	-	2	2	1	200	178	2,418	2,418	1,209
Small Business Direct Install (SBDI)	Vending Machine Occ Sensor - Refrigerated Beverage	5	1,602.5	-	2	2	1	250	208	3,205	3,205	1,602
Small Business Direct Install (SBDI)	Occupancy Sensors - Ceiling Mount (must control 350 watts)	8	299.3	0.0630	5	5	4	60	170	1,496	1,496	1,197
Small Business Direct Install (SBDI)	Occupancy Sensors - Wall Mount (must control at least 200 watts)	8	250.2	0.0108	2	2	1	40	115	500	500	250
Small Business Direct Install (SBDI)	Occupancy Sensors - Fixture Mount (must control at least 100 watts)	8	154.6	0.0054	2	2	1	25	37	309	309	155
Small Business Direct Install (SBDI)	Exterior Wallpack: 175W HID to LED	15	470.4	0.0251	972	941	830	100	225.5	457,246	442,663	390,447
Small Business Direct Install (SBDI)	Exterior Wallpack: 176 W-250 W HID to LED	15	639.2	0.1236	172	166	147	115	310	109,946	106,111	93,965
Small Business Direct Install (SBDI)	Exterior Wallpack: 251 W-400 W HID to LED	15	1,066.7	0.0900	2	2	1	185	600	2,133	2,133	1,067
Small Business Direct Install (SBDI)	Exterior Canopy: less than 175W HID to LED	15	470.4	0.0251	632	612	540	100	190.4	297,304	287,896	254,025
Small Business Direct Install (SBDI)	Exterior Canopy: 176 W-250 W HID to LED	15	639.2	0.1236	132	128	113	115	272	84,377	81,820	72,232
Small Business Direct Install (SBDI)	Exterior Canopy: 251 W-400 W HID to LED	15	1,066.7	0.0900	2	2	1	185	600	2,133	2,133	1,067
Small Business Direct Install (SBDI)	Exterior Flood: less than 175W HID to LED	15	470.4	0.0251	778	753	664	100	188.33	365,985	354,224	312,357
Small Business Direct Install (SBDI)	Exterior Flood: 176 W-250 W HID to LED	15	639.2	0.1236	146	141	125	115	310	93,326	90,130	79,903
Small Business Direct Install (SBDI)	Exterior Flood: 251 W-400 W HID to LED	15	1,066.7	0.0900	2	2	1	185	600	2,133	2,133	1,067
Small Business Direct Install (SBDI)	Exterior Pole Mount: less than 175W HID to LED	15	470.4	0.0251	680	658	581	100	187.5	319,884	309,535	273,313
Small Business Direct Install (SBDI)	Exterior Pole Mount: 176 W-250 W HID to LED	15	639.2	0.1236	146	141	125	115	310	93,326	90,130	79,903
Small Business Direct Install (SBDI)	Exterior Pole Mount: 251 W-400 W HID to LED	15	1,066.7	0.0900	2	2	1	185	600	2,133	2,133	1,067
Small Business Direct Install (SBDI)	Exterior Pole Mount: 1000W HID to LED	15	3,536.6	0.6745	2	2	1	500	615	7,073	7,073	3,537
Small Business Direct Install (SBDI)	Exterior Other: less than 175W HID to LED	15	470.4	0.0251	534	517	456	100	63.75	251,203	243,206	214,510
Small Business Direct Install (SBDI)	Exterior Other: 176 W-250 W HID to LED	15	639.2	0.1236	119	116	102	115	140	76,067	74,150	65,200
Small Business Direct Install (SBDI)	Exterior Other: 251 W-400 W HID to LED	15	1,066.7	0.0900	2	2	1	185	600	2,133	2,133	1,067
Small Business Direct Install (SBDI)	EC (electronically commutated) Motor, Reach-in Refrigerator	15	325.0	0.0320	2	2	1	70	159	650	650	325
Small Business Direct Install (SBDI)	EC (electronically commutated) Motor, Reach-in Freezer	15	409.0	0.0340	2	2	1	90	159	818	818	409
Small Business Direct Install (SBDI)	EC (electronically commutated) Motor, Walk-in Refrigerator	15	354.0	0.0486	355	343	303	70	137	125,670	121,422	107,262
Small Business Direct Install (SBDI)	EC (electronically commutated) Motor, Walk-in Freezer	15	528.0	0.0560	4	4	3	90	180	2,112	2,112	1,584
Small Business Direct Install (SBDI)	Anti-Sweat Heater Controls - Refrigerator	12	540.0	-	2	2	1	110	300	1,080	1,080	540
Small Business Direct Install (SBDI)	Anti-Sweat Heater Controls - Freezer	12	1,277.0	-	2	2	1	220	360	2,554	2,554	1,277
Small Business Direct Install (SBDI)	Strip Curtain - Walk in Refrigerator	6	13.2	0.0500	35	34	30	2.25	14.5	462	448	396
Small Business Direct Install (SBDI)	Strip Curtain - Walk in Freezer	6	92.9	0.3400	35	34	30	15	14.5	3,253	3,160	2,788
Small Business Direct Install (SBDI)	Refrigerated Display Case Lighting 5' T12/T8 to LED - Refrigerator	8.1	332.0	0.0493	2	2	1	55	180	664	664	332
Small Business Direct Install (SBDI)	Refrigerated Display Case Lighting 5' T12/T8 to LED - Freezer	8.1	358.0	0.0856	2	2	1	55	180	716	716	358
Small Business Direct Install (SBDI)	Refrigerated Display Case Lighting 6' T12/T8 to LED - Refrigerator	8.1	450.0	0.0531	2	2	1	70	200	900	900	450
Small Business Direct Install (SBDI)	Refrigerated Display Case Lighting 6' T12/T8 to LED - Freezer	8.1	498.0	0.0923	2	2	1	70	200	996	996	498
Small Business Direct Install (SBDI)	Programmable Thermostat - Single Point - Electric Only	15	2,037.5	-	272	263	464	250	5	554,200	535,863	945,400
Small Business Direct Install (SBDI)	Programmable Thermostat - Multi Point - Electric Only	15	4,658.0	-	2	2	2	325	10	9,316	9,316	9,316
Small Business Direct Install (SBDI)	"Smart" Wi-Fi Thermostat - Single Point - Electric Only	15	2,037.5	-	2	2	2	400	50	4,075	4,075	4,075
Small Business Direct Install (SBDI)	"Smart" Wi-Fi Programmable Thermostat - Multi Point - Electric Only	15	4,658.0	-	2	2	2	450	100	9,316	9,316	9,316
Small Business Direct Install (SBDI)	Pre-Rinse Sprayer - Electric	5	3,727.2	-	2	2	1	100	0	7,454	7,454	3,727
Small Business Direct Install (SBDI)	Faucet Aerator - Electric	10	391.0	-	0	0	0	50	0	-	-	-
Small Business Direct Install (SBDI)	2x2 Fluorescent Fixture to LED Panel	15	144.0	0.0377	7	7	6	20	45.82	1,008	1,008	864
Total SBDI					**10,808**	**10,465**	**9,429**			**4,032,934**	**3,905,372**	**3,900,306**

Program	Measure	Measure Life	Average Savings per Unit (kWh)	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
Multifamily Retrofit	Pre-Rinse Sprayer - Electric	5	3,727.2	-	0	0	0	100	0	-	-	-
Multifamily Retrofit	Faucet Aerator - Electric	10	391.0	-	1	1	1	50	0	391	391	391
Multifamily Retrofit	Exterior Pole Mount: 1000W HID to LED	15	3,536.6	0.6745	1	1	1	500	615	3,537	3,537	3,537
Multifamily Retrofit	Exterior Wallpack: 251 W-400 W HID to LED	15	1,066.7	0.0900	1	1	1	185	600	1,067	1,067	1,067
Multifamily Retrofit	Exterior Canopy: 251 W-400 W HID to LED	15	1,066.7	0.0900	1	1	1	185	600	1,067	1,067	1,067
Multifamily Retrofit	Exterior Flood: 251 W-400 W HID to LED	15	1,066.7	0.0900	1	1	1	185	600	1,067	1,067	1,067
Multifamily Retrofit	Exterior Pole Mount: 251 W-400 W HID to LED	15	1,066.7	0.0900	1	1	1	185	600	1,067	1,067	1,067
Multifamily Retrofit	Exterior Other: 251 W-400 W HID to LED	15	1,066.7	0.0900	1	1	1	185	600	1,067	1,067	1,067
Multifamily Retrofit	400W HID to High Bay LED ≤250W	15	589.9	0.1797	1	1	1	220	480	590	590	590
Multifamily Retrofit	250W HID to High Bay LED ≤100W	15	716.6	0.1778	0	0	0	160	460	-	-	-
Multifamily Retrofit	Exterior Wallpack: 176 W-250 W HID to LED	15	639.2	0.1236	4	4	4	115	310	2,557	2,557	2,557
Multifamily Retrofit	Exterior Canopy: 176 W-250 W HID to LED	15	639.2	0.1236	4	4	4	115	272	2,557	2,557	2,557
Multifamily Retrofit	Exterior Flood: 176 W-250 W HID to LED	15	639.2	0.1236	4	4	4	115	310	2,557	2,557	2,557
Multifamily Retrofit	Exterior Pole Mount: 176 W-250 W HID to LED	15	639.2	0.1236	4	4	4	115	310	2,557	2,557	2,557
Multifamily Retrofit	Exterior Other: 176 W-250 W HID to LED	15	639.2	0.1236	4	4	4	115	140	2,557	2,557	2,557
Multifamily Retrofit	Anti-Sweat Heater Controls - Freezer	12	1,277.0	-	0	0	0	220	360	-	-	-
Multifamily Retrofit	Exterior Wallpack: 175W HID to LED	15	470.4	0.0251	14	14	14	100	225.5	6,586	6,586	6,586
Multifamily Retrofit	Exterior Canopy: less than 175W HID to LED	15	470.4	0.0251	14	14	14	100	190.4	6,586	6,586	6,586
Multifamily Retrofit	Exterior Flood: less than 175W HID to LED	15	470.4	0.0251	14	14	14	100	188.33	6,586	6,586	6,586
Multifamily Retrofit	Exterior Pole Mount: less than 175W HID to LED	15	470.4	0.0251	14	14	14	100	187.5	6,586	6,586	6,586
Multifamily Retrofit	Exterior Other: less than 175W HID to LED	15	470.4	0.0251	14	14	14	100	63.75	6,586	6,586	6,586
Multifamily Retrofit	400W HID to High Bay Fluorescent 6-Lamp 4' HP, 28W or 25W T8	7	703.4	0.2116	1	1	1	125	300	703	703	703
Multifamily Retrofit	Anti-Sweat Heater Controls - Refrigerator	12	540.0	-	0	0	0	110	300	-	-	-
Multifamily Retrofit	250W HID to High Bay Fluorescent 4-Lamp 4' HP, 28W or 25W T8	7	519.9	0.1778	0	0	0	90	255	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 4-Lamp 8' T12/T8 to 4-Lamp 4' or 2-Lamp 8' LED Tube	15	364.8	-	0	0	0	65	250	-	-	-
Multifamily Retrofit	Vending Machine Occ Sensor - Refrigerated Beverage	5	1,602.5	-	0	0	0	250	208	-	-	-
Multifamily Retrofit	Refrigerated Display Case Lighting 6' T12/T8 to LED - Refrigerator	8.1	450.0	0.0531	0	0	0	70	200	-	-	-
Multifamily Retrofit	Refrigerated Display Case Lighting 6' T12/T8 to LED - Freezer	8.1	498.0	0.0923	0	0	0	70	200	-	-	-
Multifamily Retrofit	EC (electronically commutated) Motor, Walk-in Refrigerator	15	354.0	0.0486	0	0	0	70	137	-	-	-
Multifamily Retrofit	EC (electronically commutated) Motor, Walk-in Freezer	15	528.0	0.0560	0	0	0	90	180	-	-	-
Multifamily Retrofit	Refrigerated Display Case Lighting 5' T12/T8 to LED - Refrigerator	8.1	332.0	0.0493	0	0	0	55	180	-	-	-
Multifamily Retrofit	Refrigerated Display Case Lighting 5' T12/T8 to LED - Freezer	8.1	358.0	0.0856	0	0	0	55	180	-	-	-
Multifamily Retrofit	Vending Machine Occ Sensor - Refrigerated Glass Front Cooler	5	1,208.9	-	0	0	0	200	178	-	-	-
Multifamily Retrofit	Lamp & Ballast Retrofit: 2-Lamp 8' T12/T8 to 4-Lamp 4' or 2-Lamp 8' LED Tube	15	214.5	0.0433	2	2	2	40	175	429	429	429
Multifamily Retrofit	Occupancy Sensors - Ceiling Mount (must control 350 watts)	8	299.3	0.0630	1	1	1	60	170	299	299	299
Multifamily Retrofit	EC (electronically commutated) Motor, Reach-in Refrigerator	15	325.0	0.0320	0	0	0	70	159	-	-	-
Multifamily Retrofit	EC (electronically commutated) Motor, Reach-in Freezer	15	409.0	0.0340	0	0	0	90	159	-	-	-
Multifamily Retrofit	4-Lamp 4' T12/T8 to LED Panel	15	286.6	-	0	0	0	50	155	-	-	-
Multifamily Retrofit	Lamp & Ballast Retrofit: 1-Lamp 8' T12/T8 to 2-Lamp 4' or 1-Lamp 8' LED Tube	15	171.9	0.0353	21	21	21	30	132	3,609	3,609	3,609
Multifamily Retrofit	3-Lamp 4' T12/T8 to LED Panel	15	214.9	-	0	0	0	40	145	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit w/Reflector: 4-Lamp 8' T12 to 4-Lamp 4' or 2-Lamp 8' HP, 28W or 25W T8	15	505.3	0.1368	0	0	0	90	140	-	-	-
Multifamily Retrofit	Lamp & Ballast Retrofit: 4-Lamp 4' T12/T8 to 4' LED Tube	15	314.3	0.0645	14	14	14	50	140	4,400	4,400	4,400
Multifamily Retrofit	2-Lamp 4' T12/T8 to LED Panel	15	93.3	-	0	0	0	40	135	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 4-Lamp 4' T12/T8 to 3-Lamp 4' LED Tube	15	190.4	-	0	0	0	30	130	-	-	-
Multifamily Retrofit	Lamp & Ballast Retrofit: 3-Lamp 4' T12/T8 to 4' LED Tube	15	81.8	-	0	0	0	25	120	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 4-Lamp 4' T12/T8 to 2-Lamp 4' LED Tube	15	353.6	0.0726	3	3	3	60	120	1,061	1,061	1,061
Multifamily Retrofit	Occupancy Sensors - Wall Mount (must control at least 200 watts)	8	250.2	0.0108	0	0	0	40	115	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit w/Reflector: 2-Lamp 8' T12 to 2-Lamp 4' or 1-Lamp 8' HP, 28W or 25W T8	15	275.9	0.0631	1	1	1	50	110	276	276	276
Multifamily Retrofit	Lamp & Ballast Retrofit: 2-Lamp 8' T12 to 4-Lamp 4' or 2-Lamp 8' HP, 28W or 25W T8 w/ reflector	15	59.3	0.0230	1	1	1	25	108	59	59	59
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 4-Lamp 8' T12 to 4-Lamp 4' or 2-Lamp 8' HP, 28W or 25W T8	15	360.0	0.1368	0	0	0	60	105	-	-	-
Multifamily Retrofit	Lamp & Ballast Retrofit: 2-Lamp 8' T12 to 4-Lamp 4' or 2-Lamp 8' HP, 28W or 25W T8	15	41.6	0.0208	1	1	1	27	103	42	42	42
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit w/Reflector: 4-Lamp 4' T12 to 2-Lamp 4' HP, 28W or 25W T8	15	341.5	0.0910	35	35	35	60	58.51	11,951	11,951	11,951
Multifamily Retrofit	Lamp & Ballast Retrofit: 2-Lamp 4' T12/T8 to 4' LED Tube	15	74.4	-	0	0	0	25	100	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 3-Lamp 4' T12/T8 to 2-Lamp 4' LED Tube	15	158.1	-	0	0	0	30	100	-	-	-
Multifamily Retrofit	"Smart" Wi-Fi Programmable Thermostat - Multi Point - Electric Only	15	4,658.0	-	0	0	0	450	100	-	-	-

Program	Measure	Measure Life	Average Savings per Unit (kWh)	Demand per Unit (KW)	2018 Participation	2019 Participation	2020 Participation	Avg Incentive Paid Per Unit	Average Incremental Cost	2018 kWh Savings	2019 kWh Savings	2020 kWh Savings
Multifamily Retrofit	Lamp & Ballast Retrofit: 1-Lamp 8' T12 to 2-Lamp 4' or 1-Lamp 8' HP, 28W or 25W T8 w/ reflector	15	153.9	0.0246	1	1	1	20	93	154	154	154
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit w/Reflector: 4-Lamp 4' T12 to 3-Lamp 4' HP, 28W or 25W T8	15	247.1	0.0716	1	1	1	35	90	247	247	247
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit w/Reflector:2-Lamp 2' T12 U-tube to 2-Lamp 2' HP, 28W or 25W T8	15	108.0	0.0329	1	1	1	19	89	108	108	108
Multifamily Retrofit	Lamp & Ballast Retrofit: 1-Lamp 8' T12 to 2-Lamp 4' or 1-Lamp 8' HP, 28W or 25W T8	15	110.7	0.0246	0	0	0	22	88	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit w/Reflector:3-Lamp 4' T12 to 2-Lamp 4' HP, 28W or 25W T8	15	225.7	0.0675	1	1	1	40	88	226	226	226
Multifamily Retrofit	LED Exit Sign Fixture with Battery Backup	16	87.2	0.0077	1	1	1	60	88	87	87	87
Multifamily Retrofit	Lamp & Ballast Retrofit: 1-Lamp 4' T12/T8 to 4' LED Tube	15	112.9	0.0232	3	3	3	18	80	339	339	339
Multifamily Retrofit	Lamp & Ballast Retrofit: 4-Lamp 4' T12 to HP, 28W or 25W T8	15	116.5	0.0390	1	1	1	24	78	116	116	116
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 4-Lamp 4' T12 to 3-Lamp 4' HP, 28W or 25W T8	15	211.2	0.0648	0	0	0	35	75	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 4-Lamp 4' T12 to 2-Lamp 4' HP, 28W or 25W T8	15	264.9	0.0876	0	0	0	45	75	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 2-Lamp 4' T12/T8 to 1-Lamp 4' LED Tube	15	213.5	-	0	0	0	40	75	-	-	-
Multifamily Retrofit	Lamp & Ballast Retrofit: 3-Lamp 4' T12 to HP, 28W or 25W T8	15	104.1	0.0383	0	0	0	20	70	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 3-Lamp 4' T12 to 2-Lamp 4' HP, 28W or 25W T8	15	199.8	0.0611	0	0	0	35	57	-	-	-
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit w/Reflector: 2-Lamp 4' T12 to 1-Lamp 4' HP, 28W or 25W T8	15	149.2	0.0404	1	1	1	25	57	149	149	149
Multifamily Retrofit	ENERGY STAR® LED downlights - 60W Equivalent	15	132.3	0.0371	1	1	1	27	57	132	132	132
Multifamily Retrofit	ENERGY STAR® LED downlights - 75W+ Equivalent	15	205.3	0.0412	12	12	12	35	39	2,463	2,463	2,463
Multifamily Retrofit	Lamp & Ballast Retrofit: 2-Lamp 4' T12 to HP, 28W or 25W T8	15	85.4	0.0228	4	4	4	15	56	341	341	341
Multifamily Retrofit	ENERGY STAR® LED downlights - 40W Equivalent	15	94.3	0.0285	1	1	1	18	52	94	94	94
Multifamily Retrofit	Lamp & Ballast Retrofit: 1-Lamp 4' T12 to HP, 28W or 25W T8	15	64.0	0.0171	3	3	3	12	51	192	192	192
Multifamily Retrofit	Delamping with Lamp & Ballast Retrofit: 2-Lamp 4' T12 to 1-Lamp 4' HP, 28W or 25W T8	15	137.3	0.0246	0	0	0	25	50	-	-	-
Multifamily Retrofit	"Smart" Wi-Fi Thermostat - Single Point - Electric Only	15	2,037.5	-	0	0	0	400	50	-	-	-
Multifamily Retrofit	2x2 Fluorescent Fixture to LED Panel	15	144.0	0.0377	1	1	1	20	45.82	144	144	144
Multifamily Retrofit	Delamp 4 lamp 8ft T12 lamp and ballast	10	834.3	-	0	0	0	75	38	-	-	-
Multifamily Retrofit	Occupancy Sensors - Fixture Mount (must control at least 100 watts)	8	154.6	0.0054	0	0	0	25	37	-	-	-
Multifamily Retrofit	Delamp 2 lamp 8ft T12 lamp and ballast	10	417.2	-	0	0	0	75	36	-	-	-
Multifamily Retrofit	ENERGY STAR® LED lamps 60W Equivalent	15	120.8	0.0337	28	28	28	22	7.38	3,382	3,382	3,382
Multifamily Retrofit	ENERGY STAR® LED lamps 75W+ Equivalent	15	179.2	0.0536	1	1	1	32	35	179	179	179
Multifamily Retrofit	Delamp 1 lamp 8ft T12 lamp and ballast	10	278.1	-	0	0	0	50	34	-	-	-
Multifamily Retrofit	ENERGY STAR® LED lamps 40W Equivalent	15	64.3	0.0293	9	9	9	12	33	579	579	579
Multifamily Retrofit	Strip Curtain - Walk in Refrigerator	6	13.2	0.0500	0	0	0	2.25	14.5	-	-	-
Multifamily Retrofit	Strip Curtain - Walk in Freezer	6	92.9	0.3400	0	0	0	15	14.5	-	-	-
Multifamily Retrofit	Programmable Thermostat - Multi Point - Electric Only	15	4,658.0	-	0	0	0	325	10	-	-	-
Multifamily Retrofit	Programmable Thermostat - Single Point - Electric Only	15	2,037.5	-	7	7	14	250	5	14,263	14,261.50	28,525
Total Multifamily Retrofit					**255**	**255**	**262**			**101,590**	**101,589**	**115,853**
CVR Commercial		**15**	**1,850.6**	**0.3330**			**558**					**1,032,656**
Total C&I										**15,135,729**	**16,043,561**	**17,053,516**
Portfolio Total										**36,656,341**	**38,069,187**	**36,347,642**

Attachment 6.2 2019 DSM Market Potential Study

prepared for

VECTREN ENERGY DELIVERY OF INDIANA

*2020-2025 Integrated **Electric** DSM Market Potential Study & Action Plan*

January

2019

FINAL REPORT

prepared by

GDS ASSOCIATES INC

EMI CONSULTING

EXECUTIVE SUMMARY

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VOLUME III *Electric Appendices*

Electric ***DSM Market Potential Study***

Electric ***Action Plan***

Executive Summary

OBJECTIVES & SCOPE

This project included a demand-side management (DSM) Market Potential Study and Action Plan for Vectren Energy Delivery of Indiana ("Vectren"). The study included assessments of electric energy efficiency and demand response potential. The results of the potential study were leveraged to develop a DSM Action Plan for Vectren's 2020-2025 planning horizon. This report provides the results of the electric energy efficiency and demand response potential analysis.

The energy efficiency potential study assessed potential by customer segment (residential, commercial, and industrial – with and without opt-out customers). The effort included several preliminary tasks to assess the Vectren market and develop foundational assumptions about the customer base, sales forecasts, and savings opportunities to order to then assess the overall energy efficiency potential in the Vectren services territories.

APPROACH SUMMARY

The GDS team used a bottom-up approach to estimate energy efficiency potential in the residential sector. Bottom-up approaches begin with characterizing the eligible equipment stock, estimating savings and screening for cost-effectiveness first at the measure level, then summing savings at the end-use and service area levels. In the commercial and industrial sectors, GDS utilized the bottom-up modeling approach to first estimate measure-level savings and costs as well as cost-effectiveness, and then applied cost-effective measure savings to all applicable shares of energy load. The demand response potential assessment was conducted in a similar manner as the energy efficiency potential assessment. Below is the summary of the Maximum Achievable Potential (MAP), Realistic Achievable Potential (RAP) and Program Potential. More detail can be found in Section 1 of Volume I, Market Potential Study.

- ***Achievable Potential*** is the amount of energy that can realistically be saved given various market barriers. Achievable potential considers real-world barriers to encouraging end users to adopt efficiency measures; the non-measure costs of delivering programs (for administration, marketing, analysis, and EM&V); and the capability of programs and administrators to boost program activity over time. Barriers include financial, customer awareness and willingness to participate in programs, technical constraints, and other barriers the "program intervention" is modeled to overcome. Additional considerations include political and/or regulatory constraints. The potential study evaluated two achievable potential scenarios:
- ***Maximum Achievable Potential*** estimates achievable potential on paying incentives equal to 100% of measure incremental costs and aggressive adoption rates.
- ***Realistic Achievable Potential*** estimates achievable potential with Vectren paying incentive levels (as a percent of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.
- ***Program Potential*** refers to the efficiency potential possible given specific program funding levels and designs; in this study program potential is addressed by the DSM Action Plan, which further addresses issues such as market dynamics (net versus gross impacts), timeframe differences, proxy versus specific program delivery approaches, and budget realities.

RESULTS

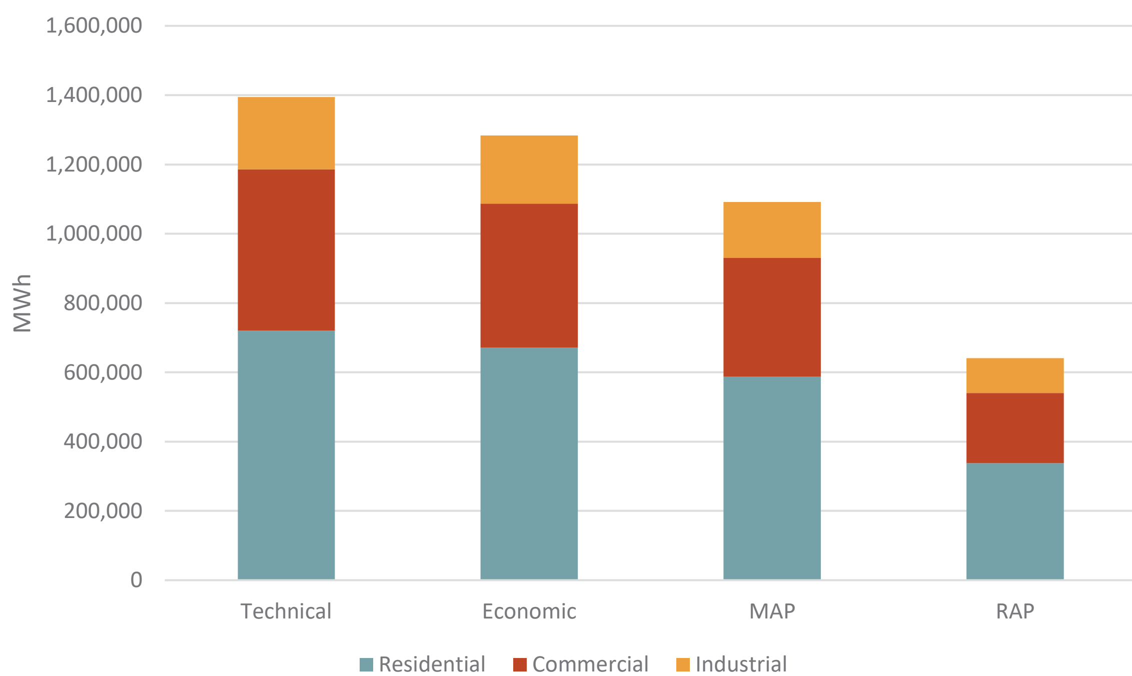
Table ES-1 summarizes the electric energy-efficiency savings for all measures at the different levels of potential relative to the baseline forecast. This provides cumulative annual technical, economic, MAP and RAP, and program potential energy savings, in total MWh and as a percentage of the sector-level sales forecast. Note that the steps of measure bundling, program design and program delivery refine the RAP results later into the Program Potential. The cumulative RAP increases to 9% cumulative annual savings over the next six years. The RAP savings estimates have a large residential sector low-income component.[1] Approximately 65% of the residential sector budget addresses the low-income market segment, with about 27% of the RAP savings are attributable to this segment.

TABLE ES-1 INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY (NET OF LARGE CUSTOMER OPT-OUT LOAD)

	2020	2021	2022	2023	2024	2025
MWh						
Technical	179,992	209,578	199,765	194,021	182,130	169,589
Economic	167,372	192,143	183,629	179,315	168,500	156,910
MAP	91,970	135,273	134,335	135,296	133,380	126,777
RAP	57,005	69,699	66,105	67,277	68,583	67,330
Program	47,451	49,716	44,565	45,375	43,309	43,244
Forecasted Sales[2]	3,340,248	3,345,466	3,360,838	3,378,011	3,402,115	3,414,693
Energy Savings (as % of Forecast)						
Technical	5.4%	6.3%	5.9%	5.7%	5.4%	5.0%
Economic	5.0%	5.7%	5.5%	5.3%	5.0%	4.6%
MAP	2.8%	4.0%	4.0%	4.0%	3.9%	3.7%
RAP	1.7%	2.1%	2.0%	2.0%	2.0%	2.0%
Program	1.4%	1.5%	1.3%	1.3%	1.3%	1.3%

Figure ES-1 provides the electric technical, economic, and achievable potential, by sector, by the end of the 20-year timeframe for the study (2020-2039). The residential sector contributes about half of the overall realistic achievable potential. Program potential only extends through 2025 and is not included in the figure below.

FIGURE ES-1 TWENTY (20)-YEAR CUMULATIVE ANNUAL ELECTRIC ENERGY EFFICIENCY POTENTIAL – ALL SECTORS COMBINED (NET OF LARGE CUSTOMER OPT-OUT LOAD)



[1] Low income households were characterized as homes that have household incomes at or below 200% of federal poverty guidelines. Based on data from the American Community 5-Year Public Use Microdata Set (PUMS), GDS used household income and number of people per household to identify the percent of the population at or below 200% of federal poverty guidelines for the Vectren South service area. 21% of single-family households and 48% of multifamily households were identified to meet the criteria.
[2] The forecasted sales here exclude opt-out customers. See Tables 1-2 through 1-5 for a comparison of the results with and without opt-out customers included in the analysis. Unless otherwise noted, the results in the report exclude opt-out sales and opt-out savings potential.

Measure-Level Realistic Achievable Potential (Net of Opt-Outs)

Table ES-2 provides the incremental RAP for each year by sector. The incremental annual savings potential ranges from 57 GWh to nearly 70 GWh. These results exclude load and savings attributed to large customers that have opted out of energy efficiency programs.

TABLE ES-2 INCREMENTAL ELECTRIC MEASURE LEVEL REALISTIC ACHIEVABLE POTENTIAL – BY SECTOR (2020-2025)

Incremental Annual MWh	2020	2021	2022	2023	2024	2025
Sector						
Residential	41,177	50,889	44,349	42,814	42,014	38,952
Commercial	10,311	12,122	13,911	15,609	16,770	17,811
Industrial	5,517	6,688	7,846	8,854	9,799	10,567
Total	57,005	69,699	66,105	67,277	68,583	67,330
Forecasted Sales (Net of Opt-Outs)	3,340,248	3,345,466	3,360,838	3,378,011	3,402,115	3,414,693
Incremental Annual Savings %						
Sector						
Residential	2.9%	3.5%	3.1%	2.9%	2.9%	2.6%
Commercial	0.8%	1.0%	1.1%	1.2%	1.3%	1.4%
Industrial	0.9%	1.0%	1.2%	1.4%	1.5%	1.6%
% of Forecasted Sales	1.7%	2.1%	2.0%	2.0%	2.0%	2.0%

Table ES-3 provides the cumulative RAP for each year across the 2020-2025 timeframe. The cumulative annual savings potential ranges from 57 GWh to nearly 309 GWh. These results assume that opt-out industrial customers do not provide any savings potential.

TABLE ES-3 CUMULATIVE ELECTRIC MEASURE LEVEL REALISTIC ACHIEVABLE POTENTIAL – BY SECTOR (2020-2025)

Cumulative Annual MWh	2020	2021	2022	2023	2024	2025
Sector						
Residential	41,177	84,538	105,533	134,072	159,025	184,648
Commercial	10,311	21,974	35,168	49,609	64,869	80,454
Industrial	5,517	11,982	19,336	27,377	35,449	43,566
Total	57,005	118,494	160,037	211,059	259,344	308,667
Forecasted Sales (Net of Opt-Outs)	3,340,248	3,345,466	3,360,838	3,378,011	3,402,115	3,414,693
Cumulative Annual Savings %						
Sector						
Residential	2.9%	5.9%	7.3%	9.2%	10.8%	12.5%
Commercial	0.8%	1.8%	2.8%	4.0%	5.1%	6.3%
Industrial	0.9%	1.9%	3.0%	4.2%	5.5%	6.7%
% of Forecasted Sales	1.7%	3.5%	4.8%	6.2%	7.6%	9.0%

Table ES-4 provides the annual budgets in the RAP scenario. The total RAP budgets across all sectors ranges from $24 million to $35 million during the 2020-2025 timeframe.

TABLE ES-4 ANNUAL BUDGETS (2020-2025) IN THE RAP SCENARIO ($ IN MILLIONS)

RAP Budgets	2020	2021	2022	2023	2024	2025
Energy Efficiency						
Incentives	$16.2	$21.1	$22.8	$24.0	$24.8	$24.6
Admin	$4.8	$6.2	$6.4	$6.6	$7.0	$7.0
Energy Efficiency Sub-Total	$21.0	$27.3	$29.2	$30.6	$31.8	$31.6
Demand Response / CVR						
Incentives	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Admin	$1.4	$1.7	$2.1	$1.6	$1.0	$0.9
Demand Response / CVR Sub-Total	$1.4	$1.7	$2.1	$1.6	$1.0	$0.9
Indirect[3]	$1.4	$1.8	$1.7	$1.9	$2.0	$2.1
Total						
Total Costs	$23.8	$30.8	$33.0	$34.0	$34.8	$34.5

Measure-Level Realistic Achievable Potential (Including Opt-Outs)

Table ES-5 provides the incremental RAP for each year across the 2020-2025 timeframe, with sales and savings estimates from opt-out customers included. The incremental annual savings potential ranges from 72 GWh to 97 GWh. The incremental RAP increases by approximately 15 to 30 GWh across the timeframe, compared to the results with opt-out customers excluded.

TABLE ES-5 INCREMENTAL ELECTRIC REALISTIC ACHIEVABLE POTENTIAL – BY SECTOR (2020-2025)

Incremental Annual MWh	2020	2021	2022	2023	2024	2025
Sector						
Residential	41,177	50,889	44,349	42,814	42,014	38,952
Commercial	11,578	13,618	15,630	17,541	18,846	20,006
Industrial	19,324	23,576	27,883	31,695	35,218	38,149
Total	72,080	88,082	87,862	92,050	96,078	97,106
Forecasted Sales	5,163,888	5,174,499	5,196,938	5,221,660	5,253,393	5,273,051
Sector						
Residential	2.9%	3.5%	3.1%	2.9%	2.9%	2.6%
Commercial	0.8%	1.0%	1.1%	1.2%	1.3%	1.4%
Industrial	0.8%	1.0%	1.2%	1.3%	1.5%	1.6%
% of Forecasted Sales	1.4%	1.7%	1.7%	1.8%	1.8%	1.8%

Table ES-6 provides the cumulative RAP for each year across the 2020-2025 timeframe, with sales and savings estimates from opt-out customers included. The cumulative annual savings potential ranges from 72 GWh to 426 GWh. The cumulative annual RAP increases by more than 100 GWh across the 2020-2025 timeframe, compared to the results with opt-out customers excluded.

[3] Indirect costs represent costs that are not specifically attributed to individual programs and can include additional outreach, evaluation, and program planning activities.

TABLE ES-6 CUMULATIVE ELECTRIC REALISTIC ACHIEVABLE POTENTIAL – BY SECTOR (2020-2025)

Cumulative Annual MWh	2020	2021	2022	2023	2024	2025
Sector						
Residential	41,177	84,538	105,533	134,072	159,025	184,648
Commercial	11,578	24,685	39,512	55,740	72,884	90,391
Industrial	19,324	41,785	67,208	94,837	123,025	151,326
Total	72,080	151,009	212,254	284,649	354,935	426,364
Forecasted Sales	5,163,888	5,174,499	5,196,938	5,221,660	5,253,393	5,273,051
Sector						
Residential	2.9%	5.9%	7.3%	9.2%	10.8%	12.5%
Commercial	0.8%	1.8%	2.8%	4.0%	5.1%	6.3%
Industrial	0.8%	1.8%	2.9%	4.0%	5.2%	6.4%
% of Forecasted Sales	1.4%	2.9%	4.1%	5.5%	6.8%	8.1%

DEMAND SAVINGS

The study also included an assessment of peak demand savings potential. Table ES-7 below provides the overall peak demand savings from energy efficiency, demand response, and CVR potential. The demand response potential assumes the energy efficiency peak demand reductions take precedent, and thereby reduce the baseline peak demand which can be further reduced by demand response.

TABLE ES-7 CUMULATIVE PEAK DEMAND SAVINGSPOTENTIAL – MAP AND RAP (2020-2025)

MW	2020	2021	2022	2023	2024	2025
MAP						
Energy Efficiency	12	28	43	58	72	85
Demand Response	22	61	103	121	124	123
CVR	0.4	0.4	0.4	1.1	1.1	1.1
Total	34	90	147	180	197	209
RAP						
Energy Efficiency	8	16	23	31	38	45
Demand Response	7	19	37	47	51	51
CVR	0.4	0.4	0.4	1.1	1.1	1.1
Total	15	35	60	79	90	98

ACTION PLAN

The results of the potential study were leveraged to develop a DSM Action Plan for the 2020-2025 timeframe. The achievable potential identified by the potential study formed the basis of the development of program potential, which further accounts for budgetary and market considerations. Furthermore, the Vectren Electric DSM Action Plan was developed as an integrated effort with the Vectren Gas DSM Action Plan, in order to optimize program design, budget, and cost-effectiveness considerations. Table ES-8 provides the incremental program potential for each year across the 2020-2025 timeframe. The incremental annual savings potential ranges from 43,244 MWh to 49,716 MWh.

TABLE ES-8 INCREMENTAL ELECTRIC PROGRAM POTENTIAL – BY SECTOR (2020-2025)

Incremental Annual MWh	2020	2021	2022	2023	2024	2025
Sector						
Residential	22,880	24,682	18,353	17,461	16,186	16,349
Commercial and Industrial	24,571	25,034	26,212	27,914	27,124	26,895
Total	47,451	49,716	44,565	45,375	43,309	43,244
Forecasted Sales (Net of Opt-Outs)	3,340,248	3,345,466	3,360,838	3,378,011	3,402,115	3,414,693
Incremental Annual Savings %						
Sector						
Residential	1.6%	1.7%	1.3%	1.2%	1.1%	1.1%
Commercial and Industrial	1.3%	1.3%	1.4%	1.5%	1.4%	1.4%
Incremental Annual Savings %						
% of Forecasted Sales	1.4%	1.5%	1.3%	1.3%	1.3%	1.3%

Table ES-9 provides the cumulative Program Potential for each year across the 2020-2025 timeframe. The cumulative annual savings potential rises from 47,451 MWh to 273,660 MWh.

TABLE ES-9 CUMULATIVE ELECTRIC PROGRAM POTENTIAL – BY SECTOR (2020-2025)

Cumulative MWh	2020	2021	2022	2023	2024	2025
Sector						
Residential	22,880	47,562	65,915	83,376	99,562	115,911
Commercial and Industrial	24,571	49,605	75,817	103,730	130,854	157,749
Total	47,451	97,167	141,732	187,107	230,416	273,660
Forecasted Sales (Net of Opt-Outs)	3,340,248	3,345,466	3,360,838	3,378,011	3,402,115	3,414,693
Cumulative Annual Savings %						
Sector						
Residential	1.6%	3.3%	4.5%	5.7%	6.8%	7.9%
Commercial and Industrial	1.3%	2.6%	4.0%	5.5%	6.8%	8.2%
% of Forecasted Sales	1.4%	2.9%	4.2%	5.5%	6.8%	8.0%

Table ES-10 provides the annual budgets in the DSM Action Plan. The portfolio-level budgets range from $10.3 million to $11.2 million during the 2020-2025 timeframe.

TABLE ES-10 DSM ACTION PLAN ANNUAL BUDGETS (2020-2025)

Annual Budgets	2020	2021	2022	2023	2024	2025
Residential						
Incentives	$1.3	$1.4	$1.3	$1.1	$1.2	$1.2
Admin	$0.4	$0.4	$0.4	$0.4	$0.4	$0.4
Implementation	$3.5	$3.8	$3.8	$3.8	$3.9	$4.0
Residential Sub-total	**$5.2**	**$5.5**	**$5.4**	**$5.3**	**$5.5**	**$5.6**
Commercial and Industrial						
Incentives	$2.4	$2.5	$2.5	$2.4	$2.4	$2.3
Admin	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2
Implementation	$1.3	$1.4	$1.4	$1.5	$1.6	$1.6
Commercial and Industrial Sub-total	**$3.9**	**$4.0**	**$4.1**	**$4.1**	**$4.2**	**$4.1**
Non-Sector Specific Costs						
Indirect	$0.5	$0.5	$0.5	$0.5	$0.6	$0.6
Evaluation	$0.5	$0.5	$0.5	$0.5	$0.5	$0.5
Other	$0.2	$0.5	$0.2	$0.2	$0.5	$0.2
Total						
DSM Portfolio Total	**$10.3**	**$11.1**	**$10.8**	**$10.7**	**$11.2**	**$11.0**

COST-EFFECTIVENESS

For planning purposes, each of the recommended programs must pass the Utility Cost Test (UCT) and the Total Resource Cost (TRC) tests, except for Income-Qualified Programs which do not need to meet cost-effectiveness tests in order to promote a greater social good. The cost-effectiveness results are reported for the UCT and the TRC tests. Each program is assessed separately to determine relative benefits and costs (in contrast to assessing each individual measure). The definitions for the four standard tests most commonly used in EE program design are described below.

- ***Total Resource Cost test (TRC).*** The benefits in this test are the lifetime avoided energy costs and avoided capacity costs. The costs in this test are the incremental measure costs plus all administrative costs spent by the program administrator.
- ***Utility Cost Test (UCT).*** The benefits in this test are the lifetime avoided energy costs and avoided capacity costs, the same as the TRC benefits. The costs in this test are the program administrator's incentive costs and administrative costs.
- ***Participant Cost Test (PCT).*** The benefits in this test are the lifetime value of retail rate savings (which is another way of saying "lost utility revenues"). The costs in this test are those seen by the participant; in other words: the incremental measure costs minus the value of incentives paid out.
- ***Rate Impact Measure test (RIM).*** The benefits of the RIM test are the same as the TRC benefits. The RIM costs are the same as the UCT, except for the addition of lost revenue. This test attempts to show the effects that EE programs will have on rates, which is almost always to raise them on a per unit basis. Thus, costs typically outweigh benefits from the point of view of this test, but the assumption is that absolute energy use decreases to a greater extent than per-unit rates are increased — resulting in lower average utility bills.

Table ES-11 provides the cost-benefit ratios for each of the major cost-effectiveness tests as well as the TRC Net Benefits by program and sector. Cost-benefit screening was performed using DSMore.

TABLE ES-11 VECTREN RECOMMENDED ACTION PLAN COST-EFFECTIVENESS SUMMARY

Program	TRC Ratio	TRC NET Benefits	UCT Ratio	PCT Ratio	RIM Ratio
Res Lighting	3.27	$9,339,929	5.38	4.99	0.69
Res HEA	2.24	$1,690,395	2.24		0.64
Res IQW	1.07	$507,171	1.14	9.65	0.66
Res Schools	4.79	$2,469,620	4.79		0.71
Res Behavior	1.82	$1,503,965	1.82		0.61
Res Appliance Recycling	2.50	$1,700,461	2.07		0.63
Res CVR	2.38	$1,909,353	2.38		0.78
Res Food Bank	8.29	$1,535,163	8.29		0.70
Res HEMS	1.01	$11,100	1.01		0.47
Direct Load Control	4.07	$10,016,215	3.06		2.28
Res New Construction	1.14	$91,580	1.98	1.28	0.75
Res Prescriptive	1.41	$3,069,767	1.91	2.01	0.77
Res Portfolio ALL E	2.12	$33,844,720	2.35	4.90	0.81
CI Prescriptive	3.06	$49,412,426	6.22	2.97	0.92
CI Custom	3.11	$20,261,839	6.46	3.45	0.77
CI Small Business	1.74	$4,065,481	2.49	3.09	0.53
CI CVR	2.55	$1,538,199	2.55		0.86
CI Portfolio ALL	**2.88**	**$75,277,946**	**5.43**	**3.13**	**0.82**
Total Portfolio ALL	***2.33***	***$102,456,927***	***3.25***	***3.56***	***0.79***

VOLUME I

2020-2025 Integrated Electric DSM Market Potential Study

prepared for

VECTREN
Live Smart

JANUARY 2019

1 Introduction

1.1 BACKGROUND & STUDY SCOPE

This Market Potential Study was conducted to support the development of a DSM Action Plan for Vectren. The study included primary market research and a comprehensive review of current programs, historical savings, and projected energy savings opportunities to develop estimates of technical, economic, and achievable potential. Separate estimates of electric energy efficiency and demand response potential were developed. The effort was highly collaborative, as the GDS Team worked closely alongside Vectren, as well as the Vectren Oversight Board, to produce reliable estimates of future saving potential, using the best available information and best practices for developing market potential saving estimates.

1.2 TYPES OF POTENTIAL ESTIMATED

The scope of this study distinguishes three types of energy efficiency potential: (1) technical, (2) economic, and (3) achievable.

- ***Technical Potential*** is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end users to adopt the efficiency measures. Technical potential is constrained only by factors such as technical feasibility and applicability of measures.
- ***Economic Potential*** refers to the subset of the technical potential that is economically cost-effective as compared to conventional supply-side energy resources. Economic potential follows the same adoption rates as technical potential. Like technical potential, the economic scenario ignores market barriers to ensuring actual implementation of efficiency. Finally, economic potential only considers the costs of efficiency measures themselves, ignoring any programmatic costs (e.g., marketing, analysis, administration) that would be necessary to capture them. This study uses the Utility Cost Test (UCT) to assess cost-effectiveness.
- ***Achievable Potential*** is the amount of energy that can realistically be saved given various market barriers. Achievable potential considers real-world barriers to encouraging end users to adopt efficiency measures; the non-measure costs of delivering programs (for administration, marketing, analysis, and EM&V); and the capability of programs and administrators to boost program activity over time. Barriers include financial, customer awareness and willingness to participate in programs, technical constraints, and other barriers the "program intervention" is modeled to overcome. Additional considerations include political and/or regulatory constraints. The potential study evaluated two achievable potential scenarios:
- ***Maximum Achievable Potential*** estimates achievable potential on paying incentives equal to 100% of measure incremental costs and aggressive adoption rates.
- ***Realistic Achievable Potential*** estimates achievable potential with Vectren paying incentive levels (as a percent of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.
- ***Program Potential*** refers to the efficiency potential possible given specific program funding levels and designs; in this study program potential is addressed by the DSM Action Plan, which further addresses issues such as market dynamics (net versus gross impacts), timeframe differences, proxy versus specific program delivery approaches, and budget realities.

1.3 STUDY LIMITATIONS

As with any assessment of energy efficiency potential, this study necessarily builds on various assumptions and data sources, including the following:

- Energy efficiency measure lives, savings, and costs
- Projected penetration rates for energy efficiency measures
- Projections of electric and natural gas avoided costs
- Future known changes to codes and standards

- Vectren load forecasts and assumptions on their disaggregation by sector, segment, and end use
- End-use saturations and fuel shares

While the GDS team has sought to use the best and most current available data, there are often reasonable alternative assumptions which would yield slightly different results.

1.4 ORGANIZATION OF REPORT

The remainder of this report is organized in seven sections as follows:

Section 2 Methodology details the methodology used to develop the estimates of technical, economic, and achievable energy efficiency and demand response potential savings.

Section 3 Market Characterization provides an overview of the Vectren service areas and a brief discussion of the forecasted energy sales by sector.

Section 4 Residential Energy Efficiency Potential provides a breakdown of the technical, economic, and achievable potential in the residential sector.

Section 5 Commercial Energy Efficiency Potential provides a breakdown of the technical, economic, and achievable potential in the commercial sector.

Section 6 Industrial Energy Efficiency Potential provides a breakdown of the technical, economic, and achievable potential in the industrial sector.

Section 7 Demand Response Potential provides a breakdown of the technical, economic, and achievable potential demand response by program type.

Appendices for the DSM Market Potential are included in Volume III of this report. MPS appendices include a discussion of sources used for the analysis, detailed measure level assumptions by customer segment, nonresidential sector potential savings (including opt-out customers), and detailed demand response results.

2 Methodology

This section describes the overall methodology utilized to assess the electric energy efficiency and demand response potential in the Vectren service area. The main objectives of this Market Potential Study were to estimate the technical, economic, MAP and RAP of energy efficiency and demand response in the Vectren electric (Vectren South) service territory; and to quantify these estimates of potential in terms of MWh and MW savings, for each level of energy efficiency and demand response potential.

The development of the DSM Action Plan, and associated savings during the 2020-2025 timeframe, are discussed in Volume II of this report.

2.1 OVERVIEW OF APPROACH

For the residential sector, GDS took a bottom-up approach to the modeling, whereby measure-level estimates of costs, savings, and useful lives were used as the basis for developing the technical, economic, and achievable potential estimates. The measure data was used to build-up the technical potential, by applying the data to each relevant market segment. The measure data allowed for benefit-cost screening to assess economic potential, which was in turn used as the basis for achievable potential, which took into consideration incentives and estimates of annual adoption rates.

For the commercial and industrial sectors, GDS took a bottom-up modeling approach to first estimate measure-level savings and costs as well as cost-effectiveness, and then applied cost-effective measure savings to all applicable shares of energy load. Disaggregated forecast data served as the foundation for the development of the energy efficiency potential estimates. The creation of the disaggregation involved two steps. First, GDS looked at actual customer groupings based on NAICS code and then calibrated our top down load allocation based these codes to determine whether the customer was captured in the load forecast. Second, GDS determined the appropriate industry for industrial customers and the building type for commercial customers.

2.2 MARKET CHARACTERIZATION

The initial step in the analysis was to gather a clear understanding of the current market segments by fuel type in the Vectren service area. The GDS team coordinated with Vectren to gather utility sales and customer data and existing market research to define appropriate market sectors, market segments, vintages, saturation data and end uses for each fuel type. This information served as the basis for completing a forecast disaggregation and market characterization of both the residential and nonresidential sectors.

2.2.1 Forecast Disaggregation

In the residential sector, GDS calibrated its building energy modeling simulations with Vectren's sales forecasts.[4] This process began with the construction of building energy models, using the BEopt™ (Building Energy Optimization)[5] software, which were specified in accordance with the most currently available data describing the residential building stock in the Vectren South service area. Models were constructed for both single-family and multifamily homes, as well as various types of heating and cooling equipment and fuel types. Key characteristics defining these models include conditioned square footage, typical building envelope conditions such as insulation levels and representative appliance and HVAC efficiency levels. The simulations yielded estimated energy consumption for each building prototype, including estimates of each key end use. These end use estimates were then multiplied by the estimated proportion of customers that applied to each end use, to calculate an estimated service territory total consumption for each end use. For example, when completing this process for the Vectren South electric potential analysis, the simulated heat

[4] Vectren's sales forecast in all sectors excludes the impact of future DSM savings. Excluding future DSM savings prevents under-estimating energy efficiency savings potential.
[5] BEopt can be used to analyze both new construction and existing home retrofits, as well as single-family detached and multi-family buildings, through evaluation of single building designs, parametric sweeps, and cost-based optimizations.

pump electric heating consumption was multiplied by the proportion of homes that rely on heat pumps for their electric heating needs, to calculate the total heat pump electric heating load in the Vectren South service territory.

The simulation process required several iterations. GDS collaborated with Vectren to verify and modify certain assumptions about the market characteristics, such as the heating fuel and equipment types. GDS adjusted its assumptions about key market characteristics and revised its BEopt models to calibrate its building energy models to within 1% of forecasted sales in 2020.

In the commercial and industrial sectors, disaggregated forecast data provides the foundation for the development of energy efficiency potential estimates. GDS disaggregated the nonresidential sector for Vectren into building or industry types using Vectren's commercial and industrial customer database and 2017 monthly sales data. GDS supplemented the Vectren customer database with a third-party dataset (purchased from InfoUSA) that provided additional SIC/NAICS code data by business.[6] This disaggregation involved two steps. First, the GDS team used rate codes to determine whether the customer was captured in either Vectren's commercial or industrial load forecast. Next, GDS determined the appropriate industry for industrial customers and the building type for commercial customers. We used the following information, either from Vectren's customer data or third-party dataset, to determine the appropriate building or industry type. Using these fields, GDS assigned customers Vectren's non-residential data sets to one of the commercial or industrial segments listed in Table 2-1.

TABLE 2-1 NON-RESIDENTIAL SEGMENTS

COMMERCIAL	INDUSTRIAL	
☑ Education	☑ Chemicals	☑ Paper
☑ Food Sales	☑ Fabricated Metals	☑ Plastics and Rubber
☑ Food Service	☑ Food and Agriculture	☑ Primary Metals
☑ Health Care	☑ Machinery	☑ Transportation Equipment
☑ Hospital	☑ Mining	☑ Wood
☑ Large Office	☑ Nonmetallic Mineral	
☑ Large Retail		
☑ Lodging		
☑ Mercantile		
☑ Office		
☑ Public Assembly		
☑ Warehouse		

GDS further disaggregated sales for each of the segments into end uses. For commercial segments, GDS primarily used Vectren's 2016 end-use forecast planning models supplemented with updated EIA 2012 Commercial Building Energy Consumption Survey (CBECS) data for the East South-Central Census region. This information was used to determine energy use intensities, expressed in kWh per square foot, for each end use within each segment.[7] We then used data compiled from metering studies, Evaluation, Measurement and Verification (EM&V), and engineering algorithms to further disaggregate energy intensities into more granular end uses and technologies. For the industrial sector, the analysis relied on the EIA's Manufacturing Energy Consumption survey to disaggregate industry-specific estimates of consumption into end uses.[8]

[6] The Vectren dataset classifies businesses by Standard Industrial Classification (SIC) code, a four-digit standardized code, that has largely been replaced by the North American Industry Classification System (NAICS) code. The GDS Team converted the Vectren SIC codes to NAICS codes, then mapped NAICS/SIC codes to building and industry types considered in this study.
[7] U.S. Energy Information Agency. *Commercial Buildings Energy Consumption Survey (CBECS)*. May 20, 2016. https://www.eia.gov/consumption/commercial/. Although the Vectren service area officially resides in the East-North Central Census region, Vectren's long-term load forecast uses the East-South Central Census region as a more accurate representation of the Vectren service area.
[8] U.S. EIA. *Manufacturing Energy Consumption Survey (MECS) 2010.* March 2013. https://www.eia.gov/consumption/manufacturing/data/2010/.

Table 2-2 lists the electric end-uses considered in the forecast disaggregation and subsequent potential assessment.

TABLE 2-2 ELECTRIC END USES

RESIDENTIAL	COMMERCIAL	INDUSTRIAL
☑ Behavioural	☑ Cooking	☑ Agriculture
☑ Clothes Washer/Dryer	☑ Cooling	☑ Computers & Office Equipment
☑ Dishwasher	☑ Lighting	☑ CHP
☑ Electronics	☑ Office Equipment	☑ Lighting
☑ Hot Water	☑ Refrigeration	☑ Machine Drive
☑ HVAC Equipment	☑ Space Heating	☑ Process Heating
☑ HVAC Shell	☑ Ventilation	☑ Process Cooling
☑ Lighting	☑ Water Heating	☑ Space Cooling
☑ Pool/Spa		☑ Space Heating
		☑ Ventilation
		☑ Water Heating

2.2.2 Eligible Opt-Out Customers

In Indiana, commercial or industrial customers with a peak load greater than 1MW are eligible to opt out of utility-funded electric energy efficiency programs. In the Vectren service area, approximately 67% of C&I customers are eligible to opt-out. Of eligible customers, nearly 76% have chosen to opt-out. As a result, only 49% of total C&I sales have not presently opted out of funding Vectren's energy efficiency programs.[9]

FIGURE 2-1 OPT-OUT SALES BY C&I SECTOR

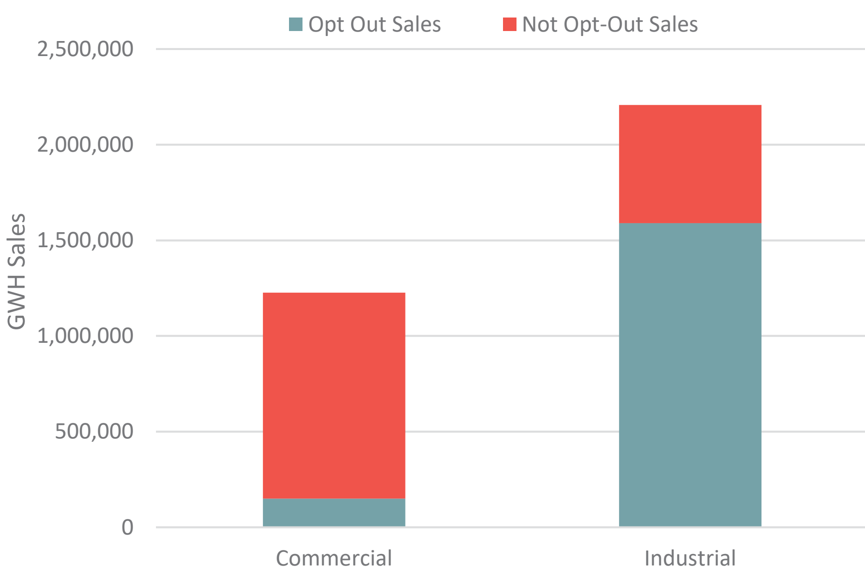


Figure 2-1 shows the total sales for the commercial and industrial sectors, as well as the sales, by sector, that have currently opted out of paying the charge levied to support utility-administered energy efficiency programs. The portion of sales that have not opted out include both ineligible load (i.e. does not meet the 1 MW monthly peak requirement) as well as eligible load that has not yet opted out.

The main body of this report focuses on the electric energy efficiency potential savings in the commercial and industrial sectors excluding sales from opt-out customers. Appendix E and Appendix F provide the respective results of commercial and industrial sector potential in a scenario that includes savings from Vectren's opt-out customers.

2.2.3 Building Stock/Equipment Saturation

To assess the potential electric energy efficiency savings available, estimates of the current saturation of baseline equipment and energy efficiency measures are necessary.

[9] These percentages were calculated based on the 2017 Vectren non-residential customer data and 2017 billing history.

2.2.3.1 Residential Sector

For the residential sector, GDS relied on several primary research efforts. The electric measure analysis was largely informed by a 2016 baseline survey of Vectren South customers. Nearly 500 responses to this survey provided a strong basis for many of the Vectren South electric measure baseline and efficient saturation estimates. A 2015 CFL and LED baseline study helped inform the saturation estimates for the lighting end use. A 2017 electric baseline thermostat survey of Vectren customers was leveraged to better characterize the increased prominence of smart and Wi-Fi-enabled thermostats.

EIA Residential Energy Consumption Survey (RECS) data from 2015 helped fill in data gaps that could not be directly informed by Vectren primary research. Other data sources included ENERGY STAR unit shipment data, Vectren evaluation reports, and baseline studies from other states. The ENERGY STAR unit shipment data filled data gaps related to the increased saturation of energy efficient equipment across the U.S. in the last decade.

2.2.3.2 Commercial Sector

For the ***commercial sector***, data collected through on-site visits as part of this study was leveraged to develop remaining factors for many of the measures. GDS coordinated with Vectren and the Oversight Board to develop a research plan, sampling plan, and a survey questionnaire used to collect data.

The study included primary onsite research with 38 of Vectren's commercial customers across all building types considered in the study.[10] The on-site data collection included facility operation schedules and building characteristics, HVAC equipment type and efficiency levels, lighting fixture inventories, control systems and strategies, and related electric consuming equipment characteristics.

The survey data was used to inform two main assumptions for the potential study, the Base Case and the Remaining factors. The Base Case Factor is the fraction of the end use energy that is applicable for the efficient technology in a given market segment. Survey data was used to determine fractional energy use for most measures in the study. The survey data provided counts for equipment and energy usage levels for the lighting, heating, cooling, water heating, motors and refrigeration end-uses. For example, T8 lighting used 88% of the energy for interior fluorescent lamps and fixtures for the surveyed buildings. The remaining usage was a combination of T12s, T5s and LED linear tube lighting. In total, 60% of the base case allocations came directly from the survey data and the other 40% came from regional potential study data from other Indiana Utilities or from GDS estimates based upon past study experience.

The remaining factor is the fraction of applicable kWh sales that are associated with equipment that has not yet been converted to the energy efficiency measure. It can also be defined as one minus the fraction of the market segment that already have the energy-efficiency measure installed, or one minus the market saturation for the measures. The commercial survey data was used to determine the remaining factors for 60% of all measures in the study. For example, the survey found that 24% of linear fluorescent lamps have already been converted to LEDs. The remaining factor for this measure is 76%. The latest ENERGY STAR shipment data report also provided remaining factors for several measures. The other remaining factors are either 100% for emerging technologies measures or estimates are based on GDS past study experience.

2.2.3.3 Industrial Sector

For the ***industrial sector***, Vectren survey data was leveraged to determine the remaining factors for several end-uses, including motors, interior and exterior lighting and fixture measures. GDS was able to approximate the percentage of remaining standard efficiency motors from the survey data (approximately 67% appear to be standard efficiency), as well as the approximate percentage of remaining constant speed motors (non-VFD) for the industrial survey group (approximately 65% constant speed). GDS was also able to determine a percentage of remaining fluorescent tube

10 The full survey dataset was provided to Vectren as a deliverable.

fixture lighting and HID fixture lighting (non-LED) to be approximately 90% from the industrial survey responses. Other industrial process remaining factors were determined based on remaining factors used in previous studies, which were determined from baseline studies in other jurisdictions, the U.S. EIA 2013 Industrial Model Documentation Report, or GDS engineering estimates.

2.2.4 Remaining Factor

The remaining factor is the proportion of a given market segment that is not yet efficient and can still be converted to an efficient alternative. If is by definition, the inverse of the saturation of an energy efficient measure, prior to any adjustments. For this study we made two key adjustments to recognize that the energy efficient saturation does not necessarily always fully represent the state of market transformation. In other words, while a percentage of installed measures may already be efficient, this does not preclude customers from backsliding, or reverting to standard technologies, or otherwise less efficient alternatives in the future, based on considerations like measure cost and availability and customer preferences (e.g. historically, some customers have disliked CFL light quality, and have reverted to incandescent and halogen bulbs after the CFLs burn out).

For measures categorized as market opportunity (i.e. replace-on-burnout), we assumed that 50% of the instances in which an efficient measure is already installed, the burnout or failure of those measures would be eligible for inclusion in the estimate of future savings potential. Essentially this adjustment implies that we are assuming that 50% of the market is transformed, and no future savings potential exists, whereas the remaining 50% of the market is not transformed and could backslide without the intervention of a Vectren program and an incentive. Similarly, for retrofit measures, we assumed that only 10% of the instances in which an efficient measure is already installed, the burnout or failure of those measures would be eligible for inclusion in the estimate of future savings potential. This recognizes the more proactive nature of retrofit measures, as the implementation of these measures are more likely to be elective in nature, compared to market opportunity measures, which are more likely to be needs-based. We recognize the uncertainty in these assumptions, but we believe these are appropriate assumptions, as they recognize a key component of the nature of customer decision making.

2.3 MEASURE CHARACTERIZATION

2.3.1 Measure Lists

The study's sector-level energy efficiency measure lists were informed by a range of sources including the Indiana TRM, current Vectren program offerings, and commercially viable emerging technologies, among others. Measure list development was a collaborative effort in which GDS developed draft lists that were shared with Vectren and the Stakeholders. The final measure lists ultimately included in the study reflected the informed comments and considerations from the parties that participated in the measure list review process.

In total, GDS analyzed 538 measure types for Vectren South – Electric. Some measures save both electric and natural gas. For those measures, the savings of both fuels were included in the benefit-cost screening.[11] Many measures were included in the study as multiple permutations to account for different specific market segments, such as different building types, efficiency levels, and replacement options. GDS developed a total of 4,155 measure permutations for this study. Each permutation was, screened for cost-effectiveness according to the Utility Cost Test (UCT). The parameters for cost-effectiveness under the UCT are discussed in detail later in Section 2.4.3.

[11] Because electric and natural gas results are presented in separate reports, costs were apportioned between electric and gas based on the relative amount of savings from each fuel type.

TABLE 2-3 NUMBER OF MEASURES EVALUATED

	# of Measures	Total # of Measure Permutations	# with UCT ≥ 1
Vectren South – Electric			
Residential	185	636	449
Commercial	219	2,190	1,890
Industrial	165	1,464	1,424
Total	550	4,155	3,681

2.3.2 Emerging Technologies

GDS considered several specific emerging technologies as part of analyzing future potential. In the residential sector, these technologies include several smart technologies, including smart appliances, smart water heater (WH) tank controls, smart window coverings, smart ceiling fans, heat pump dryers and home automation/home energy management systems. In the non-residential sector, specific emerging technologies that were considered as part of the analysis include strategic energy management, advance lighting controls, advanced rooftop controls, cloud-based energy information systems ("EIS"), high performance elevators, and escalator motor controls. While this is likely not an exhaustive list of possible emerging technologies over the next twenty years it does consider many of the known technologies that are available today but may not yet have widespread market acceptance and/or product availability.

In addition to these specific technologies, GDS acknowledges that there could be future opportunities for new technologies as equipment standards improve and market trends occur. While this analysis does not make any explicit assumption about unknown future technologies, the methodology assumes that subsequent equipment replacement that occurs over the course of the 20-year study timeframe, and at the end of the initial equipment's useful life, will continue to achieve similar levels of energy savings, relative to improved baselines, at similar incremental costs.

2.3.3 Assumptions and Sources

A significant amount of data is needed to estimate the electric savings potential for individual energy efficiency measures or programs across the residential and nonresidential customer sectors. GDS utilized data specific to Vectren when it was available and current. GDS used the most recent Vectren evaluation report findings (as well as Vectren program planning documents), 2015 Indiana Technical Reference Manual (IN TRM), the Illinois TRM, and the Michigan Energy Measures Database (MEMD) to a large amount of the data requirements. Evaluation report findings and the Indiana TRM were leveraged to the extent feasible – additional data sources were only used if these first two sources either did not address a certain measure or contained outdated information. The BEopt simulation modeling results formed the basis for most heating and cooling end use measure savings. The National Renewable Energy Laboratory (NREL) Energy Measures Database also served as a key data source in developing measure cost estimates. Additional source documents included American Council for an Energy-Efficient Economy (ACEEE) research reports covering topics like emerging technologies.

Measure Savings: GDS relied on existing Vectren evaluation report findings and the 2015 IN TRM to inform calculations supporting estimates of annual measure savings as a percentage of base equipment usage. For custom measures and measures not included in the IN TRM, GDS estimated savings from a variety of sources, including:

- Illinois TRM, MEMD, and other regional/state TRMs
- Building energy simulation software (BEopt) and engineering analyses
- Secondary sources such as the ACEEE, Department of Energy (DOE), Energy Information Administration (EIA), ENERGY STAR©, and other technical potential studies

Measure Costs: Measure costs represent either incremental or full costs. These costs typically include the incremental cost of measure installation, when appropriate based on the measure definition. For purposes of this study, nominal measure costs held constant over time.[12] One exception is an assumed decrease in costs for light emitting diode (LED) bulbs over the study horizon. LED bulb consumer costs have been declining rapidly over the last several years and future cost projections indicate a continued decrease in bulb costs.[13] GDS' treatment of LED bulb costs, LED lighting efficacy, and the impacts of the Energy Independence and Security Act ("EISA") are discussed in greater detail in Section 2.3.5, "Review of LED Lighting Assumptions."

GDS obtained measure cost estimates primarily from the Vectren program planning databases, and the 2015 IN TRM. GDS used the following data sources to supplement the IN TRM:

- Illinois TRM, MEMD, and other regional/state TRMs
- Secondary sources such as the ACEEE, ENERGY STAR, and National Renewable Energy Lab (NREL)
- Program evaluation and market assessment reports completed for utilities in other states

Measure Life: Measure life represents the number of years that energy using equipment is expected to operate. GDS obtained measure life estimates from the 2015 IN TRM and Vectren program planning databases, and used the following data sources for measures not in the IN TRM:

- Illinois TRM, MEMD, and other regional/state TRMs
- Manufacturer data
- Savings calculators and life-cycle cost analyses

All measure savings, costs, and useful life assumption sources are documented in Appendices B-D.

2.3.4 Treatment of Codes and Standards

Although this analysis does not attempt to predict how energy codes and standards will change over time, the analysis does account for the impacts of several known improvements to federal codes and standards. Although not exhaustive, key adjustments include[14]:

- The baseline efficiency for air source heat pumps (ASHP) is anticipated to improve to 14 SEER/8.2 HSPF[15] in 2015. As the existing stock of ASHPs was estimated to turn over and allowing for a sell-through period, the baseline efficiency was assumed to be the new federal standard, beginning in FY18.
- In 2015, the DOE makes amended standards effective for residential water heaters that required updated energy factors (EF) depending on the type of water heater and the rated storage volume. For electric storage water heaters with a volume greater than 55 gallons, the standards effectively require heat pumps for electric storage products. For storage tank water heaters with a volume of 55 gallons or less, the new standard (EF=0.948) becomes essentially the equivalent of today's efficient storage tank water heaters. [16]
- In March 2015, the DOE amended the standards for residential clothes washers. The new standards will require the Integrated Modified Energy Factor (MEF) (ft^3/kWh/cycle) to meet certain thresholds based on the machine configurations. The ENERGY STAR specifications for residential clothes washers will also be amended to increase the efficiency of units that can earn the ENERGY STAR label. Version 7.0 of the ENERGY STAR specification is scheduled to go into effect in March 2015. These amended federal and ENERGY STAR standards have been factored into the study.

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[12] GDS reviewed the deemed measure cost assumptions included in the Illinois TRM from 2012 (v1) through 2018 (v7). Where a direct comparison of cost was applicable, GDS found no change in measure cost across 80% of residential and nonresidential measures. In a similar search of the Michigan Energy Measure Database (MEMD) from 2011 to 2018, GDS again found that most of incremental measure costs in 2018 were either the same or higher than the recorded incremental measure cost in 2011.

[13] LED Incremental Cost Study Overall Final Report. The Cadmus Group. February 2016

[14] Key adjustments for LED screw-in lighting are addressed separately later in this section.

[15] SEER: Seasonal Energy Efficiency Ratio; HSPF: Heating Seasonal Performance Factor.

[16] Ultimately, GDS did not incorporate the requirements for large capacity water heaters into the analysis due to recent legislation that allows grid-enabled water heaters to remain at lower efficiency levels.

- In line with the phase-in of 2005 EPAct regulations, the baseline efficiency for general service linear fluorescent lamps was moved from the T12 light bulb to a T8 light bulb effective June 1, 2016.
- New U.S. Department of Energy (DOE) standards require that all general service fluorescent lamps (GSFL) manufactured after Jan. 26, 2018, meet increased efficacy standards, or lumens per watt, to encourage the adoption of high-efficiency lighting products. In the T8 category, most lamps pass the standards. However, these are primarily reduced-wattage (e.g., 25W, 28W) lamps. The basic-grade 32W lamps do not comply. The standard provides a loophole which excludes fluorescent tubes with a color rendering index (CRI) of 87 or higher. Even with that loophole, there will be fewer T8 lamps to choose from going forward and it is likely that the move to linear LEDs will accelerate.

2.3.5 Review of LED Lighting Assumptions

Recognizing that there remains significant uncertainty regarding the future potential of residential screw-in lighting, GDS reviewed the latest lighting-specific program designs and consulted with industry peers to develop critical assumptions regarding the future assumed baselines for LED screw base omnidirectional, specialty/decorative, and reflector/directional lamps over the study timeframe.

EISA Impacts. LED screw base omnidirectional and decorative lamps are impacted by the EISA 2007 regulation backstop provision, which requires all non-exempt lamps to be 45 lumens/watt, beginning in 2020. Based on this current legislation, the federal baseline in 2020 will be roughly equivalent to a CFL bulb. However, in January 2017, the Department of Energy expanded the scope of the standard to include directional and specialty bulb but stated that they may delay enforcement based on ongoing dialog with industry stakeholders. Although there is uncertainty surrounding EISA and the backstop provision, the Market Potential Study assumes the backstop provision for standard (A-lamp) screw-in bulbs will take effect beginning in 2022. The analysis assumes the expanded definition of general service lamps to include specialty and reflector sockets will impact those sockets beginning in 2023.

LED Bulb Costs. Based on EIA Technology Forecast Report, LED bulb costs were assumed to decrease over the analysis period. LED bulb costs ranged between $3 (standard) and $8.60 (reflector) in 2020, decreasing to $2-$3 by 2039. Incentives were modeled as a % of incremental cost, resulting in decreasing incentives over the analysis timeframe as well.

LED Lighting Efficacy. Using the same EIA Technical Forecast Report, LED efficacy was also assumed to improve over the analysis timeframe. By 2040, the LED wattage of a bulb equivalent to a 60W incandescent will improve from 8W (today's typical LED) down to 4W.

2.3.6 Net to Gross (NTG)

All estimates of technical, economic, and achievable potential, as well as measure level cost-effectiveness screening were conducted in terms of gross savings to reflect the absence of program design considerations in these phases of the analysis. The impacts of free-riders (participants who would have installed the high efficiency option in the absence of the program) and spillover customers (participants who install efficiency measures due to program activities, but never receive a program incentive) are considered in the DSM Action Plan component of this study.

2.4 ENERGY EFFICIENCY POTENTIAL

This section reviews the types of potential analyzed in this report, as well as some key methodological considerations in the development of technical, economic, and achievable potential.

2.4.1 Types of Potential

Potential studies often distinguish between several types of energy efficiency potential: technical, economic, achievable, and program. However, because there are often important definitional issues between studies, it is important to understand the definition and scope of each potential estimate as it applies to this analysis.

The first two types of potential, technical and economic, provide a theoretical upper bound for energy savings from energy efficiency measures. Still, even the best-designed portfolio of programs is unlikely to capture 100% of the technical or economic potential. Therefore, achievable potential attempts to estimate what savings may realistically be achieved through market interventions, when it can be captured, and how much it would cost to do so. Figure 2-2 illustrates the types of energy efficiency potential considered in this analysis. Program potential, in the form of the DSM Action Plan, is discussed in Volume II of the report.

FIGURE 2-2 TYPE OF ENERGY EFFICIENCY POTENTIAL[17]

Not Technically Feasible	TECHNICAL POTENTIAL			
Not Technically Feasible	Not Cost-Effective	ECONOMIC POTENTIAL		
Not Technically Feasible	Not Cost-Effective	Market Barriers	MAXIMUM ACHIEVABLE POTENTIAL	
Not Technically Feasible	Not Cost-Effective	Market Barriers	Partial Incentives	REALISTIC ACHIEVABLE POTENTIAL

2.4.2 Technical Potential

Technical potential is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end users to adopt the efficiency measures. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. Under technical potential, GDS assumed that 100% of new construction and market opportunity measures are adopted as those opportunities become available (e.g., as new buildings are constructed they immediately adopt efficiency measures, or as existing measures reach the end of their useful life). For retrofit measures, implementation was assumed to be resource constrained and that it was not possible to install all retrofit measures all at once. Rather, retrofit opportunities were assumed to be replaced incrementally until 100% of stock was converted to the efficient measure over a period of no more than 15 years.

2.4.2.1 Competing Measures and Interactive Effects Adjustments

GDS prevents double-counting of savings, and accounts for competing measures and interactive savings effects, through three primary adjustment factors:

Baseline Saturation Adjustment. Competing measure shares may be factored into the baseline saturation estimates. For example, nearly all homes can receive insulation, but the analysis has created multiple measure permutations to account for varying impacts of different heating/cooling combinations and have applied baseline saturations to reflect proportions of households with each heating/cooling combination.

Applicability Factor Adjustment. Combined measures into measure groups, where total applicability factor across measures is set to 100%. For example, homes cannot receive a programmable thermostat, connected thermostat, and smart thermostat. In general, the models assign the measure with the most savings the greatest applicability factor in the measure group, with competing measures picking up any remaining share.

Interactive Savings Adjustment. As savings are introduced from select measures, the per-unit savings from other measures need to be adjusted (downward) to avoid over-counting. The analysis typically prioritizes market opportunity

[17] Reproduced from "Guide to Resource Planning with Energy Efficiency." November 2007. US Environmental Protection Agency (EPA). Figure 2-1.

equipment measures (versus retrofit measures that can be installed at any time). For example, the savings from a smart thermostat are adjusted down to reflect the efficiency gains of installing an efficient air source heat pump. The analysis also prioritizes efficiency measures relative to conservation (behavioral) measures.

2.4.3 Economic Potential

Economic potential refers to the subset of the technical potential that is economically cost-effective (based on screening with the Utility Cost Test) as compared to conventional supply-side energy resources.

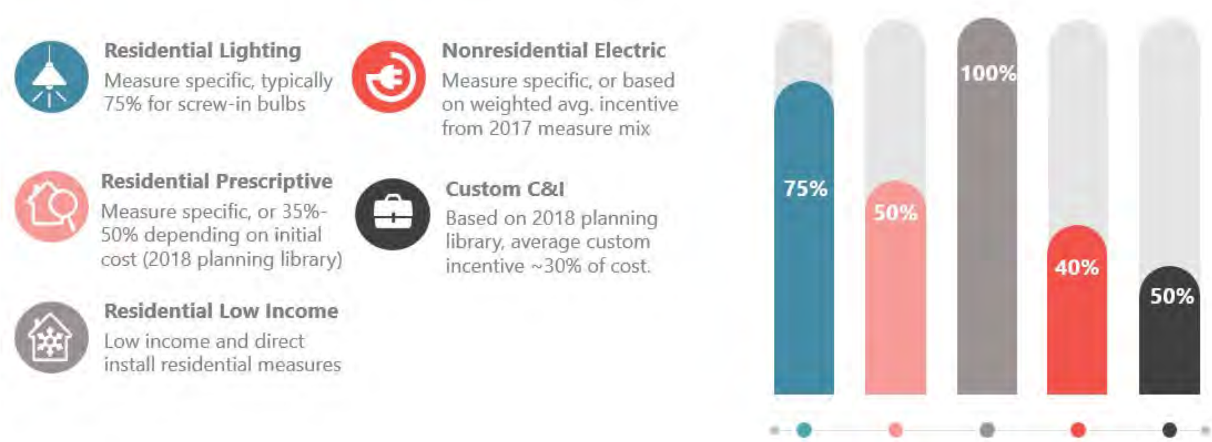
2.4.3.1 Utility Cost Test and Incentive Levels

The economic potential assessment included a screen for cost-effectiveness using the Utility Cost Test (UCT) at the measure level. In the Vectren South territory, the UCT considers both electric and natural gas savings as benefits, and utility incentives and direct install equipment expenses as the cost. Consistent with application of economic potential according to the National Action Plan for Energy Efficiency, the measure level economic screening does not consider non-incentive/measure delivery costs (e.g. admin, marketing, evaluation etc.) in determining cost-effectiveness.[18]

Apart from the low-income segment of the residential sector, all measures were required to have a UCT benefit-cost ratio greater than 1.0 to be included in economic potential and all subsequent estimates of energy efficiency potential. Low-income measures were not required to be cost-effective; all low-income specific measures are included in the economic and achievable potential estimates.

For both the calculation of the measure-level UCT, as well as the determination of RAP, historical incentive levels (as a % of incremental measure cost) were calculated for current measure offerings. Figure 2-3 describes the incentive levels by key market segment within the residential and nonresidential sectors.

FIGURE 2-3 INCENTIVES BY SECTOR AND MARKET SEGMENT



GDS relied on Vectren's measure planning library and supporting DSM Operating Plan appendices to map current measure offerings to their historical incentive levels.[19] For study measures that did not map directly to a current offering, GDS calculated the weighted average incentive level (based on 2017 participation) by sector and/or program and applied these "typical" incentive levels to the new measures.

[18] National Action Plan for Energy Efficiency: Understanding Cost-Effectiveness of Energy Efficiency Programs. Note: Non-incentive delivery costs are included in the assessment of achievable potential and the DSM Action Plan.
[19] The measure planning library was leveraged primarily for determining current incentive levels rather than for developing estimates of future costs or savings potential.

- In the residential sector, lighting incentive levels were assumed to represent 75% of the measure cost. Remaining residential incentive levels were either 50% of the incremental measure cost, or 35% of the measure cost (for more expensive measures).
- Low income and direct install measures received incentives equal to 100% of the measure cost
- In the non-residential sector, prescriptive incentives were 50% of the measure cost, and custom measures received incentives equal to 30% of the measure cost 3
- In the MAP scenario, all incentives were set to 100% of the incremental measure cost.

2.4.3.2 Avoided Costs

Avoided energy supply costs are used to assess the value of energy savings. Avoided cost values for electric energy, electric capacity, and avoided transmission and distribution (T&D) were provided by Vectren as part of an initial data request. Electric energy is based on an annual system marginal cost. For years outside of the avoided cost forecast timeframe, future year avoided costs are escalated by the rate of inflation.

2.4.4 Achievable Potential

Achievable potential is the amount of energy that can realistically be saved given various market barriers. Achievable potential considers real-world barriers to encouraging end users to adopt efficiency measures; the non-measure costs of delivering programs (for administration, marketing, analysis, and EM&V); and the capability of programs and administrators to boost program activity over time. Barriers include financial, customer awareness and willingness to participate in programs, technical constraints, and other barriers the "program intervention" is modeled to overcome. Additional considerations include political and/or regulatory constraints. The potential study evaluated two achievable potential scenarios:

- ***Maximum Achievable Potential*** estimates achievable potential on paying incentives equal to 100% of measure incremental costs and aggressive adoption rates.
- ***Realistic Achievable Potential*** estimates achievable potential with Vectren paying incentive levels (as a percent of incremental measure costs) closely calibrated to historical levels but is not constrained by any previously determined spending levels.

2.4.4.1 Market Adoption Rates

GDS assessed achievable potential on a measure-by-measure basis. In addition to accounting for the natural replacement cycle of equipment in the achievable potential scenario, GDS estimated measure specific maximum adoption rates that reflect the presence of possible market barriers and associated difficulties in achieving the 100% market adoption assumed in the technical and economic scenarios.

The initial step was to assess the long-term market adoption potential for energy efficiency technologies. Due to the wide variety of measures across multiple end-uses, GDS employed varied measure and end-use-specific ultimate adoption rates versus a singular universal market adoption curve. These long-term market adoption estimates were based on either Vectren-specific Willingness to Participate (WTP) market research or publicly available DSM research including market adoption rate surveys and other utility program benchmarking. These surveys included questions to residential homeowners and nonresidential facility managers regarding their perceived willingness to purchase and install energy efficient technologies across various end uses and incentive levels.

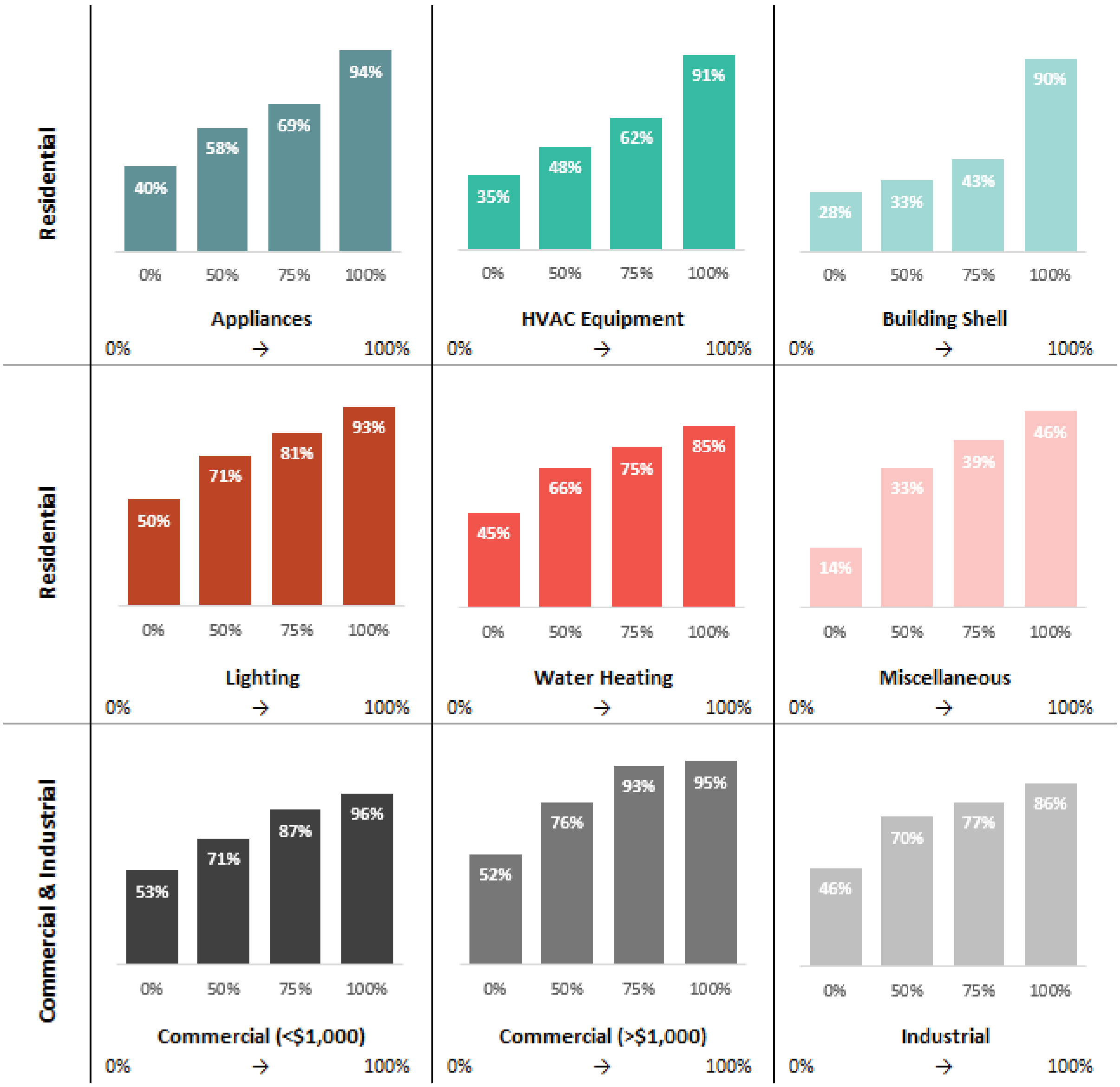
GDS utilized likelihood and willingness-to-participate data to estimate the long-term (20-year) market adoption potential for both the maximum and realistic achievable scenarios.[20] Table 2-4 presents the long-term market adoption rates at varied incentive levels used for both the residential and nonresidential sectors. When incentives are assumed to represent 100% of the measure cost (maximum achievable), the long-term market adoption ranged by sector and

[20] For the MAP Scenario, the long-term adoption rate was reached by Year15 (or earlier) and annual participation remained flat in the final five years of the analysis. In the RAP scenario, the analysis assumes the maximum adoption rate is reached over a period of 20-years or less.

end-use from 46% to 96%. For the RAP scenario, the incentive levels also varied by measure resulting in measure-specific market adoption rates.

TABLE 2-4 LONG-TERM MARKET ADOPTION RATES AT DISCRETE INCENTIVE LEVELS

(based on Willingness-to-Participate Survey Results)



GDS then estimated initial year adoption rates by reviewing the current saturation levels of efficient technologies and (if necessary) calibrating the estimates of 2020 annual potential to recent historical levels achieved by Vectren's current DSM portfolio. This calibration effort ensures that the forecasted achievable potential in 2020 is realistic and attainable. GDS then assumed a non-linear ramp rate from the initial year market adoption rate to the various long-term market adoption rates for each specific end-use.

One caveat to this approach is that the ultimate long-term adoption rate is generally a simple function of incentive levels and payback. There are other factors that may influence a customer's willingness to purchase an energy efficiency measure. For example, increased marketing and education programs can have a critical impact on the success of energy efficiency programs. Other benefits, such as increased comfort or safety and reduced maintenance costs could also factor into a customer's decision to purchase and install energy efficiency measures. To acknowledge these impacts, GDS considered the participant spillover and non-participant spillover rates (identified in prior Vectren evaluations) that demonstrate the impacts that efficiency program and their marketing/education components can have on increased technology adoption. GDS used these spillover rates to increase the long-term adoption rates (typically by 5%-7%) at each incentive level.

2.4.4.2 Non-Incentive Costs

Consistent with National Action Plan for Energy Efficiency (NAPEE) guidelines[21], utility non-incentive costs were included in the overall assessment of cost-effectiveness at the realistic achievable potential scenario. 2020 direct measure/program non-incentive costs were calibrated to recent 2016-2018 historical levels and set at $0.045 per first year kWh saved for residential lighting, $0.01 per first year kWh saved for residential behavior, $0.145 for the remaining residential measures, and $0.07 per first year kWh saved in the non-residential sectors. Non-incentive costs were then escalated annually at the rate of inflation%. [22]

In addition to non-incentive costs attributed directly to programs and measures, the analysis also included indirect program delivery that are not specifically attributed to individual programs and can include additional outreach, evaluation, and program planning activities. These costs were calibrated to 2015-2018 historical levels of $0.024 per first year kWh, escalated 5% annually.[23]

2.5 DEMAND RESPONSE AND CVR POTENTIAL

This section provides an overview of the demand response and conservation voltage reduction ("CVR") potential methodology. Summary results of the demand response analysis are provided in Section 7. Additional results details are provided in Appendix G.

2.5.1 Demand Response Program Options

Table 2-5 provides a brief description of the demand response (DR) program options considered and identifies the eligible customer segment for each demand response program that was considered in this study. This includes direct load control (DLC) and rate design options.

TABLE 2-5 DEMAND RESPONSE PROGRAM OPTIONS AND ELIGIBLE MARKETS

DR Program Option	Program Description	Eligible Markets
DLC AC (Switch)	The compressor of the air conditioner is remotely shut off (cycled) by the system operator for periods that may range from 7 ½ to 15 minutes during every 30-minute period (i.e., 25%-50% duty cycle)	Residential and Non-Residential Customers
DLC AC (Thermostat)	The system operator can remotely raise the AC's thermostat set point during peak load conditions, lowering AC load.	Residential and Non-Residential Customers

[21] National Action Plan for Energy Efficiency (2007). Guide for Conducting Energy Efficiency Potential Studies. Prepared by Optimal Energy. This study notes that economic potential only considers the cost of efficiency measures themselves, ignoring programmatic costs. Conversely, achievable potential should consider the non-measures costs of delivering programs. Pg. 2-4.
[22] As noted earlier in the report, measure costs and utility incentives were not escalated over the 20-year analysis timeframe to keep those costs constant in nominal dollars.
[23] The historic compound average annual growth rate (CAGR) over the same time is 22.6%. GDS used a more conservative escalation rate based on an expected slower growth rate in the future.

DR Program Option	Program Description	Eligible Markets
DLC Pool Pumps	The swimming pool pump is remotely shut off by the system operator for periods normally ranging from 2 to 4 hours.	Residential Customers
DLC Water Heaters	The water heater is remotely shut off by the system operator for periods normally ranging from 2 to 8 hours.	Residential and Non-Residential Customers
Critical Peak Pricing with Enabling Technology	A retail rate in which an extra-high price for electricity is provided during a limited number of critical periods (e.g. 100 hours) of the year. Market-based prices are typically provided on a day-ahead basis, or an hour-ahead basis. Includes enabling technology that connects technologies within building. Only for customers with AC.	Residential and Non-Residential Customers
Critical Peak Pricing without Enabling Technology	A retail rate in which an extra-high price for electricity is provided during a limited number of critical periods (e.g. 100 hours) of the year. Market-based prices are typically provided on a day-ahead basis, or an hour-ahead basis.	Residential and Non-Residential Customers
Real Time Pricing	A retail rate in which customers pay electricity supply rates that vary by the hour.	Non-Residential Customers
Peak Time Rebates	A program where customers are rewarded if they reduce electricity consumption during peak times with monetary rebates.	Residential and Non-Residential Customers
Time of Use Rates	A retail rate in which customers are charged higher rates for the energy they use during specific peak demand times.	Residential and Non-Residential Customers

Double-counting savings from demand response programs that affect the same end uses is a common issue that must be addressed when calculating the demand response savings potential. For example, a direct load control (DLC) program of air conditioning and a rate program both assume load reduction of the customers' air conditioners. For this reason, it is typically assumed that customers cannot participate in programs that affect the same end uses. As Vectren has offered a DLC program for many years, it was assumed that participation in this offering be prioritized before rate-based DR options. The order of the rest of the programs is based on savings where programs with higher savings per customer are prioritized.

2.5.2 Demand Response Potential Assessment Approach Overview

The analysis of DR, where possible, closely followed the approach outlined for energy efficiency. The framework for assessing the cost-effectiveness of demand response programs is based *on A Framework for Evaluating the Cost-Effectiveness of Demand Response, prepared for the National Forum on the National Action Plan (NAPA) on Demand Response*.[24] Additionally, GDS reviewed the May 2017 National Standard Practice Manual published by the National Efficiency Screening Project.[25] GDS utilized this guide to define avoided ancillary services and energy and/or capacity price suppression benefits.

The demand response analysis was conducted using the GDS Demand Response Model. The Model determines the estimated savings for each demand response program by performing a review of all benefits and cost associated with each program. GDS developed the model such that the value of future programs could be determined and to help facilitate demand response program planning strategies. The model contains approximately 50 required inputs for each program including: expected life, coincident peak ("CP") kW load reductions, proposed rebate levels, program related expenses such as vendor service fees, marketing and evaluation cost and on-going O&M expenses. This model and future program planning features can be used to standardize the cost-effectiveness screening process between Vectren departments interested in the deployment of demand response resources.

The UCT was used to determine the cost-effectiveness of each demand response program. Benefits are based on avoided demand, energy (including load shifting), wholesale cost reductions and T&D costs. Costs include incremental program equipment costs (such as control switches or smart thermostats), fixed program capital costs (such as the cost of a central controller), program administrative, marketing, and evaluation costs. Incremental equipment program costs are included for both new and replacement units (such as control switches) to account for units that are replaced at the end of their useful life.

The demand response analysis includes estimates of technical, economic, and achievable potential. Achievable potential is broken into maximum and RAP in this study:

MAP represents an estimate of the maximum cost-effective demand response potential that can be achieved over the 15-year study period. For this study, this is defined as customer participation in demand response program options that reflect a "best practices" estimate of what could eventually be achieved. MAP assumes no barriers to effective delivery of programs.

RAP represents an estimate of the amount of demand response potential that can be realistically achieved over the 20-year study period. For this study, this is defined as achieving customer participation in demand response program options that reflect a realistic estimate of what could eventually be achieved assuming typical or "average" industry experience. RAP is a discounted MAP, by considering program barriers that limit participation, therefore reducing savings that could be achieved.

Last, the analysis evaluated direct load control of thermostat potential under two possible conditions: 1) a Bring Your Own Thermostat ***(BYOT) scenario*** where the customer provides their own thermostat and are monetarily incentivized; and 2) a ***utility incentivized scenario*** where the utility provides the smart thermostat and provides a smaller monetary incentive. These options are described in more detail in Appendix G.

2.5.3 Avoided Costs

Demand response avoided costs were consistent with those utilized in the energy efficiency potential analysis and were provided by Vectren. The primary benefit of demand responses is avoided generation capacity, resulting from a

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[24] Study was prepared by Synapse Energy Economics and the Regulatory Assistance Project, February 2013.
[25] National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources, May 18, 2017, Prepared by The National Efficiency Screening Project

reduction in the need for new peaking generation capacity. Demand response can also produce energy related benefits. If the demand response option is considered "load shifting", such as direct load control of electric water heating, the consumption of energy is shifted from the control period to the period immediately following the period of control. For this study, GDS assumed that the energy is shifted with no loss of energy. If the program is not considered to be "load shifting" the measure is turned off during peak control hours, and the energy is saved altogether. Demand response programs can also potentially delay the construction of new transmission and distribution lines and facilities, which is reflected in avoided T&D costs.

2.5.4 Demand Response Program Assumptions

This section briefly discusses the general assumptions and sources used to complete the demand response potential analysis. Appendix G provides additional detail by program and sector related to load reduction, program costs, and projected participation.

Load Reduction: Demand reductions were based on load reductions found in Vectren's existing demand response programs, and various secondary data sources including the FERC and other industry reports, including demand response potential studies. DLC and thermostat-based DR options were typically calculated based on a per-unit kW demand reduction whereas rate-based DR options were typically assumed to reduce a percentage of the total facility peak load.

Useful Life: The useful life of a smart thermostat is assumed to be 15 years . Load control switches have a useful life of 15 years. This life was used for all direct load control measures in this study.

Program Costs: One-time program development costs included in the first year of the analysis for new programs. No program development costs are assumed for programs that already exist. Each new program includes an evaluation cost, with evaluation cost for existing programs already being included in the administration costs. It was assumed that there would be a cost of $50[26] per new participant for marketing for the DLC programs. Marketing costs are assumed to be 33.3% higher for MAP. All program costs were escalated each year by the general rate of inflation assumed for this study.

Saturation: The number of control units per participant was assumed to be 1 for all direct load control programs using switches (such as water heaters and air conditioning switches), because load control switches can control up to two units. However, for controllable thermostats, some participants have more than one thermostat. The average number of residential thermostats per single family home was assumed to be 1.72 thermostats.

2.5.5 DR Program Adoption Levels

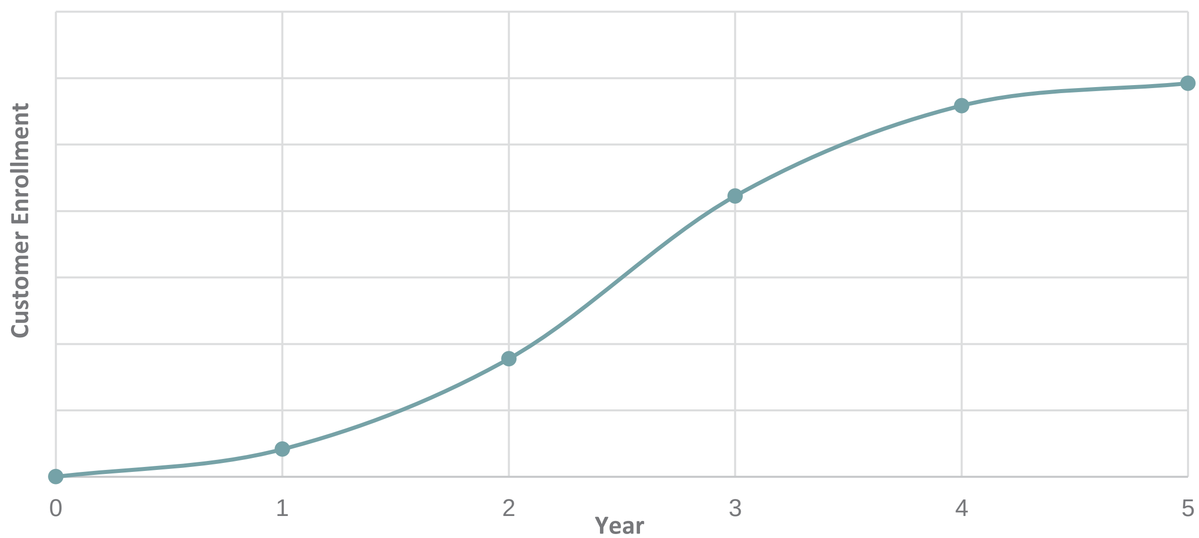
Long-term program adoption levels (or "steady state" participation) represent the enrollment rate once the fully achievable participation has been reached. GDS reviewed industry data and program adoption levels from several utility DR programs. The main sources of participant rates are several studies completed by the Brattle Group. Additional detail about participation rates and sources are shown in Appendix G. As noted earlier in this section, for direct load control programs, MAP participation rates rely on industry best adoption rates and RAP participation rates are based on industry average adoption levels. For the rate programs, the MAP steady-state participation rates assumed programs were opt-out based and RAP participation assumed opt-in status.

Customer participation in new demand response programs is assumed to reach the steady state take rate over a five-year period. The path to steady state customer participation follows an "S-shaped" curve, in which participation growth accelerates over the first half of the five-year period, and then slows over the second half of the period (see Figure 2-

[26] TVA Potential Study Volume III: Demand Response Potential, Global Energy Partners, December 2011

4). Existing programs have already gone through this ramp-up period, so they were escalated linearly to the final participation rate.

FIGURE 2-4 ILLUSTRATION OF S-SHAPED MARKET ADOPTION CURVE



2.5.6 Conservation Voltage Reduction (CVR)

GDS evaluated CVR as a demand response program capable of providing avoided energy and demand cost benefits through reduction of voltages along circuits fed by two different substations. CVR has been demonstrated by Vectren in an existing application at the Buckwood substation. Vectren plans to expand its CVR program to the East Side substation in 2020 and the Broadview substation in 2023. GDS has modeled the potential of CVR as reflecting the East Side and Broadview implementations only.

Energy and demand impacts were estimated by GDS using a combination of data sources, including the EM&V analysis of the Buckwood pilot program, an engineering report prepared by Power Systems Engineering, and data summarizing the customer counts by sector and energy sales volumes for each of the three substations. When CVR is implemented, energy savings are achieved for the hours of reduction, and Vectren indicated they intend to continue to operate CVR for a number of hours throughout the year, leading to energy savings and demand savings for the expanded program. The East Side substation is projected to save 2.63% of its residential and 4.71% of its C&I annual energy sales through application of CVR. Analysis by Power Systems Engineering indicates that the Broadview substation would achieve greater potential energy savings relative to East Side, achieving a 3.25% reduction of residential energy sales and 4.86% of C&I energy sales. Table 2-6 shows these impact details.

TABLE 2-6 CVR IMPACTS BY SUBSTATION

Substation	East Side	Broadview
Residential		
Total Energy Sales (kWh)	55,586,807	53,397,685
% Savings Assumed from CVR	2.63%	3.25%
CVR Energy Savings (kWh)	1,461,047	1,733,455
CVR Demand Savings (kW)	263	312
Commercial & Industrial		
Total Energy Sales (kWh)	21,922,082	43,766,990
% Savings Assumed from CVR	4.71%	4.86%
CVR Energy Savings (kWh)	1,032,655	2,127,540
CVR Demand Savings (kW)	186	383

Substation	East Side	Broadview
Substation Total		
Total Energy Sales (kWh)	77,508,888	97,164,675
% Savings Assumed from CVR	3.22%	3.97%
CVR Energy Savings (kWh)	2,493,702	3,860,995
CVR Demand Savings (kW)	449	695

Two sources of program costs are included in the cost effectiveness screening for CVR: implementation costs and administrative costs. Incentives are not necessary as voltage reduction is achieved without requiring participation or consent from customers and without sacrificing quality of service. Implementation costs are annualized based on a carrying cost factor that includes 30-years of straight-line depreciation, 4.0% interest for debt, and 3.2% for O&M.

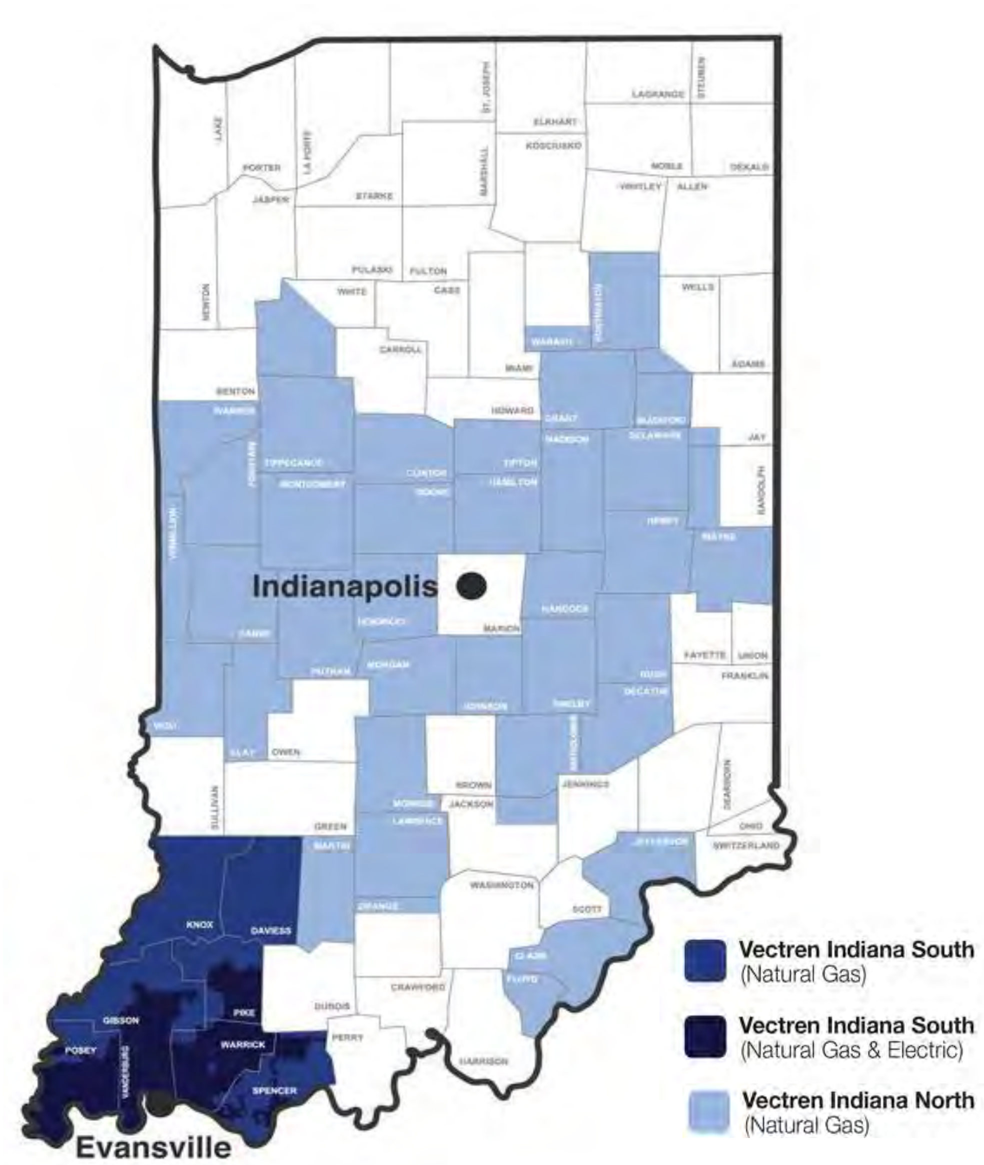
3 Market Characterization

Developing a market characterization in the context of utility electric consumption among each sector is a key foundational element to market potential studies. A market characterization describes how energy is used among the various end-uses and building types that are the subject of the potential study. This section provides a brief overview of the sales and customer forecasts for Vectren's electric customers. It also includes a more detailed breakdown of the end-use and building type consumption, along with an overview of how these segmentations were developed.

3.1 VECTREN INDIANA SERVICE AREAS

This study assessed the electric energy efficiency potential for Vectren South. Figure 3-1 provides the overall Vectren South and Vectren North territories in Indiana.

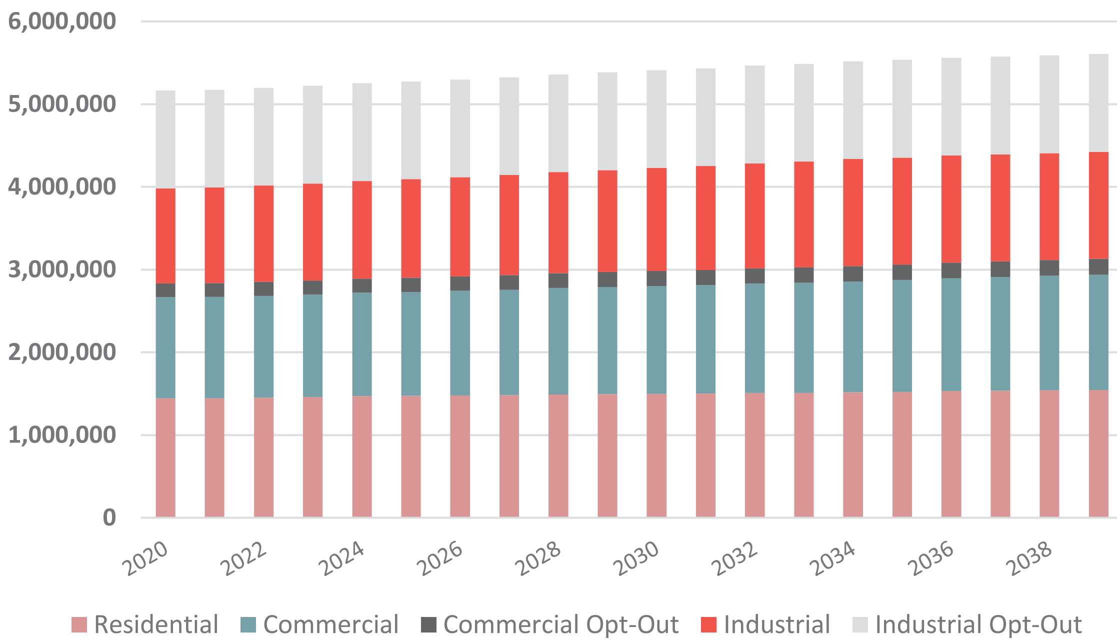
FIGURE 3-1 VECTREN SERVICE TERRITORY MAP



3.2 LOAD FORECASTS

Figure 3-2 provides the electric sales by sector across the 2020-2039 timeframe. Sales are forecasted to gradually increase from 5.2 million MWh to 5.6 million MWh from 2020 to 2039. The sales figure shows commercial and industrial sales break outs of the sales projections for opt-out customers.

FIGURE 3-2 20-YEAR ELECTRIC SALES (MWH) FORECAST BY SECTOR

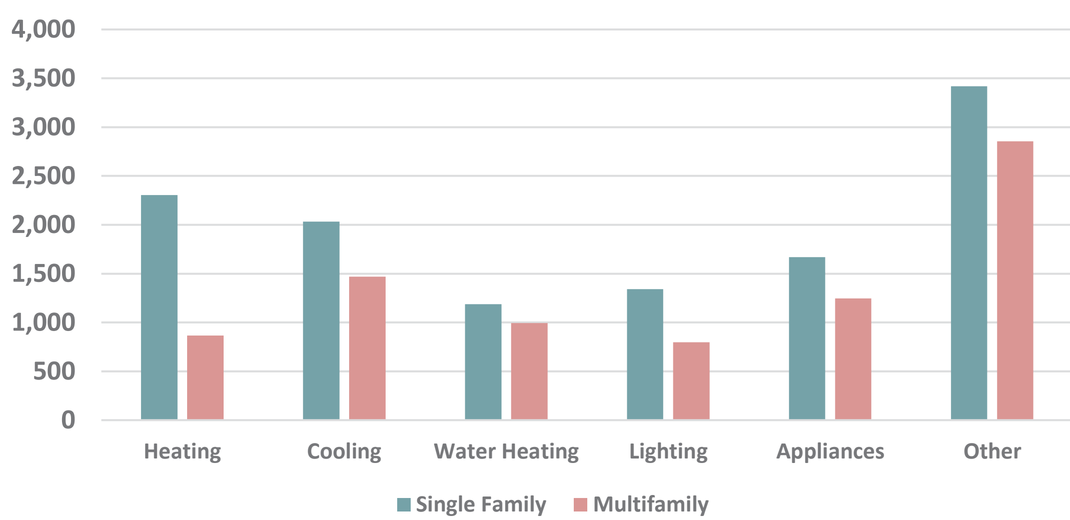


3.3 SECTOR LOAD DETAIL

3.3.1 Residential Sector

The residential electric calibration effort led to a housing-type specific end-use intensity breakdown as shown below in Figure 3-3. Overall, we estimated single-family consumption to be just shy of 12,000 kWh per year, and multifamily homes to be about 8,200 kWh per year. The "Other" end use is the leading end-use among both housing types. This reflects the increasing prominence of electronics and other plug in devices.

FIGURE 3-3 RESIDENTIAL ELECTRIC END-USE BREAKDOWN BY HOUSING TYPE



3.3.2 Commercial Sector

Figure 3-4 provides a breakdown of commercial electric sales by building type. Mercantile (25%) and Office (20%) are the leading contributors of stand-alone building types to the total commercial electric sales.[27]

FIGURE 3-4 COMMERCIAL ELECTRIC SALES BREAKDOWN BY BUILDING TYPE

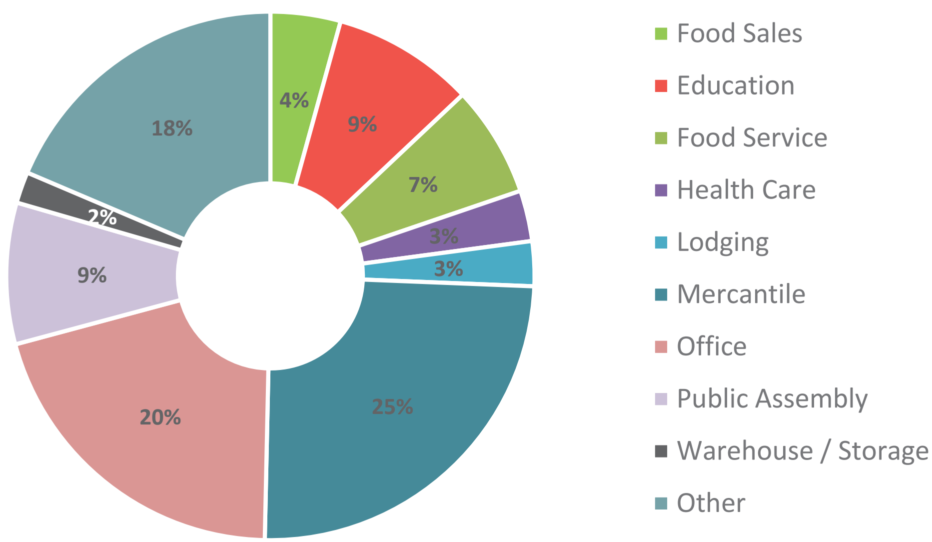
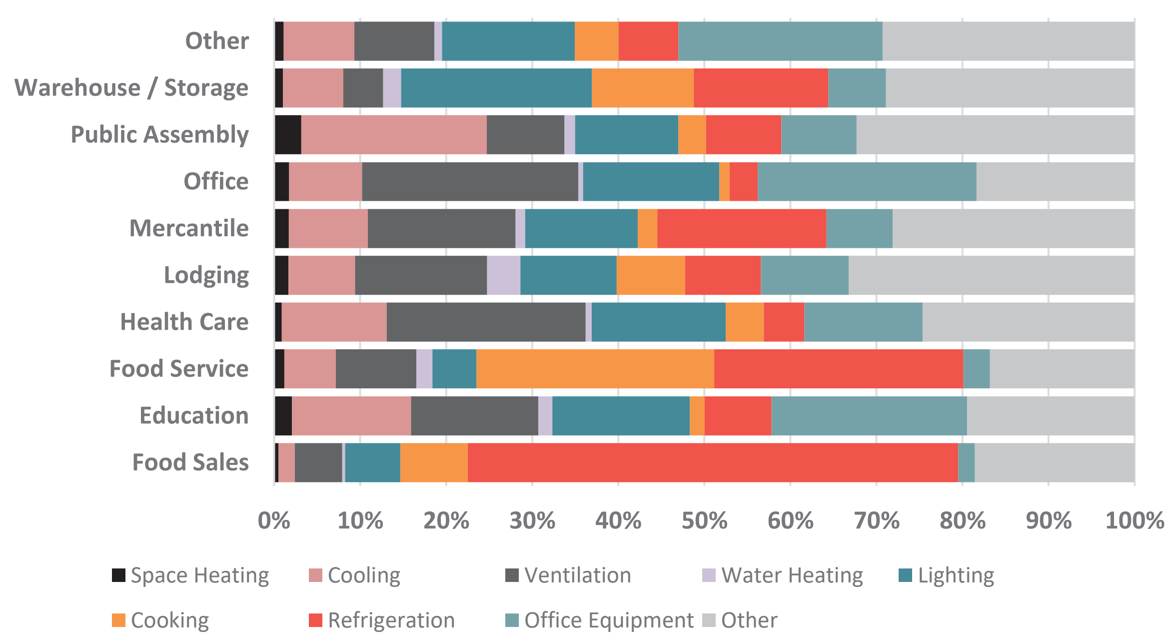


Figure 3-5 provides an illustration of the leading end-uses across all building types in the commercial sector. Ventilation, lighting, and refrigeration are prominent across most of the building types.

FIGURE 3-5 COMMERCIAL ELECTRIC END-USE BREAKDOWN BY BUILDING TYPE



[27] "Other" building types include buildings that engage in several different activities, a majority of which are commercial (e.g. retail space), though the single largest activity may be industrial or agricultural; "other" also includes miscellaneous buildings that do not fit into any other category.

3.3.3 Industrial Sector

Figure 3-6 provides a breakdown of industrial electric sales by industry type. Food (20%) and Plastics & Rubber (15%) are the leading industry types contributing to industrial electric sales.

FIGURE 3-6 INDUSTRIAL ELECTRIC INDUSTRY TYPE BREAKDOWN[28]

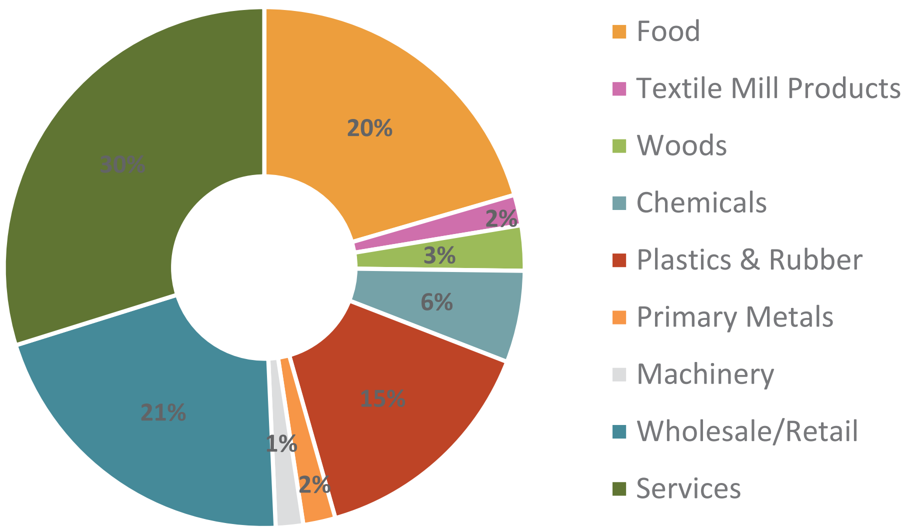
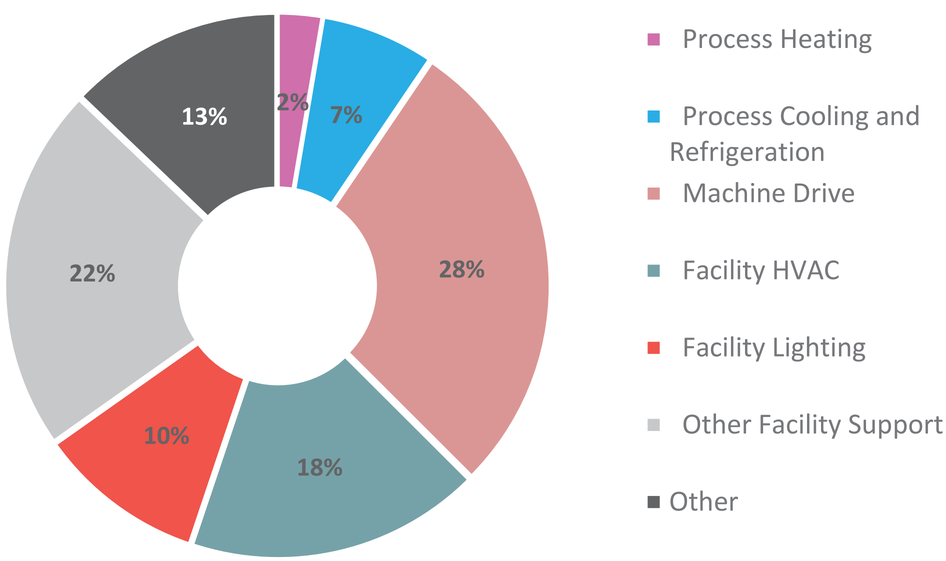


Figure 3-7 provides a breakdown of the industrial electric sales end use. Machine Drive (28%) and Facility HVAC (18%) are the leading end-uses.

FIGURE 3-7 INDUSTRIAL ELECTRIC END-USE BREAKDOWN



[28] "Wholesale/Retail" and "Services" industrial types include industrial buildings that devote a minority percentage of floor space to commercial activities like wholesale and retail trade, and construction, healthcare, education and accommodation & food service. Automotive related industries are divided between plastics, rubber, and machinery based on their NAICS codes.

4 Residential Energy Efficiency Potential

This section provides the potential results for technical, economic, MAP and RAP for the residential sector. Results are broken down by fuel type as well as end use. The cost-effectiveness results and budgets for the RAP scenario are also provided.

4.1 SCOPE OF MEASURES & END USES ANALYZED

There were 185 total unique electric measures included in the analysis. Table 4-1 provides the number of measures by end-use and fuel type (the full list of residential measures is provided in Appendix B). The measure list was developed based on a review of current Vectren programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE 4-1 RESIDENTIAL ENERGY EFFICIENCY MEASURES – BY END USE AND FUEL TYPE

End-Use	Number of Unique Measures
Appliances	26
Audit	6
Behavioral	9
HVAC Equipment	41
Lighting	15
Miscellaneous	6
New Construction	4
Plug Loads	9
HVAC Shell	55
Water Heating	14

4.2 RESIDENTIAL ELECTRIC POTENTIAL

Figure 4-1 provides the technical, economic, MAP and RAP results for the 6-year, 10-year, and 20-year timeframes. The 6-year technical potential is 35.0% of forecasted sales, and the economic potential is 32.3% of forecasted sales. The 6-year MAP is 24.0% and the RAP is 12.5%.

FIGURE 4-1 RESIDENTIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF RESIDENTIAL SALES)

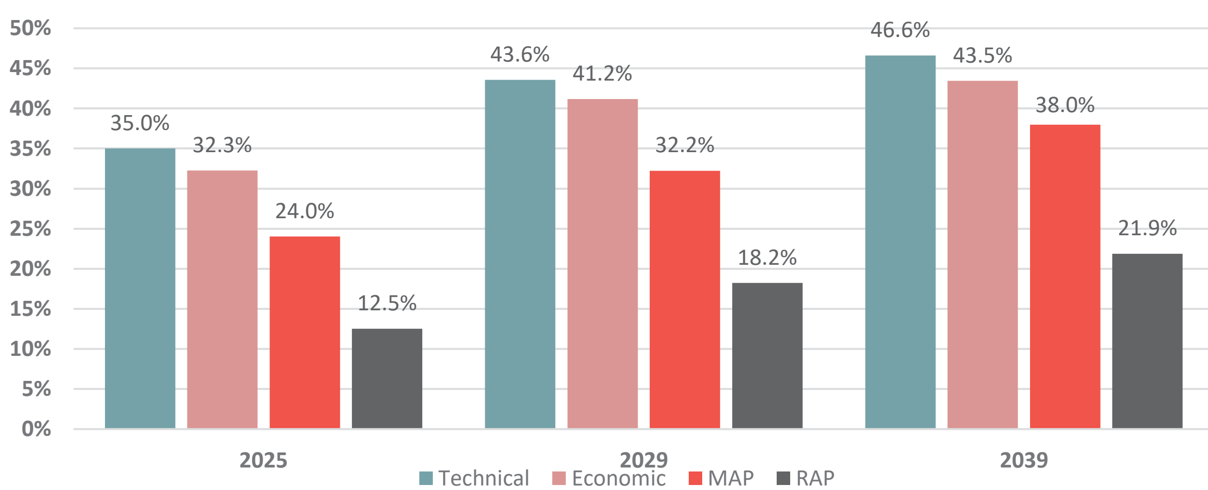


Table 4-2 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP increases to more than 12% cumulative annual savings over the next six years.

TABLE 4-2 RESIDENTIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	114,516	242,109	325,265	410,315	460,483	515,889
Economic	106,549	222,594	297,135	376,090	422,227	475,305
MAP	53,840	136,061	192,386	253,741	306,917	353,855
RAP	41,177	84,538	105,533	134,072	159,025	184,648
Forecasted Sales	1,443,774	1,444,794	1,451,508	1,458,672	1,469,169	1,473,649
Energy Savings (as % of Forecast)						
Technical	7.9%	16.8%	22.4%	28.1%	31.3%	35.0%
Economic	7.4%	15.4%	20.5%	25.8%	28.7%	32.3%
MAP	3.7%	9.4%	13.3%	17.4%	20.9%	24.0%
RAP	2.9%	5.9%	7.3%	9.2%	10.8%	12.5%

Table 4-3 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 2.6% to 3.5% per year over the next six years.

TABLE 4-3 RESIDENTIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	114,516	136,960	120,797	111,329	99,306	86,829
Economic	106,549	124,856	110,653	103,092	92,493	81,164
MAP	53,840	90,090	82,609	79,096	75,741	68,596
RAP	41,177	50,889	44,349	42,814	42,014	38,952
Forecasted Sales	1,443,774	1,444,794	1,451,508	1,458,672	1,469,169	1,473,649
Energy Savings (as % of Forecast)						
Technical	7.9%	9.5%	8.3%	7.6%	6.8%	5.9%
Economic	7.4%	8.6%	7.6%	7.1%	6.3%	5.5%
MAP	3.7%	6.2%	5.7%	5.4%	5.2%	4.7%
RAP	2.9%	3.5%	3.1%	2.9%	2.9%	2.6%

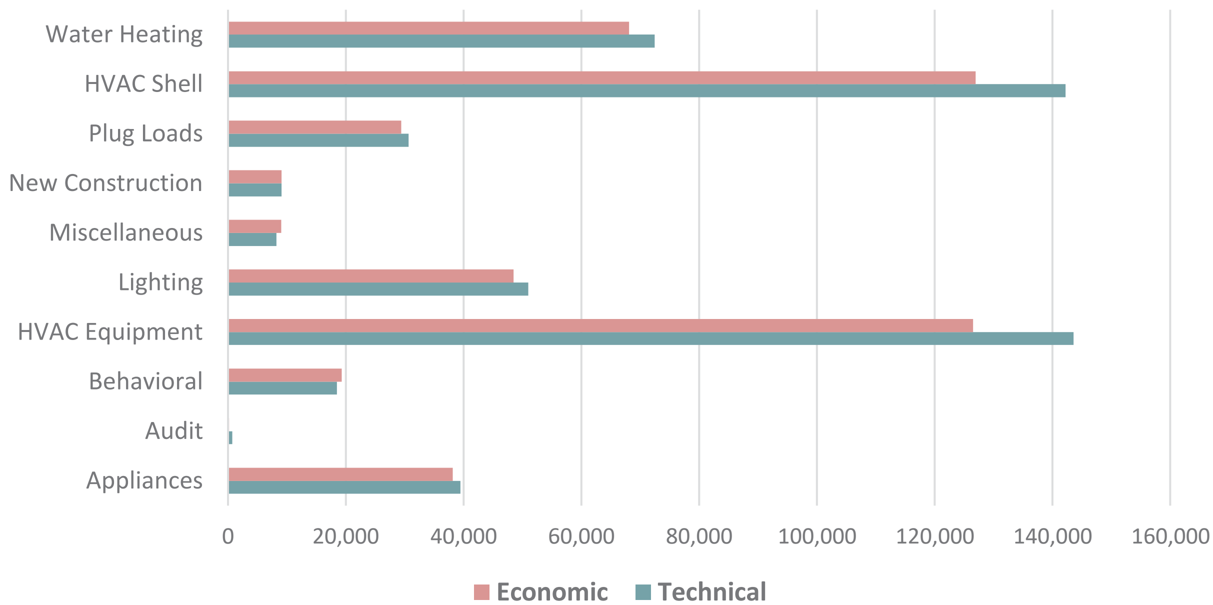
Technical & Economic Potential

Table 4-4 provides cumulative annual technical and economic potential results from 2020-2025. Figure 4-2 shows a comparison of the technical and economic potential (6-year) by end use. The HVAC Shell and HVAC Equipment are by far the leading end-uses among technical and economic potential.

TABLE 4-4 TECHNICAL AND ECONOMIC RESIDENTIAL ELECTRIC POTENTIAL

	2020	2021	2022	2023	2024	2025
Energy (MWh)						
Technical	114,516	242,109	325,265	410,315	460,483	515,889
Economic	106,549	222,594	297,135	376,090	422,227	475,305
Peak Demand (MW)						
Technical	18.9	39.3	55.4	70.1	80.0	90.1
Economic	16.7	34.2	48.2	61.1	70.1	79.3

FIGURE 4-2 6-YEAR TECHNICAL AND ECONOMIC RESIDENTIAL ELECTRIC POTENTIAL – BY END-USE



Maximum Achievable Potential

Figure 4-3 illustrates the cumulative annual MAP results by end use across the 2020-2025 timeframe. Like technical and economic potential, HVAC Shell and HVAC Equipment are the leading end uses. Water Heating, Lighting and Appliances also have significant maximum achievable potential.

FIGURE 4-3 RESIDENTIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) MAP POTENTIAL BY END-USE

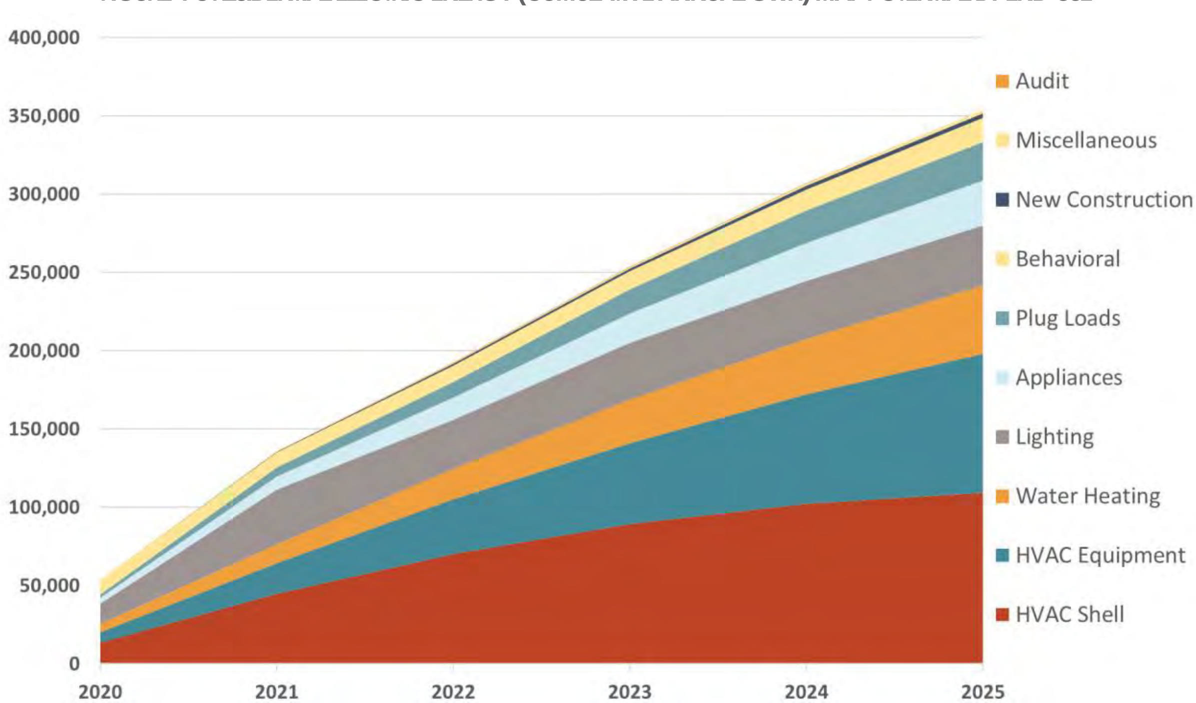


Table 4-5 provides the incremental and cumulative annual MAP across the 2020-2025 timeframe. The incremental MAP potential peaks in 2021 and declines slightly from 2022-2025 as the EISA backstop provision reduces lighting potential and the HVAC Shell end use declines after much of the retrofit measures have been exhausted quickly in the MAP scenario.

TABLE 4-5 RESIDENTIAL ELECTRIC MAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Appliances	3,722	4,817	5,313	5,351	5,133	4,722
Audit	61	119	146	167	180	187
Behavioral[29]	9,042	8,056	8,175	8,344	8,597	9,884
HVAC Equipment	6,596	13,003	15,440	17,537	18,995	19,707
Lighting	13,134	21,487	13,717	11,990	10,085	6,389
Miscellaneous[30]	161	215	278	348	421	490
New Construction	255	345	473	587	677	849
Plug Loads	2,023	3,604	4,433	5,085	6,946	6,181
HVAC Shell	13,402	31,486	26,946	21,471	16,065	11,427
Water Heating	5,444	6,957	7,689	8,217	8,642	8,759
Total	**53,840**	**90,090**	**82,609**	**79,096**	**75,741**	**68,596**
% of Forecasted Sales	**3.7%**	**6.2%**	**5.7%**	**5.4%**	**5.2%**	**4.7%**
Incremental Annual MW						
Total	7.4	12.7	12.0	11.4	10.9	10.2
% of Forecasted Demand	1.7%	2.9%	2.7%	2.6%	2.4%	2.3%
Cumulative Annual MWh[31]						
Appliances	3,722	8,540	13,780	19,046	24,047	28,656
Audit	61	119	146	167	180	187
Behavioral	9,042	9,526	10,557	11,781	13,440	15,404
HVAC Equipment	6,596	19,544	34,785	51,794	70,076	88,670
Lighting	13,134	34,830	31,327	36,243	36,889	38,538
Miscellaneous	161	376	655	1,003	1,423	1,914
New Construction	255	600	1,072	1,659	2,337	3,186
Plug Loads	2,023	5,626	10,059	15,144	20,912	24,448
HVAC Shell	13,402	44,560	70,192	89,281	102,002	109,345
Water Heating	5,444	12,339	19,814	27,624	35,612	43,506
Total	**53,840**	**136,061**	**192,386**	**253,741**	**306,917**	**353,855**
% of Forecasted Sales	**3.7%**	**9.4%**	**13.3%**	**17.4%**	**20.9%**	**24.0%**
Cumulative Annual MW						
Total	7.4	19.1	28.6	37.7	45.7	53.0
% of Forecasted Demand	1.7%	4.3%	6.4%	8.4%	10.2%	11.7%

Realistic Achievable Potential

Figure 4-4 illustrates the cumulative annual RAP results by end use across the 2020-2025 timeframe. Like maximum achievable potential, HVAC Shell and HVAC Equipment are the leading end uses. Water Heating, Lighting and Appliances also have significant realistic achievable potential.

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[29] The behavioral end-use includes home energy reports and home energy management systems (HEMs).
[30] Miscellaneous consists of pool heater, efficient pool pumps, motors and timers, and well pumps.
[31] Audit measures and most Behavioral measures have a one-year assumed measure life. For this reason, Audit savings are the same for both incremental and cumulative annual, and there is only a minor difference between incremental and cumulative annual savings for Behavioral measures.

FIGURE 4-4 RESIDENTIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) RAP POTENTIAL BY END-USE

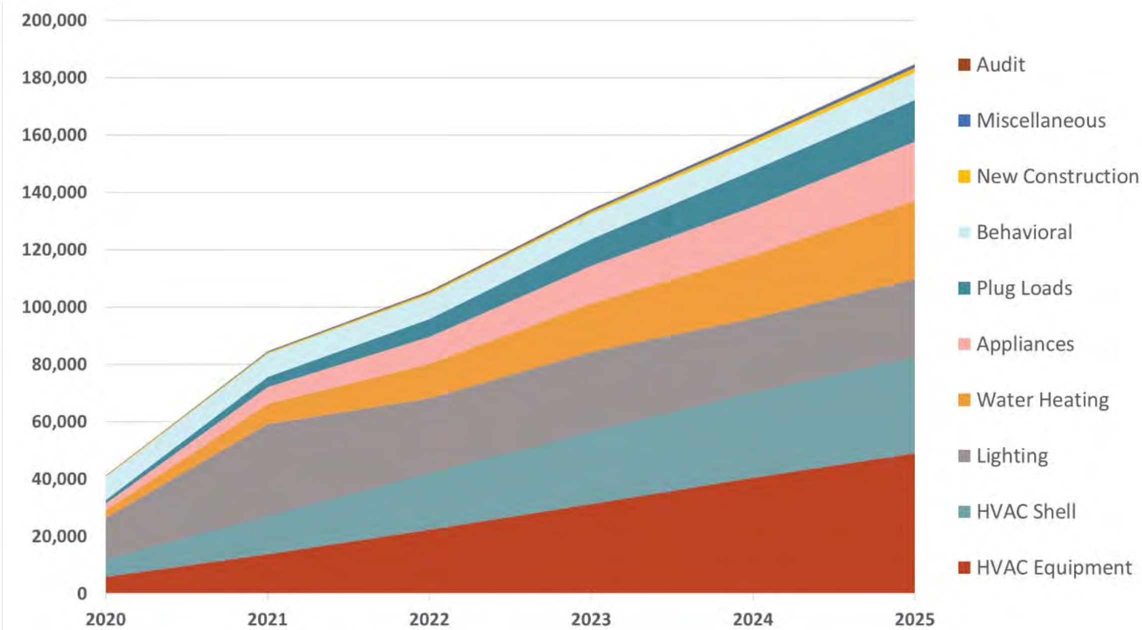


Table 4-6 provides the incremental and cumulative annual RAP across the 2020-2025 timeframe. Lighting and behavioral savings are leading end-uses of incremental RAP in the early years, and HVAC Shell, HVAC Equipment, and Water Heating increase throughout the six-year timeframe.

TABLE 4-6 RESIDENTIAL ELECTRIC RAP BY END-USE

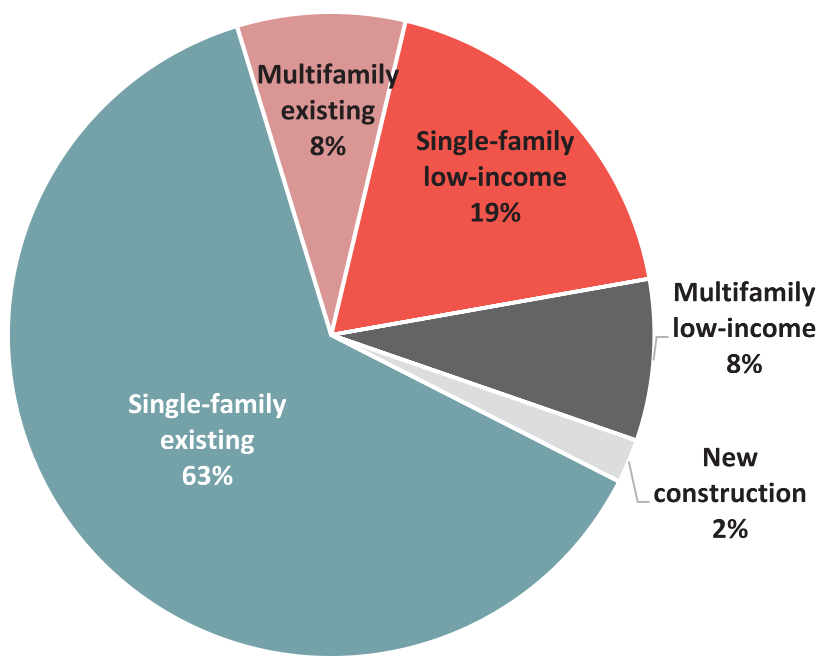
End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Appliances	2,364	3,363	3,692	3,844	3,902	3,794
Audit	39	78	93	108	121	131
Behavioral[32]	8,061	7,657	7,661	7,651	7,698	8,093
HVAC Equipment	5,848	7,985	8,594	9,039	9,321	9,579
Lighting	14,292	17,399	9,794	7,875	6,298	3,575
Miscellaneous[33]	128	153	176	200	226	252
New Construction	184	209	244	263	272	314
Plug Loads	1,267	2,394	2,688	2,922	3,799	3,433
HVAC Shell	6,246	7,198	6,529	5,752	4,960	4,234
Water Heating	2,748	4,454	4,880	5,160	5,417	5,547
Total	**41,177**	**50,889**	**44,349**	**42,814**	**42,014**	**38,952**
% of Forecasted Sales	**2.9%**	**3.5%**	**3.1%**	**2.9%**	**2.9%**	**2.6%**
Incremental Annual MW						
Total	5.5	6.9	6.5	6.4	6.3	6.1
% of Forecasted Demand	1.2%	1.6%	1.5%	1.4%	1.4%	1.3%

32 The behavioral end-use includes home energy reports and home energy management systems (HEMs).
33 Miscellaneous consists of pool heater, efficient pool pumps, motors and timers, and well pumps.

End Use	2020	2021	2022	2023	2024	2025
Cumulative Annual MWh[34]						
Appliances	2,364	5,727	9,388	13,177	16,990	20,708
Audit	39	78	93	108	121	131
Behavioral	8,061	8,159	8,496	8,768	9,179	9,711
HVAC Equipment	5,848	13,820	22,375	31,268	40,402	49,002
Lighting	14,292	31,875	26,081	27,825	25,847	27,162
Miscellaneous	128	281	456	657	882	1,135
New Construction	184	393	636	899	1,171	1,485
Plug Loads	1,267	3,661	6,349	9,270	12,634	14,534
HVAC Shell	6,246	13,364	19,709	25,173	29,755	33,555
Water Heating	2,748	7,180	11,950	16,926	22,045	27,226
Total	**41,177**	**84,538**	**105,533**	**134,072**	**159,025**	**184,648**
% of Forecasted Sales	**2.9%**	**5.9%**	**7.3%**	**9.2%**	**10.8%**	**12.5%**
Cumulative Annual MW						
Total	5.5	11.5	15.8	20.4	24.8	28.9
% of Forecasted Demand	1.2%	2.6%	3.6%	4.6%	5.5%	6.4%

Figure 4-5 illustrates a market segmentation of the RAP in the residential sector by 2025. Nearly two-thirds of the RAP is associated with single-family existing homes that are not low-income, whereas the total low-income potential is nearly 30% of the RAP.[35]

FIGURE 4-5 2025 RESIDENTIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL) RAP POTENTIAL BY MARKET SEGMENT



[34] Audit measures and most Behavioral measures have a one-year assumed measure life. For this reason, Audit savings are the same for both incremental and cumulative annual, and there is only a minor difference between incremental and cumulative annual savings for Behavioral measures.
[35] The low-income measures in the RAP analysis did not have to pass the UCT.

RAP Benefits & Costs

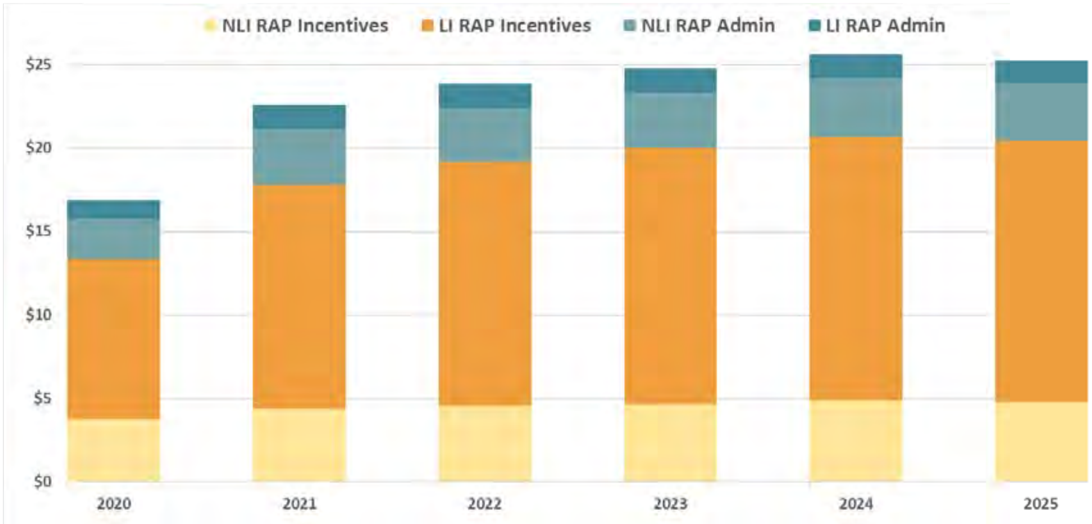
Table 4-7 provides the net present value benefits and cost, as calculated using the UCT, across the 2020-2025 timeframe for the RAP scenario. The overall UCT ratio is 1.1. However, if low-income measures were removed, the overall UCT ratio would be nearly 2.0.

TABLE 4-7 RESIDENTIAL NPV BENEFITS & COSTS RAP BY END-USE ($ IN MILLIONS)

End Use	NPV Benefits	NPV Costs	UCT Ratio
Overall Results			
Appliances	$24.8	$24.1	1.03
Audit	$0.1	$2.8	0.04
Behavioral	$10.9	$5.1	2.14
HVAC Equipment	$88.5	$107.3	0.82
Lighting	$27.3	$11.7	2.33
Miscellaneous	$5.1	$1.3	3.95
New Construction	$3.1	$0.7	4.11
Plug Loads	$12.8	$11.2	1.15
HVAC Shell	$42.0	$52.8	0.80
Water Heating	$36.7	$17.8	2.06
Total	$251.3	$234.8	1.07
Excluding Low-Income			
Appliances	$18.0	$10.0	1.80
Audit	$0.0	$0.0	0.00
Behavioral	$10.9	$5.1	2.14
HVAC Equipment	$62.8	$27.4	2.29
Lighting	$25.4	$10.4	2.44
Miscellaneous	$5.1	$1.3	3.95
New Construction	$3.1	$0.7	4.11
Plug Loads	$12.6	$9.8	1.29
HVAC Shell	$17.2	$13.8	1.25
Water Heating	$34.5	$17.0	2.02
Total	$189.5	$95.4	1.99

Figure 4-6 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2020-2025 timeframe. These budgets are further divided into low-income ("LI") and not low-income ("NLI") components. The low-income incentive portion of the budget ranges from 57% to 62% of the total budget from 2020 to 2025. RAP budgets rise to about $25 million after four years.

FIGURE 4-6 ANNUAL BUDGETS FOR RESIDENTIAL RAP ($ IN MILLIONS)



5 Commercial Energy Efficiency Potential

This section provides the potential results for technical, economic, MAP and RAP for the commercial sector. Results are broken down by end use. The cost-effectiveness results and budgets for the RAP scenario are also provided.

5.1 SCOPE OF MEASURES & END USES ANALYZED

There were 222 total electric measures included in the analysis. Table 5-1 provides the number of measures by end-use and fuel type (the full list of commercial measures is provided in Appendix C). The measure list was developed based on a review of current Vectren programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE 5-1 COMMERCIAL ENERGY EFFICIENCY MEASURES – BY FUEL TYPE

End-Use	Number of Unique Measures
Space Heating	32
Cooling	76
Ventilation	8
Water Heating	14
Lighting	26
Cooking	7
Refrigeration	23
Office Equipment	14
Behavioral	3
Other	19

5.2 COMMERCIAL ELECTRIC POTENTIAL

Figure 5-1 provides the technical, economic, MAP and RAP results for the 6-year, 10-year, and 20-year timeframes. The 6-year technical potential is 22.1% of forecasted sales, and the economic potential is 20.0% of forecasted sales. The 6-year MAP is 14.8% and the RAP is 6.3%.

FIGURE 5-1 COMMERCIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF COMMERCIAL SALES)

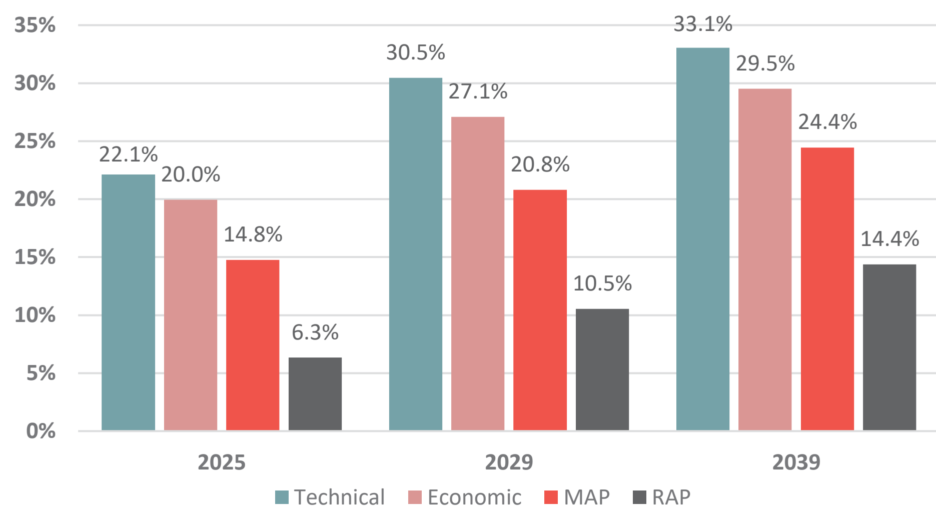


Table 5-2 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP reaches 6.3% after six years.

TABLE 5-2 COMMERCIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	44,537	90,258	139,200	189,608	237,091	280,925
Economic	41,327	83,264	127,773	173,145	215,118	253,284
MAP	26,345	55,895	88,639	123,072	156,473	187,460
RAP	10,311	21,974	35,168	49,609	64,869	80,454
Forecasted Sales	1,235,560	1,237,950	1,244,360	1,251,998	1,263,383	1,269,201
Energy Savings (as % of Forecast)						
Technical	3.6%	7.3%	11.2%	15.1%	18.8%	22.1%
Economic	3.3%	6.7%	10.3%	13.8%	17.0%	20.0%
MAP	2.1%	4.5%	7.1%	9.8%	12.4%	14.8%
RAP	0.8%	1.8%	2.8%	4.0%	5.1%	6.3%

Table 5-3 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 0.8% to 1.4% per year over the next six years.

TABLE 5-3 COMMERCIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	44,537	48,599	52,397	54,755	54,631	55,436
Economic	41,327	44,816	47,926	49,670	49,022	49,453
MAP	26,345	30,503	34,404	37,095	37,636	38,255
RAP	10,311	12,122	13,911	15,609	16,770	17,811
Forecasted Sales	1,235,560	1,237,950	1,244,360	1,251,998	1,263,383	1,269,201
Energy Savings (as % of Forecast)						
Technical	3.6%	3.9%	4.2%	4.4%	4.3%	4.4%
Economic	3.3%	3.6%	3.9%	4.0%	3.9%	3.9%
MAP	2.1%	2.5%	2.8%	3.0%	3.0%	3.0%
RAP	0.8%	1.0%	1.1%	1.2%	1.3%	1.4%

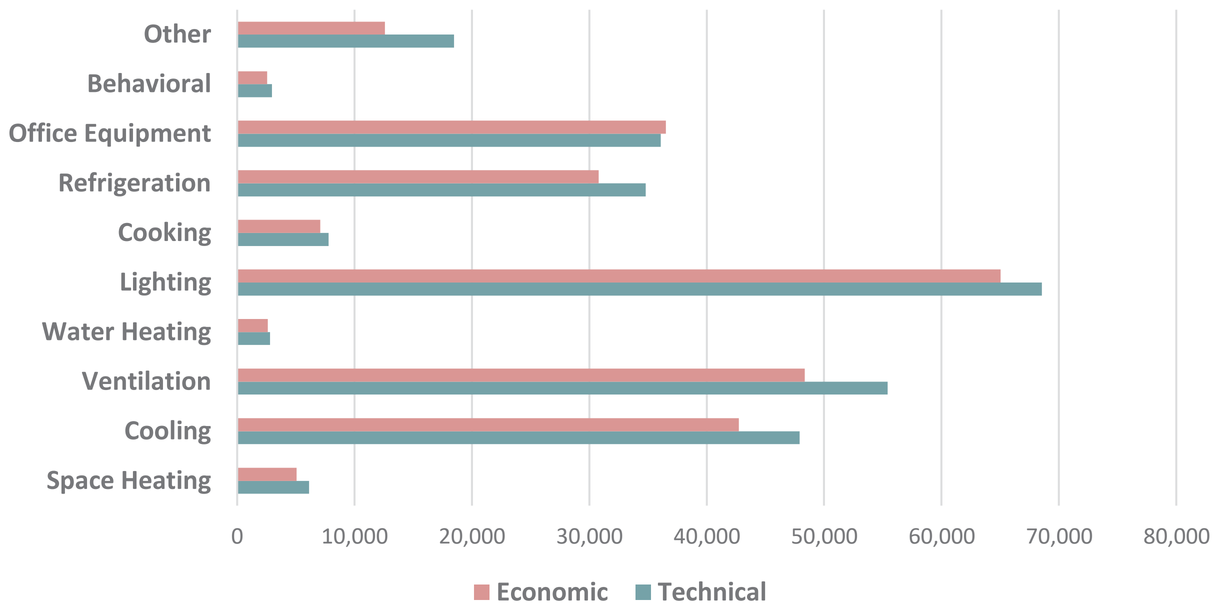
Technical & Economic Potential

Table 5-4 provides cumulative annual technical and economic potential results from 2020-2025. Figure 5-2 shows a comparison of the technical and economic potential (6-year) by end use. Lighting, Ventilation, and Cooling are the leading stand-alone end uses among technical and economic potential.

TABLE 5-4 TECHNICAL & ECONOMIC COMMERCIAL ELECTRIC POTENTIAL

	2020	2021	2022	2023	2024	2025
Energy (MWh)						
Technical	44,537	90,258	139,200	189,608	237,091	280,925
Economic	41,327	83,264	127,773	173,145	215,118	253,284
Peak Demand (MW)						
Technical	6	12	18	24	30	35
Economic	4	9	14	19	23	28

FIGURE 5-2 6-YEAR TECHNICAL AND ECONOMIC COMMERCIAL ELECTRIC POTENTIAL – BY END-USE



Maximum Achievable Potential

Figure 5-3 illustrates the cumulative annual MAP results by end use across the 2020-2025 timeframe. Like technical and economic potential, Lighting, Ventilation, and Cooling are the leading end uses. Refrigeration and Office Equipment also have significant maximum achievable potential.

FIGURE 5-3 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) MAP POTENTIAL BY END-USE

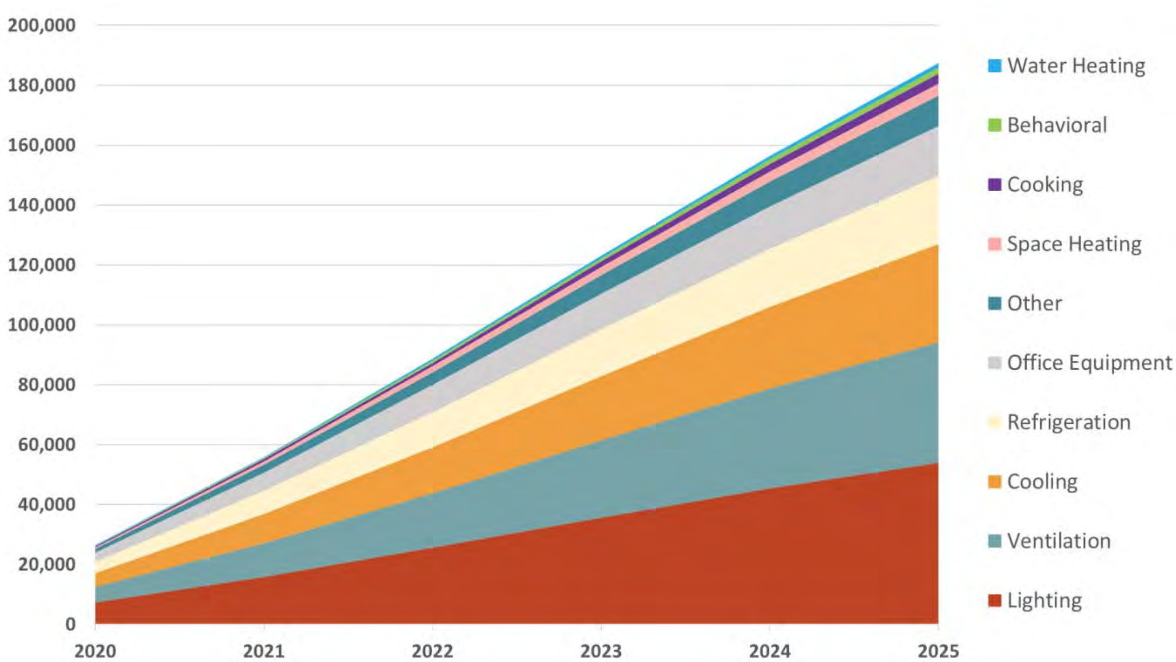


Table 5-5 provides the incremental and cumulative annual MAP across the 2020-2025 timeframe. The incremental MAP ranges from 2.1% to 3.0% of forecasted sales across the six-year timeframe. Cumulative annual MAP rises to 14.8% by 2025.

TABLE 5-5 COMMERCIAL ELECTRIC MAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Space Heating	567	663	729	740	699	619
Cooling	4,588	5,218	5,739	6,375	6,441	6,118
Ventilation	5,063	6,071	7,004	7,569	7,496	6,806
Water Heating	140	183	228	268	301	336
Lighting	7,338	8,570	9,628	10,120	9,750	8,608
Cooking	292	390	495	600	696	780
Refrigeration	3,843	4,502	4,993	5,237	5,245	6,009
Office Equipment	3,157	3,002	2,882	2,853	2,956	4,530
Behavioral	201	264	533	676	1,045	1,277
Other	1,156	1,641	2,175	2,657	3,006	3,173
Total	26,345	30,503	34,404	37,095	37,636	38,255
% of Forecasted Sales	2.1%	2.5%	2.8%	3.0%	3.0%	3.0%
Incremental Annual MW						
Total	2.1	2.5	2.9	3.0	3.1	2.9
% of Forecasted Demand	0.7%	0.8%	0.9%	1.0%	1.0%	1.0%
Cumulative Annual MWh						
Space Heating	567	1,230	1,959	2,699	3,398	4,017
Cooling	4,588	9,806	15,545	21,516	27,457	32,979
Ventilation	5,063	11,134	18,138	25,707	33,203	40,009
Water Heating	140	323	551	819	1,120	1,441
Lighting	7,338	15,908	25,535	35,656	45,406	54,014
Cooking	292	683	1,178	1,777	2,474	3,254
Refrigeration	3,843	7,617	11,630	15,621	19,368	22,748
Office Equipment	3,157	6,159	9,040	11,893	14,152	16,551
Behavioral	201	452	769	1,161	1,648	2,219
Other	1,156	2,583	4,294	6,222	8,249	10,228
Total	26,345	55,895	88,639	123,072	156,473	187,460
% of Forecasted Sales	2.1%	4.5%	7.1%	9.8%	12.4%	14.8%
Cumulative Annual MW						
Total	2.1	4.6	7.3	10.3	13.2	16.0
% of Forecasted Demand	0.7%	1.5%	2.4%	3.4%	4.4%	5.3%

Realistic Achievable Potential

Figure 5-4 illustrates the cumulative annual RAP results by end use across the 2020-2025 timeframe. Like maximum achievable potential, Lighting, Ventilation, and Cooling are the leading end uses. Refrigeration and Office Equipment also have significant realistic achievable potential.

FIGURE 5-4 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) RAP POTENTIAL BY END-USE

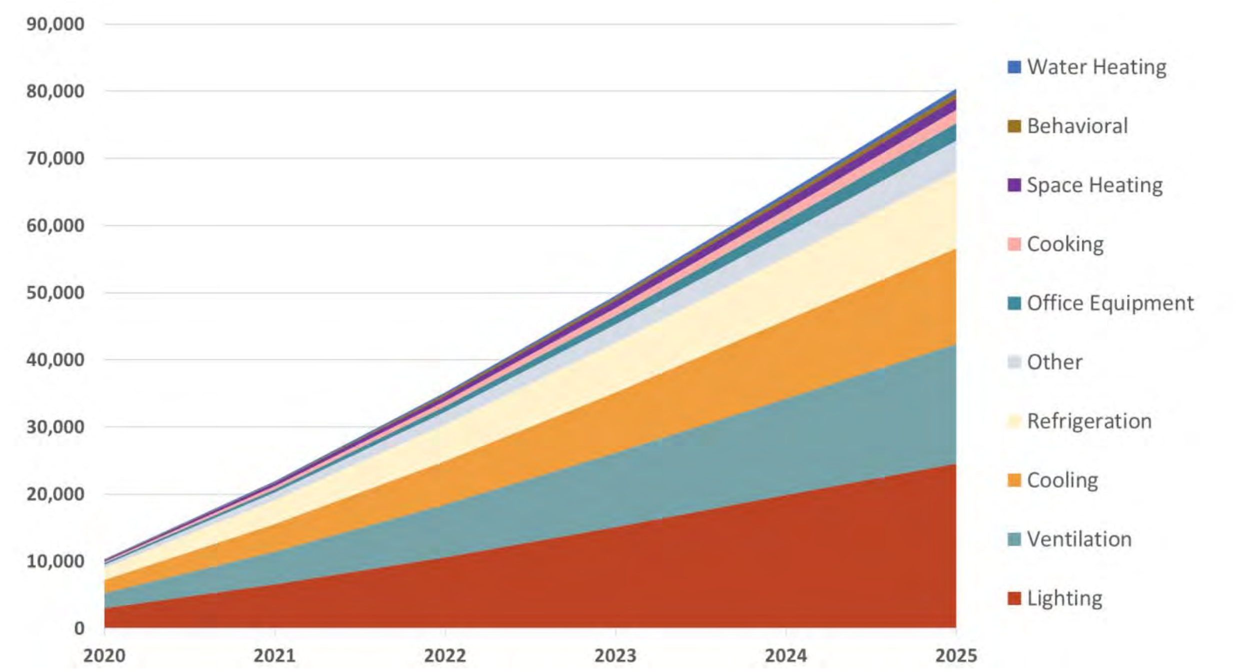


Table 5-6 provides the incremental and cumulative annual RAP across the 2020-2025 timeframe. The incremental RAP ranges from 0.8% to 1.4% of forecasted sales across the six-year timeframe. Cumulative annual RAP rises to 6.3% by 2025.

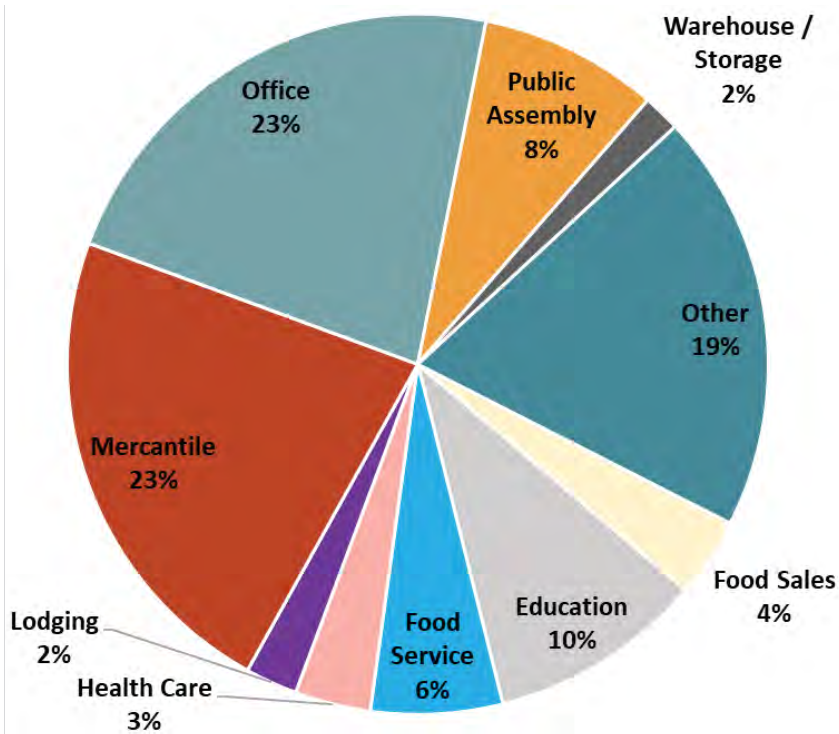
TABLE 5-6 COMMERCIAL ELECTRIC RAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Space Heating	240	271	297	311	314	308
Cooling	1,955	2,170	2,379	2,738	2,852	2,874
Ventilation	2,232	2,616	2,951	3,231	3,377	3,387
Water Heating	77	97	117	137	156	180
Lighting	3,016	3,565	4,067	4,470	4,718	4,750
Cooking	198	247	299	352	404	455
Refrigeration	1,809	2,097	2,361	2,574	2,744	3,268
Office Equipment	220	280	364	463	571	701
Behavioral	57	80	169	227	353	456
Other	507	700	907	1,106	1,282	1,433
Total	10,311	12,122	13,911	15,609	16,770	17,811
% of Forecasted Sales	0.8%	1.0%	1.1%	1.2%	1.3%	1.4%
Incremental Annual MW						
Total	0.9	1.0	1.3	1.9	2.9	4.6
% of Forecasted Demand	0.3%	0.3%	0.4%	0.6%	1.0%	1.5%
Cumulative Annual MWh						
Space Heating	240	511	808	1,119	1,433	1,741
Cooling	1,955	4,125	6,504	9,030	11,641	14,251
Ventilation	2,232	4,848	7,799	11,029	14,406	17,793
Water Heating	77	174	291	428	584	756

End Use	2020	2021	2022	2023	2024	2025
Lighting	3,016	6,581	10,648	15,117	19,835	24,585
Cooking	198	444	743	1,095	1,499	1,954
Refrigeration	1,809	3,530	5,407	7,380	9,403	11,423
Office Equipment	220	500	864	1,327	1,898	2,599
Behavioral	57	133	240	381	556	774
Other	507	1,127	1,864	2,702	3,614	4,577
Total	10,311	21,974	35,168	49,609	64,869	80,454
% of Forecasted Sales	0.8%	1.8%	2.8%	4.0%	5.1%	6.3%
Cumulative Annual MW						
Total	0.9	1.9	3.1	4.3	5.7	7.0
% of Forecasted Demand	0.3%	0.6%	1.0%	1.4%	1.9%	2.3%

Figure 5-5 illustrates a market segmentation of the RAP in the commercial sector by 2025. Mercantile, Office, and Education are the leading building types.

FIGURE 5-5 2025 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL) RAP POTENTIAL BY MARKET SEGMENT



RAP Benefits & Costs

Table 5-7 provides the net present value benefits and cost, as calculated using the UCT, across the 2020-2025 timeframe for the RAP scenario. Lighting and Cooking are the most cost-effective end-uses, and Cooling also provides significant NPV benefits.

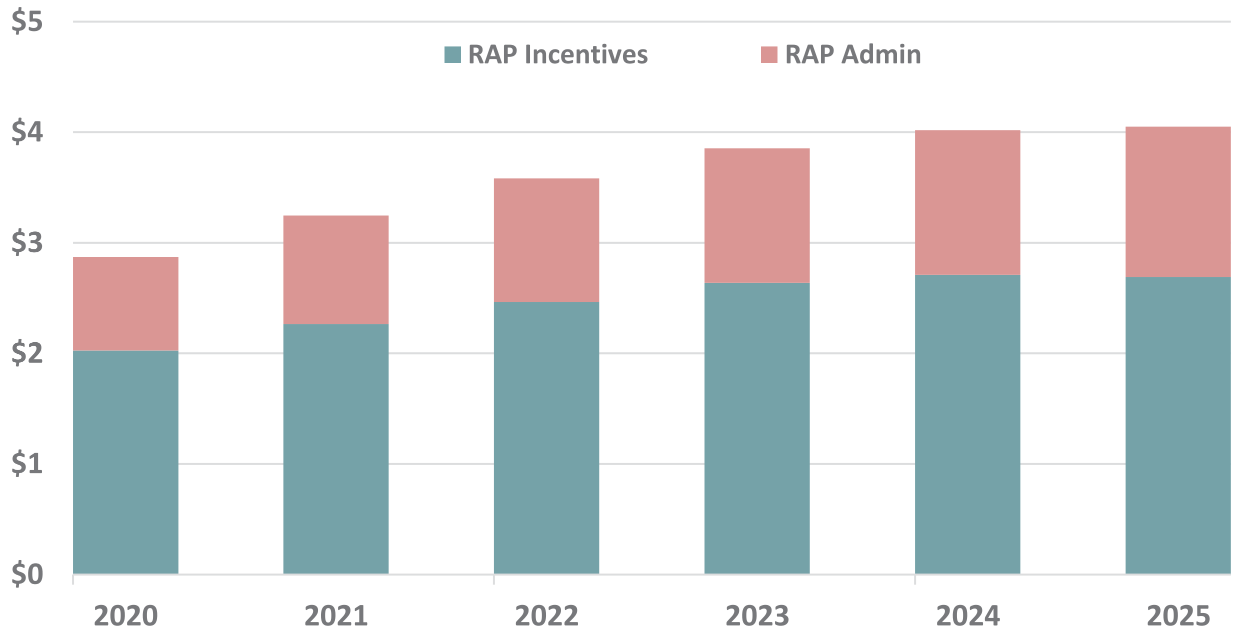
TABLE 5-7 COMMERCIAL NPV BENEFITS & COSTS RAP BY END-USE ($ IN MILLIONS)

End Use	NPV Benefits	NPV Costs	UCT Ratio
Space Heating	$0.62	$1.12	0.55
Cooling	$9.94	$3.09	3.21
Ventilation	$7.94	$5.05	1.57
Water Heating	$0.21	$0.08	2.60

End Use	NPV Benefits	NPV Costs	UCT Ratio
Lighting	$11.03	$6.03	1.83
Cooking	$0.69	$0.34	2.06
Refrigeration	$3.45	$1.33	2.59
Office Equipment	$0.88	$0.48	1.85
Behavioral	$0.11	$0.08	1.33
Other	$1.95	$0.53	3.67
Total	**$36.8**	**$18.1**	**2.03**

Figure 5-6 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2020-2025 timeframe. The incentives rise from $2.0 million to $2.7 million, and overall budgets rise from $2.9 million to $4.1 million by 2025.

FIGURE 5-6 ANNUAL BUDGETS FOR COMMERCIAL RAP ($ IN MILLIONS)



5.3 COMMERCIAL POTENTIAL INCLUDING OPT-OUT CUSTOMERS

Table 5-8 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast, excluding opt-out customers. This is the same information provided in Section 5.2. The cumulative annual energy savings across the 20-year study timeframe are also shown in the far-right column. Table 5-9 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast, including opt-out customers. The cumulative annual energy savings across the 20-year study timeframe are also shown in the far-right column.

The 20-year RAP is 17.8 GWh excluding opt-out customers. This figure rises to 20.0 GWh with opt-out customers included.

TABLE 5-8 COMMERCIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – EXCLUDING OPT-OUT CUSTOMERS

	2020	2021	2022	2023	2024	2025	2039 (cumulative)
MWh							
Technical	44,537	48,599	52,397	54,755	54,631	55,436	465,610
Economic	41,327	44,816	47,926	49,670	49,022	49,453	415,838
MAP	26,345	30,503	34,404	37,095	37,636	38,255	344,315
RAP	10,311	12,122	13,911	15,609	16,770	17,811	202,365
Forecasted Sales	1,235,560	1,237,950	1,244,360	1,251,998	1,263,383	1,269,201	1,408,342
Technical	3.6%	3.9%	4.2%	4.4%	4.3%	4.4%	33.1%
Economic	3.3%	3.6%	3.9%	4.0%	3.9%	3.9%	29.5%
MAP	2.1%	2.5%	2.8%	3.0%	3.0%	3.0%	24.4%
RAP	0.8%	1.0%	1.1%	1.2%	1.3%	1.4%	14.4%

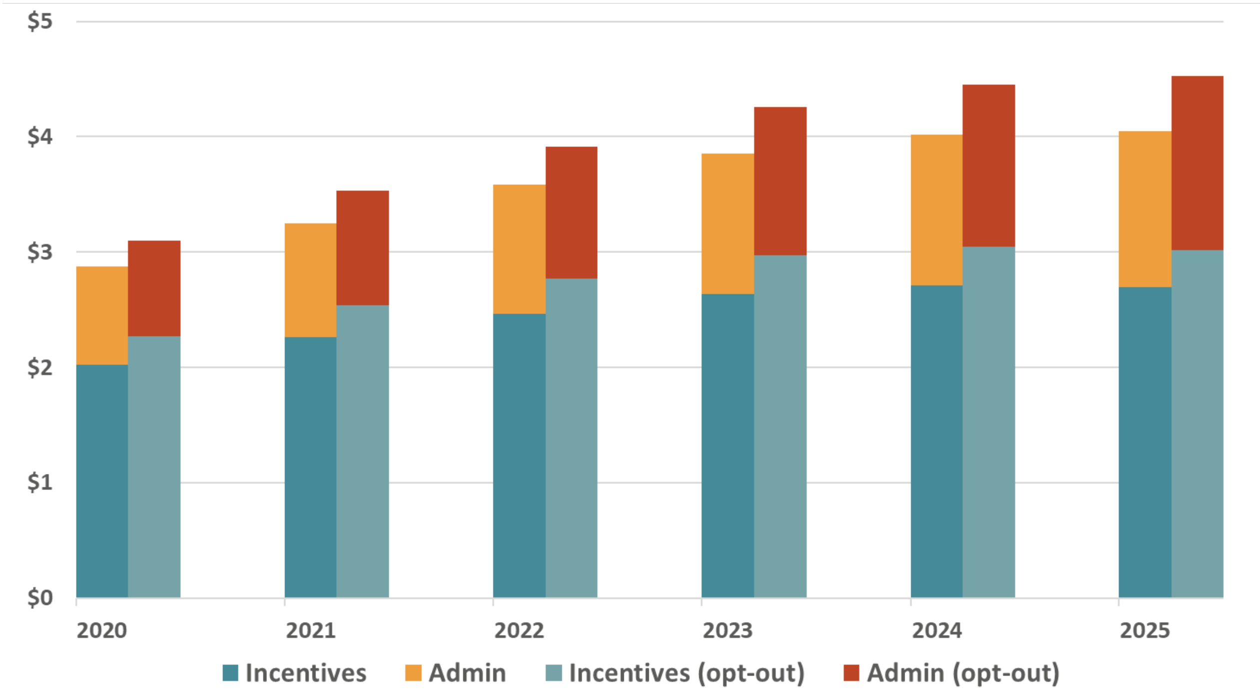
TABLE 5-9 COMMERCIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – INCLUDING OPT-OUT CUSTOMERS[36]

	2020	2021	2022	2023	2024	2025	2039 (cumulative)
MWh							
Technical	50,170	54,751	59,038	61,705	61,577	62,517	524,715
Economic	46,545	50,469	53,966	55,928	55,202	55,716	468,265
MAP	29,659	34,334	38,719	41,744	42,354	43,062	387,577
RAP	11,578	13,618	15,630	17,541	18,846	20,006	227,568
Forecasted Sales	1,390,224	1,392,929	1,400,166	1,408,787	1,421,633	1,428,202	1,585,207
Technical	3.6%	3.9%	4.2%	4.4%	4.3%	4.4%	33.1%
Economic	3.3%	3.6%	3.9%	4.0%	3.9%	3.9%	29.5%
MAP	2.1%	2.5%	2.8%	3.0%	3.0%	3.0%	24.4%
RAP	0.8%	1.0%	1.1%	1.2%	1.3%	1.4%	14.4%

Figure 5-7 provides the budget for the RAP scenario, with and without opt-out customers. The budget is broken into incentive and admin budgets for each year of the 2020-2025 timeframe. The overall budgets without opt-out customers rise from $2.9 million to $4.1 million by 2025. The budgets with opt-out customers included increase from $3.1 million to $4.5 million by 2025.

[36] Due to limited number of commercial opt-out customers and minor changes in building segmentation, savings as a percentage of sales is negligible out to three decimal places.

FIGURE 5-7 ANNUAL BUDGETS FOR COMMERCIAL RAP ($ IN MILLIONS) – WITH AND WITHOUT OPT-OUT CUSTOMERS



6 Industrial Energy Efficiency Potential

This section provides the potential results for technical, economic, MAP and RAP for the industrial sector. Results are broken down by end use. The cost-effectiveness results and budgets for the RAP scenario are also provided. The results in this section exclude the savings and sales forecast associated with opt-out customers

6.1 SCOPE OF MEASURES & END USES ANALYZED

There were 165 total unique electric measures included in the analysis. Table 6-1 provides number of measures by end-use (the full list of industrial measures is provided in Appendix D). The measure list was developed based on a review of current Vectren programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE 6-1 INDUSTRIAL ENERGY EFFICIENCY MEASURES – BY FUEL TYPE

End-Use	Number of Unique Measures
Computers & Office Equipment	6
Water Heating	6
Ventilation	7
Space Cooling	22
Space Heating	16
Cooking	7
Refrigeration	25
Lighting	20
Other	7
Machine Drive	21
Process Heating and Cooling	12
Agriculture	16

6.2 INDUSTRIAL ELECTRIC POTENTIAL

Figure 6-1 provides the technical, economic, MAP and RAP results for the 6-year, 10-year, and 20-year timeframes. The 6-year technical potential is 20.6% of forecasted sales, and the economic potential is 19.3% of forecasted sales. The 6-year MAP is 14.0% and the RAP is 6.7%.

FIGURE 6-1 INDUSTRIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF INDUSTRIAL SALES)

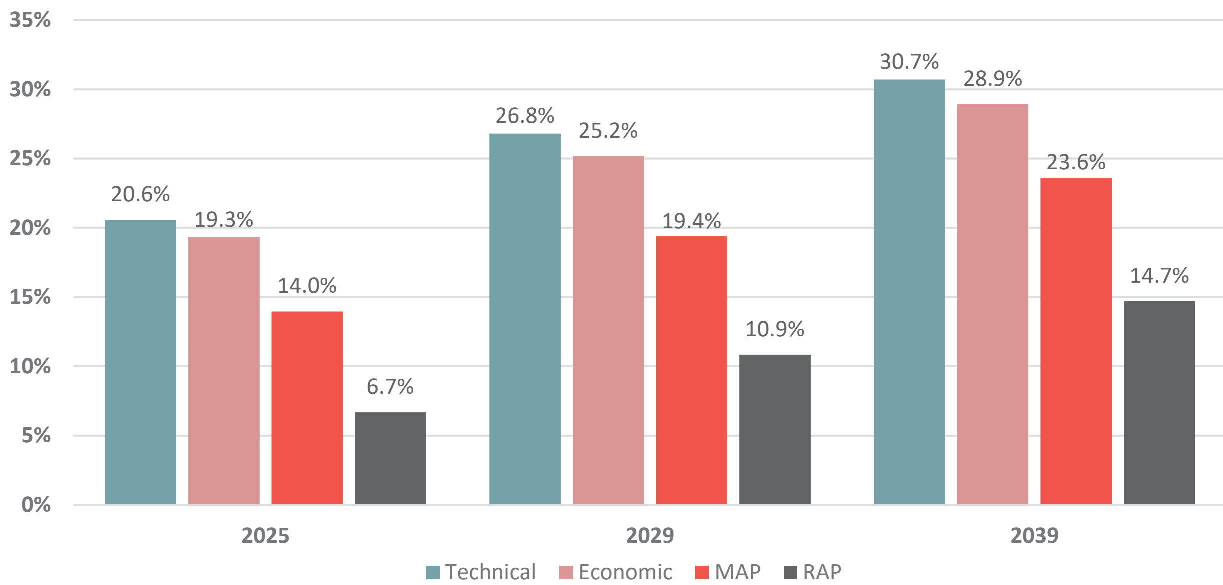


Table 6-2 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP reaches 6.7% after six years.

TABLE 6-2 INDUSTRIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	20,939	44,360	69,559	95,219	115,910	133,986
Economic	19,496	41,369	65,048	89,324	108,808	125,853
MAP	11,785	25,996	42,270	59,617	76,091	90,989
RAP	5,517	11,982	19,336	27,377	35,449	43,566
Forecasted Sales	640,023	641,915	644,247	646,702	649,006	651,371
Energy Savings (as % of Forecast)						
Technical	3.3%	6.9%	10.8%	14.7%	17.9%	20.6%
Economic	3.0%	6.4%	10.1%	13.8%	16.8%	19.3%
MAP	1.8%	4.0%	6.6%	9.2%	11.7%	14.0%
RAP	0.9%	1.9%	3.0%	4.2%	5.5%	6.7%

Table 6-3 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 0.9% to 1.6% per year over the next six years.

TABLE 6-3 INDUSTRIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	20,939	24,019	26,570	27,937	28,192	27,324
Economic	19,496	22,471	25,050	26,553	26,985	26,293
MAP	11,785	14,679	17,322	19,105	20,003	19,927
RAP	5,517	6,688	7,846	8,854	9,799	10,567
Forecasted Sales	640,023	641,915	644,247	646,702	649,006	651,371
Energy Savings (as % of Forecast)						
Technical	3.3%	3.7%	4.1%	4.3%	4.3%	4.2%
Economic	3.0%	3.5%	3.9%	4.1%	4.2%	4.0%
MAP	1.8%	2.3%	2.7%	3.0%	3.1%	3.1%

	2020	2021	2022	2023	2024	2025
MWh						
RAP	0.9%	1.0%	1.2%	1.4%	1.5%	1.6%

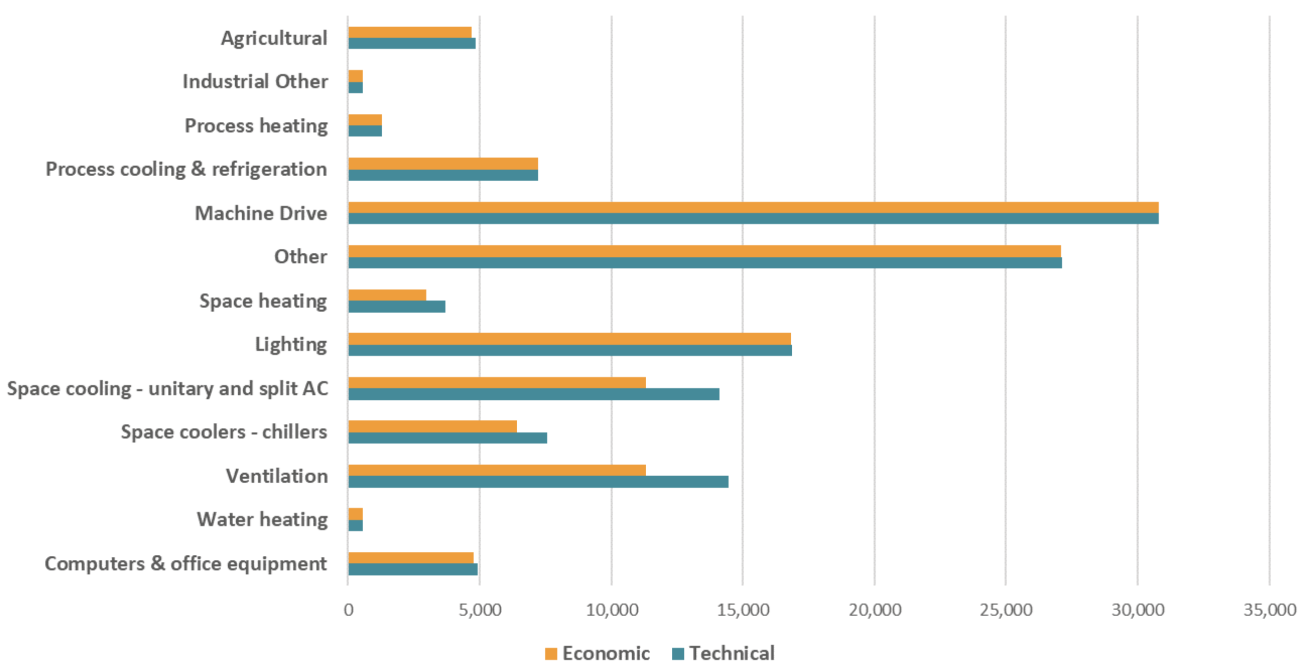
Technical & Economic Potential

Table 6-4 provides cumulative annual technical and economic potential results from 2020-2025. Figure 6-2 shows a comparison of the technical and economic potential (6-year) by end use. Machine drive, Lighting, and Ventilation are the leading stand-alone end uses among technical and economic potential.

TABLE 6-4 TECHNICAL AND ECONOMIC INDUSTRIAL ELECTRIC POTENTIAL

	2020	2021	2022	2023	2024	2025
Energy (MWh)						
Technical	20,939	44,360	69,559	95,219	115,910	133,986
Economic	19,496	41,369	65,048	89,324	108,808	125,853
Peak Demand (MW)						
Technical	5	10	15	21	25	29
Economic	4	9	14	19	24	27

FIGURE 6-2 YEAR TECHNICAL AND ECONOMIC INDUSTRIAL ELECTRIC POTENTIAL – BY END-USE



Maximum Achievable Potential

Figure 6-3 illustrates the cumulative annual MAP results by end use across the 2020-2025 timeframe. Like technical and economic potential, Machine Drive, Lighting, and Ventilation are the leading end uses. Space cooling and process cooling & refrigeration also have significant maximum achievable potential.

FIGURE 6-3 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) MAP POTENTIAL BY END-USE

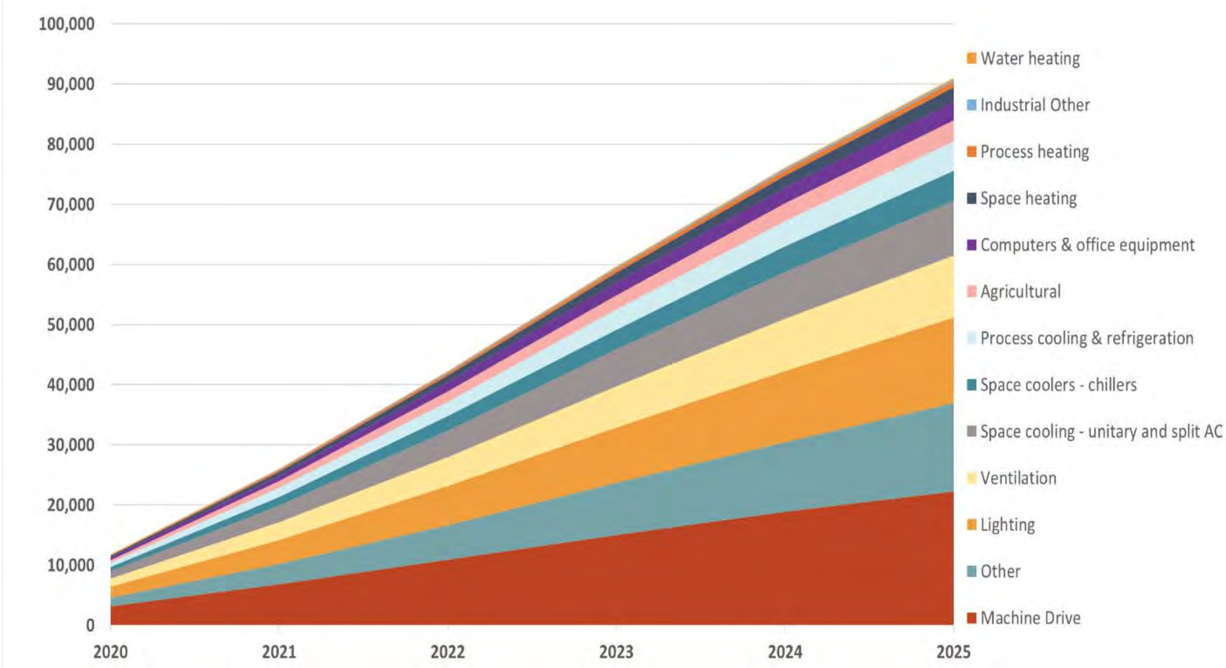


Table 6-5 provides the incremental and cumulative annual MAP across the 2020-2025 timeframe. The incremental MAP ranges from 1.8% to 3.1% of forecasted sales across the six-year timeframe. Cumulative annual MAP rises to 14.0% by 2025.

TABLE 6-5 INDUSTRIAL ELECTRIC MAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Computers & office equipment	385	494	596	678	736	867
Water heating	40	41	44	49	55	60
Ventilation	1,311	1,626	1,898	2,011	1,926	1,675
Space coolers - chillers	677	808	912	949	971	886
Space cooling - unitary and split AC	1,271	1,503	1,696	1,768	1,814	1,631
Lighting	1,797	2,238	2,662	2,951	3,008	2,839
Space heating	328	390	444	464	480	435
Other	1,466	1,909	2,391	2,877	3,392	3,930
Machine Drive	3,166	3,928	4,588	5,017	5,150	5,093
Process cooling & refrigeration	681	931	1,165	1,362	1,511	1,617
Process heating	122	169	217	259	290	306
Industrial Other	47	56	64	73	83	93
Agricultural	494	587	644	645	588	495
Total	11,785	14,679	17,322	19,105	20,003	19,927
% of Forecasted Sales	1.8%	2.3%	2.7%	3.0%	3.1%	3.1%
Incremental Annual MW						
Total	3	3	4	4	4	4
% of Forecasted Demand	2.3%	2.8%	3.3%	3.7%	3.8%	3.8%

End Use	2020	2021	2022	2023	2024	2025
Cumulative Annual MWh						
Computers & office equipment	385	878	1,474	2,153	2,630	3,056
Water heating	40	82	126	175	230	288
Ventilation	1,311	2,932	4,819	6,813	8,712	10,350
Space coolers - chillers	677	1,483	2,392	3,335	4,237	4,964
Space cooling - unitary and split AC	1,271	2,760	4,425	6,133	7,727	9,090
Lighting	1,797	3,972	6,492	9,204	11,859	14,223
Space heating	328	715	1,151	1,603	2,029	2,398
Other	1,466	3,374	5,764	8,638	11,542	14,682
Machine Drive	3,166	6,853	10,906	15,038	18,913	22,274
Process cooling & refrigeration	681	1,497	2,405	3,333	4,203	4,961
Process heating	122	271	443	625	801	956
Industrial Other	47	97	148	199	248	296
Agricultural	494	1,081	1,725	2,370	2,958	3,450
Total	11,785	25,996	42,270	59,617	76,091	90,989
% of Forecasted Sales	1.8%	4.0%	6.6%	9.2%	11.7%	14.0%
Cumulative Annual MW						
Total	3	6	9	13	17	20
% of Forecasted Demand	2.3%	5.0%	8.2%	11.6%	14.6%	17.4%

Realistic Achievable Potential

Figure 6-4 illustrates the cumulative annual RAP results by end use across the 2020-2025 timeframe. Like maximum achievable potential, Machine Drive, Lighting, and Ventilation are the leading end uses. Space cooling and process cooling & refrigeration also have significant realistic achievable potential.

FIGURE 6-4 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) RAP POTENTIAL BY END-USE

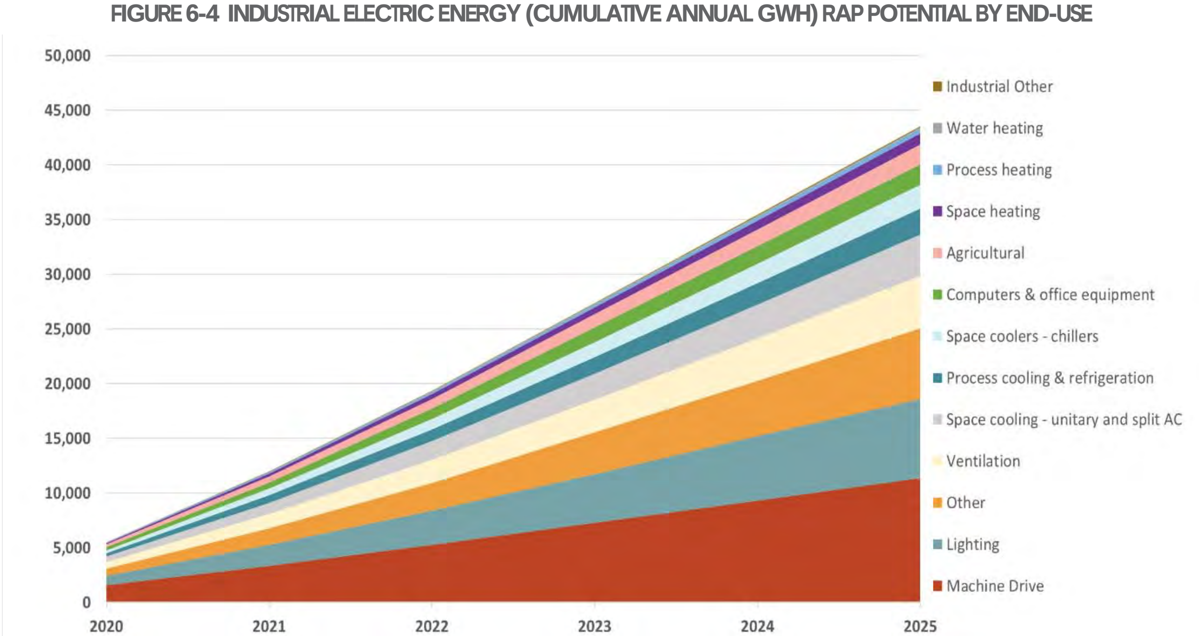


Table 6-6 provides the incremental and cumulative annual RAP across the 2020-2025 timeframe. The incremental RAP ranges from 0.9% to 1.6% of forecasted sales across the six-year timeframe. Cumulative annual RAP rises to 6.7% by 2025.

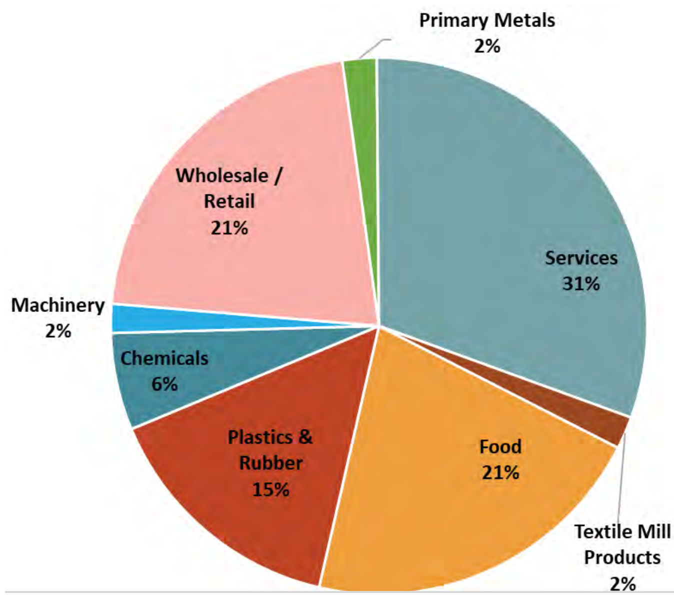
TABLE 6-6 INDUSTRIAL ELECTRIC RAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Computers & office equipment	263	316	367	415	457	544
Water heating	9	12	16	20	25	29
Ventilation	599	713	818	883	915	911
Space coolers - chillers	271	323	372	406	453	465
Space cooling - unitary and split AC	477	570	655	711	801	815
Lighting	892	1,083	1,268	1,419	1,532	1,592
Space heating	125	150	173	189	213	218
Other	649	834	1,046	1,269	1,502	1,772
Machine Drive	1,575	1,881	2,183	2,456	2,683	2,888
Process cooling & refrigeration	326	421	517	619	724	826
Process heating	56	75	95	116	136	156
Industrial Other	13	17	23	29	36	44
Agricultural	262	292	312	323	321	307
Total	5,517	6,688	7,846	8,854	9,799	10,567
% of Forecasted Sales	0.9%	1.0%	1.2%	1.4%	1.5%	1.6%
Incremental Annual MW						
Total	1	1	2	2	2	2
% of Forecasted Demand	1.1%	1.3%	1.5%	1.7%	1.9%	2.0%
Cumulative Annual MWh						
Computers & office equipment	263	579	945	1,360	1,623	1,873
Water heating	9	21	37	57	82	110
Ventilation	599	1,311	2,124	3,000	3,904	4,799
Space coolers - chillers	271	593	964	1,367	1,790	2,177
Space cooling - unitary and split AC	477	1,041	1,683	2,372	3,081	3,783
Lighting	892	1,948	3,157	4,478	5,863	7,253
Space heating	125	273	443	627	817	1,007
Other	649	1,484	2,530	3,798	5,051	6,463
Machine Drive	1,575	3,334	5,252	7,275	9,335	11,358
Process cooling & refrigeration	326	694	1,093	1,516	1,948	2,373
Process heating	56	121	195	276	361	445
Industrial Other	13	27	44	63	84	107
Agricultural	262	554	867	1,189	1,511	1,817
Total	5,517	11,982	19,336	27,377	35,449	43,566
% of Forecasted Sales	0.9%	1.9%	3.0%	4.2%	5.5%	6.7%

End Use	2020	2021	2022	2023	2024	2025
Cumulative Annual MW						
Total	1	3	4	6	8	9
% of Forecasted Demand	1.1%	2.3%	3.7%	5.3%	6.8%	8.4%

Figure 6-5 illustrates a market segmentation of the RAP in the industrial sector by 2025. Food, plastics & rubber and chemicals are the leading market segments.

FIGURE 6-5 2025 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL) RAP POTENTIAL BY MARKET SEGMENT[37]



RAP Benefits & Costs

Table 6-7 provides the net present value benefits and cost, as calculated using the UCT, across the 2020-2025 timeframe for the RAP scenario. Machine Drive is the most cost-effective end-use, and Facility Lighting provides the greatest NPV benefits.

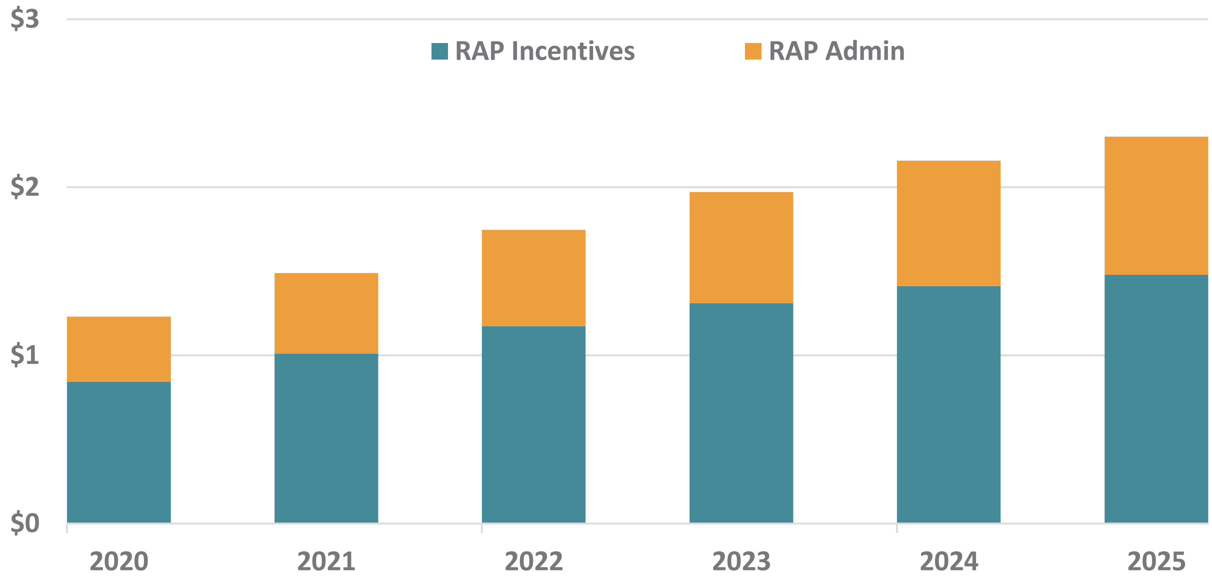
TABLE 6-7 INDUSTRIAL NPV BENEFITS AND COSTS RAP BY END-USE ($ IN MILLIONS)

End Use	NPV Benefits	NPV Costs	UCT Ratio
Machine Drive	$7.4	$1.3	5.90
Facility HVAC	$5.9	$1.4	4.18
Facility Lighting	$9.9	$3.7	2.64
Other Facility Support	$2.9	$1.2	2.45
Process Cooling and Refrigeration	$1.3	$0.4	3.64
Process Heating	$0.2	$0.0	4.59
Other	$3.6	$1.2	3.04
Total	$31.2	$9.2	3.40

[37] "Wholesale/Retail" and "Services" industrial types include industrial buildings that devote a minority percentage of floor space to commercial activities like wholesale and retail trade, and construction, healthcare, education and accommodation & food service. Automotive related industries are divided between plastics, rubber, and machinery based on their NAICS codes.

Figure 6-6 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2020-2025 timeframe. The incentives rise from $0.8 million to $1.5 million, and overall budgets rise from $1.2 million to $2.3 million by 2025.

FIGURE 6-6 ANNUAL BUDGETS FOR INDUSTRIAL RAP ($ IN MILLIONS)



6.3 INDUSTRIAL POTENTIAL INCLUDING OPT-OUT CUSTOMERS

Table 6-8 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast, excluding opt-out customers. This is the same information provided in Section 6.2. The cumulative annual energy savings across the 20-year study timeframe are also shown in the far-right column. Table 6-9 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast, including opt-out customers.[38] The cumulative annual energy savings across the 20-year study timeframe are also shown in the far-right column.

The 20-year RAP is 14.7%, excluding opt-out customers. This figure drops to 13.5%, with opt-out customers included. Though the savings as a percentage of sales decreases, the energy savings of the RAP rises from 100,008 MWh to 334,101 MWh when the opt-out customers are included in the analysis.

TABLE 6-8 INDUSTRIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – EXCLUDING OPT-OUT CUSTOMERS

	2020	2021	2022	2023	2024	2025	2039 (cumulative)
MWh							
Technical	20,939	24,019	26,570	27,937	28,192	27,324	208,784
Economic	19,496	22,471	25,050	26,553	26,985	26,293	196,720
MAP	11,785	14,679	17,322	19,105	20,003	19,927	160,447
RAP	5,517	6,688	7,846	8,854	9,799	10,567	100,008
Forecasted Sales	640,023	641,915	644,247	646,702	649,006	651,371	679,928
Energy Savings (as % of Forecast)							
Technical	3.3%	3.7%	4.1%	4.3%	4.3%	4.2%	30.7%
Economic	3.0%	3.5%	3.9%	4.1%	4.2%	4.0%	28.9%
MAP	1.8%	2.3%	2.7%	3.0%	3.1%	3.1%	23.6%
RAP	0.9%	1.0%	1.2%	1.4%	1.5%	1.6%	14.7%

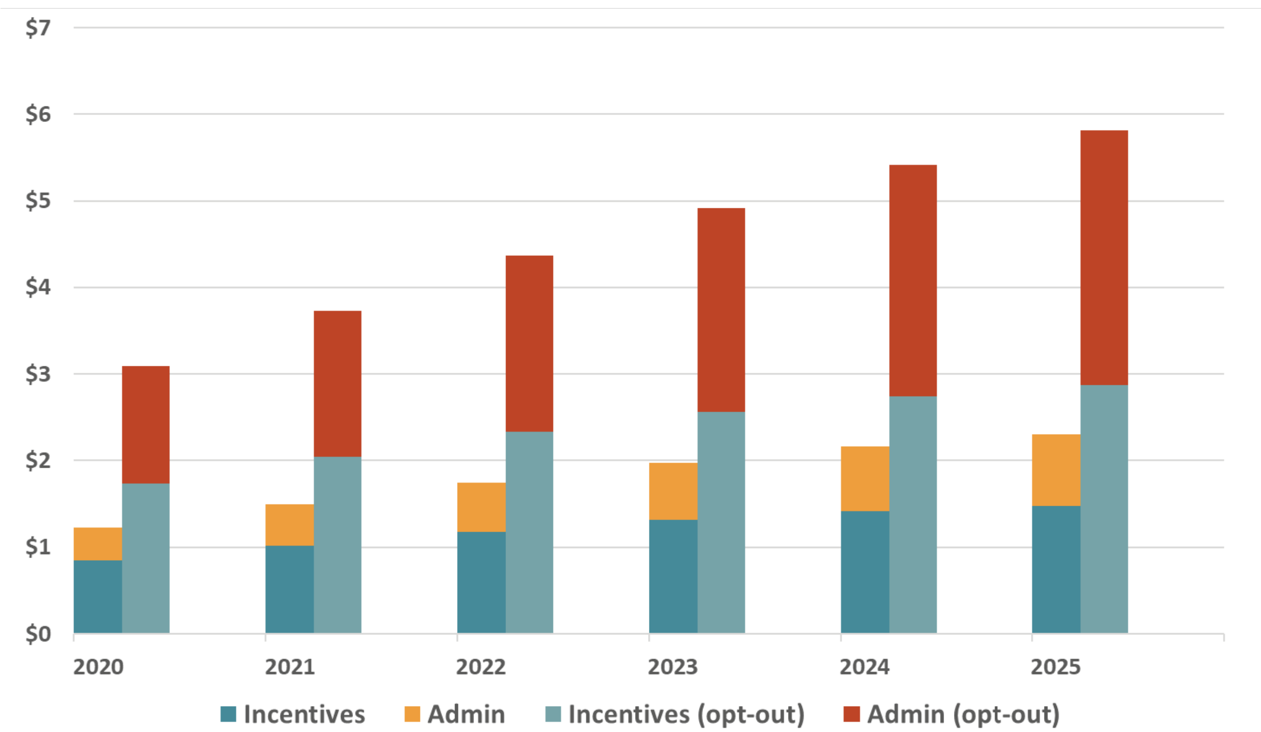
38 Note the increase in the forecasted sales with opt-out customers included.

TABLE 6-9 INDUSTRIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY – INCLUDING OPT-OUT CUSTOMERS

	2020	2021	2022	2023	2024	2025	2039 (cumulative)
MWh							
Technical	66,750	78,664	89,185	95,702	97,760	95,516	688,359
Economic	63,335	74,992	85,566	92,390	94,842	92,995	659,191
MAP	41,085	51,432	61,105	67,856	71,118	70,784	521,639
RAP	19,324	23,576	27,883	31,695	35,218	38,149	334,101
Forecasted Sales	2,329,890	2,336,776	2,345,264	2,354,201	2,362,591	2,371,200	2,475,157
Energy Savings (as % of Forecast)							
Technical	2.9%	3.4%	3.8%	4.1%	4.1%	4.0%	27.8%
Economic	2.7%	3.2%	3.6%	3.9%	4.0%	3.9%	26.6%
MAP	1.8%	2.2%	2.6%	2.9%	3.0%	3.0%	21.1%
RAP	0.8%	1.0%	1.2%	1.3%	1.5%	1.6%	13.5%

Figure 6-8 provides the budget for the RAP scenario, with and without opt-out customers. The budget is broken into incentive and admin budgets for each year of the 2020-2025 timeframe. The overall budgets without opt-out customers rise from $1.2 million to $2.3 million by 2025. The budgets with opt-out customers included increase from $3.1 million to $5.8 million by 2025.

FIGURE 6-7 ANNUAL BUDGETS FOR INDUSTRIAL RAP ($ IN MILLIONS) – WITH AND WITHOUT OPT-OUT CUSTOMERS



7 Demand Response and CVR Potential

This section provides the results of the technical, economic, MAP and RAP potential for the demand response analysis. Results are broken down by sector and program. The cost-effectiveness results and budgets for the MAP and RAP scenarios are also provided. Section 2.5 provides a description of the demand response methodology. Additional demand response results details are provided in Appendix G.

This section also provides the results of the CVR analysis. Energy and peak demand savings are provided, along with estimated budget requirements and the program benefits and costs.

7.1 TOTAL DEMAND RESPONSE POTENTIAL

Table 7-1 shows the technical, economic, and achievable (MAP and RAP) cumulative annual potential for the 2020-2025 timeframe. Achievable potential includes a participation rate to estimate the realistic number of customers that are expected to participate in each cost-effective demand response program option. These values are at the customer meter. The MAP assumes the maximum participation that would happen in the real-world, while the realistically achievable potential (RAP) discounts MAP by considering barriers to program implementation that could limit the amount of savings achieved.

TABLE 7-1 SUMMARY OF TECHNICAL, ECONOMIC, AND ACHIEVABLE POTENTIAL[39]

Potential Level	2020 Savings (MW)	2021 Savings (MW)	2022 Savings (MW)	2023 Savings (MW)	2024 Savings (MW)	2025 Savings (MW)
Technical	399	368	333	312	304	300
Economic	367	348	322	306	299	295
MAP	23	64	110	131	138	139
RAP	7	20	38	49	53	55

Table 7-2 and Table 7-3 show the achievable potential savings for the 2020-2025 timeframe. Only those programs that were found to be cost-effective are included. Critical Peak Pricing (with Enabling Technologies) are the leading programs in both the commercial and residential sectors.

TABLE 7-2 MAP SAVINGS BY PROGRAM

	Program	2020 Savings (MW)	2021 Savings (MW)	2022 Savings (MW)	2023 Savings (MW)	2024 Savings (MW)	2025 Savings (MW)
Residential	DLC AC Thermostat (Utility Incentivized)	2	3	5	7	8	10
	DLC AC Thermostat (BYOT)	2	3	5	7	8	10
	Critical Peak Pricing (with Enabling Technologies)	8	24	49	64	68	68
	Critical Peak Pricing (without Enabling Technologies)	4	11	17	19	19	18
	Peak Time Rebates	5	10	10	6	5	4
	Total	18	49	82	96	99	100

[39] The results in Table 7-1 do not account for any interactions with energy efficiency. In other words, the results are independent of the energy efficiency potential. Table 7-2 and Table 7-3 provide the DR total both without and with accounting for the interactions between energy efficiency potential and demand response potential. The "with energy efficiency interaction" results assume that energy efficiency potential comes first, then demand response.

	Program	2020 Savings (MW)	2021 Savings (MW)	2022 Savings (MW)	2023 Savings (MW)	2024 Savings (MW)	2025 Savings (MW)
Commercial	DLC AC Thermostat (Utility Incentivized)	0	1	1	1	1	2
	DLC AC Thermostat (BYOT)	0	1	1	1	1	2
	Critical Peak Pricing (with Enabling Technologies)	4	11	23	31	33	33
	Critical Peak Pricing (without Enabling Technologies)	1	2	3	3	3	3
	Time of Use Rate	0	1	1	1	1	1
	Total	5	15	28	36	38	39
Residential & Commercial Total (without energy efficiency interaction)		23	64	110	131	138	139
Residential & Commercial Total (with energy efficiency interaction)		22	61	103	121	124	123

TABLE 7-3 RAP SAVINGS BY PROGRAM

	Program	2020 Savings (MW)	2021 Savings (MW)	2022 Savings (MW)	2023 Savings (MW)	2024 Savings (MW)	2025 Savings (MW)
Residential	DLC AC Thermostat (Utility Incentivized)	1	2	3	3	4	5
	DLC AC Thermostat (BYOT)	1	2	3	3	4	5
	Critical Peak Pricing (with Enabling Technologies)	2	6	12	16	18	18
	Critical Peak Pricing (without Enabling Technologies)	1	3	5	7	7	7
	Peak Time Rebates	1	3	6	8	8	8
	Time of Use Rate	1	2	3	3	4	4
	Residential Total	5	16	30	38	41	42
Commercial	DLC AC Thermostat (Utility Incentivized)	0	0	0	0	0	1
	DLC AC Thermostat (BYOT)	0	0	0	0	0	1
	Critical Peak Pricing (with Enabling Technologies)	1	3	7	9	10	10
	Critical Peak Pricing (without Enabling Technologies)	0	1	1	2	2	2
	Commercial Total	1	4	8	11	12	12
Residential & Commercial Total (without energy efficiency interaction)		7	20	38	49	53	55
Residential & Commercial Total (with energy efficiency interaction)		7	19	37	47	51	51

Benefits & Costs

Table 7-4 and Table 7-5 show the MAP and RAP budget requirement (for only cost-effective programs) across the 2020-2025 timeframe that would be required to achieve the cumulative annual potential for each of the thermostat scenarios. GDS assumed that the Utility Incentivized Scenario would be combined with the existing energy efficiency smart thermostat program, so those customers would already have thermostats installed. Therefore, there would be no additional incentives or equipment costs for those customers. For the BYOT program, GDS assumed there would be a $75 one-time credit[40] for each new participant. The current and future hardware and software cost of a Demand Response Management System and the cost of non-equipment incentives are included in these budgets.

TABLE 7-4 SUMMARY OF MAP BUDGET REQUIREMENTS

	Utility Incentivized	BYOT
2020	$2,603,899	$2,903,578
2021	$3,795,482	$4,142,869
2022	$3,491,247	$3,886,512
2023	$1,824,460	$2,267,934
2024	$795,194	$1,286,975
2025	$524,919	$1,065,077

TABLE 7-5 SUMMARY OF RAP BUDGET REQUIREMENTS

	Utility Incentivized	BYOT
2020	$1,214,023	$1,366,348
2021	$1,519,553	$1,695,871
2022	$1,874,090	$2,074,485
2023	$1,218,690	$1,443,328
2024	$687,836	$936,763
2025	$517,151	$790,398

Table 7-6 and Table 7-7 show the MAP and RAP residential net present values of the total benefits, costs, and savings, along with the UCT ratio for each program for the length of the study. The study period is 2020 to 2034 for MAP (15 years) and 2020 to 2039 for RAP (20 years). Two scenarios were looked at for the demand response study: control of air conditioners by smart thermostats where the utility provides the thermostat (utility incentivized), or where the customer provides their own thermostat (BYOT).

TABLE 7-6 MAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM

	Program	NPV Benefits	NPV Costs	UCT Ratio
Residential	DLC AC Thermostat (Utility Incentivized)	$17,194,723	$1,983,943	8.67
	DLC AC Thermostat (BYOT)	$17,194,723	$8,202,189	2.10
	DLC AC Switch	$444,312	$981,072	0.45
	DLC Water Heaters	$70,254	$909,399	0.08
	DLC Pool Pumps	$3,606	$932,923	0.00
	Critical Peak Pricing (with Enabling Technologies)	$71,995,462	$4,229,589	17.02
	Critical Peak Pricing (without Enabling Technologies)	$22,495,433	$3,296,084	6.82

[40] Vectren South 2018 Electric DSM Operating Plan

	Program	NPV Benefits	NPV Costs	UCT Ratio
	Peak Time Rebates	$7,465,909	$2,061,985	3.62
	Time of Use Rates	$827,243	$1,655,665	0.50
Commercial	DLC AC Thermostat (Utility Incentivized)	$2,808,364	$740,617	3.79
	DLC AC Thermostat (BYOT)	$2,808,364	$1,217,479	2.31
	DLC AC Switch	$7,448	$888,343	0.01
	DLC Water Heaters	$238	$887,382	0.00
	Critical Peak Pricing (with Enabling Technologies)	$36,360,268	$1,072,797	33.89
	Critical Peak Pricing (without Enabling Technologies)	$3,959,266	$804,905	4.92
	Real Time Pricing	$166,288	$627,540	0.26
	Peak Time Rebates	$327,957	$818,521	0.40
	Time of Use Rates	$960,336	$826,947	1.16

TABLE 7-7 RAP NPV BENEFITS, COSTS, AND UCT RATIOS FOR EACH DEMAND RESPONSE PROGRAM

	Program	NPV Benefits	NPV Costs	UCT Ratio
Residential	DLC AC Thermostat (Utility Incentivized)	$13,414,527	$1,347,251	9.96
	DLC AC Thermostat (BYOT)	$13,414,527	$5,676,540	2.36
	DLC AC Switch	$161,139	$1,085,281	0.15
	DLC Water Heaters	$24,158	$1,058,798	0.02
	DLC Pool Pumps	$703	$1,101,271	0.00
	Critical Peak Pricing (with Enabling Technologies)	$23,447,290	$1,299,760	18.04
	Critical Peak Pricing (without Enabling Technologies)	$10,175,975	$1,383,206	7.36
	Peak Time Rebates	$11,651,211	$1,567,503	7.43
	Time of Use Rates	$5,036,926	$1,623,212	3.10
Commercial	DLC AC Thermostat (Utility Incentivized)	$1,332,037	$752,800	1.77
	DLC AC Thermostat (BYOT)	$1,332,037	$957,031	1.39
	DLC AC Switch	$305	$1,051,229	0.00
	DLC Water Heaters	$41	$1,051,193	0.00
	Critical Peak Pricing (with Enabling Technologies)	$13,997,560	$706,486	19.81
	Critical Peak Pricing (without Enabling Technologies)	$2,562,131	$697,914	3.67
	Real Time Pricing	$715,458	$745,708	0.96
	Peak Time Rebates	$437,224	$855,727	0.51
	Time of Use Rates	$725,868	$803,613	0.90

7.2 CVR POTENTIAL

Tables 7-8 and 7-9 show the respective incremental and cumulative annual CVR potential for the first six years of the study. Energy (MWh) and peak demand (kW) savings estimates are included in the tables.

TABLE 7-8. CVR INCREMENTAL ANNUAL POTENTIAL

	2020	2021	2022	2023	2024	2025
Projected MWh Savings	2,494	0	0	3,861	0	0
Projected kW Savings	449	0	0	695	0	0

TABLE 7-9. CVR CUMULATIVE ANNUAL POTENTIAL

	2020	2021	2022	2023	2024	2025
Projected MWh Savings	2,494	2,494	2,494	6,355	6,355	6,355
Projected kW Savings	449	449	449	1,144	1,144	1,144

Table 7-10 shows the annual budget requirements to run the CVR program with the East Side and Broadview substations. The capital cost of the East Side substation is $1,350,000, and initial equipment and software costs of the Broadview station is $1,550,000. The implementation costs for the East Side substation are $139,748 per year, and $163,225 for the Broadview substation (starting in 2023). Administrative costs are assumed to be $40,000 for the entire CVR program in 2020 and escalates by 1.5% per year thereafter.

TABLE 7-10. ANNUAL CVR BUDGET REQUIREMENTS

	CVR Budget
2020	$179,748
2021	$180,348
2022	$180,957
2023	$344,810
2024	$345,437
2025	$346,074

Table 3-9 shows the NPV benefits and costs associated with the CVR program across the 20-yr timeframe of the study. The UCT ratio is 1.38.

TABLE 7-11. NPV BENEFITS, COSTS, AND UCT RATIO FOR CVR PROGRAM

Program	NPV Benefits	NPV Costs	UCT Ratio
CVR	$4,687,972	$3,407,160	1.38

VOLUME II

2020-2025 Integrated Electric Action Plan

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Live Smart

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1 Summary of Results

1.1 VECTREN'S ACTION PLAN

The Market Potential Study serves as the basis for developing Vectren's Action Plan. The Action Plan is designed to extract the insights and data from the Market Potential Study and translate them into opportunities to deliver to customers. The Action Plan provides guidance to mobilize the results of the Market Potential Study research and design program initiatives that provide a pathway to advance efforts that are reasonable and relevant in developing Vectren's portfolio. The following section lays out the process, principles, and elements of Vectren's portfolio of programs. A summary of the results for the proposed portfolio is also provided.

1.2 GUIDING PLANNING PRINCIPLES IN DEVELOPING ACTION PLAN OFFERINGS

Vectren's Energy Efficiency Action Plan was developed in accordance with a number of guiding principles and considerations. The process was built on using the most recent Market Potential Study as the foundation, and was then designed to incorporate industry best standards, implementer experiences, and projected changes in the market (such as codes and standards) in order to translate the insights and knowledge from the Market Potential Study into actionable energy efficiency programs for Vectren's planning purposes and customers.

A review of the key planning guidelines and considerations used to frame the Action Plan follows:

TABLE 1-1 KEY PLANNING GUIDELINES IN DEVELOPING THE ACTION PLAN

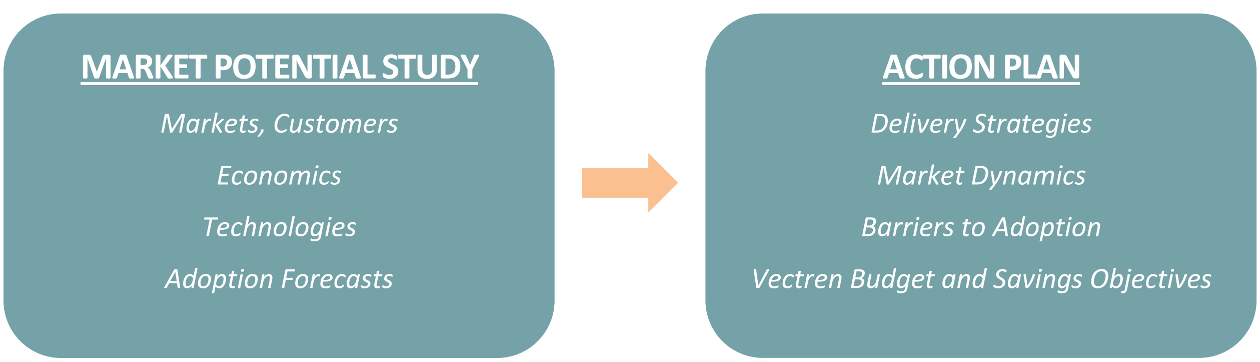
Plan Consideration	Description
Market Coverage	Consideration was given to crafting a portfolio of programs that offers opportunities for savings across all of Vectren's customer groups. This includes residential (single, multifamily and income qualified) as well as commercial and industrial markets.
Direct Link to the Market Potential Study	The Action Plan is directly linked to the Market Potential Study by using its market and cost data. It is acknowledged that there are differences between market and achievable potential due to market dynamics (net versus gross impacts), timeframe differences, proxy versus specific program delivery approaches, and budget realities. Wherever possible, the Market Potential Study serves as a primary reference source making it easier for Vectren to return to the Market Potential Study for added insights as conditions in the market change.
Leveraging Current Program Efforts	Efforts were directed at leveraging existing Vectren offerings to take advantage of market and trade ally understanding, to utilize existing market relationships, retain the relevant elements of programs already working well, and to continue promotional efforts (where relevant).
Introduce New Measures and Concepts	The approach actively looked at incorporating new, applicable measures deemed cost effective and suitable for Vectren's portfolio. This included the introduction of selected new measures in the existing prescriptive-type programs.
Cost Effectiveness Analysis	For planning purposes, each of the recommended programs must pass the Utility Cost Test (UCT) and the Total Resource Cost (TRC) tests, except for Income-Qualified Programs which do not need to meet cost-effectiveness tests in order to promote a greater social good. The cost-effectiveness results are reported for the UCT and the TRC tests. Each program is assessed separately to determine relative benefits and costs (in contrast to assessing each individual measure).
Income-Qualified Programs	Because income-qualified programs are not required to be cost-effective, the Market Potential Study did not screen out measures for income qualified programs based on any cost-effectiveness tests. The team used alternate guidelines for determining which measures would be included in the program. The team chose a "quality over quantity" approach and provided more services to each individual customer than in previous program years. To ensure that income-qualified programs did not overwhelm other energy efficiency program priorities, the team ensured that the overall program budget did not vastly exceed previous program budgets.
C&I Custom Program	Because the C&I Custom program utilizes engineering estimates for each project, customers can submit a wide range of projects through the program. Typically, C&I customers submit large projects through the program to provide an economy of scale for the company taking the time to

Plan Consideration	Description
	complete program paperwork. The Market Potential Study, however, includes all measures that C&I customers may submit through the program no matter the size of the project. Due to this project sizing difference, the Market Potential Study estimates significantly higher savings than the team believed was achievable through the program. The team adjusted C&I Custom program participation and savings based on feedback from implementers and historical program participation.
Adoption Forecasts	Forecasts of customer adoption were reviewed and applied from the Market Potential Study in combination with the historical participation from Vectren's programs. Information was also captured from actual VEDI program experience from evaluation reporting, reliance on "like-utility" estimates in offering similar programs and discussions with implementers.
Impact of Codes and Standards	The savings presented in the Action Plan considers upcoming changes to the baseline. The residential lighting program serves as a good example, where the baseline is changing in 2020 due to the Energy Independence Security Act (EISA). Since 2010, first CFLs and then LEDs have claimed significant shares of the U.S. light bulb market. As a result, the energy efficiency of the average new light bulb sold in the U.S. has increased significantly. That means the savings that energy efficiency programs can claim for helping to install an efficient LED has decreased. Starting in 2020, LED (or equivalent lights) become the standard alternative, directly impacting the amount of savings available for customers changing out their bulbs. The elimination of savings from LED lighting is included in the Vectren portfolio starting in 2021-2022. A similar situation is evident in looking at savings estimates from electrically commutated motors (ECM) as part of furnaces. The standards for ECM motors are scheduled to increase in July 2019, resulting in a loss of reportable energy savings starting in 2020 from the measure.
Program Costs and Budgets	A budget that characterizes the estimated costs for delivering programs to customers is presented for each program. The costs include all participant incentive, planning, evaluation and implementation costs forecast for each year of program operation.
Electric and Natural Gas Integration	As a combination utility, some of Vectren's programs offer savings addressing both electric and natural gas reductions. Programs such as new construction, behavioral savings, multifamily, and income-qualified weatherization all include electric and gas savings. These programs follow the need to split program costs across fuel types while the cost-effectiveness results include benefits of electric and gas reductions. This effort was directed at areas of the Vectren service territory which offer both fuel types to customers. The specific impacts of these programs are provided in the individual program write-ups.

1.3 VECTREN ENERGY EFFICIENCY ACTION PLAN BACKGROUND

The development of the Action Plan is designed to translate the insights and information from the broader Market Potential Study analysis into discrete and specific offerings for Vectren's customers. The Market Potential Study and the Action Plan are related and share common values, but the Action Plan provides more detail, specificity and mobilization strategies.

The Action Plan outlines recommended electric programs for 2020-2025, a shorter timeframe than the potential research. The Action Plan lays outs how to achieve the savings uncovered in the potential study research, shifting the broad and high-level forecast of savings opportunities in the Market Potential Study results into specific and actionable savings opportunities. An illustrative view between the Market Potential Study and the Action Plan elements follows:

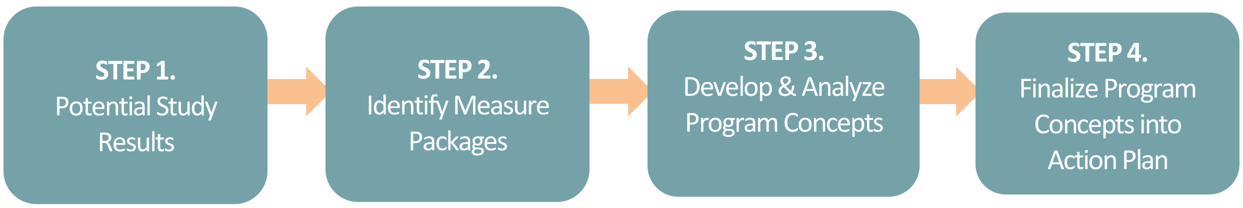


1.4 VECTREN ENERGY EFFICIENCY ACTION PLAN FRAMEWORK

The effort to develop Vectren's energy efficiency programs, for their planning purposes, follows a grounded and sequential process. The process was built on applying the recent market potential analytics as a starting point and, from there, developing program offerings that cost-effectively meet Vectren's planning and program objectives. An illustrative review of the process follows.

1.4.1 Approach

Our approach was based on conducting a series of sequential activities that take the top measures from the potential analyses and develop more detailed and defined concepts to better reflect likely delivery strategies and actual experience. This included packaging measures into programs to analyze and forecast adoption, economic impacts, and savings estimates. This approach is consistent with similar energy efficiency potential efforts and is detailed in the Guide for Conducting Energy Efficiency Potential Studies, prepared by the National Action Plan for Energy Efficiency (2007). These activities are discussed in more detail below.



1.4.2 Action Plan Activities

Step 1. Potential Study Results

The starting point for developing the programs in the Vectren Action Plan was the recently-completed Market Potential Study. This study provided a current assessment of the energy efficiency opportunities available in Vectren service territory and was built on the utility's most recent sales information, market characterization, and forecast of adoption using a number of scenarios and data on measure penetration, costs, energy savings, and overall economics. A key input used for the Action Plan was the identification of the relative savings impacts and cost and benefits for a large array of possible measures that were considered for the Vectren portfolio.

The focus on identifying relevant measures for further consideration in the Vectren portfolio was based on looking at the forecast impacts from both the Total Resource Cost (TRC) and the Utility Cost Test (UCT). Measures which passed either test were reviewed and screened to determine their applicability, market rationale, and viability to be packaged into programs for subsequent examination. The project team, working with Vectren, coordinated multiple meetings with staff and implementers to assist in our understanding of current and proposed DSM initiatives, details of Indiana and Vectren-specific markets, and the suitability of efficiency measures given the utility's customer base. For example, there were a number of retail consumer-related products that passed the relevant screening—such as energy efficient laptops, printers, SMART televisions, and monitors—but are not typically handled through utility intervention. Instead they are part of national standards and market efforts. The result was a list of 413 measures, deemed to be the most reasonable and relevant for further consideration by Vectren.

Step 2. Identify Measure Packages

Using the data and results of the MPS, relevant measures were bundled into packages to better reflect targeted end uses, typical trade ally involvement in customer transactions, and common delivery strategies. The combined packages of measures were designed to advance the analysis efforts and optimally spread delivery costs across a range of technologies. The packages were developed through discussions with Vectren staff, review of prior utility offerings and discussions with Vectren's implementors.

Step 3. Develop and Analyze Program Concepts

Measure packages were then combined into program concepts, designed to reflect program implementation. The concepts were developed through a series of interviews with Vectren's program implementers. These discussions were designed to capture their insights and suggestions as what works best in Vectren's market based on their experiences. Discussions were also conducted with Vectren staff to get a sense of prior offerings, to better understand program delivery experiences. Finally, effort was also directed at incorporating practices and findings from other utility experiences in Indiana and in the region. The results of this step provided inputs to the Action Plan modeling including: energy savings, program costs, participation and incentives. These elements are all key inputs into modeling the stream of benefits and costs and determine cost effectiveness.

Step 4. Finalize Offerings in Action Plan

The final program concepts and relevant information were incorporated into Vectren's Action Plan document. The Action Plan provides the key information for required to implement desired programs.

A review of the key Action Plan data elements and sources follows:

TABLE 1-2 ACTION PLAN DATA ELEMENTS

Action Plan Content	Description
Energy Savings	Each program contains savings estimates for kWh, kW, and therms developed from the Market Potential Study analysis. Additional sources for the savings estimates include: the Indiana TRM, prior evaluation results from VEDI, prior DSM filings, and discussions with relevant implementers.
Technology Costs	Technology cost was obtained from the Market Potential Study analysis. Additional sources included prior evaluation results from VEDI and prior DSM filings.
Estimated Useful Lifetime	Estimates of useful lifetime (EUL) were based on the Market Potential Study analytics and the Indiana Measure Library. For programs with multiple measures, the program EUL was calculated using a weighted average of the number of each measure implemented.
Incentive Strategy	The specific incentive strategy including type (rebate, loan, POS reduction, manufacturer payment), and amount was determined from discussions with Vectren. There is a good history from prior VEDI DSM efforts to detail incentive strategy and amounts to move the market. The cost economics from the Participant Test were also used to gauge impacts.
Annual Adoption	Forecasts of customer adoption from the Market Potential Study were reviewed and adjustments were applied based on historical participation in Vectren's programs, upcoming changes in codes and standards, actual performance reported in VEDI evaluation reporting, and "like-utility" estimates in offering similar programs.
NTG Impacts	NTG estimates from past evaluation studies were used for existing programs. Benchmarking against other Indiana utilities or "like utilities" was used for new initiatives. Discussions with implementers were also included.
Program Costs	Program budgets were developed using historical program cost data and past VEDI evaluations. Discussions with relevant implementation contractors also provided insight regarding typical utility management requirements and related costs.
Benefit-Cost Impacts	Each program concept also includes the impact of the relative costs and benefits for each initiative. The results include the forecast of benefit-costs from various perspectives: Participant test, Rate Impact test, Utility Cost test, and Total Resource Cost test.

2 Overview of Vectren's Energy Efficiency Portfolio

The following section outlines the portfolio of programs developed by Vectren, EMI Consulting, and GDS (referred to hereafter as "the team"). The section begins with a high-level summary of the recommended programs and then provides detailed participation estimates for each year of the Action Plan.

2.1 RECOMMENDED VECTREN ENERGY EFFICIENCY PROGRAM PORTFOLIO

The following table presents the recommended Vectren proposed portfolio. A more detailed program-by-program write-up is also provided in Section 3 to define each program's overall design and incorporate relevant technology and market data to permit modeling of load impacts, budgets, and cost-effectiveness.

TABLE 2-1 SUMMARY OF DRAFT 2020-2025 ENERGY EFFICIENCY PROGRAMS

Programs	Continuation from Previous Plan	New or Expanded Offering	Pilot Program	Participant Unit	Gas/Electric Integrated Savings
Residential Lighting	X			Bulb	
Residential Prescriptive	X	X		Equipment / Appliance / Service	X
Residential New Construction	X			Home	X
Income Qualified Weatherization	X			Home	X
Energy Efficient Schools	X			Kit	X
Residential Behavioral Savings	X	X		Home	X
Appliance Recycling	X	X		Refrigerator/ Freezer	
Home Energy Assessment	X			Home	X
Food Bank	X	X		Bulb	X
CVR Residential	X			NA	
Home Energy Management Systems		X	X	Home	X
Smart Cycle (DLC Change Out)	X			Thermostat	
Bring Your Own Thermostat	X			Thermostat	
Commercial Prescriptive	X	X		Equipment / Appliance / Service	X
Commercial Custom	X	X		Project	X
Small Business	X	X		Project	X
CVR C&I	X			NA	

2.2 SUMMARY OF ENERGY EFFICIENCY IMPACTS

An overall summary of results reflecting savings and costs is shown in Table 2-2 below. These results present an aggregation of all the programs, as well as the results by portfolio (Residential and Commercial/Industrial).

TABLE 2-2 VECTREN INDIANA ELECTRIC DSM 2020-2025 SAVINGS- ALL PROGRAMS

Year	New Participants in Year	Energy Savings in MWh Savings in Year	Summer kW Savings	Incentives, 000$	Program Costs, 000$	Indirect and Other Costs, 000$	Budget, 000$
2020	345,916	47,451	10,758	3,731	5,342	1,207	10,279
2021	382,684	49,716	10,653	3,814	5,724	1,547	11,085
2022	216,286	44,565	10,262	3,787	5,714	1,251	10,752
2023	135,923	45,375	10,907	3,551	5,867	1,253	10,670
2024	137,955	43,309	10,405	3,565	6,063	1,570	11,198
2025	138,078	43,244	10,683	3,563	6,116	1,279	10,959
Total	**1,356,842**	**273,660**	**63,667**	**22,011**	**34,826**	**8,107**	**64,944**

TABLE 2-3 VECTREN INDIANA ELECTRIC DSM 2020-2025 SAVINGS- RESIDENTIAL

Year	New Participants in Year	Energy Savings in MWh Savings in Year	Summer kW Savings	Incentives, 000$	Program Costs, 000$	Indirect and Other Costs, 000$	Budget, 000$
2020	302,908	22,880	5,784	1,321	3,860	582	5,763
2021	333,657	24,682	5,569	1,358	4,185	768	6,312
2022	162,737	18,353	4,926	1,316	4,118	515	5,949
2023	80,062	17,461	5,215	1,103	4,166	482	5,752
2024	81,637	16,186	4,879	1,166	4,297	587	6,050
2025	83,617	16,349	5,216	1,236	4,356	483	6,076
Total	**1,044,618**	**115,911**	**31,588**	**7,502**	**24,983**	**3,418**	**35,902**

TABLE 2-4 VECTREN INDIANA ELECTRIC DSM 2020-2025 SAVINGS- COMMERCIAL AND INDUSTRIAL

Year	New Participants in Year	Energy Savings in MWh Savings in Year	Summer kW Savings	Incentives, 000$	Program Costs, 000$	Indirect and Other Costs, 000$	Budget, 000$
2020	43,008	24,571	4,975	2,410	1,482	625	4,516
2021	49,027	25,034	5,084	2,456	1,539	779	4,773
2022	53,549	26,212	5,336	2,471	1,596	736	4,803
2023	55,861	27,914	5,691	2,447	1,700	771	4,919
2024	56,318	27,124	5,526	2,399	1,766	983	5,148
2025	54,461	26,895	5,467	2,327	1,760	795	4,883
Total	**312,224**	**157,749**	**32,079**	**14,510**	**9,843**	**4,689**	**29,042**

2.3 PORTFOLIO TARGETS BY YEAR

The following tables present the portfolio participation, savings, and costs targets by each program year.

TABLE 2-5 2020 PORTFOLIO TARGETS

	Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget
Residential							
Residential Lighting	239,866	8,088,914	905.24	$101,000	$186,419	$463,014	$750,433
Residential Prescriptive	7,966	2,465,148	691.22	$40,400	$347,608	$632,065	$1,020,073
Residential New Construction	86	188,624	121.46	$5,050	$50,000	$16,775	$71,825
Home Energy Assessment	300	519,393	55.48	$5,050	$240,000	-	$245,050
Income Qualified Weatherization	539	778,285	443.32	$20,200	$1,275,176	-	$1,295,376
Energy Efficient Schools	2,600	1,149,200	136.50	$20,200	$113,589	-	$133,789
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$40,400	$323,803	-	$364,203
Appliance Recycling	1,251	1,179,811	171.20	$40,400	$143,657	$61,000	$245,057
CVR Residential	-	1,461,047	430	$30,300	$218,023	-	$248,323
Smart Cycle (DLC Change Out)	1,000	-	1,015.00	$20,200	$516,000	$96,000	$632,200
BYOT (Bring Your Own Thermostat)	300	-	240.00	$20,200	$22,280	$52,280	$94,760
Food Bank	-	-	-	-	-	-	-
Home Energy Management Systems	-	-	-	$10,100	$70,000	-	$80,100
Residential Subtotal	**302,908**	**22,879,629**	**5,783.70**	**$353,500**	**$3,506,555**	**$1,321,134**	**$5,181,189**
Commercial & Industrial (C&I)							
Commercial Prescriptive	42,431	14,490,335	3,807.71	$55,550	$622,327	$1,370,010	$2,047,886
Commercial Custom	196	6,107,234	740.00	$60,600	$344,162	$491,537	$896,299
Small Business	381	2,940,932	213.00	$5,050	$215,618	$548,167	$768,835
CVR Commercial	-	1,032,656	214	$30,300	$148,233	-	$178,533
Commercial & Industrial Subtotal	**43,008**	**24,571,158**	**4,974.71**	**$151,500**	**$1,330,340**	**$2,409,714**	**$3,891,554**
Indirect Costs							
Contact Center							$63,000
Online Audit							$42,911
Outreach							$410,000
Portfolio Costs Subtotal							**$515,911**
Subtotal (Before Evaluation)							**$9,588,653**
Evaluation							$490,728
DSM Portfolio Total							**$10,079,381**
Other Costs							
Emerging Markets							$200,000
Market Potential Study							-
Other Costs Subtotal							**$200,000**
DSM Portfolio Total including Other Costs							**$10,279,381**

Note: The team did not factor in the Energy Independence and Security Act (EISA) backstop provision until 2022. The team assumed that Vectren would continue to pilot the Home Energy Management Systems program through 2020.

TABLE 2-6 2021 PORTFOLIO TARGETS

	Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget
Residential							
Residential Lighting	262,832	8,704,288	875.28	$102,616	$189,402	$455,001	$747,018
Residential Prescriptive	8,276	2,618,629	661.70	$41,046	$353,169	$645,510	$1,039,726
Residential New Construction	77	168,932	108.81	$5,131	$57,249	$15,025	$77,405
Home Energy Assessment	350	605,959	64.72	$5,131	$258,000	-	$263,131
Income Qualified Weatherization	566	823,215	467.28	$20,523	$1,293,527	-	$1,314,050
Energy Efficient Schools	2,600	1,149,200	136.50	$20,523	$117,253	-	$137,776
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$20,523	$328,984	-	$349,507
Appliance Recycling	1,344	1,285,473	172.83	$41,046	$159,415	$66,625	$267,086
CVR Residential	-	-	-	$30,785	$197,378	-	$228,163
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$20,523	$536,000	$116,000	$672,523
BYOT (Bring Your Own Thermostat)	300	-	240.00	$20,523	$30,280	$60,280	$111,083
Food Bank	6,312	1,564,332	172.21	$20,523	$92,517	-	$113,041
Home Energy Management Systems	1,000	515,000	80.00	$10,262	$212,900	-	$223,162
Residential Subtotal	**333,657**	**24,682,235**	**5,568.60**	**$359,156**	**$3,826,074**	**$1,358,441**	**$5,543,671**
Commercial & Industrial (C&I)							
Commercial Prescriptive	48,449	15,981,655	4,131.23	$56,439	$682,432	$1,424,756	$2,163,627
Commercial Custom	196	6,107,234	740.00	$61,570	$349,669	$491,537	$902,775
Small Business	382	2,944,615	213.00	$5,131	$219,172	$539,573	$763,876
CVR Commercial	-	-	-	$30,785	$133,547	-	$164,332
Commercial & Industrial Subtotal	**49,027**	**25,033,504**	**5,084.23**	**$153,924**	**$1,384,820**	**$2,455,867**	**$3,994,610**
Indirect Costs							
Contact Center							$64,008
Online Audit							$43,598
Outreach							$416,560
Portfolio Costs Subtotal							**$524,166**
Subtotal (Before Evaluation)							**$10,062,446**
Evaluation							$522,653
DSM Portfolio Total							**$10,585,099**
Other Costs							
Emerging Markets							$200,000
Market Potential Study							$300,000
Other Costs Subtotal							**$500,000**
DSM Portfolio Total including Other Costs							**$11,085,099**

Note: Participation and savings spike in 2021 due to: high Residential Prescriptive participation estimated by the Market Potential Study, the start of the Home Energy Management Systems program, the inclusion of the Food Bank program, and a final surge in participation in the Residential Lighting program estimated by the Market Potential Study.

TABLE 2-7 2022 PORTFOLIO TARGETS

	Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget
Residential							
Residential Lighting	91,708	3,259,915	255.83	$104,258	$144,380	$346,846	$595,484
Residential Prescriptive	8,303	2,722,283	737.22	$41,703	$358,820	$680,160	$1,080,683
Residential New Construction	75	164,892	106.37	$5,213	$53,186	$14,675	$73,074
Home Energy Assessment	420	727,151	77.67	$5,213	$263,225	-	$268,438
Income Qualified Weatherization	594	869,076	492.09	$20,852	$1,312,171	-	$1,333,023
Energy Efficient Schools	2,600	670,800	93.60	$20,852	$92,229	-	$113,080
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$20,852	$334,248	-	$355,099
Appliance Recycling	1,425	1,360,636	184.89	$41,703	$171,385	$70,500	$283,589
CVR Residential	-	-	-	$31,277	$190,034	-	$221,311
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$20,852	$556,000	$136,000	$712,852
BYOT (Bring Your Own Thermostat)	300	-	240.00	$20,852	$38,280	$68,280	$127,412
Food Bank	6,312	816,353	69.09	$20,852	$18,800	-	$39,651
Home Energy Management Systems	1,000	515,000	80.00	$10,426	$219,900	-	$230,326
Residential Subtotal	**162,737**	**18,353,314**	**4,926.04**	**$364,902**	**$3,752,658**	**$1,316,461**	**$5,434,021**
Commercial & Industrial (C&I)							
Commercial Prescriptive	52,971	17,154,963	4,383.05	$57,342	$733,558	$1,448,274	$2,239,173
Commercial Custom	196	6,107,234	740.00	$62,555	$355,263	$491,537	$909,355
Small Business	382	2,949,771	213.00	$5,213	$222,721	$530,824	$758,758
CVR Commercial	-	-	-	$31,277	$128,261	-	$159,538
Commercial & Industrial Subtotal	**53,549**	**26,211,968**	**5,336.05**	**$156,387**	**$1,439,803**	**$2,470,635**	**$4,066,825**
Indirect Costs							
Contact Center							$65,032
Online Audit							$44,295
Outreach							$423,225
Portfolio Costs Subtotal							**$532,552**
Subtotal (Before Evaluation)							**$10,033,398**
Evaluation							$518,856
DSM Portfolio Total							**$10,552,254**
Other Costs							
Emerging Markets							$200,000
Market Potential Study							-
Other Costs Subtotal							**$200,000**
DSM Portfolio Total including Other Costs							**$10,752,254**

Note: Savings and participation are down in 2022 as the team assumed that the EISA backstop provision would remove downstream standard screw-in lighting incentives from all programs except for direct installations.

TABLE 2-8 2023 PORTFOLIO TARGETS

	Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget
Residential							
Residential Lighting	12,231	807,282	19.16	$105,926	$32,756	$78,689	$217,370
Residential Prescriptive	8,140	2,793,920	812.09	$42,370	$364,561	$707,135	$1,114,066
Residential New Construction	73	160,852	103.94	$5,296	$50,202	$14,325	$69,824
Home Energy Assessment	504	872,581	93.20	$5,296	$267,437	-	$272,733
Income-Qualified Weatherization	623	917,290	518.75	$21,185	$1,331,114	-	$1,352,299
Energy-Efficient Schools	2,600	670,800	93.60	$21,185	$98,274	-	$119,460
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$21,185	$339,596	-	$360,781
Appliance Recycling	1,435	1,366,149	188.46	$42,370	$174,745	$70,750	$287,865
CVR Residential	-	1,461,047	430	$31,778	$270,252	-	$302,029
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$21,185	$576,000	$156,000	$753,185
BYOT (Bring Your Own Thermostat)	300	-	240.00	$21,185	$46,280	$76,280	$143,745
Food Bank	3,156	649,158	46.71	$21,185	$9,550	-	$30,735
Home Energy Management Systems	1,000	515,000	80.00	$10,593	$234,900	-	$245,493
Residential Subtotal	**80,062**	**17,461,286**	**5,215.19**	**$370,741**	**$3,795,666**	**$1,103,179**	**$5,269,586**
Commercial & Industrial (C&I)							
Commercial Prescriptive	55,283	17,821,076	4,524.43	$58,259	$769,435	$1,434,660	$2,262,354
Commercial Custom	196	6,107,234	740.00	$63,556	$360,948	$491,537	$916,040
Small Business	382	2,952,715	213.00	$5,296	$226,003	$521,287	$752,586
CVR Commercial		1,032,656	214	$31,778	$184,861	-	$216,639
Commercial & Industrial Subtotal	**55,861**	**27,913,681**	**5,691.43**	**$158,889**	**$1,541,248**	**$2,447,483**	**$4,147,620**
Indirect Costs							
Contact Center							$66,073
Online Audit							$45,004
Outreach							$429,997
Portfolio Costs Subtotal							**$541,073**
Subtotal (Before Evaluation)							**$9,958,279**
Evaluation							$512,192
DSM Portfolio Total							**$10,470,471**
Other Costs							
Emerging Markets							$200,000
Market Potential Study							-
Other Costs Subtotal							**$200,000**
DSM Portfolio Total including Other Costs							**$10,670,471**

Note: The team assumed that the EISA backstop provision would remove downstream specialty screw-in lighting incentives from all programs except for direct installations.

TABLE 2-9 2024 PORTFOLIO TARGETS

	Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget
Residential							
Residential Lighting	14,089	977,297	19.66	$107,621	$38,416	$92,287	$238,324
Residential Prescriptive	7,892	2,860,501	889.35	$43,048	$370,394	$732,410	$1,145,582
Residential New Construction	71	156,812	101.51	$5,381	$48,144	$13,975	$67,500
Home Energy Assessment	504	840,768	89.03	$5,381	$271,716	-	$277,097
Income-Qualified Weatherization	653	967,302	546.35	$21,524	$1,350,360	-	$1,371,884
Energy-Efficient Schools	2,600	670,800	93.60	$21,524	$106,392	-	$127,916
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$21,524	$345,029	-	$366,554
Appliance Recycling	1,372	1,300,910	183.54	$43,048	$168,946	$67,325	$279,320
CVR Residential	-	-	-	$32,286	$315,241	-	$347,528
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$21,524	$596,000	$176,000	$793,524
BYOT (Bring Your Own Thermostat)	300	-	240.00	$21,524	$54,280	$84,280	$160,084
Food Bank	3,156	649,158	46.71	$21,524	$9,703	-	$31,227
Home Energy Management Systems	1,000	515,000	80.00	$10,762	$245,940	-	$256,702
Residential Subtotal	**81,637**	**16,185,755**	**4,879.02**	**$376,673**	**$3,920,561**	**$1,166,277**	**$5,463,511**
Commercial & Industrial (C&I)							
Commercial Prescriptive	55,739	18,058,503	4,572.95	$59,191	$791,792	$1,394,674	$2,245,657
Commercial Custom	196	6,107,234	740.00	$64,572	$366,723	$491,537	$922,832
Small Business	383	2,957,870	213.00	$5,381	$229,663	$512,537	$747,582
CVR Commercial	-	-	-	$32,286	$216,561	-	$248,848
Commercial & Industrial Subtotal	**56,318**	**27,123,608**	**5,525.95**	**$161,431**	**$1,604,739**	**$2,398,748**	**$4,164,919**
Indirect Costs							
Contact Center							$67,130
Online Audit							$45,724
Outreach							$436,877
Portfolio Costs Subtotal							**$549,730**
Subtotal (Before Evaluation)							**$10,178,160**
Evaluation							$520,077
DSM Portfolio Total							**$10,698,237**
Other Costs							
Emerging Markets							$200,000
Market Potential Study							$300,000
Other Costs Subtotal							**$500,000**
DSM Portfolio Total including Other Costs							**$11,198,237**

Note: The team assumed that lighting direct installations would decrease from the previous year due to EISA.

TABLE 2-10 2025 PORTFOLIO TARGETS

	Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget
Residential							
Residential Lighting	15,913	1,146,410	274.12	$109,343	$44,005	$105,714	$259,061
Residential Prescriptive	8,136	2,974,980	961.29	$43,737	$376,320	$767,435	$1,187,492
Residential New Construction	70	154,792	100.29	$5,467	$46,909	$13,800	$66,176
Home Energy Assessment	504	790,845	83.15	$5,467	$276,063	-	$281,530
Income-Qualified Weatherization	685	1,018,544	575.34	$21,869	$1,369,913	-	$1,391,782
Energy-Efficient Schools	2,600	670,800	93.60	$21,869	$117,023	-	$138,891
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$21,869	$350,550	-	$372,418
Appliance Recycling	1,253	1,180,913	171.99	$43,737	$155,651	$61,050	$260,438
CVR Residential	-	-	-	$32,803	$282,073	-	$314,876
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$21,869	$616,000	$196,000	$833,869
BYOT (Bring Your Own Thermostat)	300	-	240.00	$21,869	$62,280	$92,280	$176,429
Food Bank	3,156	649,158	46.71	$21,869	$9,858	-	$31,727
Home Energy Management Systems	1,000	515,000	80.00	$10,934	$266,980	-	$277,914
Residential Subtotal	**83,617**	**16,348,650**	**5,215.76**	**$382,700**	**$3,973,626**	**$1,236,279**	**$5,592,604**
Commercial & Industrial (C&I)							
Commercial Prescriptive	53,882	17,825,085	4,513.77	$60,139	$797,128	$1,331,794	$2,189,060
Commercial Custom	196	6,107,234	740.00	$65,606	$372,590	$491,537	$929,733
Small Business	383	2,963,026	213.00	$5,467	$233,383	$503,787	$742,637
CVR Commercial	-	-	-	$32,803	$193,019	-	$225,821
Commercial & Industrial Subtotal	**54,461**	**26,895,345**	**5,466.77**	**$164,014**	**$1,596,120**	**$2,327,118**	**$4,087,252**
Indirect Costs							
Contact Center							$68,204
Online Audit							$46,456
Outreach							$443,867
Portfolio Costs Subtotal							**$558,526**
Subtotal (Before Evaluation)							**$10,238,382**
Evaluation							$520,203
DSM Portfolio Total							**$10,758,585**
Other Costs							
Emerging Markets							$200,000
Market Potential Study							-
Other Costs Subtotal							**$200,000**
DSM Portfolio Total including Other Costs							**$10,958,585**

Note: The team assumed that lighting direct installations would decrease from the previous year due to EISA.

3 Program Concepts

This section provides an overview of each program, organized by the following topic areas: 1) Background, 2) Relationship to Vectren's Market Potential Study, 3) Methods and Associated Risks, and 4) Technology and Program Data.

3.1 RESIDENTIAL LIGHTING

3.1.1 Background

The Residential Lighting Program remains an upstream program designed to reach Vectren customers through retail outlets. The program is aimed at encouraging Vectren customers to install more energy-efficient bulbs in their homes. The program consists of a buy-down strategy at the point of purchase, so it is seamless to the participant. Any customer of a participating retailer in Vectren South's electric territory is eligible for the program.

Vectren will oversee the program and work with a partner organization on delivery. The implementation contractor will verify the paperwork of the participating retail stores and spot check stores to assure that the program guidelines are being followed.

The measures will include a variety of ENERGY STAR-qualified lighting products currently available at retailers in Indiana including:

- Standard units
- Specialty units
- LED fixtures
- Exterior lighting controls

3.1.2 Relationship to Vectren's Market Potential Study

The team cross-referenced measures from the Market Potential Study with measures included in the Residential Lighting Program. As measures from the Residential Lighting Program also appear in other Vectren residential programs, the team also compared the rate of sales in other programs to the Residential Lighting Program. From this analysis, the team estimated that measures from the Residential Lighting Program have market potential well above Action Plan participation estimates.

3.1.3 Program Considerations

The program, as designed, takes the Energy Independence and Security Act (EISA) policies into account. A backstop efficiency ruling is slated to take effect in 2020 and will shift the baseline efficiency of most screw-in LED bulbs from halogens to CFLs. Though there is speculation about the timeline and likelihood of this regulation taking effect, the team conservatively assumed the EISA backstop for standard LED bulbs would take effect in 2020 and the EISA backstop for specialty bulbs would take effect in 2021. The team also assumed that non-compliant products would still be sold for up to one year after the regulations take effect, as suggested by the Uniform Methods Project.[41] Therefore, the Residential Lighting Program will discontinue standard LED incentives beginning in 2022 and for specialty lighting products in 2023.

3.1.4 Technology and Program Data

The following table provides summary of the Residential Lighting Program energy impacts and budget.

[41] https://www.nrel.gov/docs/fy18osti/70472.pdf

TABLE 3-1 RESIDENTIAL LIGHTING – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	239,866	262,832	91,708	12,231	14,089	15,913
Energy Savings (kWh)	8,088,914	8,704,288	3,259,915	807,282	977,297	1,146,410
Summer Peak Demand Savings (kW)	905	875	256	19	20	274
Total Program Budget	$750,433	$747,018	$595,484	$217,370	$238,324	$259,061
Per Participant Energy Savings (kWh)	34	33	36	66	69	72
Per Participant Demand Savings (kW)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02
Per Participant Average Incentive	$2	$2	$4	$6	$7	$7
Weighted Average Measure Life	15	15	14	9	9	9
Incremental Technology Cost	$4	$4	$6	$26	$26	$26
Net-to-Gross Ratio	84%	79%	76%	84%	84%	84%

Note: Number of participants, energy savings, and demand savings estimates based primarily on Market Potential Study results. Program budget estimate based on current schedule of work and projected rising costs from Vectren Program Cost and Measure Data spreadsheet. Per unit savings estimates based on the Market Potential Study results. Per participant energy savings, per participant demand savings, and incremental technology cost weighted by participant. Weighted average measure life and net to gross ratio weighted by kWh.

3.2 RESIDENTIAL PRESCRIPTIVE

3.2.1 Background

The Residential Prescriptive Program is designed to incent customers to purchase energy efficient equipment by covering part of the incremental cost. The program also offers home weatherization rebates to residential customers for attic and wall insulation. If a product vendor or contractor chooses to do so, they can present rebates as an “instant discount” to Vectren’s residential customers on their invoice. Vectren will oversee the program and work with an implementation partner on delivery.

Any residential customer located in the Vectren South electric service territory is eligible to participate in the program. For the equipment rebates, the applicant must reside in a single-family home or multi-family complex with up to 12 units. Only single-family homes are eligible for insulation measures.

Measures included in the program will change over time as baselines change, new technologies become available, and customer needs are identified. Measures include:

- ASHP Tune Ups
- Air Purifiers
- Air Source Heat Pumps
- Attic Insulation
- Central Air Conditioners
- Duct Sealing
- Ductless Heat Pumps
- Duel Fuel Air Source Heat Pumps
- ENERGY STAR Electric Clothes Washers (new in 2020)
- ENEGY STAR Dehumidifiers, Electric Clothes Dryers and Room Air Conditioners (new in 2020)
- Heat Pump Water Heaters

- Nest On-Line Store Thermostats
- Wi-Fi Thermostats
- Smart/CEE Tier3 Clothes Washers (new in 2020)
- Smart Programmable Thermostats
- Variable Speed Pool Pumps
- Wall Insulation
- Air Conditioning Tune Ups

3.2.2 Relation to Vectren's Market Potential Study

The team cross-referenced measures from the Market Potential Study with measures included in the existing Residential Prescriptive Program. As measures from the Residential Prescriptive Program also appear in other Vectren residential programs, the team also compared the rate of sales in other programs to the Residential Prescriptive Program. From this analysis, the team found that several Residential Prescriptive Program measures had already reached the full RAP estimated in the Market Potential Study (such as attic insulation), and the team capped future participation at the rates estimated by the potential study.

3.2.3 Program Considerations

A major change to the electric Residential Prescriptive program is the removal of the ECM HVAC motor and pool heaters measure due to changes in standards, low NTG, and low benefit-cost testing.

There are many measures are new to the program, including: dehumidifiers, clothes washers, clothes dryers, room air conditioners, water heaters, and tankless water heaters. The team provided escalating estimates for participation for these measures over the duration of the Action Plan.

3.2.4 Technology and Program Data

The following table provides summary of the Residential Prescriptive Program energy impacts and budget.

TABLE 3-2 RESIDENTIAL PRESCRIPTIVE – IMPACTS AND BUDGET (ELECTRIC)

	2020	2021	2022	2023	2024	2025
Number of Participants	7,966	8,276	8,303	8,140	7,892	8,136
Energy Savings kWh	2,465,148	2,618,629	2,722,283	2,793,920	2,860,501	2,974,980
Peak Demand kW	691	662	737	812	889	961
Total Program Budget	$1,020,073	$1,039,726	$1,080,683	$1,114,066	$1,145,852	$1,187,492
Per Participant Energy Savings (kWh)	309	316	328	343	362	366
Per Participant Demand Savings (kW)	0.09	0.08	0.09	0.10	0.11	0.12
Per Participant Average Incentive	$79	$78	$82	$87	$93	$94
Weighted Average Measure Life	13	13	14	14	14	14
Incremental Technology Cost	$148	$146	$160	$174	$191	$199
Net-to-Gross Ratio	50%	51%	51%	52%	53%	53%

Note: Number of participants, energy savings, and demand savings estimates based primarily on Market Potential Study results. Program budget estimate based on current schedule of work and projected rising costs from Vectren Program Cost and Measure Data spreadsheet. Per unit savings estimates based on the Market Potential Study results. Per participant energy savings, per participant demand savings, and incremental technology cost weighted by participant. Weighted average measure life and net to gross ratio weighted by kWh.

3.3 RESIDENTIAL NEW CONSTRUCTION

3.3.1 Background

The Residential New Construction (RNC) program will produce long-term electric and gas savings by encouraging the construction of single-family homes, duplexes, or end-unit townhomes with only one shared wall that are inspected and evaluated through the Home Efficiency Rating System (HERS). Two incentive levels have been defined by the HERS Index score the house achieves. As of 2018, Gold Star homes must achieve a HERS rating of 61 to 63. Platinum Star homes must meet a HERS rating of 60 or less.

Any customer or home builder constructing a home and meeting the program specifications in the Vectren South electric service territory is eligible to participate in the program. Program incentives are designed to be paid to both all-electric and combination homes that have natural gas heating and water heating. It is important to note that the program is structured such that an incentive will not be paid for an all-electric home that has natural gas available to the home site. Incentives can be paid to either the home builder or the customer/account holder. Incentives are based on the rating tier qualification. As part of the Quality Assurance/Quality Control process, the HERS Assessment is completed by a certified third party HERS Rater. As part of the Quality Assurance/Quality Control process, the vendor provided 100% paper verification that the equipment/products purchased meet the program efficiency standards.

3.3.2 Relation to Vectren's Market Potential Study

The Market Potential Study indicated that the market for the Residential New Construction Program is shrinking in Vectren South and is expanding in Vectren North. The team used previous program participation to calibrate rates from the Market Potential Study.

3.3.3 Program Considerations

The housing market is sensitive to market conditions and unforeseen economic circumstances may impact this program in the future.

3.3.4 Technology and Program Data

The following table provides summary of the Residential New Construction Program energy impacts and budget.

TABLE 3-3 RESIDENTIAL NEW CONSTRUCTION – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Homes	86	77	75	73	71	70
Energy Savings kWh	188,624	168,932	164,892	160,852	156,812	154,792
Peak Demand kW	121	109	106	104	102	100
Total Program Budget	$71,825	$77,405	$73,074	$69,824	$67,500	$66,176
Per Participant Energy Savings (kWh)	2,193	2,194	2,199	2,203	2,209	2,211
Per Participant Demand Savings (kW)	1.41	1.41	1.42	1.42	1.43	1.43
Per Participant Average Incentive	$195	$195	$196	$196	$197	$197
Weighted Average Measure Life	25	25	25	25	25	25
Incremental Technology Cost	$2,352	$2,353	$2,361	$2,370	$2,379	$2,384
Net-to-Gross Ratio	50%	50%	50%	50%	50%	50%

Note: Participant and energy savings estimates based primarily on Market Potential Study results. Program budget estimate based on current schedule of work and projected rising costs from Vectren Program Cost and Measure Data spreadsheet. Per

	2020	2021	2022	2023	2024	2025
unit savings estimates based on the Market Potential Study results. Per participant energy savings, per participant demand savings, and incremental technology cost weighted by participant. Weighted average measure life and net to gross ratio weighted by kWh.						

3.4 HOME ENERGY ASSESSMENT

3.4.1 Background

The Home Energy Assessment (HEA) Program is offered jointly by Vectren South Gas and Electric. This program provides customers with an on-site energy assessment, providing direct installation of energy-efficient measures including high efficiency water fixtures, LED bulbs and smart thermostats. Assessors will perform a walk-through assessment of the home, collecting data for use in identifying cost-effective energy-efficient improvements and appropriate direct install measures. Assessors will then provide an audit report to the customer while assessors are onsite to outline other retrofit opportunities within the home.

Vectren South residential customers with electric service at a single-family residence, provided the home was not built within the past five years and has not had an audit within the last three years, are eligible to participate in the program. Additionally, the home should either be owner-occupied or, if renter-occupied, where occupants have the electric service in their name.

The direct install measures available for installation at no cost include:

- Audit & Education
- Kitchen & Bathroom Aerators
- Filter Whistle
- LED bulbs
- High efficiency Showerhead
- Pipe Wrap
- Water Heater Temperature Setback
- Smart Thermostat

3.4.2 Relation to Vectren's Market Potential Study

The team cross-referenced measures from the Market Potential Study with measures included in the Home Energy Assessment Program. As measures from the Home Energy Assessment program also appear in other Vectren residential programs, the team also compared the rate of sales in other programs to the Home Energy Assessment Program. From this analysis, the team estimated that measures from the Home Energy Assessment Program have market potential well above Action Plan participation estimates.

3.4.3 Program Considerations

The impact of the EISA backstop was considered in the inclusion of LED bulbs in the Home Energy Assessment program and affects the program beginning in 2024. Because of the direct install nature of the program, it was assumed that inefficient lighting will continue to be present in customer homes throughout the timeframe of the Action Plan. Thus, inefficient lighting found in customer homes would be eligible for replacement, though fewer inefficient bulbs would be found in customer homes after 2023.

3.4.4 Technology and Program Data

The following table provides summary of the Home Energy Assessment Program energy impacts and budget.

TABLE 3-4 HOME ENERGY ASSESSMENT – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	300	350	420	504	504	504
Energy Savings kWh	519,393	605,959	727,151	872,581	840,768	790,845
Peak Demand kW	55	65	78	93	89	83
Total Program Budget	$245,050	$263,131	$268,438	$272,733	$277,097	$281,530
Per Participant Energy Savings (kWh)	1,731	1,731	1,731	1,731	1,668	1,569
Per Participant Demand Savings (kW)	0.18	0.18	0.18	0.18	0.18	0.16
Weighted Average Measure Life	13	13	13	13	13	13
Net-to-Gross Ratio	101%	101%	101%	101%	101%	101%

Note: Number of participants estimated based on interview with the current program implementer, JE Shekell. Per unit savings estimated based on 2018 Operating Plan. Program costs estimated based on current SOW and projected rising costs described by JE Shekell. Kwh and kw savings estimated by dividing total savings by total participants. Incremental technology cost estimated by summing the incremental cost of each piece of equipment and divided by number of participants. Weighted average measure life and net to gross ratio weighted by kWh.

3.5 INCOME-QUALIFIED WEATHERIZATION

3.5.1 Background

The Income-Qualified Weatherization Program (IQW) is designed to provide direct install measures and weatherization upgrades to low-income homes that otherwise would not have been able to afford the energy saving measures. The program provides direct installation of energy-saving measures and educates consumers on ways to reduce energy consumption. Eligible customers will have opportunity to receive deeper retrofit measures including refrigerators, attic insulation, duct sealing, and air infiltration reduction. Vectren will oversee the program and partner with an implementation contractor to deliver the program. A list of high consumption customers who have received Energy Assistance Program (EAP) funds within the past 12 months will be used to help prioritize those customers. In addition to utilizing the EAP List, implementers will utilize census data to target low-income areas within Vectren territory.In future years, the IQW program will shift focus to providing a more quality and in-depth approach. The focus will be to provide deeper retrofit measures where needed to fewer participants, thus reaping greater savings and benefits to the customer.

Collaboration and coordination between gas and electric low-income programs along with state and federal funding is recommended to provide the greatest efficiencies among all programs. The challenge of meeting the goals set for this program have centered on health and safety as well as customer cancellations and scheduling. Vectren is committed to finding innovative solutions to these areas. A health and safety (H&S) budget has been established and we continue to work on improving methods of customer engagement with various confirmations via phone and email reminders prior to the appointment. Vectren will look for ways to do more of a qualitative approach within this program to ensure the maximum savings is reached and H&S issues are addressed appropriately.

Measures available for installation will vary based on the home and include:

- LED bulbs/lamps (interior/exterior)
- High Efficiency Showerheads (Standard or Handheld)
- High efficiency faucet aerators
- Filter whistles
- Infiltration reduction
- Attic insulation

- Duct repair, seal and insulation
- Refrigerator replacement
- Smart thermostats
- Water Heater Temperature Setback

3.5.2 Relation to Vectren's Market Potential Study

The team cross-referenced measures from the Market Potential Study with measures included in IQW. As measures from IQW also appear in other Vectren residential programs, the team also compared the rate of sales in other programs to IQW. From this analysis, the team estimated that measures from IQW have market potential well above Action Plan participation estimates.

3.5.3 Program Considerations

Measures for the Income-Qualified Weatherization Program do not need to be cost-effective at the program level and therefore the Market Potential Study did not screen measures based on a cost-effectiveness test. The team chose measures that they felt would provide the most value to customers. The team chose a "quality over quantity" approach and provided more services to each individual customer than in previous program years. To ensure that the program did not overwhelm other energy efficiency program priorities, the team ensured that the overall program budget did not vastly exceed previous program budgets. The team dropped smart power strips from the program as they had a very low cost-effectiveness score and seemed to provide less value than other measures.

The impact of the EISA backstop was considered in the inclusion of income-qualified LED bulbs in the program beginning in 2024. It was assumed that inefficient lighting will continue to be present in customer homes throughout the timeframe of the Action Plan. Thus, inefficient lighting found in customer homes would be eligible for replacement, though fewer inefficient bulbs would be found in customer homes after 2023.

3.5.4 Technology and Program Data

The following table provides summary of IQW energy impacts and budget.

TABLE 3-5 INCOME-QUALIFIED WEATHERIZATION – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	539	566	594	623	653	685
Energy Savings kWh	778,285	823,215	869,076	917,290	967,302	1,018,544
Peak Demand kW	443	467	492	519	546	575
Total Program Budget	$1,295,376	$1,314,050	$1,333,023	$1,352,299	$1,371,884	$1,391,782
Per Participant Energy Savings (kWh)	1,444	1,454	1,463	1,472	1,481	1,487
Per Participant Demand Savings (kW)	0.82	0.83	0.83	0.83	0.84	0.84
Weighted Average Measure Life	16	16	16	16	16	16
Incremental Technology Cost	$809	$822	$833	$850	$867	$880
Net-to-Gross Ratio	100%	100%	100%	100%	100%	100%

Note: Energy savings, and demand savings estimates primarily based on the Market Potential Study results and 2018 Operating Plan estimates and projected rising costs from 2018-20 filed Energy Efficiency Plan and Vectren Program Cost and Measure Data spreadsheet. Number of participants based on historical program participation. Per participant energy and demand savings calculated by dividing total savings by participation. Weighted average measure life and net to gross weighted by kWh. Incremental cost calculated by summing the incremental cost of each piece of equipment and divided by number of participants.

3.6 ENERGY-EFFICIENT SCHOOLS

3.6.1 Background

The Energy-Efficient Schools Program is designed to produce cost-effective electric and gas savings by educating students and their families about conservation and the efficient use of electricity. The program consists of a school education program for fifth grade students attending schools served by Vectren South. To help in this effort, each child that participates will receive a take-home energy kit with various energy-saving measures for their parents to install in the home. The kits, along with the in-school teaching materials, are designed to make a lasting impression on the students and help them learn ways to conserve energy. Selected fifth grade students/schools in the Vectren South electric service territory are eligible for the program.

The kits for students will include:

- High efficiency showerheads
- High efficiency kitchen aerators
- High efficiency bathroom aerators
- LED bulbs
- LED nightlights
- Filter whistles

3.6.2 Relation to Vectren's Market Potential Study

Though the Market Potential Study estimated savings, only customers with enrolled fifth grade students will participate in the program. As such, the Market Potential Study did not serve as a useful estimate for future Energy-Efficient Schools Program participation. The team relied on previous participation and discussions with the implementer to arrive at useful estimates.

3.6.3 Program Considerations

The team assumed that previous participation is a good indicator of future participation and, in consultation with the implementer, assumed that the program had a little room to grow from the 2018-2020 filed Energy Efficiency plan. The Energy-Efficient Schools Program will discontinue standard LED incentives beginning in 2022 to account for the EISA backstop.

3.6.4 Technology and Program Data

The following table provides summary of the Energy-Efficient Schools Program energy impacts and budget.

TABLE 3-6 ENERGY-EFFICIENT SCHOOLS – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	2,600	2,600	2,600	2,600	2,600	2,600
Energy Savings kWh	1,149,200	1,149,200	670,800	670,800	670,800	670,800
Peak Demand kW	137	137	94	94	94	94
Total Program Budget	$133,789	$137,776	$113,080	$119,460	$127,916	$138,891
Per Participant Demand Savings (kWh)	442	442	258	258	258	258
Per Participant Demand Savings (kW)	0.05	0.05	0.04	0.04	0.04	0.04
Weighted Average Measure Life	12	12	10	10	10	10

	2020	2021	2022	2023	2024	2025
Net-to-Gross Ratio	100%	100%	100%	100%	100%	100%

Note: Number of participants, energy savings, and demand savings estimates primarily based on the 2018-20 filed Energy Efficiency Plan. and the 2018 Operating Plan. Program costs primarily based on current SOW and projected rising costs from 2018-20 filed Energy Efficiency Plan and Vectren Program Cost and Measure Data spreadsheet. Per participant energy savings and demand savings calculated by dividing total savings by total participation. Weighted measure life and net to gross ratio are weighted by kWh.

3.7 RESIDENTIAL BEHAVIOR SAVINGS

3.7.1 Background

The Residential Behavioral Savings Program (RBS) motivates behavior change and provides relevant, targeted information to the consumer through regularly scheduled, direct contact via mailed and emailed home energy reports. The measures for this program consist of a Home Energy Report and web portal, which anonymously compares customers' energy use with that of other customers with similar-sized home and demographics, usage history comparisons, goal setting tools, and progress trackers. Customers can view the past twelve months of their energy usage and compare and contrast their energy consumption and costs with others in the same neighborhood. The logic for the program is that once a consumer understands better how they use energy, they can then start conserving energy. Residential customers who receive electric service from Vectren South are eligible for this integrated natural gas and electric EE program.

The program will be delivered by an implementation vendor and include energy reports and a web portal. Customers typically receive between 4-6 reports annually. Additionally, customers receive monthly emails. These reports provide updates on energy consumption patterns compared to similar homes and provide energy savings strategies to reduce energy use. These reports can also promote other Vectren programs to interested customers. The web portal is an interactive system for customers to perform a self-audit, monitor energy usage over time, access energy saving tips, and be connected to other Vectren South gas and electric programs. A third-party evaluator will complete the evaluation of this program.

In 2021, Vectren plans on introducing a new targeted income cohort of participants into the program. Vectren will work with the implementation contractor and the third-party evaluator to determine a participant and non-participant group for this new cohort.

3.7.2 Relation to Vectren's Market Potential Study

The team assumed that restrictions stipulated within the current RBS implementation contract would continue through the timeframe of the Action Plan. As specified by the contract, Vectren can increase the number of treatment customers to the original contracted amount (49,000). The team ensured that this 49,000-participant estimate was below the estimate provided by the Market Potential Study.

3.7.3 Program Considerations

The team assumed that past program performance is a reasonable indicator of future performance. As the third-party evaluator estimates savings for RBS using a billing analysis, the savings resulting from the program may shift from year to year, depending on the behavior of the program participants in any given year. The program also faces the risk of customers losing interest in the program and no longer attempting to curb their energy usage.

3.7.4 Technology and Program Data

The following table provides summary of RBS energy impacts and budget.

TABLE 3-7 RESIDENTIAL BEHAVIOR SAVINGS – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	49,000	49,000	49,000	49,000	49,000	49,000
Energy Savings kWh	7,049,208	7,049,208	7,049,208	7,049,208	7,049,208	7,049,208
Peak Demand kW	1,574	1,574	1,574	1,574	1,574	1,574
Total Program Budget	$364,203	$349,507	$355,099	$360,781	$366,554	$372,418
Per Participant Energy Savings (kWh)	144	144	144	144	144	144
Per Participant Demand Savings (kW)	0.03	0.03	0.03	0.03	0.03	0.03
Weighted Average Measure Life	1	1	1	1	1	1
Net-to-Gross Ratio	100%	100%	100%	100%	100%	100%

Note: Number of participants, energy savings, and demand savings estimates primarily based on the 2018-20 filed Energy Efficiency Plan. and the 2018 Operating Plan. Program costs primarily based on current SOW and projected rising costs from 2018-20 filed Energy Efficiency Plan and Vectren Program Cost and Measure Data spreadsheet. Per participant energy savings and demand savings calculated by dividing total savings by total participation. Weighted measure life and net to gross ratio are weighted by kWh.

3.8 APPLIANCE RECYCLING

3.8.1 Background

The Residential Appliance Recycling Program encourages customers to recycle their old inefficient refrigerators, freezers, and air conditioners in an environmentally safe manner. The program recycles these appliances so that they no longer use electricity and it keeps 95% of the appliance out of landfills.

Any residential customer with an operable secondary refrigerator, freezer, or air conditioner unit receiving electric service from Vectren South is eligible to participate in the program.

Vectren works directly with an implementer to administer this program. Recycled units are logged and tracked to assure proper handling and disposal. The utility monitors the activity for disposal. Customer satisfaction surveys are also used to understand the customer experience with the program.

Measures include:

- Refrigerator recycling
- Freezer recycling
- Room air conditioner recycling (new in 2020)

3.8.2 Relation to Vectren's Market Potential Study

The team cross-referenced measures from the Market Potential Study with measures included in the Appliance Recycling Program. From this analysis, the team estimated that measures from the Appliance Recycling Program have market potential well above Action Plan participation estimates.

3.8.3 Program Considerations

After reviewing the results of the Market Potential Study and conducting an interview with the current program implementer, the team decided to add room air conditioner recycling to the program. Based on the Market Potential Study, the team also projected growth in the Appliance Recycling Program in the region over the span of the Action Plan.

3.8.4 Technology and Program Data

The following table provides summary of the Appliance Recycling Program energy impacts and budget.

TABLE 3-8 APPLIANCE RECYCLING – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	1,251	1,344	1,425	1,435	1,372	1,253
Energy Savings kWh	1,179,811	1,285,473	1,360,636	1,366,149	1,300,910	1,180,913
Peak Demand kW	171	173	185	188	184	172
Total Program Budget	$245,057	$267,086	$283,589	$287,865	$279,320	$260,438
Per Participant Energy Savings (kWh)	943	956	955	952	948	942
Per Participant Demand Savings (kW)	0.14	0.13	0.13	0.13	0.13	0.14
Per Participant Average Incentive	$49	$50	$49	$49	$49	$49
Weighted Average Measure Life	8	8	8	8	8	8
Net-to-Gross Ratio	71%	71%	71%	71%	71%	71%

Note: Number of participants, energy savings, and demand savings estimated primarily based on the Market Potential Study and 2018 Operating Plan. Program costs estimated using the Market Potential Study, the current SOW, and projected rising costs from 2018-20 filed Energy Efficiency Plan and Program Cost and Participant Data spreadsheet. Per unit savings estimated based on 2018 Operating Plan. weighted average measure life and net to gross ratio weighted by kWh. Per participant incentive and incremental technology cost weighted by participant.

3.9 FOOD BANK

3.9.1 Background

The Food Bank Program provides LED bulbs and high efficiency showerheads to food pantries in Vectren South's electric service territory. This program targets hard-to-reach, low-income customers in the Vectren South electric territory. All food pantry recipients must provide proof of income qualification to receive the food baskets.

Each participating food pantry will place a bundle of four LED bulbs and a single high efficiency showerhead in food packages. The program implementer purchases equipment from a manufacturer and the equipment is shipped in bulk to the partner food bank. Food banks then distribute the equipment to the respective food pantries in its network. Pantries include equipment when assembling food packages and equipment is provided to food recipients. Any customer visiting a food pantry in Vectren South's electric territory is eligible to participate in the program.

Measures include:

- LED bulbs
- High efficiency showerheads (new in 2021)

3.9.2 Relation to Vectren's Market Potential Study

Though the Market Potential Study estimated savings resulting from income-qualified measures, only a small portion of income-qualified customers will become food pantry recipients. As such, the Market Potential Study did not serve as a useful estimate for future Food Bank Program participation.

3.9.3 Program Considerations

Vectren expressed interest in continuing a Food Bank program after the EISA backstop was implemented. The team examined possible new measures and determined that showerheads could provide significant energy savings for food pantry recipients. The team used savings values from other income-qualified programs as a proxy for savings from the Food Bank Program.

3.9.4 Technology and Program Data

The following table provides summary of the Food Bank Program energy impacts and budget.

TABLE 3-9 FOOD BANK – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	-	6,312	6,312	3,156	3,156	3,156
Energy Savings kWh	-	1,564,332	816,353	649,158	649,158	649,158
Peak Demand kW	-	172	69	47	47	47
Total Program Budget	-	$113,041	$39,651	$30,735	$31,227	$31,727
Per Participant Energy Savings (kWh)	-	248	129	206	206	206
Per Participant Demand Savings (kW)	-	0.03	0.01	0.01	0.01	0.01
Weighted Average Measure Life	-	11	11	7	5	5
Net-to-Gross Ratio	-	100%	100%	100%	100%	100%

Note: Number of participants, energy savings, and demand savings estimated based on 2018 Operating Plan. Program costs estimated based on current SOW, projected rising costs from 2018-20 filed Energy Efficiency Plan, and Vectren Program Cost and Measure Data spreadsheet. Per unit energy savings and per unit demand savings calculated by dividing total savings by the total number of participants. Weighted average measure life and net to gross ratio weighted by kWh. Incremental technology cost calculated by summing the incremental cost of each piece of equipment and dividing by the total number of participants.

3.10 HOME ENERGY MANAGEMENT SYSTEMS

3.10.1 Background

The Home Energy Management Systems (HEMS) program is a behavioral program that provides real time energy usage data to encourage customers to take action to reduce energy consumption. The objectives of this program include:

- Motivate customers to save energy by increasing customer awareness and engagement around energy consumption and their utility bill
- Increase customer knowledge of and participation in Company programs including, but not limited to, energy efficiency programs and advanced data analytics
- Deliver energy and demand savings

The HEMS program will be piloted using advanced metering infrastructure (AMI) data to communicate energy usage to customers. The platform will utilize a smart phone application to communicate with customers about their home energy usage and provide suggestions for ways customers can save energy. To enhance customer engagement, participants in the program will receive a smart thermostat at no cost, if they do not currently have one installed in their home. Pending EM&V Report results, the program will potentially be rolled out to additional participants.

Given a successful pilot and positive EM&V Report results of the HEMS program, Vectren plans to scale the program to include additional features. The additional features would allow customers to install a device that provides real-time home energy usage data.

All Vectren South electric customers are eligible to participate in this program.

3.10.2 Relation to Vectren's Market Potential Study

The Market Potential Study provided estimates on various smart home technologies including home energy management systems. The program model is very specific and initially only relies on a phone application, the energy management systems estimate in the Market Potential Study may not accurately reflect the total market size available to the Home Energy Management Systems Program.

The team relied on savings estimates from the implementation contractor. The team compared estimates provided by the implementation contractor to the estimated savings presented in the Market Potential Study and found that the implementation contractor estimates were well within the bounds of the Market Potential Study estimates.

3.10.3 Program Considerations

The team utilized savings estimates provided by a HEMS vendor as well as publicly available evaluation documents of home energy management systems. The vendor indicated that they had evaluation-verified savings estimates, although the evaluation results were not currently public. The team acknowledges that savings estimates provided by the implementing contractor are susceptible to bias and, thus, chose a conservative estimate to provide counterbalance.

3.10.4 Technology and Program Data

The following table provides summary of the Home Energy Management Systems Program energy impacts and budget.

TABLE 3-10 HOME ENERGY MANAGEMENT SYSTEMS – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	-	1,000	1,000	1,000	1,000	1,000
Energy Savings kWh	-	515,000	515,000	515,000	515,000	515,000
Peak Demand kW	-	80	80	80	80	80
Total Program Budget	$80,100	$223,162	$230,326	$245,493	$256,702	$277,914
Per Participant Energy Savings (kWh)	-	515	515	515	515	515
Per Participant Demand Savings (kW)	-	0.08	0.08	0.08	0.08	0.08
Weighted Average Measure Life	-	6	6	6	6	6
Net-to-Gross Ratio	-	100%	100%	100%	100%	100%

Note: Number of participants, energy savings, demand savings, and program costs estimated based on interviews with the implementer. The team assumed the same weighted average measure life as the current behavioral program. The net to gross ratio is weighted by kWh.

The following table provides summary of the cumulative participants in the Home Energy Management Systems Program over the course of the Action Plan.

TABLE 3-10 HOME ENERGY MANAGEMENT SYSTEMS – PARTICIPANTS AND CUMULATIVE PARTICIPANTS

	2020	2021	2022	2023	2024	2025
Number of Participants	-	1,000	1,000	1,000	1,000	1,000
Cumulative Number of Participants	-	1,000	2,000	3,000	4,000	5,000

3.11 BRING YOUR OWN THERMOSTAT

3.11.1 Background

The Bring Your Own Thermostat Program (BYOT) is a further expansion of the Residential Smart/Wi-Fi thermostat initiative approved in 2016. BYOT allows customers who have or will purchase their own thermostat from multiple potential vendors to participate in demand response (DR) and other load curtailing programs managed through the utility. The program allows the utility to avoid the costs of hardware, installation, and maintenance associated with traditional load control methods.

By taking advantage of two-way communicating smart Wi-Fi thermostats, BYOT programs can help utilities reduce acquisition costs for load curtailment programs and improve customer satisfaction. Through the use of smart/Wi-Fi enabled thermostats, the utility can remotely verify how many customers are connected to the network at any given time and determine which thermostats are participating in DR events.

Any residential customer who receives electric service from Vectren South at a single-family residence is eligible to participate in the program. Customers will receive a one-time enrollment incentive of $75 and a bill credit of $5 during the months of June through September. The enrollment incentive, the amount which was determined based on research of other utility BYOT programs, will be provided in the first year to new enrollees only.

3.11.2 Relation to Vectren's Market Potential Study

The Market Potential Study indicated that there is substantial room in the market for this program.

3.12 SMART CYCLE

3.12.1 Background

Since 1992, Vectren South has operated a Direct Load Control (DLC) program called Summer Cycler that reduces residential and small commercial air-conditioning and water heating electricity loads during summer peak hours.

The Smart Cycle program will replace traditional DLC switches with smart thermostats over time, as the benefits associated with smart thermostats far outweigh the benefits associated with DLC switches. Smart thermostats provide an alternative to traditional residential load control switches as well as enhance the way customers manage and understand their home energy use. By installing connected devices in customer homes rather than using one-way signal switches, Vectren will be able to provide its customer base with deeper energy savings opportunities and shift future energy focus to customer engagement rather than traditional program goals and rules. The most recent Vectren electric DSM evaluation has demonstrated that smart thermostats outperform standard programmable thermostats and are a practical option to transition into future customer engagement strategies.

Customers in the Vectren South territory who currently participate in the DLC Summer Cycler Program and have access to Wi-Fi are eligible for the program. Customers receive a professionally-installed Wi-Fi thermostat at no additional cost and a monthly bill credit of $5 during the months of June through September. The current monthly credit for Summer Cycler is also $5; therefore, the annual bill credit by customer does not change.

3.12.2 Relation to Vectren's Market Potential Study

The Market Potential Study indicates that there is market potential well above Action Plan participation estimates in this program.

3.13 COMMERCIAL AND INDUSTRIAL PRESCRIPTIVE

3.13.1 Background

The Commercial & Industrial (C&I) Prescriptive Program is designed to provide financial incentives on qualifying products to produce greater energy savings in the C&I market. The rebates are designed to promote lower electric energy consumption, assist customers in managing their energy costs, and build a sustainable market around energy efficiency (EE). Program participation is achieved by offering incentives structured to cover a portion of the customer's incremental cost of installing prescriptive efficiency measures. Any participating commercial or industrial customer receiving electric service from Vectren South is eligible to participate in the program.

Top performing measures include:

- High-efficiency lighting and lighting controls
- HVAC equipment such as air conditioners, air-source heat pumps, chillers, boilers, and furnaces

New measures will include:

- Smart thermostats
- Refrigerator strip curtains
- High-efficiency hand dryers
- Efficient low-temperature compressors for refrigerators
- Refrigeration tune-ups
- Duct sealing

The full list of measures can be found in the measure library in Appendix K.

The program is delivered primarily through trade allies. Vectren South and its implementation partners work with the trade allies to make them aware of the offerings and help them promote the program to their customers. The implementation partner will provide training and technical support to the trade allies to become familiar with the EE technologies offered through the program. The program will be managed by the same implementation provider as the C&I Custom Program so that customers can seamlessly receive assistance and all incentives can be efficiently processed through a single procedure.

Incentives are provided to customers to reduce the difference in first cost between the lower-efficiency technology and the high-efficiency option. There is no fixed incentive percentage amount based on the difference in price because some technologies are newer and need higher amounts. Others have been available in the marketplace longer and do not need as much incentive to motivate customers. To verify the correct equipment was installed, site visits will be made on 5% of the installations, as well as all projects receiving incentive greater than $20,000.

3.13.2 Relation to Vectren's Market Potential Study

The team cross-referenced measures from the Market Potential Study with measures included in the C&I Prescriptive Program. As measures from the C&I Prescriptive Program also appear in the Small Business Program, the team also compared the rate of sales in this program to the C&I Prescriptive Program. From this analysis, the team estimated that most measures from the C&I Prescriptive Program have market potential well above Action Plan participation estimates. For a select few measures (high-bay and low-bay LED lighting, refrigerated LEDs, commercial dishwashers, and 90% TE boilers sized at or above 1,000 MBH), the Market Potential Study provided a lower estimate of future participants than previously experienced by the program. The team capped participation at the total number of participants estimated in the potential study for these measures.

3.13.3 Program Considerations

Advances in technology pose a risk to estimates for the C&I Prescriptive Program, although the size, scope, and directionality of that impact are difficult to define. The team developed estimates to address the largest risks to program savings: overall participation and NTG. The team modeled previous NTG estimates and tried to fit Action Plan NTGs to the trend of these historical NTG estimates.

Due to low cost-effectiveness scores in the Market Potential Study, the team dropped plug load sensors, smart power strips, window film, 90% AFUE boilers sized at less than 400 MBH, gas convection ovens, gas griddles, fluorescent lighting, and steam boilers.

3.13.4 Technology and Program Data

The following table provides summary of the C&I Prescriptive Program energy impacts and budget.

TABLE 3-11 COMMERCIAL AND INDUSTRIAL PRESCRIPTIVE – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	42,431	48,449	52,971	55,283	55,739	53,882
Energy Savings kWh	14,490,335	15,981,655	17,154,963	17,821,076	18,058,503	17,825,085
Peak Demand kW	3,808	4,131	4,383	4,524	4,573	4,514
Total Program Budget	$2,047,886	$2,163,627	$2,239,173	$2,262,354	$2,245,657	$2,189,060
Per Participant Energy Savings (kWh)	342	330	324	322	324	330
Per Participant Demand Savings (kW)	0.09	0.08	0.08	0.08	0.08	0.08
Per Participant Average Incentive	$32	$29	$27	$26	$25	$25
Weighted Average Measure Life	15	15	15	15	14	14
Incremental Technology Cost	$91	$85	$79	$74	$70	$66
Net-to-Gross Ratio	80%	80%	80%	80%	80%	80%

Note: Number of participants, energy savings, and demand savings estimates based primarily on Market Potential Study results and on estimates from Market Potential Study and 2017 EM&V report. Program budget estimate based on current schedule of work and projected rising costs from Vectren Program Cost and Measure Data spreadsheet. Per unit savings estimates based on the Market Potential Study results. Per participant energy savings, per participant demand savings, and incremental technology cost weighted by participant. Linear LED lighting incentives and incremental costs are discounted by 33% from 2020 to 2025 based on findings from the DOE's Energy Savings Forecast of Solid-State Lighting in General Illumination Applications 2016 report. Weighted average measure life and net to gross ratio weighted by kWh.

3.14 COMMERCIAL AND INDUSTRIAL CUSTOM

3.14.1 Background

The C&I Custom Program promotes the implementation of customized energy-saving projects at qualifying customer facilities. Incentives promoted through this program serve to reduce the cost of implementing energy-reducing projects and upgrading to high-efficiency equipment. Due to the nature of Vectren's custom program, a wide variety of projects are eligible, including conventional custom retrofit projects, new construction (Commercial New Construction) projects, and major renovation (Building Tune-Up) projects. Beginning in 2020, Vectren will pilot a Strategic Energy Management component, an Advanced Lighting Controls component, and a Midstream HVAC component. As the design of the pilots will depend on Vectren-specific market research into C&I customers, the team did not establish the precise program design of the pilots nor the precise incentive structure.

Any participating commercial or industrial customer receiving electric service from Vectren South is eligible to participate in the C&I Custom Program. In addition to this requirement, the Building Tune-Up component also requires buildings to be at least 50,000 square feet. For the pilot components, the implementer will target a small group of participants to test the viability of the concept in Vectren territory.

3.14.1.1 Conventional Custom Projects

Similar to previous program years, customers may propose new custom retrofit projects. Customers or trade allies with a proposed project complete an application form with the energy savings calculations for the project. The implementation team reviews all calculations and, where appropriate, completes site visits to assess and document pre-installation conditions. The implementer then informs that their project has been pre-approved and their funds are reserved for the project. Implementation engineering staff review the final project information as installed and verify the energy savings. Incentives are then paid on the verified savings. Given the variability and uniqueness of each project, all projects are pre-approved. Pre- and post-installation visits to the site to verify installation and savings are performed as defined by the program implementation partner. Monitoring and verification may occur on the largest projects. This component provides incentives based on the kWh saved as calculated by the engineering analysis.

3.14.1.2 Commercial New Construction

The Commercial New Construction (CNC) component promotes energy-efficient designs with the goal of developing projects that are more energy efficient than current Indiana building code. This program applies to new construction and major renovation projects. Major renovation is defined as the replacement of at least two systems within an existing space (e.g., lighting, HVAC, controls, building envelope). The program provides incentives as part of the facility design process to explore opportunities in modeling EE options to craft an optimal package of investments. The program also offers customers the opportunity to receive prescriptive or custom rebates toward eligible equipment in order to reduce the higher capital cost for an energy efficient solution.

To help overcome financial challenge of designing energy-efficient new construction projects, Vectren offers a Standard Energy Design Assistance (“EDA”). This provides additional engineering expertise during the design phase to identify energy-saving opportunities. C&I projects for buildings greater than 100,000 square feet still in the conceptual design phase qualify for Vectren South’s Enhanced EDA incentives which include energy modeling. The Vectren South implementation partner staff expert works with the design team through the conceptual design, schematic design, and design development processes, providing advice and counsel on measures that should be considered and EE modeling issues. Incentives are paid after the design team submits completed construction documents for review to verify that the facility design reflects the minimum energy savings requirements.

CNC provides incentives to help offset some of the expenses for the design team’s participation in the EDA process with the design team incentive. The design team incentive is a fixed amount based on the new/renovated conditioned square footage and is paid when the proposed EE projects associated with the construction documents exceed a minimum energy savings threshold. The program also offers customers the opportunity to receive prescriptive or custom rebates toward eligible equipment in order to reduce the higher capital cost for the EE solutions.

3.14.1.3 Building Tune-Up (BTU)

The BTU component provides a targeted, turnkey, and cost-effective retro-commissioning solution for small- to mid-sized customer facilities. It is designed as a comprehensive customer solution that will identify, validate, quantify, and encourage the installation of both operational and capital measures. The majority of these measures will be no- or low-cost with low payback periods and will capture energy savings from a previously untapped source: building automation systems.

The BTU component is designed to encourage high levels of implementation by customers seeking to optimize the operation of their existing HVAC system. BTU typically targets customers with buildings between 50,000 square feet and 150,000 square feet. Facility energy assessments are offered to customers who are eligible and motivated to implement multiple energy efficiency measures. BTU specifically targets measures that provide no- and low-cost operational savings. Most measures involve optimizing the building automation system (BAS) settings, but the program also investigates related capital measures, like controls, operations, processes, and HVAC. The implementation partner works collaboratively with Vectren South staff to recruit and screen customers for receiving facility energy assessments.

The following table describes the specific savings requirements related to each incentive:

TABLE 3-12 INCENTIVE SAVINGS REQUIREMENTS

Facility Size – Square Feet	Design Team Incentives	Minimum Savings
Small <25,000	$750	25,000 kWh
Medium 25,000 - 100,000	$2,250	75,000 kWh
Large >100,000	$3,750	150,000 kWh
Enhance Large >100,000	$5,000	10% beyond code

3.14.1.4 Strategic Energy Management Pilot

The Strategic Energy Management Pilot (SEM) is a guided operations and maintenance program with benchmarking and regular follow-up meetings to chart customer performance. The implementer will recruit customers to participate in the program and achieve energy savings for their facilities. The implementer will then measure their performance over time (usually a period of 6 months or a year) using energy billing data to determine the amount of energy savings the customer achieved and provide incentives to the customer accordingly. Depending on market research, the SEM pilot may also include cohorts of participants and inter-cohort and intra-cohort competition. Vectren may require the SEM pilot to fit Department of Energy (DOE) 50,001 Ready specifications. This DOE program model attempts to standardize programs across states and jurisdictions to give companies with facilities in more than one utility jurisdiction the opportunity to participate in SEM programs using similar qualification criteria and with similar program applications.

3.14.1.5 Advanced Lighting Controls Pilot

The Advanced Lighting Controls Pilot (ALC) will incentivize networked lighting control systems that include daylighting and/or occupancy sensors in the lighting fixtures. Like conventional custom projects, engineers will review project applications to establish conventional energy savings. Unlike the conventional custom projects, ALC projects may also include additional estimates for reduced hours-of-use or hours of lower energy use resulting from daylighting and/or occupancy sensors in the networked lighting.

3.14.1.6 Midstream HVAC Pilot

The Midstream HVAC Pilot will provide incentives to actors at the distributor level (firms positioned between the manufacturer and the end user). The pilot will provide incentives for HVAC equipment such as package units, heat pumps, room AC, split systems, and chillers.

Through midstream HVAC incentives, the program aims to influence the equipment that distributors stock, fine-tune incentives to fit desired program outcomes, and address the needs of the replace-on-burnout market. Because distributors have a large influence on the HVAC equipment that C&I customers eventually install, the pilot will be able to encourage distributors to supply more energy-efficient options. Midstream HVAC incentives can be more easily adjusted, as C&I customers receive the discount at the time of equipment purchase, not after a lengthy application process. Because C&I customers receive a discount at the time of purchase, the pilot may influence more quick-fire purchasing decisions such as replace-on-burnout purchases. C&I customers will not be encumbered by a lengthy application process to replace their defunct HVAC equipment.

3.14.2 Relation to Vectren's Market Potential Study

The Market Potential Study identified room in C&I markets, but due to the unique nature of each custom program project, it is difficult to compare Market Potential Study opportunity to Action Plan estimates.

3.14.3 Program Considerations

The team assumed that average participation rates from the C&I Custom Program would produce a rough estimate of participation for the program in the future. Due to the wide variations in program savings and number of participating projects over the years, this estimate has a very wide error bound.

3.14.4 Technology and Program Data

The following table provides summary of the C&I Custom Program energy impacts and budget.

TABLE 3-13 COMMERCIAL AND INDUSTRIAL CUSTOM – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	196	196	196	196	196	196
Energy Savings kWh	6,107,234	6,107,234	6,107,234	6,107,234	6,107,234	6,107,234
Peak Demand kW	740	740	740	740	740	740
Total Program Budget	$896,299	$902,775	$909,355	$916,040	$922,832	$929,733
Per Participant Energy Savings (kWh)	31,159	31,159	31,159	31,159	31,159	31,159
Per Participant Demand Savings (kW)	3.78	3.78	3.78	3.78	3.78	3.78
Per Participant Average Incentive	$2,508	$2,508	$2,508	$2,508	$2,508	$2,508
Weighted Average Measure Life	16	16	16	16	16	16
Incremental Technology Cost	$26,185	$26,185	$26,185	$26,185	$26,185	$26,185
Net-to-Gross Ratio	100%	100%	100%	100%	100%	100%

Note: Number of participants, energy savings, and program costs estimated based on program estimates for the 2015-2017 energy efficiency scorecards. Demand savings estimated based on the 2018 Operating Plan. Weighted average measure life and net to gross ratio weighted by kWh.

3.15 SMALL BUSINESS ENERGY SOLUTIONS

3.15.1 Background

The Small Business Energy Solutions Program (SBES) provides value by directly installing EE products such as high-efficiency lighting, pre-rinse sprayers, refrigeration controls, electrically-commutated motors, smart thermostats, and vending machine controls. The program helps small businesses and multi-family customers identify and install cost-effective energy-saving measures by providing an onsite energy assessment customized for their business.
Any participating Vectren South business customer with a maximum peak energy demand of less than 400 kW is eligible to participate in the program. Additionally, multi-family building owners with Vectren general electric service may qualify for the program, including apartment buildings, condominiums, cooperatives, duplexes, quadraplexes, townhomes, nursing homes, and retirement communities.

Trained trade ally energy advisors provide energy assessments to business customers with less than 400 kW peak demand and to multi-family buildings. The program implementer issues an annual Request for Qualification (RFQ) to select the trade allies with the best ability to provide high-quality and cost-effective service to small businesses and provide training to SBES trade allies on the program process, with an emphasis on improving energy efficiency sales.

Trade allies walk through small businesses and record site characteristics and energy efficiency opportunities at no cost to the customer. They provide an energy assessment report that details customer-specific opportunities, costs, energy savings, incentives, and simple payback periods. The trade ally then reviews the report with the customer, presenting the program benefits and process, while addressing any questions.

The program has two types of measures provided. The first type of measures are installed at no cost to the customer. They include, but are not limited to, the following:

- LEDs
- Wifi-enabled thermostats
- Programmable thermostats
- High efficiency pre-rinse sprayers
- Faucet aerators
- Weather stripping (exterior door)

The second types of measures require the customer to pay a portion of the labor and materials. These measures include:

- Interior LED lighting
- Exterior LED lighting
- EC Motors
- Anti-sweat heater controls
- Refrigerated LED lighting and case covers
- Lighting control
- Vending machine control
- Smart thermostats

In addition to the no-cost measures identified during the audit, the program also pays a cash incentive on every recommended and implemented improvement identified through the assessment. Incentive rates may change over time and vary with special initiatives.

Onsite verification is provided for the first three projects completed by each trade ally, in addition to the program standard of 5% of all completed projects and all projects receiving incentives greater than $20,000. These verifications allow the program to validate energy savings, in addition to providing an opportunity to ensure trade allies provide high-quality customer services and the incentivized equipment satisfies program requirements.

3.15.2 Relation to Vectren's Market Potential Study

The Market Potential Study identified savings for the overall C&I sectors but provided less-specific estimates for the small business sector. As participation in the program is small, the team assumed that historic participation trends would continue through the timeline of the action plan.

3.15.3 Program Considerations

The team reviewed estimates for the impact of the EISA backstop in other jurisdictions and found that the EISA backstop will have a much smaller impact on C&I programs compared to residential programs. This research also indicated that small businesses will face a larger impact from the backstop as their lighting characteristics more closely resemble the residential market. Because of this impact, the team assumed decreasing participation in lighting measures impacted by the EISA backstop after 2021.

The team dropped fluorescent lighting from the program as the technology will be superseded by linear LEDs and savings from LEDs are much more substantial.

3.15.4 Technology and Program Data

The following table provides summary of SBES energy impacts and budget.

TABLE 3-14 SMALL BUSINESS ENERGY SOLUTIONS – IMPACTS AND BUDGET

	2020	2021	2022	2023	2024	2025
Number of Participants	381	382	382	382	383	383
Energy Savings kWh	2,940,932	2,944,615	2,949,771	2,952,715	2,957,870	2,963,026
Peak Demand kW	213	213	213	213	213	213
Total Program Budget	$768,835	$763,876	$758,758	$752,586	$747,582	$742,637
Per Participant Energy Savings (kWh)	7,719	7,708	7,722	7,730	7,723	7,736
Per Participant Demand Savings (kW)	0.56	0.56	0.56	0.56	0.56	0.56
Per Participant Average Incentive	$1,439	$1,412	$1,390	$1,365	$1,338	$1,315
Weighted Average Measure Life	15	15	15	15	15	15
Incremental Technology Cost	$312	$311	$310	$310	$309	$308
Net-to-Gross Ratio	91%	91%	91%	91%	91%	91%

Note: Number of participants, energy savings, and demand savings estimated based on the 2018 Operating Plan. Program costs estimated using the current program SOW and projected rising costs from 2018-20 filed Energy Efficiency Plan and Vectren Program Cost and Measure Data spreadsheet. Per participant average incentive and incremental technology cost estimated by summing the values for each piece of equipment and dividing by the number of participants. Linear LED lighting incentives and incremental costs are discounted by 33% from 2020 to 2025 based on findings from the DOE's Energy Savings Forecast of Solid-State Lighting in General Illumination Applications 2016 report. Weighted average measure life and net to gross ratio are weighted by kWh.

3.16 CONSERVATION VOLTAGE REDUCTION

3.16.1 Background

Conservation Voltage Reduction (CVR) achieves energy conservation through automated monitoring and control of voltage levels provided on distribution circuits. End use customers realize lower energy and demand consumption when CVR is applied to the distribution circuit from which they are served.

CVR is both a DR and an EE program. It targets distribution circuits, in part to reduce the peak demand experienced on Vectren's electrical power supply system. The voltage reduction stemming from the CVR program operates to effectively reduce consumption during the times in which system peaks are set and as a result directly reduces peak demand. CVR also cost-effectively reduces the level of ongoing energy consumption by end-use devices located on the customer side of the utility meter, as many end-use devices consume less energy with lower voltages consistently applied. Like an equipment maintenance service program, the voltage optimization allows the customer's equipment to operate at optimum levels which saves energy without requiring direct customer intervention or change.

Delivery of the CVR Program will be achieved through the installation of control logic, telecommunication equipment, and voltage control equipment in order to control the voltage bandwidth on CVR circuits within voltage compliance levels required by the Indiana Utility Regulatory Commission.

3.16.2 Program Considerations

The team assumed similar participation in conservation voltage reduction as in previous years.

VOLUME III

APPENDICES

2020-2025 Integrated Electric DSM Market Potential Study & Action Plan

prepared for

VECTREN
Live Smart

JANUARY 2019

VOLUME III *Electric Appendices*

Electric ***DSM Market Potential Study***

Electric ***Action Plan***

APPENDIX A *DSM Market Potential Study Sources*

This appendix catalogs many of the data sources used in this study, grouped by major activity. In general, GDS attempted to utilize Vectren-specific data, where available. When Vectren-specific data was not available or reliable, GDS leveraged secondary data from nearby or regional sources.

A.1 MARKET RESEARCH

Market research studies were used to understand home and business characteristics and equipment stock characteristics. Vectren supplied GDS with several residential market research studies, and GDS conducted primary research in the small commercial sector to gather additional equipment and efficiency characteristics.

- ***Vectren Residential Market Research Studies:*** The electric measure analysis was largely informed by a 2016 baseline survey of Vectren South customers. Nearly 500 responses to this survey provided a strong basis for many of the Vectren South electric measure baseline and efficient saturation estimates. A 2015 CFL and LED baseline study helped inform the saturation estimates for the lighting end use. A 2017 electric baseline thermostat survey of Vectren customers was leveraged to better characterize the increased prominence of smart and Wi-Fi-enabled thermostats.
- ***Vectren Commercial Primary Market Research:*** GDS collected data in 38 commercial facilities to better understand electric and natural gas equipment saturation and efficiency characteristics.
- ***Industrial Surveys***: Vectren survey data was leveraged to determine the remaining factors for several end-uses, including motors, interior and exterior lighting and fixture measures.
- ***EIA/DOE Industrial Data:*** Including the DOE Industrial Electric Motor Systems Market Opportunities Report, the DOE Assessment of the Market for Compressed Air Efficiency Services, and EIA Industrial Demand Module of the National Energy Modeling System.
- ***US American Community Survey:*** Public Use Microdata Survey data was used to estimate the percent of low-income households (using annual household income and number of people per household) in the Vectren South and North territories.
- ***Energy Star Shipment Data:*** Energy Star shipment data provides a detailed historical estimate of the percent of shipped equipment/appliances that meet ENERGY STAR standards. Over the long-term, this serves as a proxy for the percent of the market that could be considered energy efficient.

A.2 FORECAST CALIBRATION

The forecast calibration effort was used to create a detailed segmentation of Vectren's load forecast and ensure that estimated savings would not overstate future potential. Vectren supplied GDS with the most recent load forecast.

- ***Vectren Load Forecast:*** The 2016 Long-Term Electric Energy and Demand load forecast consists of the most recent ITRON load forecast completed for VEDI for 2016-2036. The natural gas forecast was provided directly from Vectren for the North and South territories from 2017 to 2027. Future years were escalated by a compound average annual growth rate.
- ***Vectren Commercial and Industrial Customer Forecast:*** The 2017 historical commercial and industrial data utilized rate codes and existing NAICS code to segment historical sales by commercial building type and/or industry type.
- ***InfoUSA***: GDS utilized a third-party dataset that provided additional commercial and industrial business information, including NAICS codes, to supplement the building/industry types codes supplied by Vectren
- ***EIA Commercial Building Energy Consumption Survey:*** GDS updated the ITRON load forecast to utilize more recent information for the East South-Central region from the EIA 2012 CBECS survey.

- *EIA Manufacturing Energy Consumption Survey:* GDS used the 2014 study to further refine the industrial load forecast by end-use.
- *BEopt:* GDS developed residential building prototypes from the market research effort to develop detailed consumption estimates by end-use and calibrated these models to Vectren's residential load forecasts.

A.3 ENERGY EFFICIENCY MEASURE DATA

The energy efficiency measure analysis developed per unit savings, cost, and useful life assumptions for each energy efficiency measure in the residential, commercial, and industrial sectors. Preference was given to Vectren-specific evaluated savings and/or deemed savings/algorithms in the Indiana TRM.

- *2017 Vectren EM&V Report (Cadmus):* For the development of savings estimates of measures already offered by Vectren, GDS either used the estimates from the most recent evaluation reports or used the evaluation methodology to develop forward looking savings projections.
- *Indiana TRM v2.2:* In the absence of evaluation data, GDS attempted to leverage the Indiana TRM. Assumptions and algorithms were based off the IN TRM to the extent practical.
- *Vectren Operating Plan:* Historical incentive estimates and in some cases, incremental measure costs, were based on the Vectren Operating Plans.
- *Other TRMs:* In some cases, TRM's or deemed measure databases from other states were more applicable than the IN TRM due to more currently available estimates and the more appropriate use of updated federal standards. The Illinois TRM and the Michigan Energy Measures Database were the primary non-Indiana TRMs used.
- *Other Secondary Sources:* In some cases, following the source hierarchy listed above was not enough to develop savings estimates. In these cases, GDS leveraged other secondary research documents such as ACEEE emerging technology reports.

A.4 DEMAND RESPONSE / CVR MEASURE ANALYSIS

The DR/CVR analysis developed per unit savings, cost, and useful life assumptions for select demand response programs, and included assumptions regarding future CVR potential from two additional substations.

- *Vectren programs / 2012 FERC DR Survey:* Demand reductions were based on load reductions found in Vectren's existing demand response programs, and various secondary data sources including the FERC and other industry reports, including demand response potential studies.
- *Indiana TRM v2.2:* In the absence of evaluation data, GDS attempted to leverage the Indiana TRM. Assumptions and algorithms were based off the IN TRM to the extent practical.
- *Comverge:* Comverge provided an estimate of the load control switch useful life.
- *Nest and Ecobee:* Nest and Ecobee product data was used to develop equipment cost assumptions.
- *Other DR Potential Studies:* the absence
- *EM&V Analysis of Buckwood Pilot Program:* Energy and demand impacts for the CVR analysis
- *Power System Engineering Report:* Energy and demand impacts for the CVR analysis

A.5 AVOIDED COST/ECONOMIC ANALYSIS

Avoided costs and related economic assumptions were used to assess cost-effectiveness. In addition, historical incentive levels were tied to willingness-to-participate (WTP) research to assess long-term market adoption in the achievable potential scenario.

- *Electric and Natural Gas Avoided Costs:* Avoided cost values for electric energy, electric capacity, and avoided transmission and distribution (T&D) were provided by Vectren as part of an initial data request. Electric energy is based on an annual system marginal cost. For years outside of the avoided cost forecast timeframe, future year avoided costs are escalated by the rate of inflation. Natural gas avoided costs are calculated using EIA Annual Outlook reference tables combined with demand rates and basis differentials provided by Vectren Gas Supply.

- ***Other Economic Assumptions:*** Includes the discount rate, inflation rate, line loss assumptions and reserve margin requirement. All economic assumptions were provided by Vectren and consistent with economic modeling assumptions used for other utility planning efforts.
- ***Historical DSM Filings/Scorecards:*** Historical DSM costs and savings data from 2011 to 2017 were used to determine non-incentive program delivery costs as well as cross-cutting portfolio costs.
- ***Primary Market Research:*** Vectren conducted over 300 surveys in the residential sector (online only) and 38 on-site surveys in the commercial sector regarding customer willingness-to-purchase energy efficient equipment at various incentive levels. This Vectren-specific customer data was used to determine long-term adoption rates by end-use for the MAP and RAP achievable potential scenarios.

APPENDIX B *DSM Market Potential Study Residential Measure Detail*

Vectren Electric | **Residential Measure Assumptions**

Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
1001	Appliances	ENERGY STAR Air Purifier	SF	N/A	MO	733.0	67%	488.0	0.084	9.0	$70.00	$25.00	9.24	Air Purifier meeting ENERGY STAR spec
1002	Appliances	ENERGY STAR Refrigerator	SF	NLI	MO	569.0	9%	53.0	0.008	17.0	$40.00	$20.00	2.05	ES Qualified Refrigator (~9% more efficient)
1003	Appliances	Smart Refrigerator_ET	SF	NLI	MO	569.0	12%	70.0	0.011	17.0	$680.00	$340.00	0.16	ES Qualified Refrigerator w/ Smart Technology
1004	Appliances	ES Refrigerator Replacement	SF	LI	DI	1,193.0	35%	412.2	0.063	17.0	$580.00	$580.00	0.55	Replace Existing Refrigerator with ES Qualified Unit
1005	Appliances	Refrigerator Recycling	SF	N/A	Recycle	1,044.0	100%	1,044.0	0.140	8.0	$130.00	$130.00	3.14	Refrigerator Recycle (No Replacement)
1006	Appliances	ENERGY STAR Clothes Washer (Electrc WH/Dryer)	SF	N/A	MO	522.0	22%	112.4	0.430	14.0	$84.00	$40.00	1.95	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1007	Appliances	ENERGY STAR Clothes Washer (NG WH/E Dryer)	SF	N/A	MO	383.7	27%	101.8	0.390	14.0	$84.00	$40.00	1.82	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1008	Appliances	ENERGY STAR Clothes Washer (NG WH/NG Dryer)	SF	N/A	MO	42.3	44%	18.5	0.071	14.0	$84.00	$40.00	0.82	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1009	Appliances	Smart/CEE Tier3 Clothes Washer (Electrc WH/Dryer)_ET	SF	N/A	MO	522.0	40%	209.2	0.801	14.0	$141.00	$70.00	2.07	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1010	Appliances	Smart/CEE Tier3 Clothes Washer (NG WH/E Dryer)_ET	SF	N/A	MO	383.7	26%	100.9	0.386	14.0	$141.00	$70.00	1.33	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1011	Appliances	Smart/CEE Tier3 Clothes Washer (NG WH/NG Dryer)_ET	SF	N/A	MO	42.3	-3%	-1.2	-0.005	14.0	$141.00	$70.00	0.62	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1012	Appliances	ENERGY STAR Dishwasher (E WH)	SF	N/A	MO	307.0	12%	37.0	0.105	11.0	$76.00	$40.00	0.42	ES Qualified Dishwasher (v3.0)
1013	Appliances	ENERGY STAR Dishwasher (NG WH)	SF	N/A	MO	135.1	12%	16.3	0.046	11.0	$79.00	$40.00	0.27	ES Qualified Dishwasher (v3.0)
1014	Appliances	Smart Dishwasher (E WH)_ET	SF	N/A	MO	307.0	15%	45.5	0.129	11.0	$395.00	$200.00	0.10	Smart ES Qualified Dishwasher (v3.0)
1015	Appliances	Smart Dishwasher (NG WH)_ET	SF	N/A	MO	135.1	15%	20.0	0.057	11.0	$395.00	$200.00	0.07	Smart ES Qualified Dishwasher (v3.0)
1016	Appliances	ENERGY STAR Dehumidifier	SF	N/A	MO	904.6	20%	180.9	0.111	12.0	$9.52	$5.00	24.59	ES Qualified Dehumidifer (L/kWh = 2.0)
1017	Appliances	ENERGY STAR Freezer	SF	N/A	MO	349.5	10%	35.1	0.006	22.0	$35.00	$20.00	1.64	ES Qualified Freezer (10% more Efficient than NAECA)
1018	Appliances	Freezer Recycling	SF	N/A	Recycle	927.0	100%	927.0	0.100	8.0	$130.00	$130.00	2.62	Freezer Recycle (No Replacement)
1019	Appliances	ENERGY STAR Clothes Dryer (Electric)	SF	NLI	MO	768.9	21%	160.4	0.567	16.0	$152.00	$75.00	1.52	ES Qualified Dryer (CEF=3.93)
1020	Appliances	ENERGY STAR Clothes Dryer (NG)	SF	NLI	MO	123.0	21%	25.7	0.091	16.0	$152.00	$75.00	0.57	ES Qualified Dryer (CEF=3.93)
1021	Appliances	Smart Clothes Dryer (Electric)_ET	SF	NLI	MO	768.9	26%	202.7	0.716	16.0	$236.00	$120.00	1.20	Smart ES Qualified Dryer (5.5% additional energy savings)
1022	Appliances	Smart Clothes Dryer (NG)_ET	SF	NLI	MO	123.0	26%	32.4	0.115	16.0	$236.00	$120.00	0.45	Smart ES Qualified Dryer (5.5% additional energy savings)
1023	Appliances	Heat Pump Dryer	SF	NLI	MO	768.9	73%	558.0	1.972	12.0	$412.00	$205.00	1.57	Heat Pump Dryer (CEF=10.4)
1024	Appliances	Dryer Vent Cleaning (Electric)	SF	LI	DI	768.9	6%	42.3	0.149	2.0	$80.00	$80.00	0.06	Dryer Vent Cleaning (5.5% Savings)
1025	Appliances	Dryer Vent Cleaning (NG)	SF	LI	DI	123.0	6%	6.8	0.024	2.0	$80.00	$80.00	0.02	Dryer Vent Cleaning (5.5% Savings)
1026	Appliances	ENERGY STAR Water Cooler	SF	N/A	MO	105.9	46%	48.6	0.006	10.0	$17.00	$10.00	2.22	ES Water Cooler (Cold Water Only)
1027	Appliances	ENERGY STAR Air Purifier	SF	N/A	NC	733.0	67%	488.0	0.084	9.0	$70.00	$25.00	9.24	Air Purifier meeting ENERGY STAR spec
1028	Appliances	ENERGY STAR Refrigerator	SF	N/A	NC	569.0	9%	53.0	0.008	17.0	$40.00	$20.00	2.05	ES Qualified Refrigator (~9% more efficient)
1029	Appliances	Smart Refrigerator_ET	SF	N/A	NC	569.0	12%	70.0	0.011	17.0	$680.00	$340.00	0.16	ES Qualified Refrigerator w/ Smart Technology
1030	Appliances	ENERGY STAR Clothes Washer (Electrc WH/Dryer)	SF	N/A	NC	522.0	22%	112.4	0.430	14.0	$84.00	$40.00	1.95	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
1031	Appliances	ENERGY STAR Clothes Washer (NG WH/E Dryer)	SF	N/A	NC	383.7	27%	101.8	0.390	14.0	$84.00	$40.00	1.82	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1032	Appliances	ENERGY STAR Clothes Washer (NG WH/NG Dryer)	SF	N/A	NC	42.3	44%	18.5	0.071	14.0	$84.00	$40.00	0.82	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1033	Appliances	Smart/CEE Tier3 Clothes Washer (Electrc WH/Dryer)_ET	SF	N/A	NC	522.0	40%	209.2	0.801	14.0	$141.00	$70.00	2.07	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1034	Appliances	Smart/CEE Tier3 Clothes Washer (NG WH/E Dryer)_ET	SF	N/A	NC	383.7	26%	100.9	0.386	14.0	$141.00	$70.00	1.33	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1035	Appliances	Smart/CEE Tier3 Clothes Washer (NG WH/NG Dryer)_ET	SF	N/A	NC	42.3	-3%	-1.2	-0.005	14.0	$141.00	$70.00	0.62	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1036	Appliances	ENERGY STAR Dishwasher (E WH)	SF	N/A	NC	307.0	12%	37.0	0.105	11.0	$76.00	$40.00	0.42	ES Qualified Dishwasher (v3.0)
1037	Appliances	ENERGY STAR Dishwasher (NG WH)	SF	N/A	NC	135.1	12%	16.3	0.046	11.0	$79.00	$40.00	0.27	ES Qualified Dishwasher (v3.0)
1038	Appliances	Smart Dishwasher (E WH)_ET	SF	N/A	NC	307.0	15%	45.5	0.129	11.0	$395.00	$200.00	0.10	Smart ES Qualified Dishwasher (v3.0)
1039	Appliances	Smart Dishwasher (NG WH)_ET	SF	N/A	NC	135.1	15%	20.0	0.057	11.0	$395.00	$200.00	0.07	Smart ES Qualified Dishwasher (v3.0)
1040	Appliances	ENERGY STAR Dehumidifier	SF	N/A	NC	904.6	20%	180.9	0.111	12.0	$9.52	$5.00	24.59	ES Qualified Dehumidifer (L/kWh = 2.0)
1041	Appliances	ENERGY STAR Freezer	SF	N/A	NC	349.5	10%	35.1	0.006	22.0	$35.00	$20.00	1.64	ES Qualified Freezer (10% more Efficient than NAECA)
1042	Appliances	ENERGY STAR Clothes Dryer (Electric)	SF	N/A	NC	768.9	21%	160.4	0.567	16.0	$152.00	$75.00	1.52	ES Qualified Dryer (CEF=3.93)
1043	Appliances	ENERGY STAR Clothes Dryer (NG)	SF	N/A	NC	123.0	21%	25.7	0.091	16.0	$152.00	$75.00	0.57	ES Qualified Dryer (CEF=3.93)
1044	Appliances	Smart Clothes Dryer (Electric)_ET	SF	N/A	NC	768.9	26%	202.7	0.716	16.0	$236.00	$120.00	1.20	Smart ES Qualified Dryer (5.5% additional energy savings)
1045	Appliances	Smart Clothes Dryer (NG)_ET	SF	N/A	NC	123.0	26%	32.4	0.115	16.0	$236.00	$120.00	0.45	Smart ES Qualified Dryer (5.5% additional energy savings)
1046	Appliances	Heat Pump Dryer	SF	N/A	NC	768.9	73%	558.0	1.972	12.0	$412.00	$205.00	1.57	Heat Pump Dryer (CEF=10.4)
1047	Appliances	ENERGY STAR Water Cooler	SF	N/A	NC	105.9	46%	48.6	0.006	10.0	$17.00	$10.00	2.22	ES Water Cooler (Cold Water Only)
1048	Appliances	ENERGY STAR Air Purifier	MF	N/A	MO	733.0	67%	488.0	0.084	9.0	$70.00	$25.00	9.24	Air Purifier meeting ENERGY STAR spec
1049	Appliances	ENERGY STAR Refrigerator	MF	NLI	MO	569.0	9%	53.0	0.008	17.0	$40.00	$20.00	2.05	ES Qualified Refrigator (~9% more efficient)
1050	Appliances	Smart Refrigerator_ET	MF	NLI	MO	569.0	12%	70.0	0.011	17.0	$680.00	$340.00	0.16	ES Qualified Refrigerator w/ Smart Technology
1051	Appliances	ES Refrigerator Replacement	MF	LI	DI	1,193.0	35%	412.2	0.063	17.0	$580.00	$580.00	0.55	Replace Existing Refrigerator with ES Qualified Unit
1052	Appliances	Refrigerator Recycling	MF	N/A	Recycle	1,044.0	100%	1,044.0	0.140	8.0	$130.00	$130.00	3.14	Refrigerator Recycle (No Replacement)
1053	Appliances	ENERGY STAR Clothes Washer (Electrc WH/Dryer)	MF	N/A	MO	522.0	22%	112.4	0.430	14.0	$84.00	$40.00	1.95	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1054	Appliances	ENERGY STAR Clothes Washer (NG WH/E Dryer)	MF	N/A	MO	383.7	27%	101.8	0.390	14.0	$84.00	$40.00	1.82	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1055	Appliances	ENERGY STAR Clothes Washer (NG WH/NG Dryer)	MF	N/A	MO	42.3	44%	18.5	0.071	14.0	$84.00	$40.00	0.82	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1056	Appliances	Smart/CEE Tier3 Clothes Washer (Electrc WH/Dryer)_ET	MF	N/A	MO	522.0	40%	209.2	0.801	14.0	$141.00	$70.00	2.07	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1057	Appliances	Smart/CEE Tier3 Clothes Washer (NG WH/E Dryer)_ET	MF	N/A	MO	383.7	26%	100.9	0.386	14.0	$141.00	$70.00	1.33	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
1058	Appliances	Smart/CEE Tier3 Clothes Washer (NG WH/NG Dryer)_ET	MF	N/A	MO	42.3	-3%	-1.2	-0.005	14.0	$141.00	$70.00	0.62	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1059	Appliances	ENERGY STAR Dishwasher (E WH)	MF	N/A	MO	307.0	12%	37.0	0.105	11.0	$76.00	$40.00	0.42	ES Qualified Dishwasher (v3.0)
1060	Appliances	ENERGY STAR Dishwasher (NG WH)	MF	N/A	MO	135.1	12%	16.3	0.046	11.0	$79.00	$40.00	0.27	ES Qualified Dishwasher (v3.0)
1061	Appliances	Smart Dishwasher (E WH)_ET	MF	N/A	MO	307.0	15%	45.5	0.129	11.0	$395.00	$200.00	0.10	Smart ES Qualified Dishwasher (v3.0)
1062	Appliances	Smart Dishwasher (NG WH)_ET	MF	N/A	MO	135.1	15%	20.0	0.057	11.0	$395.00	$200.00	0.07	Smart ES Qualified Dishwasher (v3.0)
1063	Appliances	ENERGY STAR Dehumidifier	MF	N/A	MO	904.6	27%	246.7	0.151	12.0	$75.00	$40.00	4.19	ES Qualified Dehumidifer (L/kWh = 2.2)
1064	Appliances	ENERGY STAR Freezer	MF	N/A	MO	349.5	10%	35.1	0.006	22.0	$35.00	$20.00	1.64	ES Qualified Freezer (10% more Efficient than NAECA)
1065	Appliances	Freezer Recycling	MF	N/A	Recycle	927.0	100%	927.0	0.100	8.0	$130.00	$130.00	2.62	Freezer Recycle (No Replacement)
1066	Appliances	ENERGY STAR Clothes Dryer (Electric)	MF	NLI	MO	768.9	21%	160.4	0.567	16.0	$152.00	$75.00	1.52	ES Qualified Dryer (CEF=3.93)
1067	Appliances	ENERGY STAR Clothes Dryer (NG)	MF	NLI	MO	123.0	21%	25.7	0.091	16.0	$152.00	$75.00	0.57	ES Qualified Dryer (CEF=3.93)
1068	Appliances	Smart Clothes Dryer (Electric)_ET	MF	NLI	MO	768.9	26%	202.7	0.716	16.0	$236.00	$120.00	1.20	Smart ES Qualified Dryer (5.5% additional energy savings)
1069	Appliances	Smart Clothes Dryer (NG)_ET	MF	NLI	MO	123.0	26%	32.4	0.115	16.0	$236.00	$120.00	0.45	Smart ES Qualified Dryer (5.5% additional energy savings)
1070	Appliances	Heat Pump Dryer	MF	NLI	MO	768.9	73%	558.0	1.972	12.0	$412.00	$205.00	1.57	Heat Pump Dryer (CEF=10.4)
1071	Appliances	Dryer Vent Cleaning (Electric)	MF	LI	DI	768.9	6%	42.3	0.149	2.0	$80.00	$80.00	0.06	Dryer Vent Cleaning (5.5% Savings)
1072	Appliances	Dryer Vent Cleaning (NG)	MF	LI	DI	123.0	6%	6.8	0.024	2.0	$80.00	$80.00	0.02	Smart ES Qualified Dryer (5.5% additional energy savings)
1073	Appliances	ENERGY STAR Water Cooler	MF	N/A	MO	105.9	46%	48.6	0.006	10.0	$17.00	$10.00	2.22	ES Water Cooler (Cold Water Only)
1074	Appliances	ENERGY STAR Air Purifier	MF	N/A	NC	733.0	67%	488.0	0.084	9.0	$70.00	$25.00	9.24	Air Purifier meeting ENERGY STAR spec
1075	Appliances	ENERGY STAR Refrigerator	MF	N/A	NC	569.0	9%	53.0	0.008	17.0	$40.00	$20.00	2.05	ES Qualified Refrigator (~9% more efficient)
1076	Appliances	Smart Refrigerator_ET	MF	N/A	NC	569.0	12%	70.0	0.011	17.0	$680.00	$340.00	0.16	ES Qualified Refrigerator w/ Smart Technology
1077	Appliances	ENERGY STAR Clothes Washer (Electrc WH/Dryer)	MF	N/A	NC	522.0	22%	112.4	0.430	14.0	$84.00	$40.00	1.95	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1078	Appliances	ENERGY STAR Clothes Washer (NG WH/E Dryer)	MF	N/A	NC	383.7	27%	101.8	0.390	14.0	$84.00	$40.00	1.82	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1079	Appliances	ENERGY STAR Clothes Washer (NG WH/NG Dryer)	MF	N/A	NC	42.3	44%	18.5	0.071	14.0	$84.00	$40.00	0.82	ES Qualified ClothesWasher (IMEF=2.23 ; 1.75 Baseline)
1080	Appliances	Smart/CEE Tier3 Clothes Washer (Electrc WH/Dryer)_ET	MF	N/A	NC	522.0	40%	209.2	0.801	14.0	$141.00	$70.00	2.07	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1081	Appliances	Smart/CEE Tier3 Clothes Washer (NG WH/E Dryer)_ET	*MF*	N/A	NC	383.7	26%	100.9	0.386	14.0	$141.00	$70.00	1.33	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1082	Appliances	Smart/CEE Tier3 Clothes Washer (NG WH/NG Dryer)_ET	*MF*	N/A	NC	42.3	-3%	-1.2	-0.005	14.0	$141.00	$70.00	0.62	CEE Tier 3 Qualified ClothesWasher (IMEF=2.92 ; 1.75 Baseline)
1083	Appliances	ENERGY STAR Dishwasher (E WH)	MF	N/A	NC	307.0	12%	37.0	0.105	11.0	$76.00	$40.00	0.42	ES Qualified Dishwasher (v3.0)
1084	Appliances	ENERGY STAR Dishwasher (NG WH)	MF	N/A	NC	135.1	12%	16.3	0.046	11.0	$79.00	$40.00	0.27	ES Qualified Dishwasher (v3.0)
1085	Appliances	Smart Dishwasher (E WH)_ET	MF	N/A	NC	307.0	15%	45.5	0.129	11.0	$395.00	$200.00	0.10	Smart ES Qualified Dishwasher (v3.0)

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
1086	Appliances	Smart Dishwasher (NG WH)_ET	MF	N/A	NC	135.1	15%	20.0	0.057	11.0	$395.00	$200.00	0.07	Smart ES Qualified Dishwasher (v3.0)
1087	Appliances	ENERGY STAR Dehumidifier	MF	N/A	NC	904.6	27%	246.7	0.151	12.0	$75.00	$40.00	4.19	ES Qualified Dehumidifer (L/kWh = 2.2)
1088	Appliances	ENERGY STAR Freezer	MF	N/A	NC	349.5	10%	35.1	0.006	22.0	$35.00	$20.00	1.64	ES Qualified Freezer (10% more Efficient than NAECA)
1089	Appliances	ENERGY STAR Clothes Dryer (Electric)	MF	N/A	NC	768.9	21%	160.4	0.567	16.0	$152.00	$75.00	1.52	ES Qualified Dryer (CEF=3.93)
1090	Appliances	ENERGY STAR Clothes Dryer (NG)	MF	N/A	NC	123.0	21%	25.7	0.091	16.0	$152.00	$75.00	0.57	ES Qualified Dryer (CEF=3.93)
1091	Appliances	Smart Clothes Dryer (Electric)_ET	MF	N/A	NC	768.9	26%	202.7	0.716	16.0	$236.00	$120.00	1.20	Smart ES Qualified Dryer (5.5% additional energy savings)
1092	Appliances	Smart Clothes Dryer (NG)_ET	MF	N/A	NC	123.0	26%	32.4	0.115	16.0	$236.00	$120.00	0.45	Smart ES Qualified Dryer (5.5% additional energy savings)
1093	Appliances	Heat Pump Dryer	MF	N/A	NC	768.9	73%	558.0	1.972	12.0	$412.00	$205.00	1.57	Heat Pump Dryer (CEF=10.4)
1094	Appliances	ENERGY STAR Water Cooler	MF	N/A	NC	105.9	46%	48.6	0.006	10.0	$17.00	$10.00	2.22	ES Water Cooler (Cold Water Only)
2001	Audit	Audit Recommendations (elec) - Single-family	SF	NLI	Retrofit	19,402.4	0%	32.0	0.006	1.0	$80.00	$80.00	0.02	Walk through audit and recommendations for behavioral and installation measures
2002	Audit	Audit Recommendations (elec) - Single-family	SF	LI	DI	19,402.4	0%	32.0	0.006	1.0	$80.00	$80.00	0.02	Walk through audit and recommendations for behavioral and installation measures
2003	Audit	Audit Recommendations (elec) - Multifamily	MF	NLI	Retrofit	12,314.1	0%	32.0	0.005	1.0	$80.00	$80.00	0.02	Walk through audit and recommendations for behavioral and installation measures
2004	Audit	Audit Recommendations (elec) - Multifamily	MF	LI	DI	12,314.1	0%	32.0	0.005	1.0	$80.00	$80.00	0.02	Walk through audit and recommendations for behavioral and installation measures
2005	Audit	Audit Recommendations (elec) - Mobile	*Mobile*	NLI	Retrofit	19,402.4	0%	32.0	0.006	1.0	$80.00	$80.00	0.02	Walk through audit and recommendations for behavioral and installation measures
2006	Audit	Audit Recommendations (elec) - Mobile	*Mobile*	LI	DI	19,402.4	0%	32.0	0.006	1.0	$80.00	$80.00	0.02	Walk through audit and recommendations for behavioral and installation measures
2007	Audit	Audit Recommendations (gas) - Single-family	SF	NLI	Retrofit	9,318.6	0%	32.0	0.007	1.0	$80.00	$80.00	0.07	Walk through audit and recommendations for behavioral and installation measures
2008	Audit	Audit Recommendations (gas) - Single-family	SF	LI	DI	9,318.6	0%	32.0	0.007	1.0	$80.00	$80.00	0.07	Walk through audit and recommendations for behavioral and installation measures
2009	Audit	Audit Recommendations (gas) - Multifamily	MF	NLI	Retrofit	6,821.7	0%	32.0	0.005	1.0	$80.00	$80.00	0.07	Walk through audit and recommendations for behavioral and installation measures
2010	Audit	Audit Recommendations (gas) - Multifamily	MF	LI	DI	6,821.7	0%	32.0	0.005	1.0	$80.00	$80.00	0.07	Walk through audit and recommendations for behavioral and installation measures
2011	Audit	Audit Recommendations (gas) - Mobile	Mobile	NLI	Retrofit	9,318.6	0%	32.0	0.007	1.0	$80.00	$80.00	0.07	Walk through audit and recommendations for behavioral and installation measures
2012	Audit	Audit Recommendations (gas) - Mobile	Mobile	LI	DI	9,318.6	0%	32.0	0.007	1.0	$80.00	$80.00	0.07	Walk through audit and recommendations for behavioral and installation measures
3001	Behavioral	Home Energy Reports (Heat pump)	SF	N/A	Opt-Out	16,590.8	2%	265.5	0.049	1.0	$7.85	$7.90	1.68	Pre-pay billing

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
3002	Behavioral	Home Energy Reports (Electric furnace/CAC)	SF	N/A	Opt-Out	21,954.3	2%	351.3	0.051	1.0	$7.85	$7.90	2.13	Distribution of home energy reports encouraging adoption of energy-savings improvements
3003	Behavioral	Pre-pay (Heat pump)	SF	N/A	Opt-In	16,590.8	11%	1,825.0	0.334	3.0	$40.00	$0.00	3E+08	Pre-pay billing
3004	Behavioral	Pre-pay (Electric furnace/CAC)	SF	N/A	Opt-In	21,954.3	11%	2,415.0	0.353	3.0	$40.00	$0.00	3.E+08	Pre-pay billing
3005	Behavioral	Home Energy Management System (Heat pump)	*SF*	N/A	Retrofit	16,590.8	3%	532.6	0.097	5.0	$90.00	$45.00	2.66	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
3006	Behavioral	Home Energy Management System (Electric furnace/CAC)	*SF*	N/A	Retrofit	21,954.3	3%	704.7	0.103	5.0	$90.00	$45.00	3.38	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
3007	Behavioral	Home Energy Reports (Heat pump)	*SF*	N/A	NC	15,337.8	2%	245.4	0.036	1.0	$7.85	$7.90	1.55	Pre-pay billing
3008	Behavioral	Pre-pay (Heat pump)	*SF*	N/A	NC	15,337.8	11%	1,687.2	0.245	3.0	$40.00	$0.00	2.E+08	Pre-pay billing
3009	Behavioral	Home Energy Management System (Heat pump)	*SF*	N/A	NC	15,337.8	3%	365.0	0.044	5.0	$90.00	$45.00	1.75	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
3010	Behavioral	Home Energy Reports (Heat pump)	*MF*	N/A	Opt-Out	11,369.4	2%	181.9	0.022	1.0	$7.85	$7.90	1.10	Pre-pay billing
3011	Behavioral	Home Energy Reports (Electric furnace/CAC)	*MF*	N/A	Opt-Out	13,171.6	2%	210.7	0.025	1.0	$7.85	$7.90	1.27	Distribution of home energy reports encouraging adoption of energy-savings improvements
3012	Behavioral	Pre-pay (Heat pump)	*MF*	N/A	Opt-In	11,369.4	11%	1,250.6	0.150	3.0	$40.00	$0.00	2.E+08	Pre-pay billing
3013	Behavioral	Pre-pay (Electric furnace/CAC)	*MF*	N/A	Opt-In	13,171.6	11%	1,448.9	0.169	3.0	$40.00	$0.00	2E+08	Pre-pay billing
3014	Behavioral	Home Energy Management System (Heat pump)	*MF*	N/A	Retrofit	11,369.4	3%	422.8	0.049	5.0	$90.00	$45.00	1.97	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
3015	Behavioral	Home Energy Management System (Electric furnace/CAC)	*MF*	N/A	Retrofit	13,171.6	3%	492.3	0.071	5.0	$90.00	$45.00	2.39	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
3016	Behavioral	Home Energy Reports (Heat pump)	*MF*	N/A	NC	10,959.2	2%	175.3	0.021	1.0	$7.85	$7.90	1.05	Pre-pay billing
3017	Behavioral	Pre-pay (Heat pump)	*MF*	N/A	NC	10,959.2	11%	1,205.5	0.146	3.0	$40.00	$0.00	2E+08	Pre-pay billing
3018	Behavioral	Home Energy Management System (Heat pump)	*MF*	N/A	NC	10,959.2	3%	351.8	0.043	5.0	$90.00	$45.00	1.67	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
3019	Behavioral	Home Energy Reports (Gas furnace/CAC)	*SF*	N/A	Opt-Out	9,318.6	1%	121.1	0.045	1.0	$7.85	$7.90	1.48	Distribution of home energy reports encouraging adoption of energy-savings improvements
3020	Behavioral	Pre-pay (Gas furnace/CAC)	*SF*	N/A	Opt-In	9,318.6	11%	1,025.0	0.377	3.0	$40.00	$0.00	3.E+08	Pre-pay billing
3021	Behavioral	Home Energy Management System (Gas furnace/CAC)	*SF*	N/A	Retrofit	9,318.6	3%	299.1	0.110	5.0	$90.00	$45.00	2.98	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
3022	Behavioral	Home Energy Reports (Gas furnace/CAC)	*SF*	N/A	NC	8,582.1	1%	111.6	0.032	1.0	$7.85	$7.90	1.09	Distribution of home energy reports encouraging adoption of energy-savings improvements
3023	Behavioral	Pre-pay (Gas furnace/CAC)	*SF*	N/A	NC	8,582.1	11%	944.0	0.269	3.0	$40.00	$0.00	2E+08	Pre-pay billing
3024	Behavioral	Home Energy Management System (Gas furnace/CAC)	*SF*	N/A	NC	8,582.1	3%	275.5	0.078	5.0	$90.00	$45.00	2.18	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
3025	Behavioral	Home Energy Reports (Gas furnace/CAC)	*MF*	N/A	Opt-Out	6,821.7	1%	88.7	0.022	1.0	$7.85	$7.90	0.91	Distribution of home energy reports encouraging adoption of energy-savings improvements
3026	Behavioral	Pre-pay (Gas furnace/CAC)	*MF*	N/A	Opt-In	6,821.7	11%	750.4	0.183	3.0	$40.00	$0.00	2.E+08	Pre-pay billing
3027	Behavioral	Home Energy Management System (Gas furnace/CAC)	*MF*	N/A	Retrofit	6,821.7	3%	219.0	0.053	5.0	$90.00	$45.00	1.82	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
3028	Behavioral	Home Energy Reports (Gas furnace/CAC)	*MF*	N/A	NC	10,165.2	1%	132.1	0.021	1.0	$7.85	$7.90	0.96	Distribution of home energy reports encouraging adoption of energy-savings improvements
3029	Behavioral	Pre-pay (Gas furnace/CAC)	*MF*	N/A	NC	10,165.2	11%	1,118.2	0.180	5.0	$40.00	$0.00	3E+08	Pre-pay billing
3030	Behavioral	Home Energy Management System (Gas furnace/CAC)	*MF*	N/A	NC	10,165.2	3%	326.3	0.053	5.0	$90.00	$45.00	1.90	HEMS are hardware and software systems that can control and monitor one or more energy uses in the home
4001	HVAC Equipment	ASHP Tune Up	*SF*	NLI	Retrofit	6,321.2	5%	316.1	0.152	5.0	$64.00	$64.00	1.53	Air source heat pump tune up
4002	HVAC Equipment	Air Source Heat Pump 16 SEER - Heat pump baseline	*SF*	NLI	MO	6,321.2	9%	566.2	0.612	18.0	$870.00	$300.00	2.47	16 SEER 9.0 hspf air source heat pump
4003	HVAC Equipment	Air Source Heat Pump 16 SEER - Furnace baseline	*SF*	NLI	MO	11,684.8	51%	5,929.7	0.922	18.0	$2,121.00	$300.00	13.12	16 SEER 9.0 hspf air source heat pump
4004	HVAC Equipment	AC Tune Up	*SF*	NLI	Retrofit	2,713.0	5%	135.6	0.161	5.0	$64.00	$64.00	1.11	Central air conditioner tune-up
4005	HVAC Equipment	Central Air Conditioner 16 SEER	*SF*	NLI	MO	2,713.0	18%	483.4	0.508	18.0	$400.00	$200.00	3.41	16 SEER central air conditioner
4006	HVAC Equipment	Smart Thermostat - Heat pump baseline	*SF*	NLI	Retrofit	6,321.2	10%	658.6	0.000	15.0	$154.00	$60.00	5.26	Smart thermostat
4007	HVAC Equipment	WIFI Thermostat - Heat pump baseline	SF	NLI	Retrofit	6,321.2	6%	377.8	0.000	15.0	$103.20	$50.00	3.62	WifI (non-smart) thermostat
4008	HVAC Equipment	Smart Thermostat - Furnace baseline	SF	NLI	Retrofit	11,684.8	11%	1,239.0	0.000	15.0	$154.00	$60.00	9.89	Smart thermostat
4009	HVAC Equipment	WIFI Thermostat - Furnace baseline	SF	NLI	Retrofit	11,684.8	5%	568.0	0.000	15.0	$103.20	$50.00	5.44	WifI (non-smart) thermostat
4010	HVAC Equipment	Filter Whistle	SF	NLI	Retrofit	9,132.9	4%	319.7	0.109	15.0	$1.64	$1.64	139.02	Whistle to remind owners to change air filter
4011	HVAC Equipment	ASHP Tune Up	SF	LI	DI	6,321.2	5%	316.1	0.152	5.0	$64.00	$64.00	1.53	Air source heat pump tune up
4012	HVAC Equipment	Air Source Heat Pump 16 SEER - Heat pump baseline	SF	LI	DI	6,321.2	9%	566.2	0.612	18.0	$5,400.00	$5,400.00	0.14	16 SEER 9.0 hspf air source heat pump
4013	HVAC Equipment	Air Source Heat Pump 16 SEER - Furnace baseline	SF	LI	DI	11,684.8	51%	5,929.7	0.922	18.0	$5,400.00	$5,400.00	0.73	16 SEER 9.0 hspf air source heat pump
4014	HVAC Equipment	AC Tune Up	SF	LI	DI	2,713.0	5%	135.6	0.161	5.0	$64.00	$64.00	1.11	Central air conditioner tune-up
4015	HVAC Equipment	Central Air Conditioner 16 SEER	SF	LI	DI	2,713.0	18%	483.4	0.508	18.0	$3,500.00	$3,500.00	0.20	16 SEER central air conditioner
4016	HVAC Equipment	Smart Thermostat - Heat pump baseline	SF	LI	DI	6,321.2	10%	658.6	0.000	15.0	$154.00	$154.00	2.05	Smart thermostat
4017	HVAC Equipment	WIFI Thermostat - Heat pump baseline	SF	LI	DI	6,321.2	6%	377.8	0.000	15.0	$103.20	$103.20	1.75	WifI (non-smart) thermostat
4018	HVAC Equipment	Smart Thermostat - Furnace baseline	SF	LI	DI	11,684.8	11%	1,239.0	0.000	15.0	$154.00	$154.00	3.85	Smart thermostat
4019	HVAC Equipment	WIFI Thermostat - Furnace baseline	SF	LI	DI	11,684.8	5%	568.0	0.000	15.0	$103.20	$103.20	2.64	WifI (non-smart) thermostat
4020	HVAC Equipment	Filter Whistle	SF	LI	DI	9,132.9	4%	319.7	0.109	15.0	$1.64	$1.64	139.02	Whistle to remind owners to change air filter

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
4021	HVAC Equipment	Air Source Heat Pump 18 SEER - Heat pump baseline	SF	NLI	MO	6,321.2	17%	1,058.6	0.770	18.0	$1,156.00	$500.00	2.33	18 SEER air source heat pump
4022	HVAC Equipment	Ductless Heat Pump 17 SEER 9.5 HSPF - Heat pump baseline	SF	NLI	MO	6,321.2	6%	349.5	2.740	18.0	$1,666.67	$500.00	4.51	17 SEER / 9.5 hspf ductless heat pump
4023	HVAC Equipment	Ductless Heat Pump 19 SEER 9.5 HSPF - Heat pump baseline	SF	NLI	MO	6,321.2	7%	427.5	2.650	18.0	$2,333.33	$500.00	4.46	19 SEER / 9.5 hspf ductless heat pump
4024	HVAC Equipment	Ductless Heat Pump 21 SEER 10.0 HSPF - Heat pump baseline	SF	NLI	MO	6,321.2	8%	523.0	2.589	18.0	$2,833.33	$500.00	4.47	21 SEER / 10.0 hspf ductless heat pump
4025	HVAC Equipment	Ductless Heat Pump 23 SEER 10.0 HSPF - Heat pump baseline	SF	NLI	MO	6,321.2	9%	575.2	2.542	18.0	$3,333.33	$500.00	4.46	23 SEER / 10.0 hspf ductless heat pump
4026	HVAC Equipment	Dual Fuel Air Source Heat Pump 16 SEER - Heat pump baseline	SF	NLI	MO	6,321.2	45%	2,871.9	0.612	18.0	$1,000.00	$300.00	2.24	16 SEER Dual-fuel heat pump
4027	HVAC Equipment	Dual Fuel Air Source Heat Pump 18 SEER - Heat pump baseline	SF	NLI	MO	6,321.2	50%	3,171.0	0.770	18.0	$1,286.00	$500.00	1.97	18 SEER Dual-fuel heat pump
4028	HVAC Equipment	Ground Source Heat Pump - Heat pump baseline	SF	NLI	MO	6,321.2	8%	491.2	-0.213	18.0	$3,609.00	$1,000.00	0.12	Geothermal heat pump
4029	HVAC Equipment	Air Source Heat Pump 18 SEER - Furnace baseline	SF	NLI	MO	11,684.8	55%	6,422.1	1.059	18.0	$2,407.00	$500.00	8.71	18 SEER air source heat pump
4030	HVAC Equipment	Ductless Heat Pump 17 SEER 9.5 HSPF - Furnace baseline	SF	NLI	MO	11,684.8	26%	2,988.6	2.915	18.0	$1,666.67	$500.00	7.85	17 SEER / 9.5 hspf ductless heat pump
4031	HVAC Equipment	Ductless Heat Pump 19 SEER 9.5 HSPF - Furnace baseline	SF	NLI	MO	11,684.8	26%	3,066.6	2.825	18.0	$2,333.33	$500.00	7.80	19 SEER / 9.5 hspf ductless heat pump
4032	HVAC Equipment	Ductless Heat Pump 21 SEER 10.0 HSPF - Furnace baseline	SF	NLI	MO	11,684.8	27%	3,207.2	2.765	18.0	$2,833.33	$500.00	7.86	21 SEER / 10.0 hspf ductless heat pump
4033	HVAC Equipment	Ductless Heat Pump 23 SEER 10.0 HSPF - Furnace baseline	SF	NLI	MO	11,684.8	28%	3,259.3	2.718	18.0	$3,333.33	$500.00	7.85	23 SEER / 10.0 hspf ductless heat pump
4034	HVAC Equipment	Dual Fuel Air Source Heat Pump 16 SEER - Furnace baseline	SF	NLI	MO	11,684.8	70%	8,235.5	0.922	18.0	$2,848.00	$300.00	12.88	16 SEER Dual-fuel heat pump
4035	HVAC Equipment	Dual Fuel Air Source Heat Pump 18 SEER - Furnace baseline	SF	NLI	MO	11,684.8	73%	8,534.6	1.059	18.0	$3,134.00	$500.00	8.36	18 SEER Dual-fuel heat pump
4036	HVAC Equipment	Ground Source Heat Pump - Furnace baseline	SF	NLI	MO	11,684.8	50%	5,854.7	0.082	18.0	$3,609.00	$1,000.00	3.31	Geothermal heat pump
4037	HVAC Equipment	Central Air Conditioner 18 SEER	SF	NLI	MO	2,713.0	30%	823.3	0.950	18.0	$800.00	$400.00	2.97	18 SEER central air conditioner
4038	HVAC Equipment	ECM HVAC Motor	SF	NLI	Retrofit	9,132.9	5%	412.0	0.000	10.0	$97.00	$50.00	2.73	Electrically commutated motor
4039	HVAC Equipment	ENERGY STAR Room Air Conditioner	SF	N/A	MO	489.9	10%	49.0	0.110	9.0	$40.00	$10.00	4.83	ENERGY STAR Room Air Conditioner in place of standard efficiency alternative
4040	HVAC Equipment	Smart Room AC_ET	SF	N/A	MO	489.9	3%	14.7	0.033	9.0	$205.00	$60.00	0.24	Window-mounted AC unit with smart capability
4041	HVAC Equipment	Smart Room AC - controls retrofit_ET	SF	N/A	Retrofit	489.9	3%	14.7	0.033	9.0	$110.00	$30.00	0.48	Smart control retrofit kit
4042	HVAC Equipment	Room Air Conditioner Recycling	SF	N/A	Recycle	656.3	100%	656.3	1.475	3.0	$129.00	$40.00	6.17	Recycling of tertiary room air conditioner
4043	HVAC Equipment	Programmable Thermostat - Heat pump baseline	SF	N/A	Retrofit	6,321.2	4%	229.0	0.000	15.0	$35.00	$10.00	10.97	Programmable thermostat
4044	HVAC Equipment	Programmable Thermostat - Furnace baseline	SF	N/A	Retrofit	11,684.8	3%	354.6	0.000	15.0	$35.00	$10.00	16.99	Programmable thermostat

Vectren Electric		Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
4045	HVAC Equipment	Smart Vents/Sensors_ET	SF	N/A	Retrofit	9,132.9	10%	913.3	0.313	15.0	$800.00	$400.00	1.63	Smart vents relay temperature and occupancy information to a smart thermostat (or other control device) to reduce energy waste in unoccupied areas of the home
4046	HVAC Equipment	Smart Ceiling Fan_ET	SF	N/A	Retrofit	2,643.1	8%	198.2	0.235	20.0	$2,400.00	$1,000.00	0.31	Smart ceiling fans save energy by turning off when rooms are unoccupied and by helping the home's central HVAC maintain indoor comfort
4047	HVAC Equipment	Whole House Attic Fan	SF	N/A	Retrofit	2,643.1	13%	338.0	0.000	20.0	$546.60	$275.00	0.74	Whole house attic fan
4048	HVAC Equipment	Attic Fan	SF	N/A	Retrofit	2,643.1	10%	264.3	0.000	20.0	$120.48	$40.00	3.96	Attic fans can reduce the need for AC by reducing heat transfer from the attic through the ceiling of the house
4049	HVAC Equipment	Air Source Heat Pump 16 SEER - Heat pump baseline	SF	N/A	NC	4,984.5	8%	419.9	0.405	18.0	$870.00	$300.00	1.97	16 SEER 9.0 hspf air source heat pump
4050	HVAC Equipment	Air Source Heat Pump 18 SEER - Heat pump baseline	SF	N/A	NC	4,984.5	17%	825.1	0.576	18.0	$1,156.00	$500.00	1.92	18 SEER air source heat pump
4051	HVAC Equipment	Ductless Heat Pump 17 SEER 9.5 HSPF - Heat pump baseline	SF	N/A	NC	4,984.5	6%	319.4	1.931	18.0	$1,666.67	$500.00	3.57	17 SEER / 9.5 hspf ductless heat pump
4052	HVAC Equipment	Ductless Heat Pump 19 SEER 9.5 HSPF - Heat pump baseline	SF	N/A	NC	4,984.5	8%	397.4	1.841	18.0	$2,333.33	$500.00	3.51	19 SEER / 9.5 hspf ductless heat pump
4053	HVAC Equipment	Ductless Heat Pump 21 SEER 10.0 HSPF - Heat pump baseline	SF	N/A	NC	4,984.5	10%	485.0	1.780	18.0	$2,833.33	$500.00	3.51	21 SEER / 10.0 hspf ductless heat pump
4054	HVAC Equipment	Ductless Heat Pump 23 SEER 10.0 HSPF - Heat pump baseline	SF	N/A	NC	4,984.5	11%	537.1	1.733	18.0	$3,333.33	$500.00	3.48	23 SEER / 10.0 hspf ductless heat pump
4055	HVAC Equipment	Dual Fuel Air Source Heat Pump 16 SEER - Heat pump baseline	SF	N/A	NC	4,984.5	36%	1,797.4	0.405	18.0	$1,000.00	$300.00	2.09	16 SEER Dual-fuel heat pump
4056	HVAC Equipment	Dual Fuel Air Source Heat Pump 18 SEER - Heat pump baseline	SF	N/A	NC	4,984.5	42%	2,083.8	0.576	18.0	$1,286.00	$500.00	1.86	18 SEER Dual-fuel heat pump
4057	HVAC Equipment	Ground Source Heat Pump - Heat pump baseline	SF	N/A	NC	4,984.5	7%	368.9	-0.084	18.0	$3,609.00	$1,000.00	0.14	Geothermal heat pump
4058	HVAC Equipment	Central Air Conditioner 16 SEER	SF	N/A	NC	2,364.4	18%	432.6	0.429	18.0	$400.00	$200.00	3.06	16 SEER central air conditioner
4059	HVAC Equipment	Central Air Conditioner 18 SEER	SF	N/A	NC	2,364.4	30%	711.3	0.716	18.0	$800.00	$400.00	2.57	18 SEER central air conditioner
4060	HVAC Equipment	ENERGY STAR Room Air Conditioner	SF	N/A	NC	489.9	10%	49.0	0.110	9.0	$40.00	$10.00	4.83	ENERGY STAR Room Air Conditioner in place of standard efficiency alternative
4061	HVAC Equipment	Smart Room AC_ET	SF	N/A	NC	489.9	3%	14.7	0.033	9.0	$205.00	$60.00	0.24	Window-mounted AC unit with smart capability
4062	HVAC Equipment	Programmable Thermostat - Heat pump baseline	SF	N/A	NC	4,984.5	4%	185.1	0.000	15.0	$35.00	$10.00	8.87	Programmable thermostat
4063	HVAC Equipment	Smart Thermostat - Heat pump baseline	SF	N/A	NC	4,984.5	10%	517.9	0.000	15.0	$154.00	$60.00	4.14	Smart thermostat
4064	HVAC Equipment	WIFI Thermostat - Heat pump baseline	SF	N/A	NC	4,984.5	6%	306.6	0.000	15.0	$103.20	$50.00	2.94	WifI (non-smart) thermostat
4065	HVAC Equipment	Filter Whistle	SF	N/A	NC	4,984.5	4%	174.5	0.078	15.0	$1.64	$1.64	86.34	Whistle to remind owners to change air filter

Vectren Electric	Residential Measure Assumptions													
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4066	HVAC Equipment	Smart Vents/Sensors_ET	SF	N/A	NC	4,984.5	10%	498.4	0.223	15.0	$800.00	$400.00	1.01	Smart vents relay temperature and occupancy information to a smart thermostat (or other control device) to reduce energy waste in unoccupied areas of the home
4067	HVAC Equipment	ASHP Tune Up	MF	NLI	Retrofit	3,171.0	5%	158.5	0.068	5.0	$64.00	$64.00	0.82	Air source heat pump tune up
4068	HVAC Equipment	Air Source Heat Pump 16 SEER - Heat pump baseline	MF	NLI	MO	3,171.0	7%	217.1	0.182	18.0	$870.00	$300.00	0.90	16 SEER 9.0 hspf air source heat pump
4069	HVAC Equipment	Air Source Heat Pump 16 SEER - Furnace baseline	MF	NLI	MO	4,973.1	41%	2,019.3	0.391	18.0	$2,121.00	$300.00	4.80	16 SEER 9.0 hspf air source heat pump
4070	HVAC Equipment	AC Tune Up	MF	NLI	Retrofit	2,017.5	5%	100.9	0.077	5.0	$64.00	$64.00	0.71	Central air conditioner tune-up
4071	HVAC Equipment	Central Air Conditioner 16 SEER	MF	NLI	MO	2,017.5	19%	382.4	0.259	18.0	$400.00	$200.00	2.30	16 SEER central air conditioner
4072	HVAC Equipment	Smart Thermostat - Heat pump baseline	MF	NLI	Retrofit	3,171.0	10%	324.3	0.000	15.0	$154.00	$60.00	2.59	Smart thermostat
4073	HVAC Equipment	WIFI Thermostat - Heat pump baseline	MF	NLI	Retrofit	3,171.0	7%	226.4	0.000	15.0	$103.20	$50.00	2.17	WifI (non-smart) thermostat
4074	HVAC Equipment	Smart Thermostat - Furnace baseline	MF	NLI	Retrofit	4,973.1	10%	518.2	0.000	15.0	$154.00	$60.00	4.14	Smart thermostat
4075	HVAC Equipment	WIFI Thermostat - Furnace baseline	MF	NLI	Retrofit	4,973.1	6%	297.1	0.000	15.0	$103.20	$50.00	2.85	WifI (non-smart) thermostat
4076	HVAC Equipment	Filter Whistle	MF	NLI	Retrofit	4,115.7	4%	144.0	0.051	15.0	$1.64	$1.64	68.64	Whistle to remind owners to change air filter
4077	HVAC Equipment	ASHP Tune Up	MF	LI	DI	3,171.0	5%	158.5	0.068	5.0	$64.00	$64.00	0.82	Air source heat pump tune up
4078	HVAC Equipment	Air Source Heat Pump 16 SEER - Heat pump baseline	MF	LI	DI	3,171.0	7%	217.1	0.182	18.0	$5,400.00	$5,400.00	0.05	16 SEER 9.0 hspf air source heat pump
4079	HVAC Equipment	Air Source Heat Pump 16 SEER - Furnace baseline	MF	LI	DI	4,973.1	41%	2,019.3	0.391	18.0	$5,400.00	$5,400.00	0.27	16 SEER 9.0 hspf air source heat pump
4080	HVAC Equipment	AC Tune Up	MF	LI	DI	2,017.5	5%	100.9	0.077	5.0	$64.00	$64.00	0.71	Central air conditioner tune-up
4081	HVAC Equipment	Central Air Conditioner 16 SEER	MF	LI	DI	2,017.5	19%	382.4	0.259	18.0	$3,500.00	$3,500.00	0.13	16 SEER central air conditioner
4082	HVAC Equipment	Smart Thermostat - Heat pump baseline	MF	LI	DI	3,171.0	10%	324.3	0.000	15.0	$154.00	$154.00	1.01	Smart thermostat
4083	HVAC Equipment	WIFI Thermostat - Heat pump baseline	MF	LI	DI	3,171.0	7%	226.4	0.000	15.0	$103.20	$103.20	1.05	WifI (non-smart) thermostat
4084	HVAC Equipment	Smart Thermostat - Furnace baseline	MF	LI	DI	4,973.1	10%	518.2	0.000	15.0	$154.00	$154.00	1.61	Smart thermostat
4085	HVAC Equipment	WIFI Thermostat - Furnace baseline	MF	LI	DI	4,973.1	6%	297.1	0.000	15.0	$103.20	$103.20	1.38	WifI (non-smart) thermostat
4086	HVAC Equipment	Filter Whistle	MF	LI	DI	4,115.7	4%	144.0	0.051	15.0	$1.64	$1.64	68.64	Whistle to remind owners to change air filter
4087	HVAC Equipment	Air Source Heat Pump 18 SEER - Heat pump baseline	MF	NLI	MO	3,171.0	16%	500.3	0.330	18.0	$1,156.00	$500.00	1.10	18 SEER air source heat pump
4088	HVAC Equipment	Ductless Heat Pump 17 SEER 9.5 HSPF - Heat pump baseline	MF	NLI	MO	3,171.0	9%	270.4	1.065	18.0	$1,666.67	$500.00	2.34	17 SEER / 9.5 hspf ductless heat pump
4089	HVAC Equipment	Ductless Heat Pump 19 SEER 9.5 HSPF - Heat pump baseline	MF	NLI	MO	3,171.0	11%	348.4	0.975	18.0	$2,333.33	$500.00	2.25	19 SEER / 9.5 hspf ductless heat pump
4090	HVAC Equipment	Ductless Heat Pump 21 SEER 10.0 HSPF - Heat pump baseline	MF	NLI	MO	3,171.0	13%	422.8	0.914	18.0	$2,833.33	$500.00	2.22	21 SEER / 10.0 hspf ductless heat pump

Vectren Electric		Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
4091	HVAC Equipment	Ductless Heat Pump 23 SEER 10.0 HSPF - Heat pump baseline	MF	NLI	MO	3,171.0	15%	475.0	0.867	18.0	$3,333.33	$500.00	2.19	23 SEER / 10.0 hspf ductless heat pump
4092	HVAC Equipment	Dual Fuel Air Source Heat Pump 16 SEER - Heat pump baseline	MF	NLI	MO	3,171.0	29%	918.5	0.182	18.0	$1,000.00	$300.00	0.82	16 SEER Dual-fuel heat pump
4093	HVAC Equipment	Dual Fuel Air Source Heat Pump 18 SEER - Heat pump baseline	MF	NLI	MO	3,171.0	36%	1,141.1	0.330	18.0	$1,286.00	$500.00	0.99	18 SEER Dual-fuel heat pump
4094	HVAC Equipment	Air Source Heat Pump 18 SEER - Furnace baseline	MF	NLI	MO	4,973.1	46%	2,302.4	0.535	18.0	$2,407.00	$500.00	3.45	18 SEER air source heat pump
4095	HVAC Equipment	Ductless Heat Pump 17 SEER 9.5 HSPF - Furnace baseline	MF	NLI	MO	4,973.1	23%	1,137.5	1.242	18.0	$1,666.67	$500.00	3.64	17 SEER / 9.5 hspf ductless heat pump
4096	HVAC Equipment	Ductless Heat Pump 19 SEER 9.5 HSPF - Furnace baseline	MF	NLI	MO	4,973.1	24%	1,215.5	1.152	18.0	$2,333.33	$500.00	3.56	19 SEER / 9.5 hspf ductless heat pump
4097	HVAC Equipment	Ductless Heat Pump 21 SEER 10.0 HSPF - Furnace baseline	MF	NLI	MO	4,973.1	26%	1,304.1	1.091	18.0	$2,833.33	$500.00	3.54	21 SEER / 10.0 hspf ductless heat pump
4098	HVAC Equipment	Ductless Heat Pump 23 SEER 10.0 HSPF - Furnace baseline	MF	NLI	MO	4,973.1	27%	1,356.3	1.044	18.0	$3,333.33	$500.00	3.51	23 SEER / 10.0 hspf ductless heat pump
4099	HVAC Equipment	Dual Fuel Air Source Heat Pump 16 SEER - Furnace baseline	MF	NLI	MO	4,973.1	55%	2,720.7	0.391	18.0	$2,848.00	$300.00	4.72	16 SEER Dual-fuel heat pump
4100	HVAC Equipment	Dual Fuel Air Source Heat Pump 18 SEER - Furnace baseline	MF	NLI	MO	4,973.1	59%	2,943.3	0.535	18.0	$3,134.00	$500.00	3.33	18 SEER Dual-fuel heat pump
4101	HVAC Equipment	Central Air Conditioner 18 SEER	MF	NLI	MO	2,017.5	31%	631.3	0.470	18.0	$800.00	$400.00	1.91	18 SEER central air conditioner
4102	HVAC Equipment	ECM HVAC Motor	MF	NLI	Retrofit	4,115.7	10%	412.0	0.000	10.0	$97.00	$50.00	2.73	Electrically commutated motor
4103	HVAC Equipment	ENERGY STAR Room Air Conditioner	MF	N/A	MO	489.9	10%	49.0	0.110	9.0	$40.00	$10.00	4.83	ENERGY STAR Room Air Conditioner in place of standard efficiency alternative
4104	HVAC Equipment	Smart Room AC_ET	MF	N/A	MO	489.9	3%	14.7	0.033	9.0	$205.00	$60.00	0.24	Window-mounted AC unit with smart capability
4105	HVAC Equipment	Smart Room AC - controls retrofit_ET	MF	N/A	Retrofit	489.9	3%	14.7	0.033	9.0	$110.00	$30.00	0.48	Smart control retrofit kit
4106	HVAC Equipment	Room Air Conditioner Recycling	MF	N/A	Recycle	656.3	100%	656.3	1.475	3.0	$129.00	$40.00	6.17	Recycling of tertiary room air conditioner
4107	HVAC Equipment	Programmable Thermostat - Heat pump baseline	MF	N/A	Retrofit	3,171.0	4%	134.3	0.000	15.0	$35.00	$10.00	6.43	Programmable thermostat
4108	HVAC Equipment	Programmable Thermostat - Furnace baseline	MF	N/A	Retrofit	4,973.1	4%	180.1	0.000	15.0	$35.00	$10.00	8.63	Programmable thermostat
4109	HVAC Equipment	Smart Vents/Sensors_ET	MF	N/A	Retrofit	4,115.7	10%	411.6	0.145	15.0	$800.00	$400.00	0.80	Smart vents relay temperature and occupancy information to a smart thermostat (or other control device) to reduce energy waste in unoccupied areas of the home
4110	HVAC Equipment	Smart Ceiling Fan_ET	MF	N/A	Retrofit	1,943.4	7%	145.8	0.109	20.0	$2,400.00	$1,000.00	0.20	Smart ceiling fans save energy by turning off when rooms are unoccupied and by helping the home's central HVAC maintain indoor comfort
4111	HVAC Equipment	Whole House Attic Fan	MF	N/A	Retrofit	1,943.4	17%	338.0	0.000	20.0	$546.60	$275.00	0.74	Whole house attic fan
4112	HVAC Equipment	Attic Fan	MF	N/A	Retrofit	1,943.4	10%	194.3	0.000	20.0	$120.48	$40.00	2.91	Attic fans can reduce the need for AC by reducing heat transfer from the attic through the ceiling of the house

Vectren Electric		Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
4113	HVAC Equipment	Air Source Heat Pump 16 SEER - Heat pump baseline	MF	N/A	NC	2,870.1	6%	185.4	0.185	18.0	$870.00	$300.00	0.81	16 SEER 9.0 hspf air source heat pump
4114	HVAC Equipment	Air Source Heat Pump 18 SEER - Heat pump baseline	MF	N/A	NC	2,870.1	16%	445.7	0.329	18.0	$1,156.00	$500.00	1.00	18 SEER air source heat pump
4115	HVAC Equipment	Ductless Heat Pump 17 SEER 9.5 HSPF - Heat pump baseline	MF	N/A	NC	2,870.1	9%	265.3	1.031	18.0	$1,666.67	$500.00	2.12	17 SEER / 9.5 hspf ductless heat pump
4116	HVAC Equipment	Ductless Heat Pump 19 SEER 9.5 HSPF - Heat pump baseline	MF	N/A	NC	2,870.1	12%	343.3	0.941	18.0	$2,333.33	$500.00	2.04	19 SEER / 9.5 hspf ductless heat pump
4117	HVAC Equipment	Ductless Heat Pump 21 SEER 10.0 HSPF - Heat pump baseline	MF	N/A	NC	2,870.1	15%	416.4	0.880	18.0	$2,833.33	$500.00	2.02	21 SEER / 10.0 hspf ductless heat pump
4118	HVAC Equipment	Ductless Heat Pump 23 SEER 10.0 HSPF - Heat pump baseline	MF	N/A	NC	2,870.1	16%	468.6	0.833	18.0	$3,333.33	$500.00	1.99	23 SEER / 10.0 hspf ductless heat pump
4119	HVAC Equipment	Dual Fuel Air Source Heat Pump 16 SEER - Heat pump baseline	MF	N/A	NC	2,870.1	28%	815.1	0.185	18.0	$1,000.00	$300.00	0.73	16 SEER Dual-fuel heat pump
4120	HVAC Equipment	Dual Fuel Air Source Heat Pump 18 SEER - Heat pump baseline	MF	N/A	NC	2,870.1	36%	1,020.9	0.329	18.0	$1,286.00	$500.00	0.89	18 SEER Dual-fuel heat pump
4121	HVAC Equipment	Central Air Conditioner 16 SEER	MF	N/A	NC	1,897.8	20%	378.3	0.295	18.0	$400.00	$200.00	2.36	16 SEER central air conditioner
4122	HVAC Equipment	Central Air Conditioner 18 SEER	MF	N/A	NC	1,897.8	32%	602.1	0.498	18.0	$800.00	$400.00	1.87	18 SEER central air conditioner
4123	HVAC Equipment	ENERGY STAR Room Air Conditioner	MF	N/A	NC	489.9	10%	49.0	0.110	9.0	$40.00	$10.00	4.83	ENERGY STAR Room Air Conditioner in place of standard efficiency alternative
4124	HVAC Equipment	Smart Room AC_ET	MF	N/A	NC	489.9	3%	14.7	0.033	9.0	$205.00	$60.00	0.24	Window-mounted AC unit with smart capability
4125	HVAC Equipment	Programmable Thermostat - Heat pump baseline	MF	N/A	NC	2,870.1	4%	122.7	0.000	15.0	$35.00	$10.00	5.88	Programmable thermostat
4126	HVAC Equipment	Smart Thermostat - Heat pump baseline	MF	N/A	NC	2,870.1	10%	293.2	0.000	15.0	$154.00	$60.00	2.34	Smart thermostat
4127	HVAC Equipment	WIFI Thermostat - Heat pump baseline	MF	N/A	NC	2,870.1	7%	207.0	0.000	15.0	$103.20	$50.00	1.98	WifI (non-smart) thermostat
4128	HVAC Equipment	Filter Whistle	MF	N/A	NC	2,870.1	4%	100.5	0.046	15.0	$1.64	$1.64	51.70	Whistle to remind owners to change air filter
4129	HVAC Equipment	Smart Vents/Sensors_ET	MF	N/A	NC	2,870.1	10%	287.0	0.133	15.0	$800.00	$400.00	0.61	Smart vents relay temperature and occupancy information to a smart thermostat (or other control device) to reduce energy waste in unoccupied areas of the home
4130	HVAC Equipment	Smart Thermostat - Gas / CAC	SF	NLI	Retrofit	2,939.6	10%	292.7	0.000	15.0	$154.00	$60.00	7.41	Smart thermostat
4131	HVAC Equipment	WIFI Thermostat - Gas / CAC	SF	NLI	Retrofit	2,939.6	9%	258.0	0.000	15.0	$103.20	$50.00	4.36	WifI (non-smart) thermostat
4132	HVAC Equipment	Filter Whistle	SF	NLI	Retrofit	2,939.6	3%	95.2	0.120	15.0	$1.64	$1.64	105.83	Whistle to remind owners to change air filter
4133	HVAC Equipment	Smart Thermostat - Gas / CAC	SF	LI	DI	2,939.6	10%	292.7	0.000	15.0	$154.00	$154.00	2.89	Smart thermostat
4134	HVAC Equipment	WIFI Thermostat - Gas / CAC	SF	LI	DI	2,939.6	9%	258.0	0.000	15.0	$103.20	$103.20	2.11	WifI (non-smart) thermostat
4135	HVAC Equipment	Filter Whistle	SF	LI	DI	2,939.6	3%	95.2	0.120	15.0	$1.64	$1.64	105.83	Whistle to remind owners to change air filter
4136	HVAC Equipment	Programmable Thermostat - Gas / CAC	SF	N/A	Retrofit	2,939.6	5%	149.8	0.000	15.0	$35.00	$10.00	13.49	Programmable thermostat

Vectren Electric		Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
4137	HVAC Equipment	Smart Vents/Sensors_ET	SF	N/A	Retrofit	2,939.6	10%	294.0	0.343	15.0	$800.00	$400.00	1.60	Smart vents relay temperature and occupancy information to a smart thermostat (or other control device) to reduce energy waste in unoccupied areas of the home
4138	HVAC Equipment	Programmable Thermostat - Gas / CAC	SF	N/A	NC	2,479.3	5%	129.5	0.000	18.0	$35.00	$10.00	11.87	Programmable thermostat
4139	HVAC Equipment	Smart Thermostat - Gas / CAC	SF	N/A	NC	2,479.3	10%	245.9	0.000	15.0	$154.00	$60.00	5.28	Smart thermostat
4140	HVAC Equipment	WIFI Thermostat - Gas / CAC	SF	N/A	NC	2,479.3	9%	223.6	0.000	15.0	$103.20	$50.00	3.38	WifI (non-smart) thermostat
4141	HVAC Equipment	Filter Whistle	SF	N/A	NC	2,479.3	3%	81.9	0.107	15.0	$1.64	$1.64	83.65	Whistle to remind owners to change air filter
4142	HVAC Equipment	Smart Vents/Sensors_ET	SF	N/A	NC	2,479.3	10%	247.9	0.305	15.0	$800.00	$400.00	1.21	Smart vents relay temperature and occupancy information to a smart thermostat (or other control device) to reduce energy waste in unoccupied areas of the home
4143	HVAC Equipment	Smart Thermostat - Gas / CAC	MF	NLI	Retrofit	2,163.0	10%	213.2	0.000	15.0	$154.00	$60.00	3.27	Smart thermostat
4144	HVAC Equipment	WIFI Thermostat - Gas / CAC	MF	NLI	Retrofit	2,163.0	9%	202.7	0.000	15.0	$103.20	$50.00	2.53	WifI (non-smart) thermostat
4145	HVAC Equipment	Filter Whistle	MF	NLI	Retrofit	2,163.0	3%	73.4	0.058	15.0	$1.64	$1.64	61.32	Whistle to remind owners to change air filter
4146	HVAC Equipment	Smart Thermostat - Gas / CAC	MF	LI	DI	2,163.0	10%	213.2	0.000	15.0	$154.00	$154.00	1.27	Smart thermostat
4147	HVAC Equipment	WIFI Thermostat - Gas / CAC	MF	LI	DI	2,163.0	9%	202.7	0.000	15.0	$103.20	$103.20	1.22	WifI (non-smart) thermostat
4148	HVAC Equipment	Filter Whistle	MF	LI	DI	2,163.0	3%	73.4	0.058	15.0	$1.64	$1.64	61.32	Whistle to remind owners to change air filter
4149	HVAC Equipment	Programmable Thermostat - Gas / CAC	MF	N/A	Retrofit	2,163.0	5%	117.0	0.000	15.0	$35.00	$10.00	7.56	Programmable thermostat
4150	HVAC Equipment	Smart Vents/Sensors_ET	MF	N/A	Retrofit	2,163.0	10%	216.3	0.166	15.0	$800.00	$400.00	0.83	Smart vents relay temperature and occupancy information to a smart thermostat (or other control device) to reduce energy waste in unoccupied areas of the home
4151	HVAC Equipment	Programmable Thermostat - Gas / CAC	MF	N/A	NC	1,964.8	5%	106.0	0.000	15.0	$35.00	$10.00	7.20	Programmable thermostat
4152	HVAC Equipment	Smart Thermostat - Gas / CAC	MF	N/A	NC	1,964.8	10%	193.8	0.000	15.0	$154.00	$60.00	3.25	Smart thermostat
4153	HVAC Equipment	WIFI Thermostat - Gas / CAC	MF	N/A	NC	1,964.8	9%	183.6	0.000	15.0	$103.20	$50.00	2.40	WifI (non-smart) thermostat
4154	HVAC Equipment	Filter Whistle	MF	N/A	NC	1,964.8	3%	66.5	0.057	15.0	$1.64	$1.64	57.41	Whistle to remind owners to change air filter
4155	HVAC Equipment	Smart Vents/Sensors_ET	MF	N/A	NC	1,964.8	10%	196.5	0.164	15.0	$800.00	$400.00	0.79	Smart vents relay temperature and occupancy information to a smart thermostat (or other control device) to reduce energy waste in unoccupied areas of the home
5001	Lighting	LED 9W (Standard)	SF	NLI	MO	37.5	86%	32.2	0.040	15.0	$1.01	$0.76	25.14	Standard LED Replacing Standard Halogen/CFL Bulb
5002	Lighting	LED 5W Globe (Specialty)	SF	NLI	MO	28.7	84%	24.1	0.023	15.0	$4.00	$3.00	4.36	Specialty LED Replacing Specialty Halogen/Incandescent Bulb

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
5003	Lighting	LED R30 Dimmable (Reflector)	SF	NLI	MO	40.1	83%	33.1	0.041	15.0	$5.34	$4.01	4.98	Reflector LED Replacing Standard Halogen/Incandescent Bulb
5004	Lighting	LED Fixtures	SF	NLI	MO	82.0	74%	60.8	0.061	15.0	$20.25	$5.06	8.26	Residential Occupancy Sensors (DIRECT INSTALL)
5005	Lighting	Linear LED	SF	NLI	Retrofit	23.5	44%	10.3	0.014	9.0	$7.00	$5.25	0.73	T8 Linear Tube Fluorescent Replacing T12 LTF
5006	Lighting	Residential Occupancy Sensors	SF	NLI	Retrofit	108.9	35%	38.1	0.048	10.0	$30.00	$7.50	2.46	Residential Occupancy Sensors
5007	Lighting	Smart Lighting Switch_ET	SF	NLI	Retrofit	106.5	35%	37.3	0.047	10.0	$25.00	$6.25	2.88	Residential Occupancy Sensors
5008	Lighting	LED Nightlights	SF	NLI	Retrofit	14.6	93%	13.6	0.005	16.0	$2.75	$0.69	10.02	LED Nightlights Replacing Incandescent Nightlights
5009	Lighting	LED 13W (Exterior)	SF	NLI	MO	126.7	83%	105.2	0.048	15.0	$4.76	$4.00	12.59	Exterior LED Replacing Exterior Halogen/CFL Bulb
5010	Lighting	Exterior Lighting Controls	SF	NLI	Retrofit	178.1	35%	62.3	0.028	10.0	$30.00	$7.50	2.75	Residential Occupancy Sensors
5011	Lighting	DI LED 9W (Standard)	SF	NLI	DI	37.5	86%	32.2	0.040	15.0	$3.00	$3.00	6.35	Standard LED Replacing Standard Halogen/CFL Bulb
5012	Lighting	DI LED 5W Globe (Specialty)	SF	NLI	DI	28.7	84%	24.1	0.023	15.0	$5.00	$5.00	2.62	Specialty LED Replacing Specialty Halogen/Incandescent Bulb (DIRECT INSTALL)
5013	Lighting	DI LED R30 Dimmable (Reflector)	SF	NLI	DI	39.0	83%	32.3	0.040	15.0	$8.63	$8.63	2.25	Reflector LED Replacing Standard Halogen/Incandescent Bulb (DIRECT INSTALL)
5014	Lighting	DI LED Nightlights	SF	NLI	DI	14.6	93%	13.6	0.005	16.0	$2.75	$2.75	2.50	LED Nightlights Replacing Incandescent Nightlights (DIRECT INSTALL)
5015	Lighting	DI LED 9W (Standard)	SF	LI	DI	37.5	86%	32.2	0.040	15.0	$3.00	$3.00	6.35	Standard LED Replacing Standard Halogen/CFL Bulb
5016	Lighting	DI LED 5W Globe (Specialty)	SF	LI	DI	28.7	84%	24.1	0.023	15.0	$5.00	$5.00	2.62	Specialty LED Replacing Specialty Halogen/Incandescent Bulb (DIRECT INSTALL)
5017	Lighting	DI LED R30 Dimmable (Reflector)	SF	LI	DI	39.0	83%	32.3	0.040	15.0	$8.63	$8.63	2.25	Reflector LED Replacing Standard Halogen/Incandescent Bulb (DIRECT INSTALL)
5018	Lighting	DI LED Nightlights	SF	LI	DI	14.6	93%	13.6	0.005	16.0	$2.75	$2.75	2.50	LED Nightlights Replacing Incandescent Nightlights (DIRECT INSTALL)
5019	Lighting	DI LED 13W (Exterior)	SF	LI	DI	126.7	83%	105.2	0.048	15.0	$6.76	$6.76	7.45	Exterior LED Replacing Exterior Halogen/CFL Bulb
5020	Lighting	LED 9W (Standard)	SF	N/A	NC	37.5	86%	32.2	0.040	15.0	$1.01	$0.76	25.14	Standard LED Replacing Standard Halogen/CFL Bulb
5021	Lighting	LED 5W Globe (Specialty)	SF	N/A	NC	28.7	84%	24.1	0.023	15.0	$4.00	$3.00	4.36	Specialty LED Replacing Specialty Halogen/Incandescent Bulb
5022	Lighting	LED R30 Dimmable (Reflector)	SF	N/A	NC	40.1	83%	33.1	0.041	15.0	$5.34	$4.01	4.98	Reflector LED Replacing Standard Halogen/Incandescent Bulb
5023	Lighting	LED Fixtures	SF	N/A	NC	82.0	74%	60.8	0.061	15.0	$20.25	$5.06	8.26	Residential Occupancy Sensors (DIRECT INSTALL)
5024	Lighting	Linear LED	SF	N/A	NC	23.5	44%	10.3	0.014	9.0	$2.50	$1.88	2.06	T8 Linear Tube Fluorescent Replacing T12 LTF
5025	Lighting	Residential Occupancy Sensors	SF	N/A	NC	108.9	35%	38.1	0.048	10.0	$30.00	$7.50	2.46	Residential Occupancy Sensors
5026	Lighting	Smart Lighting Switch_ET	SF	N/A	NC	106.5	35%	37.3	0.047	10.0	$25.00	$6.25	2.88	Residential Occupancy Sensors
5027	Lighting	LED Nightlights	SF	N/A	NC	14.6	93%	13.6	0.005	16.0	$2.75	$0.69	10.02	LED Nightlights Replacing Incandescent Nightlights
5028	Lighting	LED 13W (Exterior)	SF	N/A	NC	126.7	83%	105.2	0.048	15.0	$4.76	$4.00	12.59	Exterior LED Replacing Exterior Halogen/CFL Bulb
5029	Lighting	Exterior Lighting Controls	SF	N/A	NC	178.1	35%	62.3	0.028	10.0	$30.00	$7.50	2.75	Residential Occupancy Sensors

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5030	Lighting	LED 9W (Standard)	MF	NLI	MO	37.5	86%	32.2	0.040	15.0	$1.01	$0.76	25.14	Standard LED Replacing Standard Halogen/CFL Bulb
5031	Lighting	LED 5W Globe (Specialty)	MF	NLI	MO	28.7	84%	24.1	0.023	15.0	$4.00	$3.00	4.36	Specialty LED Replacing Specialty Halogen/Incandescent Bulb
5032	Lighting	LED R30 Dimmable (Reflector)	MF	NLI	MO	40.1	83%	33.1	0.041	15.0	$5.34	$4.01	4.98	Reflector LED Replacing Standard Halogen/Incandescent Bulb
5033	Lighting	LED Fixtures	MF	NLI	MO	82.0	74%	60.8	0.061	15.0	$20.25	$5.06	8.26	Residential Occupancy Sensors (DIRECT INSTALL)
5034	Lighting	Linear LED	MF	NLI	Retrofit	23.5	44%	10.3	0.014	9.0	$7.00	$5.25	0.73	T8 Linear Tube Fluorescent Replacing T12 LTF
5035	Lighting	Residential Occupancy Sensors	MF	NLI	Retrofit	108.9	35%	38.1	0.048	10.0	$30.00	$7.50	2.46	Residential Occupancy Sensors
5036	Lighting	Smart Lighting Switch_ET	MF	NLI	Retrofit	106.5	35%	37.3	0.047	10.0	$25.00	$6.25	2.88	Residential Occupancy Sensors
5037	Lighting	LED Nightlights	MF	NLI	Retrofit	14.6	93%	13.6	0.005	16.0	$2.75	$0.69	10.02	LED Nightlights Replacing Incandescent Nightlights
5038	Lighting	LED 13W (Exterior)	MF	NLI	MO	126.7	83%	105.2	0.048	15.0	$4.76	$4.00	12.59	Exterior LED Replacing Exterior Halogen/CFL Bulb
5039	Lighting	Exterior Lighting Controls	MF	NLI	Retrofit	178.1	35%	62.3	0.028	10.0	$30.00	$7.50	2.75	Residential Occupancy Sensors
5040	Lighting	DI LED 9W (Standard)	MF	NLI	DI	37.5	86%	32.2	0.040	15.0	$3.00	$3.00	6.35	Standard LED Replacing Standard Halogen/CFL Bulb
5041	Lighting	DI LED 5W Globe (Specialty)	MF	NLI	DI	28.7	84%	24.1	0.023	15.0	$5.00	$5.00	2.62	Specialty LED Replacing Specialty Halogen/Incandescent Bulb (DIRECT INSTALL)
5042	Lighting	DI LED R30 Dimmable (Reflector)	MF	NLI	DI	39.0	83%	32.3	0.040	15.0	$8.63	$8.63	2.25	Reflector LED Replacing Standard Halogen/Incandescent Bulb (DIRECT INSTALL)
5043	Lighting	DI LED Nightlights	MF	NLI	DI	14.6	93%	13.6	0.005	16.0	$2.75	$2.75	2.50	LED Nightlights Replacing Incandescent Nightlights (DIRECT INSTALL)
5044	Lighting	DI LED 9W (Standard)	MF	LI	DI	37.5	86%	32.2	0.040	15.0	$3.00	$3.00	6.35	Standard LED Replacing Standard Halogen/CFL Bulb
5045	Lighting	DI LED 5W Globe (Specialty)	MF	LI	DI	28.7	84%	24.1	0.023	15.0	$5.00	$5.00	2.62	Specialty LED Replacing Specialty Halogen/Incandescent Bulb (DIRECT INSTALL)
5046	Lighting	DI LED R30 Dimmable (Reflector)	MF	LI	DI	39.0	83%	32.3	0.040	15.0	$8.63	$8.63	2.25	Reflector LED Replacing Standard Halogen/Incandescent Bulb (DIRECT INSTALL)
5047	Lighting	DI LED Nightlights	MF	LI	DI	14.6	93%	13.6	0.005	16.0	$2.75	$2.75	2.50	LED Nightlights Replacing Incandescent Nightlights (DIRECT INSTALL)
5048	Lighting	DI LED 13W (Exterior)	MF	LI	DI	126.7	83%	105.2	0.048	15.0	$6.76	$6.76	7.45	Exterior LED Replacing Exterior Halogen/CFL Bulb
5049	Lighting	LED 9W (Standard)	MF	N/A	NC	37.5	86%	32.2	0.040	15.0	$1.01	$0.76	25.14	Standard LED Replacing Standard Halogen/CFL Bulb
5050	Lighting	LED 5W Globe (Specialty)	MF	N/A	NC	28.7	84%	24.1	0.023	15.0	$4.00	$3.00	4.36	Specialty LED Replacing Specialty Halogen/Incandescent Bulb
5051	Lighting	LED R30 Dimmable (Reflector)	MF	N/A	NC	40.1	83%	33.1	0.041	15.0	$5.34	$4.01	4.98	Reflector LED Replacing Standard Halogen/Incandescent Bulb
5052	Lighting	LED Fixtures	MF	N/A	NC	82.0	74%	60.8	0.061	15.0	$20.25	$5.06	8.26	Residential Occupancy Sensors (DIRECT INSTALL)
5053	Lighting	Linear LED	MF	N/A	NC	23.5	44%	10.3	0.014	9.0	$2.50	$1.88	2.06	T8 Linear Tube Fluorescent Replacing T12 LTF
5054	Lighting	Residential Occupancy Sensors	MF	N/A	NC	108.9	35%	38.1	0.048	10.0	$30.00	$7.50	2.46	Residential Occupancy Sensors
5055	Lighting	Smart Lighting Switch_ET	MF	N/A	NC	106.5	35%	37.3	0.047	10.0	$25.00	$6.25	2.88	Residential Occupancy Sensors

Vectren Electric	Residential Measure Assumptions													
Measure #	**End-Use**	**Measure Name**	**Home Type**	**Income Type**	**Replacement Type**	**Base Annual Electric**	**% Elec Savings**	**Per Unit Elec Savings**	**Per Unit Summer NCP kW**	**Useful Life**	**Initial Measure Cost**	**Historical Incentive Amount**	**UCT Ratio**	**Measure Description**
5056	Lighting	LED Nightlights	MF	N/A	NC	14.6	93%	13.6	0.005	16.0	$2.75	$0.69	10.02	LED Nightlights Replacing Incandescent Nightlights
5057	Lighting	LED 13W (Exterior)	MF	N/A	NC	126.7	83%	105.2	0.048	15.0	$4.76	$4.00	12.59	Exterior LED Replacing Exterior Halogen/CFL Bulb
5058	Lighting	Exterior Lighting Controls	MF	N/A	NC	178.1	35%	62.3	0.028	10.0	$30.00	$7.50	2.75	Residential Occupancy Sensors
6001	Miscellaneous	Pool Heater	SF	N/A	MO	9,785.1	12%	1,173.5	0.000	10.0	$3,333.33	$1,000.00	0.39	Installation of high efficiency pool pump heater
6002	Miscellaneous	Pool Heater - Solar System	SF	N/A	MO	9,785.1	38%	3,735.8	0.000	10.0	$3,500.00	$1,000.00	1.24	This measure replaces a conventional pool heater with a solar system
6003	Miscellaneous	Hot Tub/Spa	SF	N/A	MO	0.0	0%	417.3	0.048	15.0	$350.00	$122.50	2.11	Installation of an efficient hot tub / spa
6004	Miscellaneous	Variable Speed Pool Pump	SF	N/A	MO	1,363.5	86%	1,172.6	2.068	10.0	$750.00	$300.00	7.62	Installation of variable speed pool pump
6005	Miscellaneous	Pool Timer	SF	N/A	Retrofit	0.0	0%	129.0	0.063	25.0	$115.00	$30.00	6.38	Installation of pool pump timer
6006	Miscellaneous	Well Pump	SF	N/A	MO	0.0	0%	187.0	0.022	20.0	$110.00	$30.00	4.80	Installation of high efficiency well pump in place of typical efficiency unit
6007	Miscellaneous	Pool Heater	SF	N/A	NC	9,785.1	12%	1,173.5	0.000	10.0	$3,333.33	$1,000.00	0.39	Installation of high efficiency pool pump heater
6008	Miscellaneous	Pool Heater - Solar System	SF	N/A	NC	9,785.1	35%	3,437.0	0.000	10.0	$3,500.00	$1,000.00	1.14	Installation of a solar pool heater instead of a conventional pool heater
6009	Miscellaneous	Hot Tub/Spa	SF	N/A	NC	0.0	0%	417.3	0.048	15.0	$350.00	$110.00	2.35	Installation of an efficient hot tub / spa
6010	Miscellaneous	Variable Speed Pool Pump	SF	N/A	NC	1,363.5	86%	1,172.6	2.068	10.0	$750.00	$300.00	7.62	Installation of variable speed pool pump
6011	Miscellaneous	Pool Timer	SF	N/A	NC	0.0	0%	108.3	0.063	25.0	$50.00	$20.00	8.85	Installation of pool pump timer
6012	Miscellaneous	Well Pump	SF	N/A	NC	0.0	0%	187.0	0.022	20.0	$110.00	$30.00	4.80	Installation of high efficiency well pump in place of typical efficiency unit
7001	New Construction	Gold Star: HERS Index Score ≤ 63 - Electric Heated	SF	N/A	NC	15,337.8	37%	5,675.0	0.824	25.0	$2,504.19	$700.00	6.78	Construction of home meeting Gold Star standard (HERS <=63)
7002	New Construction	Platinum Star: HERS Index Score ≤ 60 - Electric Heated	SF	N/A	NC	15,337.8	40%	6,135.1	0.891	25.0	$3,079.19	$800.00	6.41	Construction of home meeting Platinum Star standard (HERS <=60)
7003	New Construction	Gold Star: HERS Index Score ≤ 63 - Electric Heated	MF	N/A	NC	10,959.2	37%	4,054.9	0.491	25.0	$2,504.19	$1,000.00	3.32	Construction of home meeting Gold Star standard (HERS <=63)
7004	New Construction	Platinum Star: HERS Index Score ≤ 60 - Electric Heated	MF	N/A	NC	10,959.2	40%	4,383.7	0.531	25.0	$3,079.19	$1,000.00	3.59	Construction of home meeting Platinum Star standard (HERS <=60)
7005	New Construction	Gold Star: HERS Index Score ≤ 63 - Gas Heated	SF	N/A	NC	8,582.1	37%	3,175.4	0.904	25.0	$1,573.27	$175.00	23.67	Construction of home meeting Gold Star standard (HERS <=63)
7006	New Construction	Platinum Star: HERS Index Score ≤ 60 - Gas Heated	SF	N/A	NC	8,582.1	40%	3,432.8	0.977	25.0	$1,778.27	$200.00	22.40	Construction of home meeting Platinum Star standard (HERS <=60)
7007	New Construction	Gold Star: HERS Index Score ≤ 63 - Gas Heated	MF	N/A	NC	10,165.2	37%	3,761.1	0.605	25.0	$1,573.27	$775.00	4.72	Construction of home meeting Gold Star standard (HERS <=63)
7008	New Construction	Platinum Star: HERS Index Score ≤ 60 - Gas Heated	MF	N/A	NC	10,165.2	40%	4,066.1	0.655	25.0	$1,778.27	$900.00	4.40	Construction of home meeting Platinum Star standard (HERS <=60)
8001	Plug Loads	Smart Power Strips - Tier 1	SF	NLI	Retrofit	197.0	12%	23.0	0.003	4.0	$35.00	$35.00	0.10	Use of a smart strip instead of a standard power strip
8002	Plug Loads	Smart Power Strips - Tier 1	SF	LI	DI	197.0	12%	23.0	0.003	4.0	$35.00	$35.00	0.10	Use of a smart strip instead of a standard power strip
8003	Plug Loads	Efficient Laptop	SF	N/A	MO	50.3	72%	36.0	0.004	4.0	$8.00	$5.00	1.22	Installation of high-efficiency laptop computers in homes with laptop computers
8004	Plug Loads	Efficient Monitor	SF	N/A	MO	66.2	61%	40.2	0.020	5.0	$10.00	$5.00	3.83	Installation of high-efficiency displays (50% more efficient than ENERGY STAR minimum spec) for desktop computers in homes with desktop computers
8005	Plug Loads	Efficient Personal Computer	SF	N/A	MO	238.5	32%	77.0	0.023	4.0	$8.00	$5.00	3.34	Installation of high-efficiency desktop computers in homes with desktop computers

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
8006	Plug Loads	Efficient Multifunction	SF	N/A	MO	70.1	66%	46.4	0.011	6.0	$1.00	$5.00	2.71	Installation of high efficiency multifunction device instead of a standard efficiency unit
8007	Plug Loads	Efficient TV	SF	N/A	MO	664.4	27%	179.4	0.098	6.0	$10.00	$5.00	10.48	ENERGY STAR 7.0 television
8008	Plug Loads	Smart Television	SF	N/A	MO	664.4	27%	179.4	0.098	6.0	$10.00	$5.00	10.48	ENERGY STAR 7.0 television
8009	Plug Loads	Smart Power Strips - Tier 2	SF	N/A	Retrofit	678.0	36%	244.1	0.028	4.0	$80.00	$20.00	1.92	Use of a advanced power strip instead of a standard power strip
8010	Plug Loads	Smart Plug or Outlet_ET	SF	N/A	Retrofit	678.0	0%	0.0	0.000	4.0	$20.00	$10.00	0.00	Installation of smart plug to control plug loads
8011	Plug Loads	Efficient Laptop	SF	N/A	NC	50.3	72%	36.0	0.004	4.0	$8.00	$5.00	1.22	Installation of high-efficiency laptop computers in homes with laptop computers
8012	Plug Loads	Efficient Monitor	SF	N/A	NC	66.2	61%	40.2	0.020	5.0	$10.00	$5.00	3.83	Installation of high-efficiency displays (50% more efficient than ENERGY STAR minimum spec) for desktop computers in homes with desktop computers
8013	Plug Loads	Efficient Personal Computer	SF	N/A	NC	238.5	32%	77.0	0.023	4.0	$8.00	$5.00	3.34	Installation of high-efficiency desktop computers in homes with desktop computers
8014	Plug Loads	Efficient Multifunction	SF	N/A	NC	70.1	66%	46.4	0.011	6.0	$1.00	$5.00	2.71	Installation of high efficiency multifunction device instead of a standard efficiency unit
8015	Plug Loads	Efficient TV	SF	N/A	NC	664.4	27%	179.4	0.098	6.0	$10.00	$5.00	10.48	ENERGY STAR 7.0 television
8016	Plug Loads	Smart Television	SF	N/A	NC	664.4	27%	179.4	0.098	6.0	$10.00	$5.00	10.48	ENERGY STAR 7.0 television
8017	Plug Loads	Smart Power Strips - Tier 1	SF	N/A	NC	197.0	12%	23.0	0.003	4.0	$35.00	$35.00	0.10	Use of a smart strip instead of a standard power strip
8018	Plug Loads	Smart Power Strips - Tier 2	SF	N/A	NC	678.0	36%	244.1	0.028	4.0	$80.00	$20.00	1.92	Use of a advanced power strip instead of a standard power strip
8019	Plug Loads	Smart Plug or Outlet_ET	SF	N/A	NC	678.0	0%	0.0	0.000	4.0	$20.00	$10.00	0.00	Installation of smart plug to control plug loads
8020	Plug Loads	Smart Power Strips - Tier 1	MF	NLI	Retrofit	197.0	12%	23.0	0.003	4.0	$35.00	$35.00	0.10	Use of a smart strip instead of a standard power strip
8021	Plug Loads	Smart Power Strips - Tier 1	MF	LI	DI	197.0	12%	23.0	0.003	4.0	$35.00	$35.00	0.10	Use of a smart strip instead of a standard power strip
8022	Plug Loads	Efficient Laptop	MF	N/A	MO	50.3	72%	36.0	0.004	4.0	$8.00	$5.00	1.22	Installation of high-efficiency laptop computers in homes with laptop computers
8023	Plug Loads	Efficient Monitor	MF	N/A	MO	66.2	61%	40.2	0.020	5.0	$10.00	$5.00	3.83	Installation of high-efficiency displays (50% more efficient than ENERGY STAR minimum spec) for desktop computers in homes with desktop computers
8024	Plug Loads	Efficient Personal Computer	MF	N/A	MO	238.5	32%	77.0	0.023	4.0	$8.00	$5.00	3.34	Installation of high-efficiency desktop computers in homes with desktop computers
8025	Plug Loads	Efficient Multifunction	MF	N/A	MO	70.1	66%	46.4	0.011	6.0	$1.00	$5.00	2.71	Installation of high efficiency multifunction device instead of a standard efficiency unit
8026	Plug Loads	Efficient TV	MF	N/A	MO	664.4	27%	179.4	0.098	6.0	$10.00	$5.00	10.48	ENERGY STAR 7.0 television
8027	Plug Loads	Smart Television	MF	N/A	MO	664.4	27%	179.4	0.098	6.0	$10.00	$5.00	10.48	ENERGY STAR 7.0 television
8028	Plug Loads	Smart Power Strips - Tier 2	MF	N/A	Retrofit	678.0	36%	244.1	0.028	4.0	$80.00	$20.00	1.92	Use of a advanced power strip instead of a standard power strip
8029	Plug Loads	Smart Plug or Outlet_ET	MF	N/A	Retrofit	678.0	0%	0.0	0.000	4.0	$20.00	$10.00	0.00	Installation of smart plug to control plug loads

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
8030	Plug Loads	Efficient Laptop	MF	N/A	NC	50.3	72%	36.0	0.004	4.0	$8.00	$5.00	1.22	Installation of high-efficiency laptop computers in homes with laptop computers
8031	Plug Loads	Efficient Monitor	MF	N/A	NC	66.2	61%	40.2	0.020	5.0	$10.00	$5.00	3.83	Installation of high-efficiency displays (50% more efficient than ENERGY STAR minimum spec) for desktop computers in homes with desktop computers
8032	Plug Loads	Efficient Personal Computer	MF	N/A	NC	238.5	32%	77.0	0.023	4.0	$8.00	$5.00	3.34	Installation of high-efficiency desktop computers in homes with desktop computers
8033	Plug Loads	Efficient Multifunction	MF	N/A	NC	70.1	66%	46.4	0.011	6.0	$1.00	$5.00	2.71	Installation of high efficiency multifunction device instead of a standard efficiency unit
8034	Plug Loads	Efficient TV	MF	N/A	NC	664.4	27%	179.4	0.098	6.0	$10.00	$5.00	10.48	ENERGY STAR 7.0 television
8035	Plug Loads	Smart Television	MF	N/A	NC	664.4	27%	179.4	0.098	6.0	$10.00	$5.00	10.48	ENERGY STAR 7.0 television
8036	Plug Loads	Smart Power Strips - Tier 1	MF	N/A	NC	197.0	12%	23.0	0.003	4.0	$35.00	$35.00	0.10	Use of a smart strip instead of a standard power strip
8037	Plug Loads	Smart Power Strips - Tier 2	MF	N/A	NC	678.0	36%	244.1	0.028	4.0	$80.00	$20.00	1.92	Use of a advanced power strip instead of a standard power strip
8038	Plug Loads	Smart Plug or Outlet_ET	MF	N/A	NC	678.0	0%	0.0	0.000	4.0	$20.00	$10.00	0.00	Installation of smart plug to control plug loads
9001	HVAC Shell	Duct Sealing - Average Sealing - Heat pump	SF	NLI	Retrofit	7,269.4	3%	242.8	0.064	20.0	$200.00	$175.00	1.14	15% to 10% leakage
9002	HVAC Shell	Duct Sealing - Inadequate Sealing - Heat pump	SF	NLI	Retrofit	7,376.9	5%	397.5	0.158	20.0	$350.00	$300.00	1.21	20% to 15% leakage
9003	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Heat pump	SF	NLI	Retrofit	7,502.4	14%	1,013.0	0.414	20.0	$1,442.50	$1,000.00	0.94	25% to 15% leakage
9004	HVAC Shell	Wall Insulation - Heat pump	SF	NLI	Retrofit	8,887.1	29%	2,565.9	0.867	25.0	$2,746.80	$450.00	5.67	R0 to R11 wall insulation
9005	HVAC Shell	Air Sealing Average Sealing - Heat pump	SF	NLI	Retrofit	6,321.2	11%	709.6	0.179	15.0	$624.65	$200.00	2.32	10 ACH 50 to 7 ACH 50
9006	HVAC Shell	Air Sealing Inadequate Sealing - Heat pump	SF	NLI	Retrofit	7,284.2	13%	963.0	0.251	15.0	$967.20	$200.00	3.15	14 ACH 50 to 10 ACH 50
9007	HVAC Shell	Air Sealing Poor Sealing - Heat pump	SF	NLI	Retrofit	8,949.1	19%	1,664.9	0.389	15.0	$967.20	$200.00	5.46	20 ACH 50 to 14 ACH 50
9008	HVAC Shell	Attic Insulation - Average Insulation - Heat pump	SF	NLI	Retrofit	6,321.2	3%	190.5	0.067	25.0	$1,259.70	$450.00	0.43	R30 to R60
9009	HVAC Shell	Attic Insulation - Inadequate Insulation - Heat pump	SF	NLI	Retrofit	6,568.9	7%	438.2	0.172	25.0	$1,744.20	$450.00	1.04	R19 to R60
9010	HVAC Shell	Attic Insulation - Poor Insulation - Heat pump	SF	NLI	Retrofit	6,932.3	11%	761.0	0.321	25.0	$1,550.40	$450.00	1.84	R11 to R49
9011	HVAC Shell	Duct Sealing - Average Sealing - Electric furnace	SF	NLI	Retrofit	13,437.5	3%	411.6	0.036	20.0	$200.00	$175.00	1.59	15% to 10% leakage
9012	HVAC Shell	Duct Sealing - Inadequate Sealing - Electric furnace	SF	NLI	Retrofit	13,620.9	5%	677.9	0.109	20.0	$350.00	$300.00	1.65	20% to 15% leakage
9013	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Electric furnace	SF	NLI	Retrofit	13,842.1	13%	1,759.1	0.282	20.0	$1,442.50	$1,000.00	1.29	25% to 15% leakage
9014	HVAC Shell	Wall Insulation - Electric furnace	SF	NLI	Retrofit	17,267.5	32%	5,582.7	0.887	25.0	$2,746.80	$450.00	10.41	R0 to R11 wall insulation
9015	HVAC Shell	Air Sealing Average Sealing - Electric furnace	SF	NLI	Retrofit	11,684.8	14%	1,598.5	0.215	15.0	$624.65	$200.00	4.58	10 ACH 50 to 7 ACH 50
9016	HVAC Shell	Air Sealing Inadequate Sealing - Electric furnace	SF	NLI	Retrofit	13,876.8	16%	2,192.0	0.294	15.0	$967.20	$200.00	6.27	14 ACH 50 to 10 ACH 50
9017	HVAC Shell	Air Sealing Poor Sealing - Electric furnace	SF	NLI	Retrofit	17,296.5	20%	3,419.8	0.378	15.0	$967.20	$200.00	9.63	20 ACH 50 to 14 ACH 50

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
9018	HVAC Shell	Attic Insulation - Average Insulation - Electric furnace	SF	NLI	Retrofit	11,684.8	3%	349.3	0.052	25.0	$1,259.70	$450.00	0.65	R30 to R60
9019	HVAC Shell	Attic Insulation - Inadequate Insulation - Electric furnace	SF	NLI	Retrofit	12,144.6	7%	809.2	0.133	25.0	$1,744.20	$450.00	1.53	R19 to R60
9020	HVAC Shell	Attic Insulation - Poor Insulation - Electric furnace	SF	NLI	Retrofit	12,884.7	11%	1,476.9	0.278	25.0	$1,550.40	$450.00	2.87	R11 to R49
9021	HVAC Shell	Duct Sealing - Average Sealing - Heat pump	SF	LI	DI	7,269.4	3%	242.8	0.064	20.0	$200.00	$200.00	1.00	15% to 10% leakage
9022	HVAC Shell	Duct Sealing - Inadequate Sealing - Heat pump	SF	LI	DI	7,376.9	5%	397.5	0.158	20.0	$350.00	$350.00	1.04	20% to 15% leakage
9023	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Heat pump	SF	LI	DI	7,502.4	14%	1,013.0	0.414	20.0	$1,442.50	$1,442.50	0.65	25% to 15% leakage
9024	HVAC Shell	Wall Insulation - Heat pump	SF	LI	DI	8,887.1	29%	2,565.9	0.867	25.0	$2,746.80	$2,746.80	0.93	R0 to R11 wall insulation
9025	HVAC Shell	Air Sealing Average Sealing - Heat pump	SF	LI	DI	6,321.2	11%	709.6	0.179	15.0	$624.65	$624.65	0.74	10 ACH 50 to 7 ACH 50
9026	HVAC Shell	Air Sealing Inadequate Sealing - Heat pump	SF	LI	DI	7,284.2	13%	963.0	0.251	15.0	$967.20	$967.20	0.65	14 ACH 50 to 10 ACH 50
9027	HVAC Shell	Air Sealing Poor Sealing - Heat pump	SF	LI	DI	8,949.1	19%	1,664.9	0.389	15.0	$967.20	$967.20	1.13	20 ACH 50 to 14 ACH 50
9028	HVAC Shell	Attic Insulation - Average Insulation - Heat pump	SF	LI	DI	6,321.2	3%	190.5	0.067	25.0	$1,259.70	$1,259.70	0.16	R30 to R60
9029	HVAC Shell	Attic Insulation - Inadequate Insulation - Heat pump	SF	LI	DI	6,568.9	7%	438.2	0.172	25.0	$1,744.20	$1,744.20	0.27	R19 to R60
9030	HVAC Shell	Attic Insulation - Poor Insulation - Heat pump	SF	LI	DI	6,932.3	11%	761.0	0.3	25.0	$1,550.40	$1,550.40	0.53	R11 to R49
9031	HVAC Shell	Duct Sealing - Average Sealing - Electric furnace	SF	LI	DI	13,437.5	3%	411.6	0.036	20.0	$200.00	$200.00	1.39	15% to 10% leakage
9032	HVAC Shell	Duct Sealing - Inadequate Sealing - Electric furnace	SF	LI	DI	13,620.9	5%	677.9	0.109	20.0	$350.00	$350.00	1.42	20% to 15% leakage
9033	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Electric furnace	SF	LI	DI	13,842.1	13%	1,759.1	0.282	20.0	$1,442.50	$1,442.50	0.89	25% to 15% leakage
9034	HVAC Shell	Wall Insulation - Electric furnace	SF	LI	DI	17,267.5	32%	5,582.7	0.887	25.0	$2,746.80	$2,746.80	1.71	R0 to R11 wall insulation
9035	HVAC Shell	Air Sealing Average Sealing - Electric furnace	SF	LI	DI	11,684.8	14%	1,598.5	0.215	15.0	$624.65	$624.65	1.47	10 ACH 50 to 7 ACH 50
9036	HVAC Shell	Air Sealing Inadequate Sealing - Electric furnace	SF	LI	DI	13,876.8	16%	2,192.0	0.294	15.0	$967.20	$967.20	1.30	14 ACH 50 to 10 ACH 50
9037	HVAC Shell	Air Sealing Poor Sealing - Electric furnace	SF	LI	DI	17,296.5	20%	3,419.8	0.378	15.0	$967.20	$967.20	1.99	20 ACH 50 to 14 ACH 50
9038	HVAC Shell	Attic Insulation - Average Insulation - Electric furnace	SF	LI	DI	11,684.8	3%	349.3	0.052	25.0	$1,259.70	$1,259.70	0.23	R30 to R60
9039	HVAC Shell	Attic Insulation - Inadequate Insulation - Electric furnace	SF	LI	DI	12,144.6	7%	809.2	0.133	25.0	$1,744.20	$1,744.20	0.40	R19 to R60
9040	HVAC Shell	Attic Insulation - Poor Insulation - Electric furnace	SF	LI	DI	12,884.7	11%	1,476.9	0.278	25.0	$1,550.40	$1,550.40	0.83	R11 to R49
9041	HVAC Shell	Radiant Barrier - Heat pump	SF	N/A	Retrofit	6,321.2	1%	82.5	0.1	20.0	$416.67	$130.00	0.90	Installation of radiant barrier
9042	HVAC Shell	Cool Roof - Heat pump	SF	N/A	Retrofit	6,321.2	2%	111.1	0.1	20.0	$3,876.00	$1,000.00	0.18	Installation of cool roof
9043	HVAC Shell	Wall Sheathing - Heat pump	SF	N/A	Retrofit	6,321.2	14%	879.9	0.269	20.0	$2,943.00	$1,000.00	0.77	R12 polyiso
9044	HVAC Shell	ENERGY STAR Windows - Heat pump	SF	N/A	Retrofit	6,321.2	9%	548.8	0.372	25.0	$13,601.25	$1,000.00	0.74	U=0.30; SHGC=0.40
9045	HVAC Shell	Basement Sidewall Insulation - Heat pump	SF	N/A	Retrofit	6,678.1	5%	356.9	0.033	25.0	$2,720.00	$1,000.00	0.28	R0 to R13 sidewall insulation

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
9046	HVAC Shell	Floor Insulation Above Crawlspace - Heat pump	SF	N/A	Retrofit	6,359.1	1%	37.9	-0.044	25.0	$316.20	$90.00	0.00	R13 floor insulation
9047	HVAC Shell	ENERGY STAR Door - Heat pump	SF	N/A	Retrofit	6,321.2	2%	129.9	0.046	25.0	$388.00	$120.00	1.10	Fiberglasss
9048	HVAC Shell	Smart Window Coverings - Shade/Blind/Controller/Sensor - Heat pump_ET	SF	N/A	Retrofit	6,321.2	16%	979.8	0.471	7.0	$14,875.00	$1,000.00	0.41	Smart shades
9049	HVAC Shell	Smart Window Coverings - Film/Transformer - Heat pump_ET	SF	N/A	Retrofit	6,321.2	16%	979.8	0.471	7.0	$8,160.75	$1,000.00	0.41	Smart films
9050	HVAC Shell	Radiant Barrier - Electric furnace	SF	N/A	Retrofit	11,684.8	1%	102.2	0.065	20.0	$416.67	$130.00	0.91	Installation of radiant barrier
9051	HVAC Shell	Cool Roof - Electric furnace	SF	N/A	Retrofit	11,684.8	0%	-21.1	0.079	20.0	$3,876.00	$1,000.00	0.06	Installation of cool roof
9052	HVAC Shell	Wall Sheathing - Electric furnace	SF	N/A	Retrofit	11,684.8	16%	1,837.2	0.2	20.0	$2,943.00	$1,000.00	1.31	R12 polyiso
9053	HVAC Shell	ENERGY STAR Windows - Electric furnace	SF	N/A	Retrofit	11,684.8	7%	798.3	0.3	25.0	$13,601.25	$1,000.00	0.89	U=0.30; SHGC=0.40
9054	HVAC Shell	Basement Sidewall Insulation - Electric furnace	SF	N/A	Retrofit	12,616.3	7%	931.6	0.031	25.0	$2,720.00	$1,000.00	0.67	R0 to R13 sidewall insulation
9055	HVAC Shell	Floor Insulation Above Crawlspace - Electric furnace	SF	N/A	Retrofit	11,922.5	2%	237.7	-0.028	25.0	$316.20	$90.00	1.54	R13 floor insulation
9056	HVAC Shell	ENERGY STAR Door - Electric furnace	SF	N/A	Retrofit	11,684.8	2%	227.3	0.035	25.0	$388.00	$120.00	1.58	Fiberglasss
9057	HVAC Shell	Smart Window Coverings - Shade/Blind/Controller/Sensor - Electric furnace_ET	SF	N/A	Retrofit	11,684.8	16%	1,811.1	0.498	7.0	$14,875.00	$1,000.00	0.62	Smart shades
9058	HVAC Shell	Smart Window Coverings - Film/Transformer - Electric furnace_ET	SF	N/A	Retrofit	11,684.8	16%	1,811.1	0.498	7.0	$8,160.75	$1,000.00	0.62	Smart films
9059	HVAC Shell	Duct Sealing - Average Sealing - Heat pump	MF	NLI	Retrofit	3,646.6	8%	300.6	0.140	20.0	$200.00	$175.00	1.81	15% to 10% leakage
9060	HVAC Shell	Duct Sealing - Inadequate Sealing - Heat pump	MF	NLI	Retrofit	3,815.6	16%	624.5	0.281	20.0	$350.00	$300.00	2.20	20% to 15% leakage
9061	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Heat pump	MF	NLI	Retrofit	4,021.6	41%	1,630.6	0.741	20.0	$981.00	$500.00	3.46	25% to 15% leakage
9062	HVAC Shell	Wall Insulation - Heat pump	MF	NLI	Retrofit	4,066.7	22%	895.7	0.261	25.0	$1,159.20	$450.00	2.04	R0 to R11 wall insulation
9063	HVAC Shell	Air Sealing Average Sealing - Heat pump	MF	NLI	Retrofit	3,171.0	7%	207.6	0.0	15.0	$309.69	$200.00	0.57	10 ACH 50 to 7 ACH 50
9064	HVAC Shell	Air Sealing Inadequate Sealing - Heat pump	MF	NLI	Retrofit	3,580.6	11%	409.6	0.1	15.0	$479.52	$200.00	1.35	14 ACH 50 to 10 ACH 50
9065	HVAC Shell	Air Sealing Poor Sealing - Heat pump	MF	NLI	Retrofit	4,306.5	17%	725.9	0.152	15.0	$479.52	$200.00	2.42	20 ACH 50 to 14 ACH 50
9066	HVAC Shell	Attic Insulation - Average Insulation - Heat pump	MF	NLI	Retrofit	3,171.0	3%	102.4	0.045	25.0	$1,298.70	$450.00	0.27	R30 to R60
9067	HVAC Shell	Attic Insulation - Inadequate Insulation - Heat pump	MF	NLI	Retrofit	3,295.1	7%	226.5	0.101	25.0	$1,798.20	$450.00	0.60	R19 to R60
9068	HVAC Shell	Attic Insulation - Poor Insulation - Heat pump	MF	NLI	Retrofit	3,479.2	11%	393.2	0.178	25.0	$1,598.40	$450.00	1.04	R11 to R49
9069	HVAC Shell	Duct Sealing - Average Sealing - Electric furnace	MF	NLI	Retrofit	5,719.1	8%	457.5	0.203	20.0	$200.00	$175.00	2.71	15% to 10% leakage
9070	HVAC Shell	Duct Sealing - Inadequate Sealing - Electric furnace	MF	NLI	Retrofit	5,935.5	13%	799.9	0.319	20.0	$350.00	$300.00	2.68	20% to 15% leakage
9071	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Electric furnace	MF	NLI	Retrofit	6,195.8	33%	2,072.8	0.861	20.0	$981.00	$500.00	4.24	25% to 15% leakage

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
9072	HVAC Shell	Wall Insulation - Electric furnace	MF	NLI	Retrofit	6,808.6	27%	1,835.5	0.274	25.0	$1,159.20	$450.00	3.52	R0 to R11 wall insulation
9073	HVAC Shell	Air Sealing Average Sealing - Electric furnace	MF	NLI	Retrofit	4,973.1	11%	531.4	0.025	15.0	$309.69	$200.00	1.38	10 ACH 50 to 7 ACH 50
9074	HVAC Shell	Air Sealing Inadequate Sealing - Electric furnace	MF	NLI	Retrofit	5,850.0	15%	876.9	0.094	15.0	$479.52	$200.00	2.50	14 ACH 50 to 10 ACH 50
9075	HVAC Shell	Air Sealing Poor Sealing - Electric furnace	MF	NLI	Retrofit	7,325.7	20%	1,475.7	0.162	15.0	$479.52	$200.00	4.26	20 ACH 50 to 14 ACH 50
9076	HVAC Shell	Attic Insulation - Average Insulation - Electric furnace	MF	NLI	Retrofit	4,973.1	4%	200.1	0.063	25.0	$1,298.70	$450.00	0.46	R30 to R60
9077	HVAC Shell	Attic Insulation - Inadequate Insulation - Electric furnace	MF	NLI	Retrofit	5,177.1	8%	404.1	0.123	25.0	$1,798.20	$450.00	0.92	R19 to R60
9078	HVAC Shell	Attic Insulation - Poor Insulation - Electric furnace	MF	NLI	Retrofit	5,506.9	13%	695.7	0.205	25.0	$1,598.40	$450.00	1.58	R11 to R49
9079	HVAC Shell	Duct Sealing - Average Sealing - Heat pump	MF	LI	DI	3,646.6	8%	300.6	0.140	20.0	$200.00	$200.00	1.58	15% to 10% leakage
9080	HVAC Shell	Duct Sealing - Inadequate Sealing - Heat pump	MF	LI	DI	3,815.6	16%	624.5	0.281	20.0	$350.00	$350.00	1.89	20% to 15% leakage
9081	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Heat pump	MF	LI	DI	4,021.6	41%	1,630.6	0.741	20.0	$981.00	$981.00	1.76	25% to 15% leakage
9082	HVAC Shell	Wall Insulation - Heat pump	MF	LI	DI	4,066.7	22%	895.7	0.261	25.0	$1,159.20	$1,159.20	0.79	R0 to R11 wall insulation
9083	HVAC Shell	Air Sealing Average Sealing - Heat pump	MF	LI	DI	3,171.0	7%	207.6	0.017	15.0	$309.69	$309.69	0.37	10 ACH 50 to 7 ACH 50
9084	HVAC Shell	Air Sealing Inadequate Sealing - Heat pump	MF	LI	DI	3,580.6	11%	409.6	0.087	15.0	$479.52	$479.52	0.56	14 ACH 50 to 10 ACH 50
9085	HVAC Shell	Air Sealing Poor Sealing - Heat pump	MF	LI	DI	4,306.5	17%	725.9	0.152	15.0	$479.52	$479.52	1.01	20 ACH 50 to 14 ACH 50
9086	HVAC Shell	Attic Insulation - Average Insulation - Heat pump	MF	LI	DI	3,171.0	3%	102.4	0.045	25.0	$1,298.70	$1,298.70	0.09	R30 to R60
9087	HVAC Shell	Attic Insulation - Inadequate Insulation - Heat pump	MF	LI	DI	3,295.1	7%	226.5	0.101	25.0	$1,798.20	$1,798.20	0.15	R19 to R60
9088	HVAC Shell	Attic Insulation - Poor Insulation - Heat pump	MF	LI	DI	3,479.2	11%	393.2	0.178	25.0	$1,598.40	$1,598.40	0.29	R11 to R49
9089	HVAC Shell	Duct Sealing - Average Sealing - Electric furnace	MF	LI	DI	5,719.1	8%	457.5	0.203	20.0	$200.00	$200.00	2.37	15% to 10% leakage
9090	HVAC Shell	Duct Sealing - Inadequate Sealing - Electric furnace	MF	LI	DI	5,935.5	13%	799.9	0.319	20.0	$350.00	$350.00	2.30	20% to 15% leakage
9091	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Electric furnace	MF	LI	DI	6,195.8	33%	2,072.8	0.861	20.0	$981.00	$981.00	2.16	25% to 15% leakage
9092	HVAC Shell	Wall Insulation - Electric furnace	MF	LI	DI	6,808.6	27%	1,835.5	0.274	25.0	$1,159.20	$1,159.20	1.36	R0 to R11 wall insulation
9093	HVAC Shell	Air Sealing Average Sealing - Electric furnace	MF	LI	DI	4,973.1	11%	531.4	0.025	15.0	$309.69	$309.69	0.89	10 ACH 50 to 7 ACH 50
9094	HVAC Shell	Air Sealing Inadequate Sealing - Electric furnace	MF	LI	DI	5,850.0	15%	876.9	0.094	15.0	$479.52	$479.52	1.04	14 ACH 50 to 10 ACH 50
9095	HVAC Shell	Air Sealing Poor Sealing - Electric furnace	MF	LI	DI	7,325.7	20%	1,475.7	0.162	15.0	$479.52	$479.52	1.78	20 ACH 50 to 14 ACH 50
9096	HVAC Shell	Attic Insulation - Average Insulation - Electric furnace	MF	LI	DI	4,973.1	4%	200.1	0.063	25.0	$1,298.70	$1,298.70	0.16	R30 to R60
9097	HVAC Shell	Attic Insulation - Inadequate Insulation - Electric furnace	MF	LI	DI	5,177.1	8%	404.1	0.123	25.0	$1,798.20	$1,798.20	0.23	R19 to R60
9098	HVAC Shell	Attic Insulation - Poor Insulation - Electric furnace	MF	LI	DI	5,506.9	13%	695.7	0.205	25.0	$1,598.40	$1,598.40	0.44	R11 to R49
9099	HVAC Shell	Radiant Barrier - Heat pump	MF	N/A	Retrofit	3,171.0	-6%	-202.0	-0.062	20.0	$429.57	$130.00	0.00	Installation of radiant barrier

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
9100	HVAC Shell	Cool Roof - Heat pump	MF	N/A	Retrofit	3,171.0	-22%	-698.2	-0.120	20.0	$3,996.00	$1,000.00	0.00	Installation of cool roof
9101	HVAC Shell	Wall Sheathing - Heat pump	MF	N/A	Retrofit	3,171.0	10%	311.5	0.091	25.0	$1,242.00	$625.00	0.50	R12 polyiso
9102	HVAC Shell	ENERGY STAR Windows - Heat pump	MF	N/A	Retrofit	3,171.0	8%	266.8	0.162	25.0	$6,743.25	$1,000.00	0.35	U=0.30; SHGC=0.40
9103	HVAC Shell	Basement Sidewall Insulation - Heat pump	MF	N/A	Retrofit	3,477.9	9%	306.9	0.064	25.0	$2,815.20	$1,000.00	0.28	R0 to R13 sidewall insulation
9104	HVAC Shell	Floor Insulation Above Crawlspace - Heat pump	MF	N/A	Retrofit	3,277.2	3%	106.2	0.201	25.0	$849.15	$425.00	0.23	R13 floor insulation
9105	HVAC Shell	Smart Window Coverings - Shade/Blind/Controller/Sensor - Heat pump_ET	MF	N/A	Retrofit	3,171.0	16%	491.5	0.211	7.0	$8,500.00	$1,000.00	0.22	Smart shades
9106	HVAC Shell	Smart Window Coverings - Film/Transformer - Heat pump_ET	MF	N/A	Retrofit	3,171.0	16%	491.5	0.211	7.0	$4,045.95	$1,000.00	0.22	Smart films
9107	HVAC Shell	Radiant Barrier - Electric furnace	MF	N/A	Retrofit	4,973.1	-6%	-281.8	-0.073	20.0	$429.57	$130.00	0.00	Installation of radiant barrier
9108	HVAC Shell	Cool Roof - Electric furnace	MF	N/A	Retrofit	4,973.1	-33%	-1,661.4	-0.092	20.0	$3,996.00	$1,000.00	0.00	Installation of cool roof
9109	HVAC Shell	Wall Sheathing - Electric furnace	MF	N/A	Retrofit	4,973.1	13%	662.3	0.414	25.0	$1,242.00	$625.00	1.44	R12 polyiso
9110	HVAC Shell	ENERGY STAR Windows - Electric furnace	MF	N/A	Retrofit	4,973.1	8%	415.9	0.184	25.0	$6,743.25	$1,000.00	0.48	U=0.30; SHGC=0.40
9111	HVAC Shell	Basement Sidewall Insulation - Electric furnace	MF	N/A	Retrofit	5,634.1	12%	661.0	0.069	25.0	$2,815.20	$1,000.00	0.54	R0 to R13 sidewall insulation
9112	HVAC Shell	Floor Insulation Above Crawlspace - Electric furnace	MF	N/A	Retrofit	7,848.5	37%	2,875.4	-0.304	25.0	$849.15	$425.00	3.86	R13 floor insulation
9113	HVAC Shell	Smart Window Coverings - Shade/Blind/Controller/Sensor - Electric furnace_ET	MF	N/A	Retrofit	4,973.1	16%	770.8	0.238	7.0	$8,500.00	$1,000.00	0.30	Smart shades
9114	HVAC Shell	Smart Window Coverings - Film/Transformer - Electric furnace_ET	MF	N/A	Retrofit	4,973.1	16%	770.8	0.238	7.0	$4,045.95	$1,000.00	0.30	Smart films
9115	HVAC Shell	Duct Sealing - Average Sealing - Gas Heating	SF	NLI	Retrofit	3,380.5	5%	161.5	0.131	20.0	$200.00	$175.00	1.61	15% to 10% leakage
9116	HVAC Shell	Duct Sealing - Inadequate Sealing - Gas Heating	SF	NLI	Retrofit	3,442.6	7%	229.5	0.115	20.0	$350.00	$300.00	1.25	20% to 15% leakage
9117	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Gas Heating	SF	NLI	Retrofit	3,501.7	15%	526.8	0.297	20.0	$1,442.50	$1,000.00	0.91	25% to 15% leakage
9118	HVAC Shell	Wall Insulation - Gas Heating	SF	NLI	Retrofit	3,509.2	16%	569.6	0.541	25.0	$2,746.80	$450.00	6.29	R0 to R11 wall insulation
9119	HVAC Shell	Air Sealing - Average Sealing - Gas Heating	SF	NLI	Retrofit	2,939.6	7%	206.9	0.353	15.0	$624.65	$100.00	7.18	10 ACH 50 to 7 ACH 50
9120	HVAC Shell	Air Sealing - Inadequate Sealing - Gas Heating	SF	NLI	Retrofit	3,363.5	13%	423.9	0.392	15.0	$967.20	$100.00	10.02	14 ACH 50 to 10 ACH 50
9121	HVAC Shell	Air Sealing - Poor Sealing - Gas Heating	SF	NLI	Retrofit	4,030.0	17%	666.6	0.558	15.0	$967.20	$100.00	15.38	20 ACH 50 to 14 ACH 50
9122	HVAC Shell	Attic Insulation - Average Insulation - Gas Heating	SF	NLI	Retrofit	2,939.6	2%	62.9	0.076	25.0	$1,259.70	$450.00	0.48	R30 to R60
9123	HVAC Shell	Attic Insulation - Inadequate Insulation - Gas Heating	SF	NLI	Retrofit	2,997.7	4%	120.9	0.143	25.0	$1,744.20	$450.00	1.00	R19 to R60
9124	HVAC Shell	Attic Insulation - Poor Insulation - Gas Heating	SF	NLI	Retrofit	3,135.8	8%	241.1	0.225	25.0	$1,550.40	$450.00	1.81	R11 to R49
9125	HVAC Shell	Duct Sealing - Average Sealing - Gas Heating	SF	LI	DI	3,380.5	5%	161.5	0.131	20.0	$200.00	$200.00	1.41	15% to 10% leakage
9126	HVAC Shell	Duct Sealing - Inadequate Sealing - Gas Heating	SF	LI	DI	3,442.6	7%	229.5	0.115	20.0	$350.00	$350.00	1.08	20% to 15% leakage

Vectren Electric		Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
9127	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Gas Heating	SF	LI	DI	3,501.7	15%	526.8	0.297	20.0	$1,442.50	$1,442.50	0.63	25% to 15% leakage
9128	HVAC Shell	Wall Insulation - Gas Heating	SF	LI	DI	3,509.2	16%	569.6	0.541	25.0	$2,746.80	$2,746.80	1.03	R0 to R11 wall insulation
9129	HVAC Shell	Air Sealing - Average Sealing - Gas Heating	SF	LI	DI	2,939.6	7%	206.9	0.353	15.0	$624.65	$624.65	1.15	10 ACH 50 to 7 ACH 50
9130	HVAC Shell	Air Sealing - Inadequate Sealing - Gas Heating	SF	LI	DI	3,363.5	13%	423.9	0.392	15.0	$967.20	$967.20	1.04	14 ACH 50 to 10 ACH 50
9131	HVAC Shell	Air Sealing - Poor Sealing - Gas Heating	SF	LI	DI	4,030.0	17%	666.6	0.558	15.0	$967.20	$967.20	1.59	20 ACH 50 to 14 ACH 50
9132	HVAC Shell	Attic Insulation - Average Insulation - Gas Heating	SF	LI	DI	2,939.6	2%	62.9	0.076	25.0	$1,259.70	$1,259.70	0.17	R30 to R60
9133	HVAC Shell	Attic Insulation - Inadequate Insulation - Gas Heating	SF	LI	DI	2,997.7	4%	120.9	0.143	25.0	$1,744.20	$1,744.20	0.26	R19 to R60
9134	HVAC Shell	Attic Insulation - Poor Insulation - Gas Heating	SF	LI	DI	3,135.8	8%	241.1	0.225	25.0	$1,550.40	$1,550.40	0.52	R11 to R49
9135	HVAC Shell	Wall Sheathing - Gas Heating	SF	N/A	Retrofit	2,939.6	4%	125.1	0.192	25.0	$2,943.00	$1,000.00	0.92	R12 polyiso
9136	HVAC Shell	ENERGY STAR Windows - Gas Heating	SF	N/A	Retrofit	2,939.6	8%	249.6	0.535	25.0	$13,601.25	$1,000.00	0.76	U=0.30; SHGC=0.40
9137	HVAC Shell	Basement Sidewall Insulation - Gas Heating	SF	N/A	Retrofit	2,976.4	1%	36.8	0.036	25.0	$2,720.00	$1,000.00	0.48	R0 to R13 sidewall insulation
9138	HVAC Shell	Floor Insulation Above Crawlspace - Gas Heating	SF	N/A	Retrofit	2,908.9	-1%	-30.7	-0.036	25.0	$316.20	$90.00	0.73	R13 floor insulation
9139	HVAC Shell	ENERGY STAR Door - Gas Heating	SF	N/A	Retrofit	2,939.6	1%	34.6	0.052	25.0	$388.00	$120.00	1.25	Fiberglasss
9140	HVAC Shell	Smart Window Coverings - Shade/Blind/Controller/Sensor - Gas Heating_ET	SF	N/A	Retrofit	2,939.6	16%	455.6	0.531	7.0	$14,875.00	$1,000.00	0.53	Smart shades
9141	HVAC Shell	Smart Window Coverings - Film/Transformer - Gas Heating_ET	SF	N/A	Retrofit	2,939.6	16%	455.6	0.531	7.0	$8,160.75	$1,000.00	0.53	Smart films
9142	HVAC Shell	Duct Sealing - Average Sealing - Gas Heating	MF	NLI	Retrofit	2,487.5	26%	638.5	0.484	20.0	$200.00	$175.00	6.06	15% to 10% leakage
9143	HVAC Shell	Duct Sealing - Inadequate Sealing - Gas Heating	MF	NLI	Retrofit	2,631.4	20%	532.0	0.309	20.0	$350.00	$300.00	2.41	20% to 15% leakage
9144	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Gas Heating	MF	NLI	Retrofit	2,796.3	48%	1,342.7	0.788	20.0	$981.00	$500.00	3.67	25% to 15% leakage
9145	HVAC Shell	Wall Insulation - Gas Heating	MF	NLI	Retrofit	2,385.4	9%	222.4	0.221	25.0	$1,159.20	$450.00	2.12	R0 to R11 wall insulation
9146	HVAC Shell	Air Sealing - Average Sealing - Gas Heating	MF	NLI	Retrofit	2,163.0	9%	200.4	0.183	15.0	$309.69	$100.00	4.26	10 ACH 50 to 7 ACH 50
9147	HVAC Shell	Air Sealing - Inadequate Sealing - Gas Heating	MF	NLI	Retrofit	2,390.9	10%	227.9	0.162	15.0	$479.52	$100.00	5.01	14 ACH 50 to 10 ACH 50
9148	HVAC Shell	Air Sealing - Poor Sealing - Gas Heating	MF	NLI	Retrofit	2,758.6	13%	367.7	0.187	15.0	$479.52	$100.00	7.43	20 ACH 50 to 14 ACH 50
9149	HVAC Shell	Attic Insulation - Average Insulation - Gas Heating	MF	NLI	Retrofit	2,163.0	8%	172.1	0.145	25.0	$1,298.70	$450.00	0.86	R30 to R60
9150	HVAC Shell	Attic Insulation - Inadequate Insulation - Gas Heating	MF	NLI	Retrofit	2,203.0	10%	212.1	0.181	25.0	$1,798.20	$450.00	1.10	R19 to R60
9151	HVAC Shell	Attic Insulation - Poor Insulation - Gas Heating	MF	NLI	Retrofit	2,290.4	13%	291.6	0.245	25.0	$1,598.40	$450.00	1.51	R11 to R49
9152	HVAC Shell	Duct Sealing - Average Sealing - Gas Heating	MF	LI	DI	2,487.5	26%	638.5	0.484	20.0	$200.00	$200.00	5.30	15% to 10% leakage
9153	HVAC Shell	Duct Sealing - Inadequate Sealing - Gas Heating	MF	LI	DI	2,631.4	20%	532.0	0.309	20.0	$350.00	$350.00	2.06	20% to 15% leakage

Vectren Electric	Residential Measure Assumptions													
Measure #	End-Use	Measure Name	Home Type	Income Type	Replacement Type	Base Annual Electric	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	Historical Incentive Amount	UCT Ratio	Measure Description
9154	HVAC Shell	Duct Sealing/Insulation - Poor Sealing - Gas Heating	MF	LI	DI	2,796.3	48%	1,342.7	0.788	20.0	$981.00	$981.00	1.87	25% to 15% leakage
9155	HVAC Shell	Wall Insulation - Gas Heating	MF	LI	DI	2,385.4	9%	222.4	0.221	25.0	$1,159.20	$1,159.20	0.82	R0 to R11 wall insulation
9156	HVAC Shell	Air Sealing - Average Sealing - Gas Heating	MF	LI	DI	2,163.0	9%	200.4	0.183	15.0	$309.69	$309.69	1.38	10 ACH 50 to 7 ACH 50
9157	HVAC Shell	Air Sealing - Inadequate Sealing - Gas Heating	MF	LI	DI	2,390.9	10%	227.9	0.162	15.0	$479.52	$479.52	1.04	14 ACH 50 to 10 ACH 50
9158	HVAC Shell	Air Sealing - Poor Sealing - Gas Heating	MF	LI	DI	2,758.6	13%	367.7	0.187	15.0	$479.52	$479.52	1.55	20 ACH 50 to 14 ACH 50
9159	HVAC Shell	Attic Insulation - Average Insulation - Gas Heating	MF	LI	DI	2,163.0	8%	172.1	0.145	25.0	$1,298.70	$1,298.70	0.30	R30 to R60
9160	HVAC Shell	Attic Insulation - Inadequate Insulation - Gas Heating	MF	LI	DI	2,203.0	10%	212.1	0.181	25.0	$1,798.20	$1,798.20	0.28	R19 to R60
9161	HVAC Shell	Attic Insulation - Poor Insulation - Gas Heating	MF	LI	DI	2,290.4	13%	291.6	0.245	25.0	$1,598.40	$1,598.40	0.43	R11 to R49
9162	HVAC Shell	Wall Sheathing - Gas Heating	MF	N/A	Retrofit	2,163.0	9%	203.7	0.190	25.0	$1,242.00	$625.00	0.96	R12 polyiso
9163	HVAC Shell	ENERGY STAR Windows - Gas Heating	MF	N/A	Retrofit	2,163.0	13%	286.7	0.281	25.0	$6,743.25	$1,000.00	0.64	U=0.30; SHGC=0.40
9164	HVAC Shell	Basement Sidewall Insulation - Gas Heating	MF	N/A	Retrofit	2,293.7	2%	43.4	-0.002	25.0	$2,815.20	$1,000.00	0.26	R0 to R13 sidewall insulation
9165	HVAC Shell	Floor Insulation Above Crawlspace - Gas Heating	MF	N/A	Retrofit	2,157.6	-1%	-27.1	-0.019	25.0	$849.15	$425.00	0.02	R13 floor insulation
9166	HVAC Shell	Smart Window Coverings - Shade/Blind/Controller/Sensor - Gas Heating_ET	MF	N/A	Retrofit	2,163.0	16%	335.3	0.258	7.0	$8,500.00	$1,000.00	0.28	Smart shades
9167	HVAC Shell	Smart Window Coverings - Film/Transformer - Gas Heating_ET	MF	N/A	Retrofit	2,163.0	16%	335.3	0.258	7.0	$4,045.95	$1,000.00	0.28	Smart films
10001	Water Heating	Water Heater Wrap	SF	N/A	Retrofit	3,536.2	2%	80.4	0.009	5.0	$20.00	$20.00	0.98	Add WH Wrap to reduce standby losses (Electric Only)
10002	Water Heating	Water Heater Temperature Setback	SF	NLI	Retrofit	733.6	11%	81.5	0.009	15.0	$6.50	$6.50	8.11	WH Temp Setback from 135 to 120
10003	Water Heating	Water Heater Timer	SF	NLI	Retrofit	3,536.2	9%	318.0	0.036	15.0	$60.00	$30.00	6.85	Install Timer to turn off at night or other periods (Electric Only)
10004	Water Heating	Pipe Wrap	SF	NLI	Retrofit	3,536.2	3%	106.1	0.012	15.0	$1.72	$1.72	39.87	Adding Pipe Wrap to Uninsulated Pipes
10005	Water Heating	Heat Pump Water Heater	SF	N/A	MO	3,536.2	67%	2,368.0	0.935	10.0	$1,000.00	$300.00	3.59	Heat Pump Water Heater
10006	Water Heating	Solar Water Heater with Electric Backup	SF	N/A	MO	3,536.2	50%	1,777.0	0.702	10.0	$9,506.00	$2,850.00	0.26	Solar WH (EF=1.8)
10007	Water Heating	Smart Water Heater - Tank Controls and Sensors_ET	SF	N/A	Retrofit	3,536.2	15%	530.0	0.209	10.0	$120.00	$60.00	4.26	Smart WH Controls
10008	Water Heating	Bathroom Aerator 1.0 gpm	SF	NLI	Retrofit	49.8	47%	23.6	2.153	10.0	$0.52	$0.52	20.53	1.0 GPM Bathroom FA
10009	Water Heating	Kitchen Flip Aerator 1.5 gpm	SF	NLI	Retrofit	396.6	39%	152.8	2.114	10.0	$1.34	$1.34	43.53	1.5 GPM Kitchen FA
10010	Water Heating	Low Flow Showerhead 1.5 gpm	SF	NLI	Retrofit	611.2	43%	262.6	6.429	10.0	$3.32	$3.32	31.13	1.5 GPM Low Flow Showerhead
10011	Water Heating	Thermostatic Restrictor Shower Valve	SF	N/A	Retrofit	611.2	11%	69.7	2.302	10.0	$30.00	$15.00	1.93	Thermostatic Restrictor Shower Valve (on base flow device)
10012	Water Heating	Shower Timer	SF	N/A	Retrofit	611.2	9%	53.6	0.321	2.0	$5.00	$5.00	1.28	Shower Timer limit time to 5 mins (per shower)
10013	Water Heating	Drain water Heat Recovery	SF	N/A	Retrofit	3,536.2	25%	884.0	0.101	20.0	$742.00	$225.00	3.14	Drainpipe heat exchanger
10014	Water Heating	Desuperheater	SF	N/A	Retrofit	3,536.2	44%	1,556.0	0.178	25.0	$620.00	$185.00	7.69	Install Desuperheater (Paid with GSHP)
10015	Water Heating	Bathroom Aerator 1.0 gpm	SF	LI	DI	49.8	47%	23.6	2.153	10.0	$0.52	$0.52	20.53	1.0 GPM Bathroom FA
10016	Water Heating	Kitchen Flip Aerator 1.5 gpm	SF	LI	DI	396.6	39%	152.8	2.114	10.0	$1.34	$1.34	43.53	1.5 GPM Kitchen FA

Vectren Electric	Residential Measure Assumptions													
Measure #	**End-Use**	**Measure Name**	**Home Type**	**Income Type**	**Replacement Type**	**Base Annual Electric**	**% Elec Savings**	**Per Unit Elec Savings**	**Per Unit Summer NCP kW**	**Useful Life**	**Initial Measure Cost**	**Historical Incentive Amount**	**UCT Ratio**	**Measure Description**
10017	Water Heating	Low Flow Showerhead 1.5 gpm	SF	LI	DI	611.2	43%	262.6	6.429	10.0	$3.32	$3.32	31.13	1.5 GPM Low Flow Showerhead
10018	Water Heating	Pipe Wrap	SF	LI	DI	3,536.2	3%	106.1	0.012	15.0	$1.72	$1.72	39.87	Adding Pipe Wrap to Uninsulated Pipes
10019	Water Heating	Water Heater Temperature Setback	SF	LI	DI	733.6	11%	81.5	0.009	15.0	$6.50	$6.50	8.11	WH Temp Setback from 135 to 120
10020	Water Heating	Water Heater Temperature Setback	SF	N/A	NC	733.6	11%	81.5	0.009	15.0	$6.50	$6.50	8.11	WH Temp Setback from 135 to 120
10021	Water Heating	Water Heater Timer	SF	N/A	NC	3,536.2	9%	318.0	0.036	15.0	$60.00	$30.00	6.85	Install Timer to turn off at night or other periods (Electric Only)
10022	Water Heating	Pipe Wrap	SF	N/A	NC	3,536.2	3%	106.1	0.012	15.0	$1.72	$1.72	39.87	Adding Pipe Wrap to Uninsulated Pipes
10023	Water Heating	Heat Pump Water Heater	SF	N/A	NC	3,536.2	67%	2,368.0	0.935	10.0	$1,000.00	$300.00	3.59	Heat Pump Water Heater
10024	Water Heating	Solar Water Heater with Electric Backup	SF	N/A	NC	3,536.2	50%	1,777.0	0.702	10.0	$9,506.00	$2,850.00	0.26	Solar WH (EF=1.8)
10025	Water Heating	Smart Water Heater - Tank Controls and Sensors_ET	SF	N/A	NC	3,536.2	15%	530.0	0.209	10.0	$120.00	$60.00	4.26	Smart WH Controls
10026	Water Heating	Bathroom Aerator 1.0 gpm	SF	N/A	NC	49.8	47%	23.6	2.153	10.0	$0.52	$0.52	20.53	1.0 GPM Bathroom FA
10027	Water Heating	Kitchen Flip Aerator 1.5 gpm	SF	N/A	NC	396.6	39%	152.8	2.114	10.0	$1.34	$1.34	43.53	1.5 GPM Kitchen FA
10028	Water Heating	Low Flow Showerhead 1.5 gpm	SF	N/A	NC	611.2	43%	262.6	6.429	10.0	$3.32	$3.32	31.13	1.5 GPM Low Flow Showerhead
10029	Water Heating	Thermostatic Restrictor Shower Valve	SF	N/A	NC	611.2	11%	69.7	2.302	10.0	$30.00	$15.00	1.93	Thermostatic Restrictor Shower Valve (on base flow device)
10030	Water Heating	Shower Timer	SF	N/A	NC	611.2	9%	53.6	0.321	2.0	$5.00	$5.00	1.28	Shower Timer limit time to 5 mins (per shower)
10031	Water Heating	Drain water Heat Recovery	SF	N/A	NC	3,536.2	25%	884.0	0.101	20.0	$742.00	$225.00	3.14	Drainpipe heat exchanger
10032	Water Heating	Desuperheater	SF	N/A	NC	3,536.2	44%	1,556.0	0.178	25.0	$620.00	$185.00	7.69	Install Desuperheater (Paid with GSHP)
10033	Water Heating	Water Heater Wrap	MF	N/A	Retrofit	2,662.9	2%	60.5	0.007	5.0	$20.00	$20.00	0.74	Add WH Wrap to reduce standby losses (Electric Only)
10034	Water Heating	Water Heater Temperature Setback	MF	NLI	Retrofit	733.6	11%	81.5	0.009	15.0	$6.50	$6.50	8.11	WH Temp Setback from 135 to 120
10035	Water Heating	Water Heater Timer	MF	NLI	Retrofit	2,662.9	9%	240.0	0.027	15.0	$60.00	$30.00	5.17	Install Timer to turn off at night or other periods (Electric Only)
10036	Water Heating	Pipe Wrap	MF	NLI	Retrofit	2,662.9	3%	79.9	0.009	15.0	$1.72	$1.72	30.03	Adding Pipe Wrap to Uninsulated Pipes
10037	Water Heating	Heat Pump Water Heater	MF	N/A	MO	2,662.9	58%	1,544.0	0.610	10.0	$1,000.00	$300.00	2.27	Heat Pump Water Heater
10038	Water Heating	Smart Water Heater - Tank Controls and Sensors_ET	MF	N/A	Retrofit	2,662.9	15%	399.0	0.158	10.0	$120.00	$60.00	3.21	Smart WH Controls
10039	Water Heating	Bathroom Aerator 1.0 gpm	MF	NLI	Retrofit	57.2	47%	27.1	2.153	10.0	$0.52	$0.52	22.77	1.0 GPM Bathroom FA
10040	Water Heating	Kitchen Flip Aerator 1.5 gpm	MF	NLI	Retrofit	274.9	39%	105.9	2.114	10.0	$1.34	$1.34	31.94	1.5 GPM Kitchen FA
10041	Water Heating	Low Flow Showerhead 1.5 gpm	MF	NLI	Retrofit	649.6	43%	279.1	6.429	10.0	$1.34	$1.34	81.22	1.5 GPM Low Flow Showerhead
10042	Water Heating	Thermostatic Restrictor Shower Valve	MF	N/A	Retrofit	649.6	11%	74.1	2.446	10.0	$30.00	$15.00	2.05	Thermostatic Restrictor Shower Valve (on base flow device)
10043	Water Heating	Shower Timer	MF	N/A	Retrofit	649.6	9%	56.9	0.321	2.0	$5.00	$5.00	1.33	Shower Timer limit time to 5 mins (per shower)
10044	Water Heating	Drain water Heat Recovery	MF	N/A	Retrofit	2,662.9	25%	666.0	0.076	20.0	$742.00	$225.00	2.36	Drainpipe heat exchanger
10045	Water Heating	Desuperheater	MF	N/A	Retrofit	2,662.9	44%	1,172.0	0.134	25.0	$620.00	$185.00	5.80	Install Desuperheater (Paid with GSHP)
10046	Water Heating	Bathroom Aerator 1.0 gpm	MF	LI	DI	57.2	47%	27.1	2.153	10.0	$0.52	$0.52	22.77	1.0 GPM Bathroom FA
10047	Water Heating	Kitchen Flip Aerator 1.5 gpm	MF	LI	DI	274.9	39%	105.9	2.114	10.0	$1.34	$1.34	31.94	1.5 GPM Kitchen FA
10048	Water Heating	Low Flow Showerhead 1.5 gpm	MF	LI	DI	649.6	43%	279.1	6.429	10.0	$1.34	$1.34	81.22	1.5 GPM Low Flow Showerhead
10049	Water Heating	Pipe Wrap	MF	LI	DI	2,662.9	3%	79.9	0.009	15.0	$1.72	$1.72	30.03	Adding Pipe Wrap to Uninsulated Pipes
10050	Water Heating	Water Heater Temperature Setback	MF	LI	DI	733.6	11%	81.5	0.009	15.0	$6.50	$6.50	8.11	WH Temp Setback from 135 to 120

Vectren Electric		Residential Measure Assumptions												
Measure #	**End-Use**	**Measure Name**	**Home Type**	**Income Type**	**Replacement Type**	**Base Annual Electric**	**% Elec Savings**	**Per Unit Elec Savings**	**Per Unit Summer NCP kW**	**Useful Life**	**Initial Measure Cost**	**Historical Incentive Amount**	**UCT Ratio**	**Measure Description**
10051	Water Heating	Water Heater Temperature Setback	MF	N/A	NC	733.6	11%	81.5	0.009	15.0	$6.50	$6.50	8.11	WH Temp Setback from 135 to 120
10052	Water Heating	Water Heater Timer	MF	N/A	NC	2,662.9	9%	240.0	0.027	15.0	$60.00	$30.00	5.17	Install Timer to turn off at night or other periods (Electric Only)
10053	Water Heating	Pipe Wrap	MF	N/A	NC	2,662.9	3%	79.9	0.009	15.0	$1.72	$1.72	30.03	Adding Pipe Wrap to Uninsulated Pipes
10054	Water Heating	Heat Pump Water Heater	MF	N/A	NC	2,662.9	58%	1,544.0	0.610	10.0	$1,000.00	$300.00	2.27	Heat Pump Water Heater
10055	Water Heating	Smart Water Heater - Tank Controls and Sensors_ET	MF	N/A	NC	2,662.9	15%	399.0	0.158	10.0	$120.00	$60.00	3.21	Smart WH Controls
10056	Water Heating	Bathroom Aerator 1.0 gpm	MF	N/A	NC	57.2	47%	27.1	2.153	10.0	$0.52	$0.52	22.77	1.0 GPM Bathroom FA
10057	Water Heating	Kitchen Flip Aerator 1.5 gpm	MF	N/A	NC	274.9	39%	105.9	2.114	10.0	$1.34	$1.34	31.94	1.5 GPM Kitchen FA
10058	Water Heating	Low Flow Showerhead 1.5 gpm	MF	N/A	NC	649.6	43%	279.1	6.429	10.0	$1.34	$1.34	81.22	1.5 GPM Low Flow Showerhead
10059	Water Heating	Thermostatic Restrictor Shower Valve	MF	N/A	NC	649.6	11%	74.1	2.446	10.0	$30.00	$15.00	2.05	Thermostatic Restrictor Shower Valve (on base flow device)
10060	Water Heating	Shower Timer	MF	N/A	NC	649.6	9%	56.9	0.321	2.0	$5.00	$5.00	1.33	Shower Timer limit time to 5 mins (per shower)
10061	Water Heating	Drain water Heat Recovery	MF	N/A	NC	2,662.9	25%	666.0	0.076	20.0	$742.00	$225.00	2.36	Drainpipe heat exchanger
10062	Water Heating	Desuperheater	MF	N/A	NC	2,662.9	44%	1,172.0	0.134	25.0	$620.00	$185.00	5.80	Install Desuperheater (Paid with GSHP)

Key Acronyms

DI:	Direct-install
LI:	Low-income
MF:	Multifamily
MO:	Market opportunity
NC:	New Construction
NLI:	Non-low-income
SF:	Single-family

APPENDIX C *DSM Market Potential Study Commercial Measure Detail*

Vectren Electric		Commercial Measure Assumptions						
Measure #	End-Use	Measure Name	% Elec Savings	Per Unit Elec Savings	Per Unit NCP kW	Useful Life	Initial Measure Cost	UCT Ratio
1	Interior Lighting	Compact Fluorescent - 2019	67.8%	198.8	0.039	3.0	$1.20	64.96
2	Interior Lighting	LED Exit Sign	91.3%	206.8	0.021	16.0	$30.00	10.52
3	Interior Lighting	High Performance T8 (vs RWT8) 4ft	19%	50	0.011	15	$18.00	4.98
4	Interior Lighting	Wall Mounted Occupancy Sensor	24.0%	335.3	0.000	8.0	$51.00	4.41
5	Interior Lighting	Fixture Mounted Occupancy Sensor	24%	198	0.000	8	$91.83	1.45
6	Interior Lighting	Remote Mounted Occupancy Sensor	24%	568	0.000	8	$101.00	3.78
7	Interior Lighting	High Bay LED vs (Metal Halide 250W)	35%	476	0.104	15	$200.00	5.65
8	Interior Lighting	High Bay LED vs (Metal Halide 400W)	53%	1,492	0.326	15	$250.00	14.15
9	Interior Lighting	High performance T5 (replacing T8)	44%	461	0.101	15	$100.00	8.20
10	Interior Lighting	CFL Hard Wired Fixture - 2019	69%	199	0.044	12	$37.50	7.94
11	Interior Lighting	CFL High Wattage 31-115 - 2019	55%	383	0.084	3	$21.00	7.46
12	Interior Lighting	CFL High Wattage 150-199 -2019	58%	1,088	0.238	3	$57.00	7.80
13	Interior Lighting	Low Bay LED (vs T8HO)	42%	306	0.067	15	$331.00	1.64
14	Interior Lighting	High Bay LED (vs T8HO)	35%	472	0.103	15	$482.00	1.74
15	Interior Lighting	LED Screw-In Bulb	51%	149	0.027	15	$1.20	207.76
16	Interior Lighting	LED Downlight Fixtures	68%	168	0.037	15	$27.00	11.07
17	Interior Lighting	LED Linear Replacement Lamps	37%	99	0.022	15	$25.00	7.04
18	Interior Lighting	LED Troffer	38%	106	0.023	15	$62.00	3.03
19	Interior Lighting	Light Tube	10%	250	0.104	10	$500.00	0.95
20	Interior Lighting	Central Lighting Controls	10%	4,077	1.000	8	$103.00	43.51
21	Interior Lighting	Lighting Power Density Reduction (NC)	10%	4,077	1.000	15	$220.00	45.78
22	Interior Lighting	Switching Controls for Multi-Level Lighting	30%	12,232	3.000	8	$274.00	49.07
23	Interior Lighting	Smart Advanced Lighting Controls	47%	2	0.001	10	$1.51	2.63
24	Interior Lighting	Smart Web-based lighting Mgmt System	35%	3	0.001	10	$1.15	5.41
25	Exterior Lighting	Outdoor LED (< 250W MH)	65%	495	0.101	15	$238.50	3.01
26	Exterior Lighting	Outdoor LED (> 250W MH)	54%	983	0.201	15	$592.00	2.41
27	Space Cooling - Unitary / Split	Split System, <65,000 Btu/hr (CEE Tier 1)	13%	143	0.123	15	$63.00	8.91
28	Space Cooling - Unitary / Split	Split System, <65,000 Btu/hr (CEE Tier 2)	19%	201	0.173	15	$127.00	6.22
29	Space Cooling - Unitary / Split	Single Package System <65,000 Btu/hr (CEE Tier 1)	7%	66	0.057	15	$63.00	4.14
30	Space Cooling - Unitary / Split	Single Package System <65,000 Btu/hr (CEE Tier2)	13%	124	0.107	15	$127.00	3.85
31	Space Cooling - Unitary / Split	<135,000 Btu/hr (CEE Tier 1) (2019- 2022)	8%	86	0.074	15	$63.00	5.37
32	Space Cooling - Unitary / Split	<135,000 Btu/hr (CEE Tier 2) (2019-2022)	13%	140	0.121	15	$127.00	4.35
33	Space Cooling - Unitary / Split	<135,000 Btu/hr (CEE Advanced Tier) (2023+)	18%	169	0.146	15	$127.00	5.24
34	Space Cooling - Unitary / Split	<240,000 Btu/hr (CEE Tier 1) (2019 - 2022)	6%	69	0.060	15	$63.00	4.31
35	Space Cooling - Unitary / Split	<240,000 Btu/hr (CEE Tier 2) (2019 - 2022)	13%	144	0.125	15	$127.00	4.47
36	Space Cooling - Unitary / Split	<240,000 Btu/hr (CEE Advanced Tier) (2023+)	17%	163	0.141	15	$127.00	5.06
37	Space Cooling - Unitary / Split	<760,000 Btu/hr (CEE Tier 1) (2019 -2022)	6%	69	0.060	15	$19.00	14.37
38	Space Cooling - Unitary / Split	<760,000 Btu/hr (CEE Tier 2) (2019 -2022)	12%	148	0.127	15	$38.00	15.30
39	Space Cooling - Unitary / Split	<760,000 Btu/hr (CEE Advanced Tier) (2023+)	9%	96	0.083	15	$38.00	9.93

Vectren Electric		Commercial Measure Assumptions						
Measure #	End-Use	Measure Name	% Elec Savings	Per Unit Elec Savings	Per Unit NCP kW	Useful Life	Initial Measure Cost	UCT Ratio
40	Space Cooling - Unitary / Split	Tier 1) (2019 -2022)	3%	44	0.038	15	$19.00	9.03
41	Space Cooling - Unitary / Split	Tier 2) (2019 -2022)	9%	113	0.097	15	$38.00	11.70
42	Space Cooling - Unitary / Split	PTAC, <7,000 Btu/hr	8%	106	0.078	15	$84.00	4.51
43	Space Cooling - Unitary / Split	PTAC ≥7,000 Btu/h and ≤15,000 Btu/hr	11%	162	0.124	15	$84.00	7.05
44	Space Cooling - Unitary / Split	PTHP, ≥7,000 Btu/hr and ≤15,000 Btu/hr	11%	177	0.130	15	$84.00	7.52
45	Space Cooling - Unitary / Split	HVAC Tune-up (2019-2022)	15%	164	0.000	3	$35.00	1.98
46	Space Cooling - Unitary / Split	HVAC Tune-up (2023+)	15%	150	0.000	3	$35.00	1.80
47	Space Cooling - Unitary / Split	Air Source Heat Pump <65,000 BtuH (CEE Tier 1)	7%	66	0.057	15	$50.00	1.14
48	Space Cooling - Unitary / Split	Air Source Heat Pump <65,000 BtuH (CEE Tier 2)	13%	124	0.107	15	$50.00	2.38
49	Space Cooling - Unitary / Split	Btu/hr (CEE Tier 1) (2019-2022)	10%	117	0.101	15	$50.00	1.99
50	Space Cooling - Unitary / Split	Btu/hr (CEE Tier 1) (2023+)	10%	101	0.088	15	$50.00	2.08
51	Space Cooling - Unitary / Split	Btu/hr (CEE Tier 1) (2019 -2022)	9%	112	0.097	15	$50.00	1.94
52	Space Cooling - Unitary / Split	Btu/hr (CEE Tier 1) (2023+)	9%	97	0.083	15	$50.00	1.76
53	Space Cooling - Unitary / Split	(2019 -2022)	10%	133	0.115	15	$50.00	2.22
54	Space Cooling - Unitary / Split	(2023+)	10%	113	0.098	15	$50.00	2.00
55	Space Cooling - Unitary / Split	Ground Source Heat Pump <135,000 Btu/hr	10%	110	0.095	15	$75.00	1.57
56	Space Cooling - Unitary / Split	Water Source Heat Pump <17,000Btu/hr	13%	147	0.126	15	$75.00	1.90
57	Space Cooling - Unitary / Split	<135,000Btu/hr	7%	76	0.066	15	$75.00	1.05
58	Space Cooling - Unitary / Split	Advanced Rooftop Controls	45%	3,034	2.617	9	$187.50	57.49
59	Space Cooling - Unitary / Split	Commercial/Industrial CO2 Heat Pump	70%	351	0.000	10	$87.78	5.52
60	Space Cooling - Unitary / Split	Room A/C	4%	16	0.037	9	$40.00	2.23
61	Space Cooling - Unitary / Split	Cool roof	15%	89	0.045	20	$88.22	0.65
62	Space Cooling - Unitary / Split	Ceiling Insulation	8%	87	0.044	30	$58.59	2.34
63	Space Cooling - Unitary / Split	Wall insulation	2%	507	0.136	30	$8.32	71.55
64	Space Cooling - Unitary / Split	Roof Insulation	8%	24	0.019	30	$11.36	4.35
65	Space Cooling - Unitary / Split	Destratification Fan	50%	8	-0.007	15	$7.27	0.51
66	Space Cooling - Unitary / Split	EMS	10%	310	0.014	15	$0.86	194.09
67	Space Cooling - Unitary / Split	Duct sealing 15% leakage base	5%	19	0.013	18	$10.85	2.47
68	Space Cooling - Unitary / Split	Integrated Building Design	30%	2	0.000	20	$0.11	16.35
69	Space Cooling - Unitary / Split	Retrocommissioning	16%	1	0.000	7	$0.03	12.80
70	Space Cooling - Unitary / Split	Commissioning	13%	1	0.000	7	$0.12	2.69
71	Space Cooling - Unitary / Split	Commercial Window Film	5%	209	0.050	10	$35.50	1.94
72	Space Cooling - Unitary / Split	High Performance Glazing	6%	2	0.070	20	$6.82	8.95
73	Space Cooling - Unitary / Split	Programable Thermostats	10%	945	0.000	4	$22.44	5.36
74	Space Cooling - Unitary / Split	Cooling	25%	119	0.047	8	$18.89	3.19
75	Space Cooling - Unitary / Split	Smart Thermostats	8%	660	0.000	10	$29.75	6.50
76	Space Cooling - Unitary / Split	Smart Cloud-Based Enery Information System (EIS)	8%	89	0.000	10	$0.61	42.60
77	Space Cooling - Chillers	Air Cooled Chiller <150 tons	13%	318	0.116	20	$127.00	8.04
78	Space Cooling - Chillers	Air Cooled Chiller ≥150 tons	13%	305	0.112	20	$127.00	7.28

Vectren Electric		Commercial Measure Assumptions						
Measure #	End-Use	Measure Name	% Elec Savings	Per Unit Elec Savings	Per Unit NCP kW	Useful Life	Initial Measure Cost	UCT Ratio
79	Space Cooling - Chillers	Water Cooled Screw Chiller <150 ton	13%	191	0.070	20	$177.68	3.46
80	Space Cooling - Chillers	Water Cooled Screw Chiller ≥150 tons and < 300 tons	19%	273	0.100	20	$127.00	6.91
81	Space Cooling - Chillers	Water Cooled Screw Chiller ≥300 ton	21%	300	0.110	20	$87.00	11.09
82	Space Cooling - Chillers	Water Cooled Centrifugal Chiller <150 ton	20%	300	0.110	20	$166.10	5.81
83	Space Cooling - Chillers	tons	27%	410	0.150	20	$122.87	10.71
84	Space Cooling - Chillers	Water Cooled Centrifugal Chiller ≥300 ton	25%	355	0.130	20	$92.22	12.37
85	Space Cooling - Chillers	Air Cooled Chiller Tune-up/Diagnostics	8%	187	0.000	5	$5.66	20.10
86	Space Cooling - Chillers	WaterCooled Chiller/Tune-up/Diagnostics	8%	119	0.000	5	$5.66	12.78
87	Space Cooling - Chillers	Chilled Water Reset Controls	25%	173	0.030	10	$681.34	0.39
88	Space Cooling - Chillers	Cool roof	15%	89	0.045	20	$88.22	0.65
89	Space Cooling - Chillers	Ceiling Insulation	8%	87	0.044	30	$58.59	2.34
90	Space Cooling - Chillers	Wall insulation	2%	507	0.136	30	$8.32	71.55
91	Space Cooling - Chillers	Roof Insulation	8%	24	0.019	30	$11.36	4.35
92	Space Cooling - Chillers	Destratification Fan	50%	8	-0.007	15	$7.27	0.51
93	Space Cooling - Chillers	EMS	10%	310	0.014	15	$0.86	194.09
94	Space Cooling - Chillers	Duct sealing 15% leakage base	5%	19	0.013	18	$10.85	2.47
95	Space Cooling - Chillers	Integrated Building Design	30%	2	0.000	20	$0.11	16.35
96	Space Cooling - Chillers	Retrocommissioning	16%	1	0.000	7	$0.03	12.80
97	Space Cooling - Chillers	Commissioning	13%	1	0.000	7	$0.12	2.69
98	Space Cooling - Chillers	Commercial Window Film	5%	209	0.050	10	$35.50	1.94
99	Space Cooling - Chillers	High Performance Glazing	6%	2	0.070	20	$6.82	8.95
100	Space Cooling - Chillers	Programable Thermostats	10%	945	0.000	4	$22.44	5.36
101	Space Cooling - Chillers	Smart Thermostats	8%	660	0.000	10	$29.75	6.50
102	Space Cooling - Chillers	Smart Cloud-Based Enery Information System (EIS)	8%	89	0.000	10	$0.61	42.60
103	Space Heating	PTHP, <7,000 Btu/hr	8%	65	0.100	15	$84.00	1.12
104	Space Heating	PTHP, ≥7,000 Btu/hr and ≤15,000 Btu/hr	11%	94	0.146	15	$84.00	1.63
105	Space Heating	Tier 1)	4%	33	0.052	15	$50.00	1.14
106	Space Heating	Tier 2)	9%	84	0.130	15	$50.00	2.38
107	Space Heating	System (CEE Tier 1)	6%	57	0.088	15	$50.00	4.14
108	Space Heating	System (CEE Tier 2)	6%	57	0.088	15	$50.00	3.85
109	Space Heating	Btu/hr (CEE Tier 1) (2019-2022)	8%	57	0.089	15	$50.00	1.99
110	Space Heating	Btu/hr (CEE Tier 1) (2023+)	6%	37	0.057	15	$50.00	2.08
111	Space Heating	Btu/hr (CEE Tier 1) (2019 -2022)	9%	61	0.094	15	$50.00	1.94
112	Space Heating	Btu/hr (CEE Tier 1) (2023+)	6%	39	0.061	15	$50.00	1.76
113	Space Heating	(2019 -2022)	9%	61	0.094	15	$50.00	2.22
114	Space Heating	(2023+)	9%	61	0.094	15	$50.00	2.00
115	Space Heating	Ground Source Heat Pump <135,000 Btu/hr	10%	61	0.008	15	$75.00	1.57
116	Space Heating	Water Source Heat Pump < 135,000Btu/hr	13%	68	0.009	15	$75.00	1.90
117	Space Heating	<135,000Btu/hr	7%	38	0.005	15	$75.00	1.05

Vectren Electric		Commercial Measure Assumptions						
Measure #	End-Use	Measure Name	% Elec Savings	Per Unit Elec Savings	Per Unit NCP kW	Useful Life	Initial Measure Cost	UCT Ratio
118	Space Heating	Commercial/Industrial CO2 Heat Pump	70%	189	0.000	10	$47.22	5.52
119	Space Heating	Cool roof	15%	41	0.021	20	$88.22	0.65
120	Space Heating	Ceiling Insulation	8%	40	0.020	30	$58.59	2.34
121	Space Heating	Wall insulation	2%	236	0.063	30	$8.32	71.55
122	Space Heating	Roof Insulation	8%	11	0.009	30	$11.36	4.35
123	Space Heating	Destratification Fan	50%	4	-0.003	15	$7.27	0.51
124	Space Heating	EMS	10%	144	0.007	15	$0.86	194.09
125	Space Heating	Duct sealing 15% leakage base	5%	9	0.006	18	$10.85	2.47
126	Space Heating	Integrated Building Design	30%	1	0.000	20	$0.11	16.35
127	Space Heating	Retrocommissioning	16%	0	0.000	7	$0.03	12.80
128	Space Heating	Commissioning	13%	0	0.000	7	$0.12	2.69
129	Space Heating	Commercial Window Film	5%	97	0.023	10	$35.50	1.94
130	Space Heating	High Performance Glazing	6%	1	0.032	20	$6.82	8.95
131	Space Heating	Programable Thermostats	10%	945	0.000	4	$22.44	5.36
132	Space Heating	Cooling	25%	119	0.047	8	$18.89	3.19
133	Space Heating	Smart Thermostats	8%	660	0.000	10	$29.75	6.50
134	Space Heating	Smart Cloud-Based Enery Information System (EIS)	8%	89	0.000	10	$0.61	42.60
135	Ventilation	VFD Supply and Return Fans, < 2 HP	30%	2,497	0.369	15	$1,330.00	2.73
136	Ventilation	VFD Supply and Return Fans, <3 to 10 HP	30%	6,242	0.922	15	$1,622.00	5.59
137	Ventilation	VFD Supply and Return Fans, 11 to 50 HP	30%	37,450	5.530	15	$3,059.00	17.79
138	Ventilation	Enthalpy Economizer	20%	117	0.000	10	$400.00	0.30
139	Ventilation	Improved Duct Sealing	23%	70	0.000	18	$107.91	1.43
140	Ventilation	Electronically-Commutated Permanent Magnet Motors	65%	1,635	0.000	15	$3,059.00	0.78
141	Ventilation	High Volume Low Speed Fans	50%	8,379	3.067	10	$4,185.00	4.03
142	Ventilation	VFD Tower Fan	30%	829	0.265	10	$155.96	5.50
143	Motors	VFD on Chilled Water Pump Motor, 5 HP	15%	28,580	0.000	15	$1,330.00	31.22
144	Motors	VFD on Chilled Water Pump Motor, 7.5 HP	15%	42,870	0.000	15	$1,622.00	38.40
145	Motors	VFD on Chilled Water Pump Motor, 20 HP	15%	171,480	0.000	15	$3,059.00	81.44
146	Motors	High Performance Elevators	80%	12,982	1.406	25	$54,690.00	0.64
147	Motors	Escalators Motor Efficiency Controllers	30%	5,414.000	0.620	20	$6,900.00	1.86
148	Other	NEMA Premium Transformer, single-phase	2%	0.163	0.000	30	$0.24	3.16
149	Other	NEMA Premium Transformer, three-phase	2%	0.244	0.000	30	$0.18	4.81
150	Other	High Efficiency Transformer, single-phase	2%	0.393	0.000	30	$0.46	3.56
151	Other	High Efficiency Transformer, three-phase	2%	0	0.000	30	$0.44	5.50
152	Water Heating	High Efficiency Storage (tank)	0%	9	0.000	15	$70.00	0.18
153	Water Heating	retrofit	20%	1,284	0.000	5	$92.90	7.30
154	Water Heating	On Demand (tankless)	7%	7,905	0.000	5	$1,050.00	3.97
155	Water Heating	dryer	38%	86	0.000	7	$19.35	3.32
156	Water Heating	Electric dryer	25%	542	0.000	7	$72.00	5.62

Vectren Electric		Commercial Measure Assumptions							
Measure #	End-Use	Measure Name	% Elec Savings	Per Unit Elec Savings	Per Unit NCP kW	Useful Life	Initial Measure Cost	UCT Ratio
157	Water Heating	Gas Dryer	33%	429	0.000	7	$66.91	4.78
158	Water Heating	Electric Dryer	27%	884	0.000	7	$93.21	7.08
159	Water Heating	ES Dishwasher, High Temp, Elec Heat, Elec Booster	30%	11,358	0.000	15	$419.05	39.44
160	Water Heating	ES Dishwasher, High Temp, Gas Heat, Elec Booster	26%	4,862	0.000	15	$265.03	26.69
161	Water Heating	ES Dishwasher, High Temp, Gas Heat, Gas Booster	15%	1,699	0.000	15	$115.95	21.32
162	Water Heating	ES Dishwasher, Low Temp, Elec Heat	33%	12,783	0.000	16	$95.07	205.29
163	Water Heating	ES Dishwasher, Low Temp, Gas Heat	5%	584	0.000	16	$8.73	102.14
164	Water Heating	Tank Insulation	91%	468	0.000	15	$2.22	409.25
165	Water Heating	Heat Pump Water Heater	59%	2,124	0.000	10	$433.00	6.77
166	Cooking	High Efficiency Combination Oven	35%	6,368	0.000	12	$100.00	77.30
167	Cooking	Induction Cooktop	20%	784	0.000	11	$3,000.00	0.39
168	Cooking	Electric Energy Star Fryers	17%	3,126	0.000	12	$275.67	13.76
169	Cooking	Electric Energy Star Steamers,3-6 pan	57%	9,967	0.000	12	$3,400.00	3.56
170	Cooking	Energy Star Convection Ovens	16%	1,937	0.000	12	$388.00	6.06
171	Cooking	Energy Star Griddles	12%	1,909	0.000	12	$860.00	2.69
172	Cooking	Energy Star Hot Food Holding Cabinet	53%	1,730	0.000	12	$902.00	2.33
173	Refrigeration	Glass Door Freezer, <15-49 cu ft, Energy Star	43%	3,595	0.000	12	$166.00	26.26
174	Refrigeration	Glass Door Freezer, 50+ cu ft, Energy Star	45%	9,804	0.000	12	$407.00	29.21
175	Refrigeration	Solid Door Freezer, <15-49 cu ft, Energy Star	36%	1,489	0.000	12	$166.00	10.88
176	Refrigeration	Solid Door Freezer, 50+ cu ft, Energy Star	46%	5,322	0.000	12	$407.00	15.86
177	Refrigeration	Glass Door Refrigerator, <15 - 49 cu ft, Energy Star	36%	828	0.000	12	$164.00	6.12
178	Refrigeration	Glass Door Refrigerator, 50+ cu ft, Energy Star	35%	1,577	0.000	12	$249.00	7.68
179	Refrigeration	Solid Door Refrigerator, <15-49 cu ft, Energy Star	38%	635	0.000	12	$164.00	4.70
180	Refrigeration	Solid Door Refrigerator, 50+ cu ft, Energy Star	48%	1,675	0.000	12	$249.00	8.16
181	Refrigeration	self contained	7%	537	0.000	1	$75.00	1.04
182	Refrigeration	contained	7%	1,388	0.000	1	$75.00	2.68
183	Refrigeration	Anti-sweat heater controls on freezers	55%	2,557	0.000	12	$200.00	15.50
184	Refrigeration	Anti-sweat heater controls, on refrigerators	55%	1,082	0.000	12	$200.00	6.56
185	Refrigeration	Vending Miser, Cold Beverage	46%	1,612	0.000	5	$215.50	3.95
186	Refrigeration	Brushless DC Motors (ECM) for freezers and coolers	44%	1,064	0.000	15	$177.00	8.73
187	Refrigeration	Humidity Door Heater Controls for freezers and coolers	55%	1,820	0.000	12	$200.00	11.03
188	Refrigeration	Refrigerated Case Covers	9%	945	0.000	5	$252.00	1.98
189	Refrigeration	Zero Energy Doors for freezers and coolers	20%	1,360	0.000	10	$290.00	6.47
190	Refrigeration	Evaporator Coil Defrost Control	30%	197	0.002	10	$500.00	0.56
191	Refrigeration	Evaporator Fan Motor Control for freezers and coolers	36%	1,524	0.000	16	$291.00	10.64
192	Refrigeration	Ice Machine, Energy Star, Self-Contained	7%	263	0.000	9	$56.00	0.51
193	Refrigeration	LED Case Lighting (retrofit)	45%	437	0.000	8	$250.00	0.19
194	Refrigeration	Efficient Refrigeration Condenser	2%	120	0.000	15	$35.00	0.50
195	Refrigeration	Efficient low-temp compressor	1%	875	0.000	13	$552.00	2.74

Vectren Electric		Commercial Measure Assumptions						
Measure #	End-Use	Measure Name	% Elec Savings	Per Unit Elec Savings	Per Unit NCP kW	Useful Life	Initial Measure Cost	UCT Ratio
196	Compressed Air	Automatic Drains	0%	2,097	0.000	5	$355.00	4.15
197	Compressed Air	Cycling and High Efficiency Dryers	35%	4	0.000	10	$6.00	0.93
198	Compressed Air	Efficient Air Compressors	18%	914	0.000	15	$250.00	5.30
199	Compressed Air	Low Pressure Drop-Filters	3%	65	0.000	10	$22.00	4.05
200	Compressed Air	Receiver Capacity Addition	10%	9,159	0.000	10	$2,000.00	6.31
201	Compressed Air	Engineered Nozzles for blow-off	71%	22,230	0.000	15	$14.00	2304.40
202	Compressed Air	Compressed Air Leak Survey and Repair	50%	496	0.000	1	$6.00	11.94
203	Office Equipment	Commercial Plug Load - Smart Strip Outlets	15%	23	0.000	8	$15.00	1.32
204	Office Equipment	Plug Load Occupancy Sensor	15%	169	0.000	8	$70.00	2.03
205	Office Equipment	Energy Star Compliant Refrigerator	20%	120	0.000	17	$30.00	6.35
206	Office Equipment	Energy Star Computers	43%	81	0.000	4	$5.00	9.07
207	Office Equipment	Computer Power Management Software	46%	161	0.000	5	$29.00	3.91
208	Office Equipment	Energy Star UPS	11%	105	0.000	10	$1,303.35	0.11
209	Office Equipment	High Efficiency Hand Dryer	69%	965	0.000	10	$450.00	2.96
210	Office Equipment	Electrically Commutated Plug Fans in data centers	33%	1,445	0.000	15	$718.00	3.90
211	Office Equipment	High Efficiency CRAC unit	30%	162	0.000	15	$62.50	5.03
212	Office Equipment	Computer Room Air Conditioner Economizer	47%	358	0.000	15	$82.00	8.46
213	Office Equipment	Computer Room Hot Aisle Cold Aisle Configuration	13%	125	0.000	15	$156.00	1.55
214	Office Equipment	Computer Room Air Side Economizer	47%	440	0.000	10	$25.00	24.30
215	Office Equipment	VFD for Process Fans -CRAC units	43%	2,279	0.000	15	$200.00	22.07
216	Office Equipment	Vending Miser for Non-Refrig Equip	46%	343	0.000	5	$108.00	0.34
217	Pools	Heat Pump Pool Heater	61%	5,732	0.000	10	$4,000.00	1.98
218	Pools	High efficiency spas/hot tubs	15%	375	0.000	10	$300.00	1.72
219	Pools	VFD Retrofit on Pool Circulation Pump	35%	1,425	0.000	12	$200.00	11.52
220	Behavioral	Reports)	3%	7,852	0.896	2	$8.88	271.30
221	Behavioral	Whole-Building Energy Monitoring	10%	2	0.000	2	$1.00	0.52
222	Behavioral	Energy Use Displays	9%	23,555	2.693	1	$250.00	14.60

APPENDIX D *DSM Market Potential Study Industrial Measure Detail*

Vectren Electric **Industrial Measure Assumptions**

Measure #	End-Use	Measure Name	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	UCT Ratio
101	Appliances, Computers, Office Equipment	Energy Star Compliant Single Door Refrigerator	20.0%	120.0	0.000	17.0	$30.00	7.38
102	Appliances, Computers, Office Equipment	Energy Star computers	43.0%	80.5	0.000	4.0	$5.00	17.75
103	Appliances, Computers, Office Equipment	Energy Efficient "Smart" Power Strip for PC/Monitor/Printer	15.0%	23.4	0.000	8.0	$15.00	1.58
104	Appliances, Computers, Office Equipment	PC Network Energy Management Controls replacing no central control	46.0%	161.0	0.000	5.0	$29.00	3.24
106	Appliances, Computers, Office Equipment	Energy Star UPS	10.5%	104.8	0.000	10.0	$1,303.35	0.13
107	Appliances, Computers, Office Equipment	High Efficiency CRAC Unit	30.0%	162.3	0.020	15.0	$62.50	4.96
151	Water Heating	Heat Pump Water Heater	58.8%	2,123.7	0.000	10.0	$433.00	5.08
152	Water Heating	Electric Tankless Water Heater	7.4%	7,905.0	0.000	5.0	$1,050.00	3.97
154	Water Heating	High Efficiency Storage (tank)	0.2%	8.6	0.000	15.0	$70.00	0.18
168	Water Heating	Tank Insulation (electric)	91.0%	468.0	0.000	15.0	$2.22	306.25
169	Water Heating	Drain Water Heat Recovery Water Heater	25.0%	546.0	4.490	25.0	$631.00	2.30
171	Water Heating	Process Cooling Condenser Heat Recovery	33.0%	5,720.0	1.205	15.0	$254.00	49.23
301	Envelope	Integrated Building Design	40.0%	2.0	0.000	15.0	$0.27	9.99
302	Envelope	Energy Efficient Windows	13.9%	2.0	0.022	20.0	$17.04	8.95
302	Envelope	Energy Efficient Windows	13.9%	2.0	0.022	20.0	$17.04	8.95
303	Envelope	Cool Roofing	15.0%	51.3	0.028	20.0	$332.44	0.39
304	Envelope	Ceiling Insulation	8.0%	65.5	0.024	20.0	$47.16	1.46
305	Envelope	Window Improvements	0.7%	85.3	0.033	15.3	$286.16	0.24
306	Envelope	Wall Insulation	1.7%	364.8	0.076	20.0	$4.57	85.75
307	Envelope	Roof Insulation	0.8%	22.1	0.014	20.0	$54.88	2.70
308	Envelope	Improved Duct Sealing	1.4%	37.6	0.019	18.0	$107.91	1.51
321	Ventilation	Economizer	12.0%	136.6	0.001	12.5	$123.00	0.98
327	Ventilation	EMS for Manufacturing HVAC Fan	44.0%	2,197.0	0.250	15.0	$800.00	10.16
328	Ventilation	VFD supply and return fans, <3 to 10 hp	30.0%	6,241.7	0.922	15.0	$2,852.00	7.57
329	Ventilation	VFD supply and return fans, 11 to 50 hp	30.0%	37,450.0	5.530	15.0	$12,899.00	24.08
332	Ventilation	High Volume Low Speed Fans	50.0%	8,379.0	3.067	10.0	$4,197.75	3.99
333	Ventilation	Engineered CKV Hood	42.8%	727.2	0.288	15.0	$124.62	187.25
341	Space Cooling - Chillers	Air-Cooled Chiller, <150 ton	13.1%	318.0	0.086	20.0	$2,540.00	8.04
343	Space Cooling - Chillers	Water Side Economizer	10.0%	1,047.5	0.000	15.0	$50.00	7.75
345	Space Cooling - Chillers	Water-Cooled Chiller > 300 ton	25.0%	355.1	0.096	20.0	$92.22	11.09
348	Space Cooling - Chillers	Water-Cooled Chiller < 150 ton	20.0%	300.5	0.081	20.0	$166.10	5.81
350	Space Cooling - Chillers	Chiller Tune Up	8.0%	119.1	0.032	5.0	$5.66	12.78
362	HVAC Controls	Programmable Thermostats	10.0%	945.3	0.000	4.0	$56.09	5.36
363	HVAC Controls	EMS install	10.0%	310.4	0.014	15.0	$4.71	115.04
364	HVAC Controls	EMS Optimization	0.5%	358.9	0.041	20.0	$37.62	0.00
365	HVAC Controls	HVAC Occupancy Sensors	19.0%	99.3	0.076	15.0	$107.58	0.00
367	HVAC Controls	Zoning	0.0%	187.4	0.000	15.0	$500.00	0.00
368	HVAC Controls	Setback with Electric Heat	10.0%	3,451.6	0.000	9.0	$71.00	0.00
369	HVAC Controls	EMS Pump Scheduling	10.0%	1,524.4	0.280	15.0	$1.32	0.00
370	HVAC Controls	Web Enabled EMS	10.0%	670.8	-0.098	15.0	$19.10	0.00
371	HVAC Controls	Retrocommissioning	9.0%	0.9	0.000	7.0	$0.08	7.54
382	Space Cooling - Unitary and Split AC	DX Packaged Sysytem >65000 Btuh CEE Tier 1	18.2%	86.0	0.055	15.0	$63.00	5.37
384	Space Cooling - Unitary and Split AC	Split System, <65,000 Btu/hr (CEE Tier 1)	12.3%	142.6	0.091	15.0	$897.32	8.91
385	Space Cooling - Unitary and Split AC	Ground Source Heat Pump - Cooling	4.9%	110.3	0.012	15.0	$75.00	1.57
387	Space Cooling - Unitary and Split AC	Water Loop Heat Pump (WLHP) - Cooling	11.5%	146.5	0.094	15.0	$75.00	1.90
391	Space Cooling - Unitary and Split AC	HVAC Tune-up	6.8%	58.6	0.079	3.0	$32.40	1.48
401	Cooking	HE Steamer	56.6%	9,966.7	0.000	12.0	$3,400.00	3.56
402	Cooking	HE Combination Oven	34.8%	6,397.9	0.000	12.0	$100.00	77.30
403	Cooking	HE Convection Ovens	16.1%	1,937.1	0.000	12.0	$388.00	6.06
404	Cooking	HE Holding Cabinet	52.7%	1,730.0	0.000	12.0	$902.00	2.33
405	Cooking	HE Fryer	17.2%	3,126.0	0.000	12.0	$275.67	13.76
406	Cooking	HE Griddle	12.1%	1,909.1	0.000	12.0	$860.00	2.69
408	Cooking	Induction Cooktops	20.0%	784.0	0.000	11.0	$3,000.00	0.29
506	Lighting	High performance T5 (replacing T8)	22.4%	461.1	0.094	15.0	$100.00	8.19
507	Lighting	Outdoor LED (>250 W MH)	56.9%	983.3	0.201	15.0	$592.00	3.01
509	Lighting	LED Exit Sign	81.8%	88.6	0.012	16.0	$30.00	10.52
512	Lighting	LED High Bay Lighting	35.0%	471.8	0.096	15.0	$482.00	1.74
513	Lighting	LED Low Bay Lighting	42.5%	305.0	0.062	15.0	$331.00	1.64
514	Lighting	Light Tube	10.0%	250.0	0.104	10.0	$500.00	0.95
515	Lighting	High bay 4 lamp HPT8 vs (Metal halide 250 W)	50.1%	677.0	0.138	15.0	$200.00	4.69
522	Lighting	CFL Hard Wired Fixture	69.0%	199.0	0.041	12.0	$37.50	7.94
523	Lighting	Compact Fluorescent	67.8%	198.8	0.036	2.5	$1.20	64.96
524	Lighting	LED Screw In Bulb	63.9%	253.5	0.043	15.0	$1.20	207.76
528	Lighting	LED Downlight	66.2%	168.1	0.034	15.0	$27.00	11.07
529	Lighting	LED Troffer	25.1%	58.3	0.012	15.0	$62.00	3.03
536	Lighting	LED Linear Replacement Lamps	26.3%	61.2	0.012	15.0	$25.00	7.04
549	Lighting	SEM	2.3%	36.6	0.001	1.0	$1.00	4.67
551	Lighting Controls	Smart Advanced Lighting Controls	40.0%	2.2	0.001	10.0	$3.02	1.98
552	Lighting Controls	Smart Web Based Lighting Controls	28.5%	3.5	0.001	10.0	$2.30	4.05
557	Lighting Controls	Wall Occupancy Sensor	24.0%	335.0	0.068	8.0	$51.00	4.41
559	Lighting Controls	Central Lighting Control	10.0%	4,077.3	0.704	8.0	$103.00	43.51
560	Lighting Controls	Switching Controls for Multilevel Lighting (Non-HID)	20.0%	8,154.6	1.407	8.0	$274.00	49.07
561	Lighting Controls	Lighting Power Density - Interior	10.0%	4,077.3	0.704	15.0	$220.00	34.34
601	Refrigeration	Vending Miser for Soft Drink Vending Machines	46.0%	1,611.8	0.000	5.0	$215.50	3.95
602	Refrigeration	Refrigerated Case Covers	6.0%	2,900.0	0.331	4.0	$150.00	9.53
603	Refrigeration	Refrigeration Economizer	30.0%	166.7	-0.001	15.0	$126.76	1.18
606	Refrigeration	Commercial Ice-makers	6.8%	263.1	0.041	9.0	$55.00	1.22
607	Refrigeration	Evaporator Fan Motor Controls on S-P motors	25.1%	1,155.0	0.119	5.0	$300.00	2.23
608	Refrigeration	Evaporator Fan Motor Controls on PSC motors	25.0%	796.0	0.082	5.0	$300.00	1.54
609	Refrigeration	Evaporator Fan Motor Controls on ECM motors	35.8%	1,524.0	0.174	16.0	$291.00	7.98
610	Refrigeration	H.E. Evaporative Fan Motors	30.0%	773.2	0.088	15.0	$60.00	18.59
611	Refrigeration	Zero-Energy Doors	20.0%	1,800.0	0.151	10.0	$290.00	6.03
612	Refrigeration	Door Heater Controls	55.0%	1,082.6	0.000	12.0	$200.00	11.03

Vectren Electric		Industrial Measure Assumptions						
Measure #	End-Use	Measure Name	% Elec Savings	Per Unit Elec Savings	Per Unit Summer NCP kW	Useful Life	Initial Measure Cost	UCT Ratio
613	Refrigeration	Discus and Scroll Compressors	7.5%	1,500.0	0.220	13.0	$825.00	2.58
614	Refrigeration	Floating Head Pressure Control	9.2%	1,264.0	0.000	15.0	$80.00	15.46
619	Refrigeration	ENERGY STAR Commercial Solid Door Refrigerators	38.3%	635.0	0.000	12.0	$164.00	4.70
620	Refrigeration	ENERGY STAR Commercial Solid Door Freezers	35.8%	1,489.0	0.000	12.0	$166.00	10.88
621	Refrigeration	ENERGY STAR Commercial Glass Door Refrigerators	30.2%	754.0	0.086	12.0	$600.00	1.54
622	Refrigeration	ENERGY STAR Commercial Glass Door Freezers	33.7%	3,671.0	0.419	12.0	$450.00	9.98
623	Refrigeration	Strip Curtains	80.2%	269.5	0.028	4.0	$7.50	17.14
624	Refrigeration	Efficient Refrigeration Condenser	1.8%	120.0	0.000	15.0	$35.00	1.18
625	Refrigeration	Door Gaskets - Cooler and Freezer	99.7%	98.0	0.011	4.0	$2.25	21.36
626	Refrigeration	Reach-in Refrigerated display case door retrofit	43.0%	1,014.0	0.185	12.0	$670.00	2.97
627	Refrigeration	LED Case Lighting	45.5%	437.5	0.000	8.0	$250.00	1.08
628	Refrigeration	ECM case fan motors	8.8%	1,064.0	0.121	15.0	$177.00	8.73
629	Refrigeration	Efficient low-temp compressor	1.1%	283.5	0.048	13.0	$552.00	0.77
630	Refrigeration	Automatic High Speed Doors - between freezer and cooler	15.0%	968.3	0.110	12.0	$150.00	7.89
631	Refrigeration	Refrigerant charging correction	14.0%	77.7	0.080	2.0	$10.36	7.01
801	Space Heating	PTHP, 1 ton	23.2%	94.3	0.108	15.0	$84.00	1.28
803	Space Heating	Ground Source Heat Pump - Heating	4.9%	22.7	0.014	15.0	$375.00	1.00
805	Space Heating	Water Loop Heat Pump (WLHP) - Heating	11.5%	67.9	0.129	15.0	$75.00	1.03
901	Other	High Efficiency Transformer, single-phase	2.5%	0.4	0.000	30.0	$0.46	3.53
902	Other	NEMA Premium Transformer, single-phase	2.5%	0.2	0.000	30.0	$0.24	2.92
903	Other	NEMA Premium Transformer, three-phase	2.5%	0.2	0.000	30.0	$0.18	2.94
909	Other	High Efficiency Transformer, three-phase	2.5%	0.4	0.000	30.0	$0.44	5.57
911	Other	Parking Garage Exhaust Fan CO Control	48.0%	2,413.0	0.275	15.0	$1,800.00	9.43
912	Other	Optimized Snow and Ice Melt Controls	92.0%	0.1	0.000	15.0	$15.15	1.16
913	Other	Engine Block Heater Timer	64.0%	576.0	0.800	5.0	$50.00	29.89
1001	Machine Drive	Sensors & Controls	3.0%	1.0	0.000	15.0	$0.01	14.66
1002	Machine Drive	Compressed Air Outdoor Air Intake	2.2%	109.8	0.015	20.0	$5.00	52.35
1003	Machine Drive	Electric Supply System Improvements	3.0%	1.0	0.000	15.0	$0.01	20.44
1004	Machine Drive	Advanced Efficient Motors	2.3%	1.0	0.000	20.0	$0.04	5.92
1005	Machine Drive	Industrial Motor Management	1.0%	1.0	0.000	5.0	$0.02	10.33
1006	Machine Drive	Compressed Air Low Pressure Drop Filters	1.3%	64.7	0.010	10.0	$22.00	1.85
1007	Machine Drive	Motor System Optimization (Including ASD)	19.0%	1.0	0.000	15.0	$0.01	21.92
1008	Machine Drive	Pump System Efficiency Improvements	16.4%	1.0	0.000	15.0	$0.01	25.62
1009	Machine Drive	Fan System Improvements	6.0%	1.0	0.000	15.0	$0.02	8.54
1010	Machine Drive	Efficient Air Compressors	18.0%	957.6	0.130	14.0	$177.78	7.15
1011	Machine Drive	Compressed Air Pressure Flow Controller	1.5%	73.0	0.010	15.0	$25.00	5.77
1012	Machine Drive	VFD for Process Fans	28.0%	707.0	0.000	15.0	$46.00	32.68
1013	Machine Drive	VFD for Process Pumps	29.0%	1,082.0	0.000	15.0	$94.00	24.47
1014	Machine Drive	High Efficiency Pumps	7.4%	201.0	0.000	15.0	$31.00	22.86
1015	Machine Drive	Compressed Air Audits and Leak Repair	8.0%	496.1	0.069	1.0	$8.00	9.74
1016	Machine Drive	Compressed Air replacement with Air Blowers	8.5%	5,587.7	4.180	15.0	$620.00	38.08
1017	Machine Drive	Compressed Air Automatic Drains	2.2%	2,097.0	0.332	5.0	$100.00	4.41
1018	Machine Drive	Compressed Air Storage Tank	8.5%	423.0	0.059	20.0	$36.00	28.02
1019	Machine Drive	Compressed Air High Efficiency Dryers	1.0%	48.0	0.000	15.0	$10.00	10.21
1020	Machine Drive	Compressed Air Nozzles	7.5%	21,142.0	6.340	20.0	$76.75	14.60
1026	Process Cooling & Refrig	Sensors & Controls	3.0%	1.0	0.000	15.0	$0.01	14.66
1027	Process Cooling & Refrig	Energy Information System	1.0%	1.0	0.000	15.0	$0.06	3.35
1028	Process Cooling & Refrig	Electric Supply System Improvements	3.0%	1.0	0.000	15.0	$0.01	20.44
1029	Process Cooling & Refrig	Improved Refrigeration	10.0%	1.0	0.000	15.0	$0.00	62.53
1031	Process Heating	Sensors & Controls	3.0%	1.0	0.000	15.0	$0.01	14.66
1032	Process Heating	Energy Information System	1.0%	1.0	0.000	15.0	$0.06	3.35
1033	Process Heating	Electric Supply System Improvements	3.0%	1.0	0.000	15.0	$0.01	20.44
1034	Process Heating	Decrease Oven Exhaust Flow	60.0%	399.0	0.087	20.0	$1.00	43.21
1041	Industrial Other	High Efficiency Welders	12.0%	761.0	0.390	20.0	$200.00	15.35
1042	Industrial Other	3 Phase High Eff Battery Charger	8.0%	2,595.0	0.289	20.0	$872.50	6.74
1043	Industrial Other	Barrel Insulation - Inj. Molding (plastics)	18.0%	1,210.0	0.291	10.0	$80.00	25.78
1044	Industrial Other	Pellet Dryer Insulation (plastics)	17.0%	185.0	0.100	10.0	$40.00	7.71
1045	Industrial Other	Injection Molding Machine - efficient (plastics)	51.0%	223.0	0.050	20.0	$125.00	4.93
1047	Industrial Other	Dewpoint Sensor Control for Dessicant Plastic Dryer	8.5%	565.0	0.100	15.0	$150.00	1.95
1051	Agriculture	Other Industrial -Low-Energy Livestock Waterer	47.7%	1,593.0	1.000	10.0	$788.00	3.12
1052	Agriculture	Other Industrial -Dairy Refrigerator Tune-Up	4.0%	0.1	0.000	5.0	$0.05	1.58
1053	Agriculture	Greenhouse Environmental Controls	10.0%	98.0	0.000	15.0	$125.00	1.67
1054	Agriculture	Scroll Compressor with Heat Exchanger for Dairy Refrigeration	10.5%	190.0	0.000	15.0	$1,500.00	0.27
1055	Agriculture	Variable Speed Drive withHeat Exchanger, Milk	15.0%	878.0	0.000	15.0	$2,725.00	0.69
1056	Agriculture	Milk Pre-Cooler Heat Exchanger	50.0%	1.0	0.000	15.0	$0.15	14.17
1057	Agriculture	Variable Speed Drives for Dairy Vacuum Pumps	34.8%	598.0	0.000	10.0	$250.00	3.69
1058	Agriculture	VFD for Process Fans - Agriculture	23.0%	520.0	0.000	15.0	$46.00	24.03
1059	Agriculture	VFD for Process Pumps - Agriculture	43.0%	290.0	0.000	15.0	$46.00	13.40
1060	Agriculture	VFD for Process Pumps - Irrigation	43.0%	195.0	0.000	10.0	$46.00	6.53
1061	Agriculture	Grain Storage Temperature and Moisture Management Controller	49.0%	349.0	0.000	15.0	$233.00	3.18
1062	Agriculture	Low Pressure Sprinkler Nozzles	15.0%	5.0	0.000	15.0	$1.00	10.63
1063	Agriculture	Fan Thermostat Controller	53.4%	1,586.0	0.000	15.0	$50.00	67.44
1064	Agriculture	LED Poultry Lights	57.4%	5.8	0.001	9.0	$1.53	2.67
1065	Agriculture	Long Daylighting Dairy	30.0%	6.2	0.001	16.0	$1.79	2.57
1066	Agriculture	Evaporator Fan Motor Controls Ag	35.4%	537.1	0.270	20.0	$30.13	5.07

APPENDIX E *DSM Market Potential Study Commercial Opt-Out Results*

This section provides the potential results for technical, economic, MAP and RAP for the commercial sector, with opt-out customers included. Results are broken down by end use. The cost-effectiveness results and budgets for the RAP scenario are also provided.

E.1 SCOPE OF MEASURES & END USES ANALYZED

There were 222 total electric measures included in the analysis. Table E-1 provides the number of measures by end-use and fuel type (the full list of commercial measures is provided in Appendix C). The measure list was developed based on a review of current Vectren programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE E-1 COMMERCIAL ENERGY EFFICIENCY MEASURES – BY FUEL TYPE

End-Use	Number of Unique Measures
Space Heating	32
Cooling	76
Ventilation	8
Water Heating	14
Lighting	26
Cooking	7
Refrigeration	23
Office Equipment	14
Behavioral	3
Other	19

E.2 COMMERCIAL ELECTRIC POTENTIAL

Figure E-1 provides the technical, economic, MAP and RAP results for the 6-year, 10-year, and 20-year timeframes. The 6-year technical potential is 22.2% of forecasted sales, and the economic potential is 20.0% of forecasted sales. The 6-year MAP is 14.8% and the RAP is 6.3%.

FIGURE E-1 COMMERCIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF COMMERCIAL SALES)

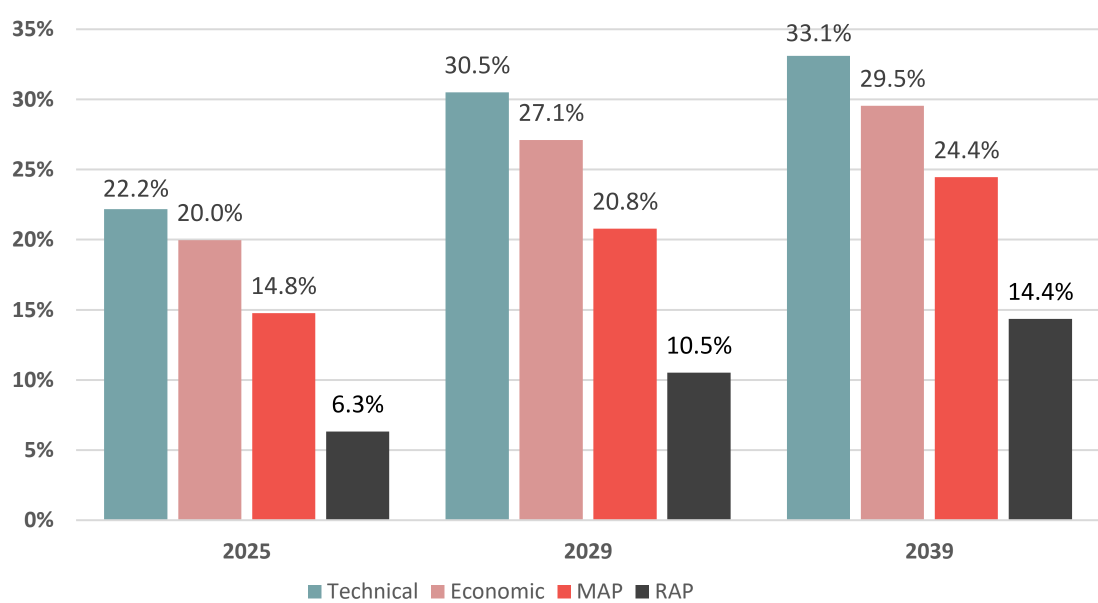


Table E-2 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP reaches 6.3% after six years.

TABLE E-2 COMMERCIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	50,170	101,739	156,928	213,761	267,250	316,621
Economic	46,545	93,832	143,992	195,103	242,328	285,256
MAP	29,659	62,928	99,777	138,516	176,072	210,908
RAP	11,578	24,685	39,512	55,740	72,884	90,391
Forecasted Sales	1,390,224	1,392,929	1,400,166	1,408,787	1,421,633	1,428,202
Technical	3.6%	7.3%	11.2%	15.2%	18.8%	22.2%
Economic	3.3%	6.7%	10.3%	13.8%	17.0%	20.0%
MAP	2.1%	4.5%	7.1%	9.8%	12.4%	14.8%
RAP	0.8%	1.8%	2.8%	4.0%	5.1%	6.3%

Table E-3 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 0.8% to 1.4% per year over the next six years.

TABLE E-3 COMMERCIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	50,170	54,751	59,038	61,705	61,577	62,517
Economic	46,545	50,469	53,966	55,928	55,202	55,716
MAP	29,659	34,334	38,719	41,744	42,354	43,062
RAP	11,578	13,618	15,630	17,541	18,846	20,006
Forecasted Sales	1,390,224	1,392,929	1,400,166	1,408,787	1,421,633	1,428,202
Technical	3.6%	3.9%	4.2%	4.4%	4.3%	4.4%
Economic	3.3%	3.6%	3.9%	4.0%	3.9%	3.9%
MAP	2.1%	2.5%	2.8%	3.0%	3.0%	3.0%
RAP	0.8%	1.0%	1.1%	1.2%	1.3%	1.4%

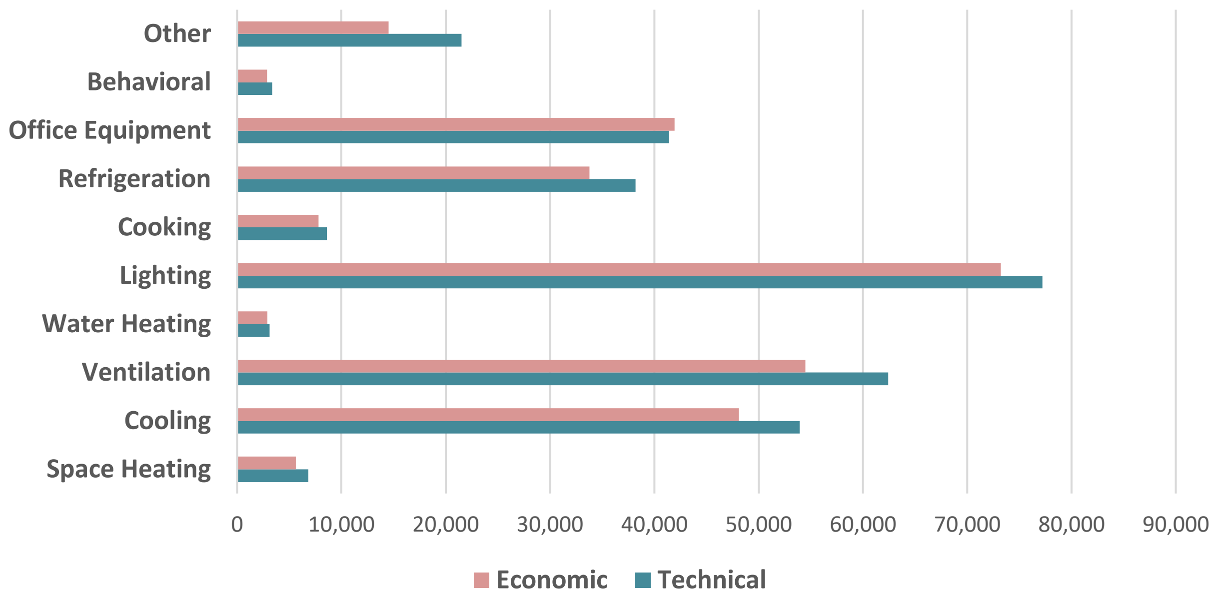
Technical & Economic Potential

Table E-4 provides cumulative annual technical and economic potential results from 2020-2025. Figure E-2 shows a comparison of the technical and economic potential (6-year) by end use. Lighting, Ventilation, and Cooling are the leading stand-alone end uses among technical and economic potential.

TABLE E-4 TECHNICAL & ECONOMIC COMMERCIAL ELECTRIC POTENTIAL

	2020	2021	2022	2023	2024	2025
Energy (MWh)						
Technical	50,170	101,739	156,928	213,761	267,250	316,621
Economic	46,545	93,832	143,992	195,103	242,328	285,256
Peak Demand (MW)						
Technical	7	13	20	28	34	40
Economic	5	10	16	21	27	32

FIGURE E-2 6-YEAR TECHNICAL AND ECONOMIC COMMERCIAL ELECTRIC POTENTIAL – BY END-USE



Maximum Achievable Potential

Figure E-3 illustrates the cumulative annual MAP results by end use across the 2020-2025 timeframe. Like technical and economic potential, Lighting, Ventilation, and Cooling are the leading end uses. Refrigeration and Office Equipment also have significant maximum achievable potential.

FIGURE E-3 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) MAP POTENTIAL BY END-USE

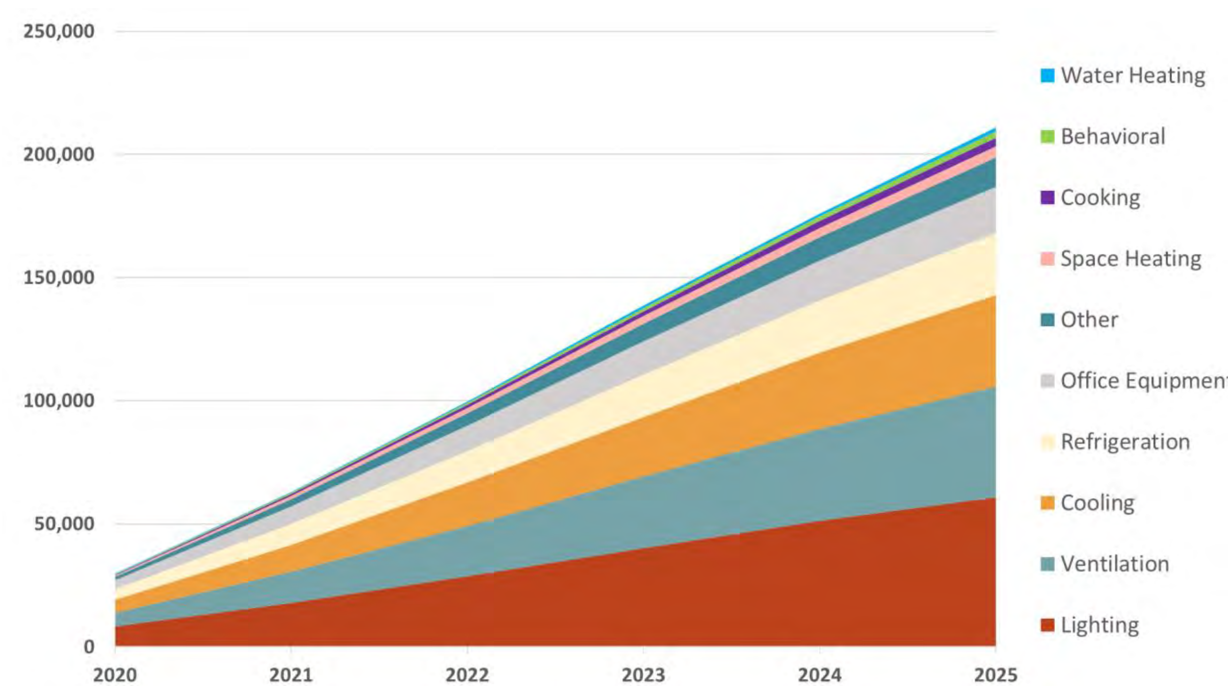


Table E-5 provides the incremental and cumulative annual MAP across the 2020-2025 timeframe. The incremental MAP ranges from 2.1% to 3.0% of forecasted sales across the six-year timeframe. Cumulative annual MAP rises to 14.8% by 2025.

TABLE E-5 COMMERCIAL ELECTRIC MAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Space Heating	632	738	812	825	779	690
Cooling	5,164	5,873	6,459	7,175	7,250	6,886
Ventilation	5,703	6,840	7,891	8,528	8,447	7,669
Water Heating	156	204	254	300	336	374
Lighting	8,277	9,662	10,844	11,386	10,957	9,665
Cooking	323	431	548	663	770	863
Refrigeration	4,216	4,939	5,477	5,745	5,754	6,593
Office Equipment	3,624	3,446	3,308	3,275	3,394	5,201
Behavioral	226	297	600	761	1,176	1,437
Other	1,336	1,903	2,525	3,086	3,491	3,684
Total	29,659	34,334	38,719	41,744	42,354	43,062
% of Forecasted Sales	2.1%	2.5%	2.8%	3.0%	3.0%	3.0%
Incremental Annual MW						
Total	2.4	2.9	3.3	3.5	3.5	3.3
% of Forecasted Demand	0.7%	0.9%	1.0%	1.0%	1.0%	1.0%
Cumulative Annual MWh						
Space Heating	632	1,371	2,183	3,008	3,787	4,477
Cooling	5,164	11,037	17,496	24,217	30,902	37,118
Ventilation	5,703	12,543	20,434	28,962	37,409	45,078
Water Heating	156	361	615	914	1,250	1,608
Lighting	8,277	17,939	28,784	40,169	51,127	60,791
Cooking	323	755	1,302	1,965	2,735	3,598
Refrigeration	4,216	8,357	12,760	17,138	21,249	24,958
Office Equipment	3,624	7,070	10,378	13,653	16,245	19,000
Behavioral	226	509	866	1,307	1,855	2,498
Other	1,336	2,986	4,960	7,183	9,513	11,783
Total	29,659	62,928	99,777	138,516	176,072	210,908
% of Forecasted Sales	2.1%	4.5%	7.1%	9.8%	12.4%	14.8%
Cumulative Annual MW						
Total	2.4	5.2	8.4	11.8	15.1	18.2
% of Forecasted Demand	0.7%	1.6%	2.5%	3.5%	4.5%	5.4%

Realistic Achievable Potential

Figure E-4 illustrates the cumulative annual RAP results by end use across the 2020-2025 timeframe. Like maximum achievable potential, Lighting, Ventilation, and Cooling are the leading end uses. Refrigeration and Office Equipment also have significant realistic achievable potential.

FIGURE E-4 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) RAP POTENTIAL BY END-USE

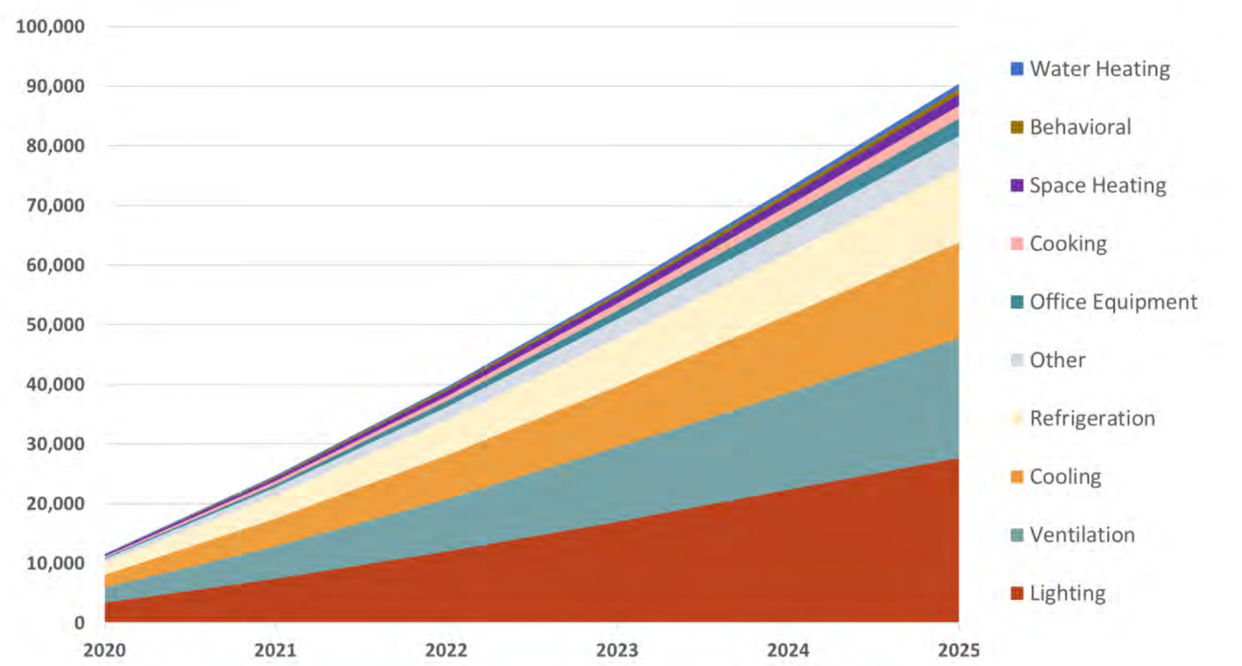


Table E-6 provides the incremental and cumulative annual RAP across the 2020-2025 timeframe. The incremental RAP ranges from 0.8% to 1.4% of forecasted sales across the six-year timeframe. Cumulative annual RAP rises to 6.3% by 2025.

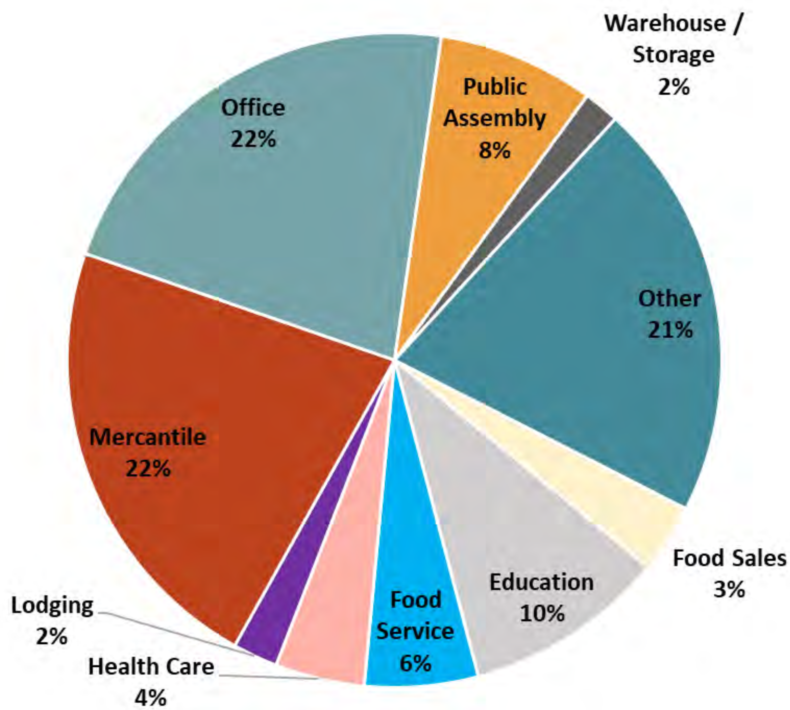
TABLE E-6 COMMERCIAL ELECTRIC RAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Space Heating	267	302	331	346	350	344
Cooling	2,200	2,443	2,678	3,082	3,210	3,235
Ventilation	2,515	2,947	3,325	3,641	3,805	3,817
Water Heating	86	108	131	153	174	200
Lighting	3,401	4,020	4,582	5,032	5,306	5,337
Cooking	218	273	330	389	447	503
Refrigeration	1,985	2,301	2,591	2,824	3,010	3,585
Office Equipment	253	322	418	531	655	805
Behavioral	64	90	190	256	397	513
Other	588	813	1,054	1,287	1,491	1,668
Total	11,578	13,618	15,630	17,541	18,846	20,006
% of Forecasted Sales	0.8%	1.0%	1.1%	1.2%	1.3%	1.4%
Incremental Annual MW						
Total	1.0	1.2	1.4	1.5	1.6	1.6
% of Forecasted Demand	0.3%	0.4%	0.4%	0.4%	0.5%	0.5%
Cumulative Annual MWh						
Space Heating	267	570	901	1,247	1,597	1,941
Cooling	2,200	4,643	7,321	10,165	13,103	16,042
Ventilation	2,515	5,463	8,787	12,428	16,234	20,050
Water Heating	86	194	325	478	652	844

End Use	2020	2021	2022	2023	2024	2025
Lighting	3,401	7,421	12,003	17,035	22,341	27,677
Cooking	218	491	822	1,211	1,657	2,160
Refrigeration	1,985	3,873	5,932	8,097	10,316	12,533
Office Equipment	253	574	992	1,524	2,179	2,983
Behavioral	64	150	270	429	626	871
Other	588	1,306	2,158	3,127	4,180	5,290
Total	11,578	24,685	39,512	55,740	72,884	90,391
% of Forecasted Sales	0.8%	1.8%	2.8%	4.0%	5.1%	6.3%
Cumulative Annual MW						
Total	1.0	2.2	3.5	4.9	6.5	8.0
% of Forecasted Demand	0.3%	0.6%	1.0%	1.5%	1.9%	2.4%

Figure E-5 illustrates a market segmentation of the RAP in the commercial sector by 2025. Mercantile, Office, and Education are the leading building types.

FIGURE E-5 2025 COMMERCIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL) RAP POTENTIAL BY MARKET SEGMENT



RAP Benefits & Costs

Table E-7 provides the net present value benefits and cost, as calculated using the UCT, across the 2020-2025 timeframe for the RAP scenario. Cooling and Water Heating are the most cost-effective end-uses, and Lighting also provides significant NPV benefits.

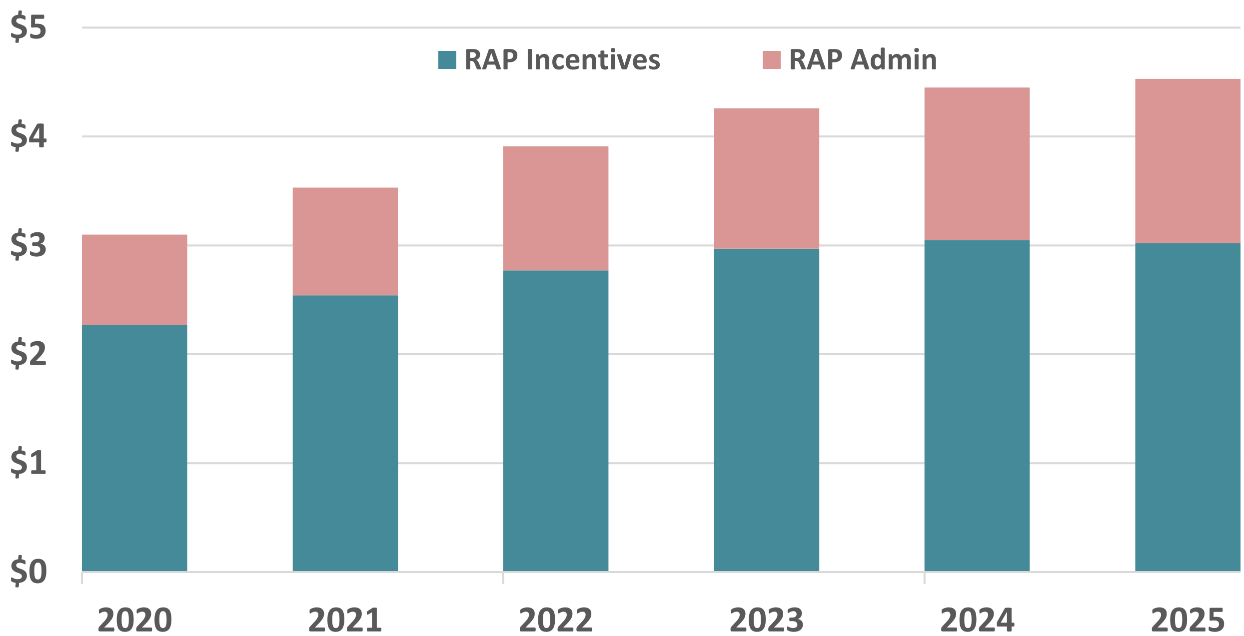
TABLE E-7 COMMERCIAL NPV BENEFITS & COSTS RAP BY END-USE ($ IN MILLIONS)

End Use	NPV Benefits	NPV Costs	UCT Ratio
Space Heating	$0.63	$1.76	0.36
Cooling	$25.49	$7.83	3.25
Ventilation	$7.94	$5.05	1.57
Water Heating	$0.21	$0.08	2.60

End Use	NPV Benefits	NPV Costs	UCT Ratio
Lighting	$10.75	$5.99	1.79
Cooking	$0.69	$0.34	2.06
Refrigeration	$3.45	$2.83	1.22
Office Equipment	$0.72	$0.29	2.47
Behavioral	$0.10	$0.08	1.33
Other	$1.95	$0.62	3.14
Total	$51.9	$24.9	2.09

Figure E-6 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2020-2025 timeframe. The incentives rise from $2.3 million to $2.1 million, and overall budgets rise from $3.1 million to $4.5 million by 2025.

FIGURE E-6 ANNUAL BUDGETS FOR COMMERCIAL RAP ($ IN MILLIONS)



APPENDIX F *DSM Market Potential Study Industrial Opt-Out Results*

This section provides the potential results for technical, economic, MAP and RAP for the industrial sector, with opt-out customers included. Results are broken down by end use. The cost-effectiveness results and budgets for the RAP scenario are also provided.

F.1 SCOPE OF MEASURES & END USES ANALYZED

There were 165 total unique electric measures included in the analysis. Table F-1 provides number of measures by end-use (the full list of industrial measures is provided in Appendix D). The measure list was developed based on a review of current Vectren programs, the Indiana TRM, other regional TRMs, and industry documents related to emerging technologies. Data collection activities to characterize measures formed the basis of the assessment of incremental costs, electric energy and demand savings, and measure life.

TABLE F-1 INDUSTRIAL ENERGY EFFICIENCY MEASURES – BY FUEL TYPE

End-Use	Number of Unique Measures
Computers & Office Equipment	6
Water Heating	6
Ventilation	7
Space Cooling	22
Space Heating	16
Cooking	7
Refrigeration	25
Lighting	20
Other	7
Machine Drive	21
Process Heating and Cooling	12
Agriculture	16

F.2 INDUSTRIAL ELECTRIC POTENTIAL

Figure F-1 provides the technical, economic, MAP and RAP results for the 6-year, 10-year, and 20-year timeframes. The 6-year technical potential is 18.9% of forecasted sales, and the economic potential is 18.0% of forecasted sales. The 6-year MAP is 13.2% and the RAP is 6.4%.

FIGURE F-1 INDUSTRIAL ELECTRIC ENERGY CUMULATIVE ANNUAL POTENTIAL (AS A % OF INDUSTRIAL SALES)

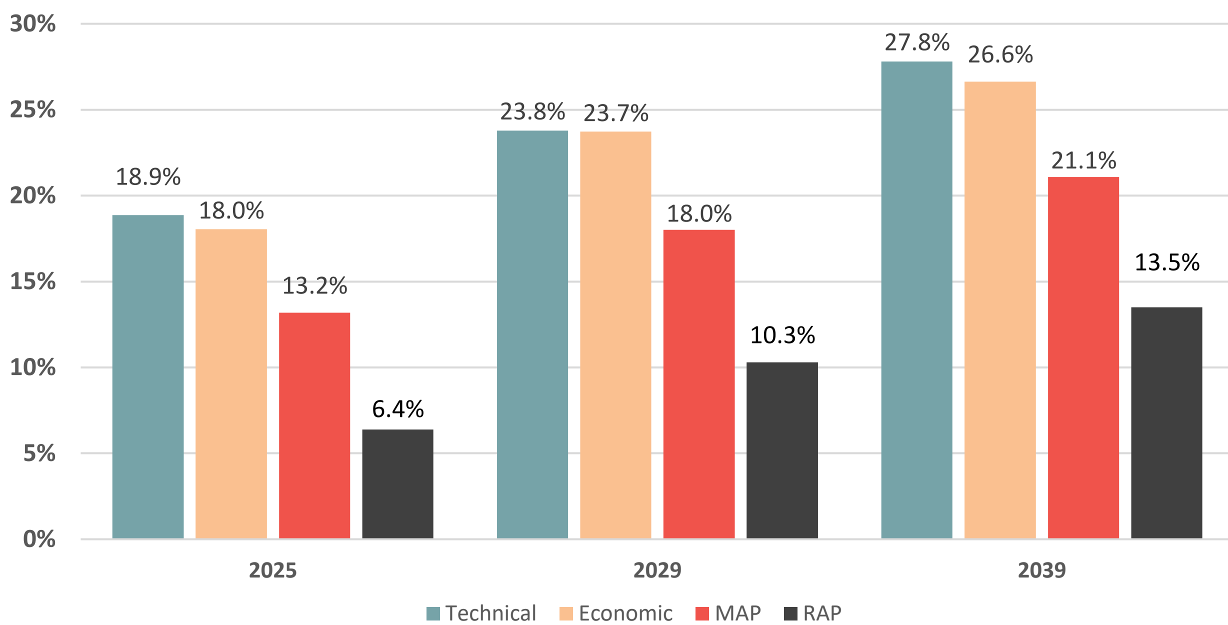


Table F-2 provides cumulative annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The RAP reaches 6.4% after six years.

TABLE F-2 INDUSTRIAL CUMULATIVE ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	66,750	142,458	224,968	309,520	383,043	447,367
Economic	63,335	135,371	214,263	295,502	366,107	427,911
MAP	41,085	90,213	146,167	205,384	261,922	312,473
RAP	19,324	41,785	67,208	94,837	123,025	151,326
Forecasted Sales	2,329,890	2,336,776	2,345,264	2,354,201	2,362,591	2,371,200
Energy Savings (as % of Forecast)						
Technical	2.9%	6.1%	9.6%	13.1%	16.2%	18.9%
Economic	2.7%	5.8%	9.1%	12.6%	15.5%	18.0%
MAP	1.8%	3.9%	6.2%	8.7%	11.1%	13.2%
RAP	0.8%	1.8%	2.9%	4.0%	5.2%	6.4%

Table F-3 provides the incremental annual technical, economic, MAP and RAP energy savings, in total MWh and as a percentage of the sector-level sales forecast. The incremental RAP ranges from 0.8% to 1.6% per year over the next six years.

TABLE F-3 INDUSTRIAL INCREMENTAL ANNUAL ENERGY EFFICIENCY POTENTIAL SUMMARY

	2020	2021	2022	2023	2024	2025
MWh						
Technical	66,750	78,664	89,185	95,702	97,760	95,516
Economic	63,335	74,992	85,566	92,390	94,842	92,995
MAP	41,085	51,432	61,105	67,856	71,118	70,784
RAP	19,324	23,576	27,883	31,695	35,218	38,149
Forecasted Sales	2,329,890	2,336,776	2,345,264	2,354,201	2,362,591	2,371,200
Energy Savings (as % of Forecast)						
Technical	2.9%	3.4%	3.8%	4.1%	4.1%	4.0%

	2020	2021	2022	2023	2024	2025
MWh						
Economic	2.7%	3.2%	3.6%	3.9%	4.0%	3.9%
MAP	1.8%	2.2%	2.6%	2.9%	3.0%	3.0%
RAP	0.8%	1.0%	1.2%	1.3%	1.5%	1.6%

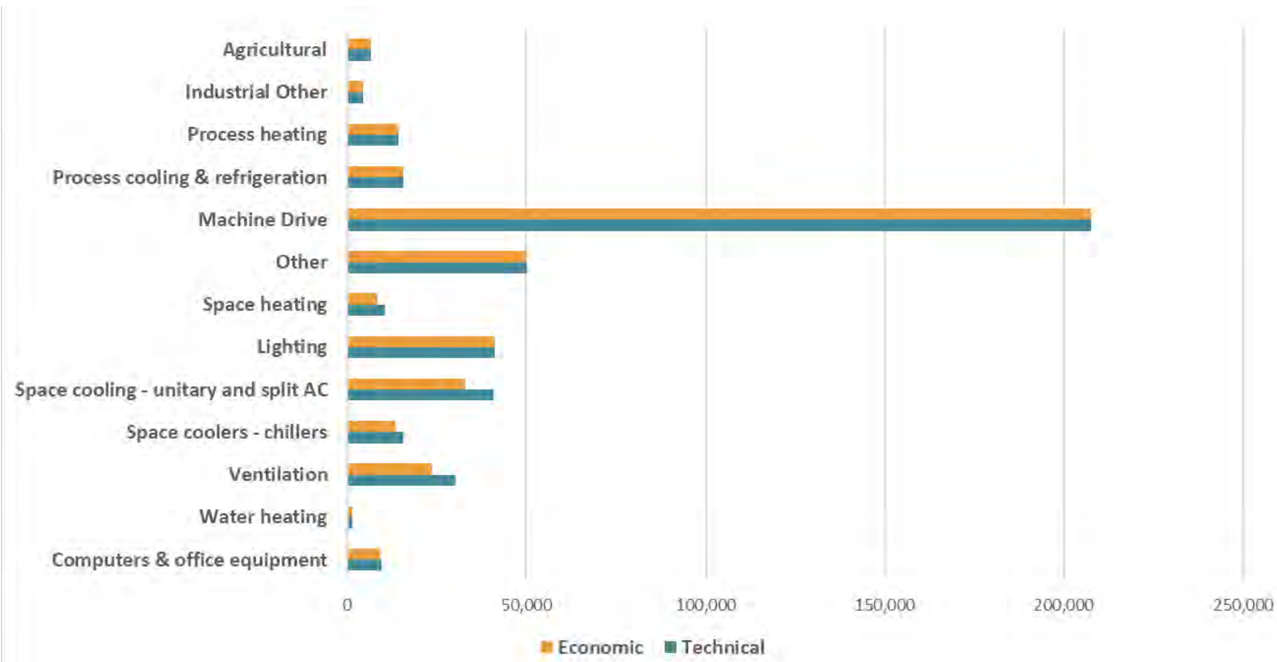
Technical & Economic Potential

Table F-4 provides cumulative annual technical and economic potential results from 2020-2025. Figure F-2 shows a comparison of the technical and economic potential (6-year) by end use. Machine drive, Lighting, and Space Cooling – unitary and split AC are the leading stand-alone end uses among technical and economic potential.

TABLE F-4 TECHNICAL AND ECONOMIC INDUSTRIAL ELECTRIC POTENTIAL

	2020	2021	2022	2023	2024	2025
Energy (MWh)						
Technical	66,750	142,458	224,968	309,520	383,043	447,367
Economic	63,335	135,371	214,263	295,502	366,107	427,911
Peak Demand (MW)						
Technical	12	25	40	54	67	78
Economic	11	24	38	52	64	74

FIGURE F-2 YEAR TECHNICAL AND ECONOMIC INDUSTRIAL ELECTRIC POTENTIAL – BY END-USE



Maximum Achievable Potential

Figure F-3 illustrates the cumulative annual MAP results by end use across the 2020-2025 timeframe. Like technical and economic potential, Machine Drive, Lighting, and Space Cooling – unitary and split AC are the leading end uses. Ventilation and Space coolers – chillers also have significant maximum achievable potential.

FIGURE F-3 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) MAP POTENTIAL BY END-USE

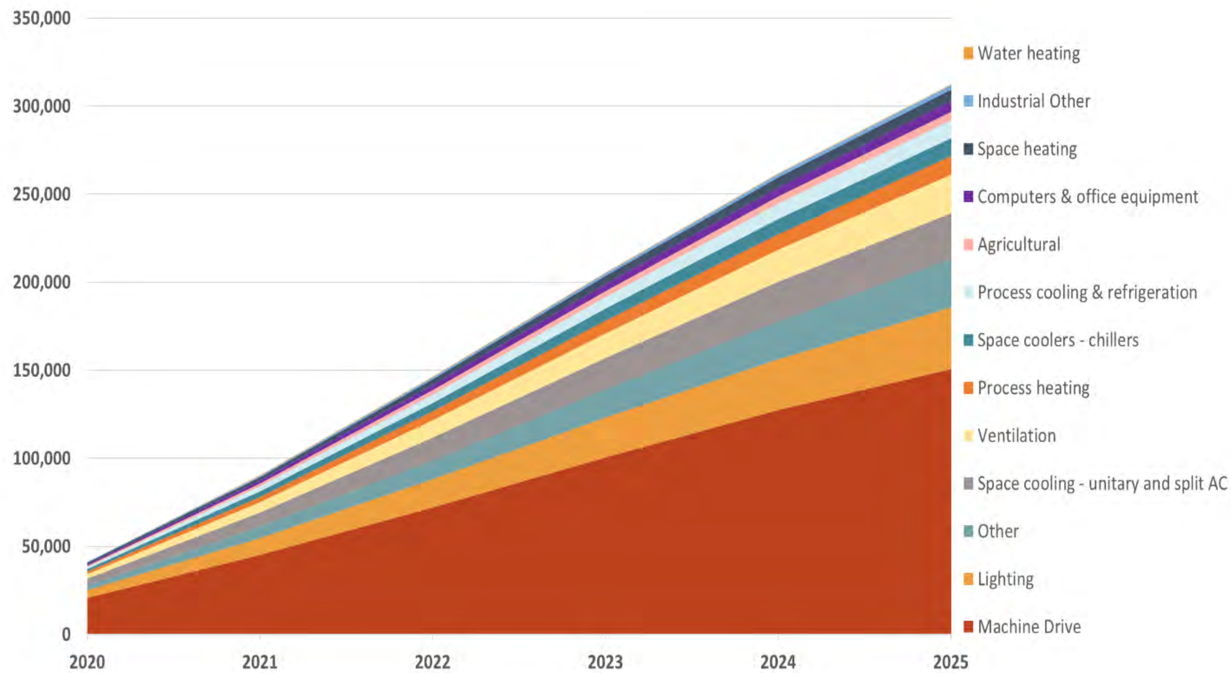


Table F-5 provides the incremental and cumulative annual MAP across the 2020-2025 timeframe. The incremental MAP ranges from 1.8% to 3.0% of forecasted sales across the six-year timeframe. Cumulative annual MAP rises to 13.1% by 2025.

TABLE F-5 INDUSTRIAL ELECTRIC MAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Computers & office equipment	747	960	1,161	1,323	1,438	1,690
Water heating	89	92	98	109	123	134
Ventilation	2,728	3,394	3,978	4,236	4,083	3,582
Space coolers - chillers	1,410	1,685	1,908	1,991	2,042	1,872
Space cooling - unitary and split AC	3,688	4,383	4,974	5,221	5,393	4,904
Lighting	4,373	5,445	6,488	7,215	7,379	6,985
Space heating	921	1,103	1,260	1,327	1,381	1,264
Other	2,729	3,547	4,438	5,333	6,285	7,279
Machine Drive	20,695	25,930	30,767	34,161	35,486	35,311
Process cooling & refrigeration	1,307	1,812	2,312	2,747	3,082	3,314
Process heating	1,324	1,836	2,373	2,818	3,105	3,227
Industrial Other	392	433	460	483	509	537
Agricultural	683	810	890	891	812	684
Total	41,085	51,432	61,105	67,856	71,118	70,784
% of Forecasted Sales	1.8%	2.2%	2.6%	2.9%	3.0%	3.0%
Incremental Annual MW						
Total	7	9	11	12	12	12
% of Forecasted Demand	1.8%	2.2%	2.6%	2.9%	3.0%	3.0%

End Use	2020	2021	2022	2023	2024	2025
Cumulative Annual MWh						
Computers & office equipment	747	1,707	2,868	4,191	5,122	5,950
Water heating	89	181	279	389	512	643
Ventilation	2,728	6,101	10,030	14,185	18,147	21,568
Space coolers - chillers	1,410	3,088	4,981	6,947	8,828	10,343
Space cooling - unitary and split AC	3,688	8,010	12,845	17,811	22,452	26,423
Lighting	4,373	9,662	15,802	22,429	28,941	34,762
Space heating	921	2,010	3,237	4,509	5,711	6,752
Other	2,729	6,276	10,711	16,038	21,434	27,268
Machine Drive	20,695	45,027	72,224	100,437	127,306	150,868
Process cooling & refrigeration	1,307	2,901	4,725	6,648	8,513	10,194
Process heating	1,324	2,960	4,887	6,952	8,944	10,679
Industrial Other	392	798	1,196	1,574	1,928	2,258
Agricultural	683	1,493	2,382	3,273	4,084	4,765
Total	41,085	90,213	146,167	205,384	261,922	312,473
% of Forecasted Sales	1.8%	3.9%	6.2%	8.7%	11.1%	13.2%
Cumulative Annual MW						
Total	7	16	26	36	46	54
% of Forecasted Demand	1.8%	3.9%	6.3%	8.8%	11.1%	13.1%

Realistic Achievable Potential

Figure F-4 illustrates the cumulative annual RAP results by end use across the 2020-2025 timeframe. Like maximum achievable potential, Machine Drive, Lighting, and Space Cooling – unitary and split AC are the leading end uses. Ventilation and Space coolers – chillers also have significant maximum achievable potential.

FIGURE F-4 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL GWH) RAP POTENTIAL BY END-USE

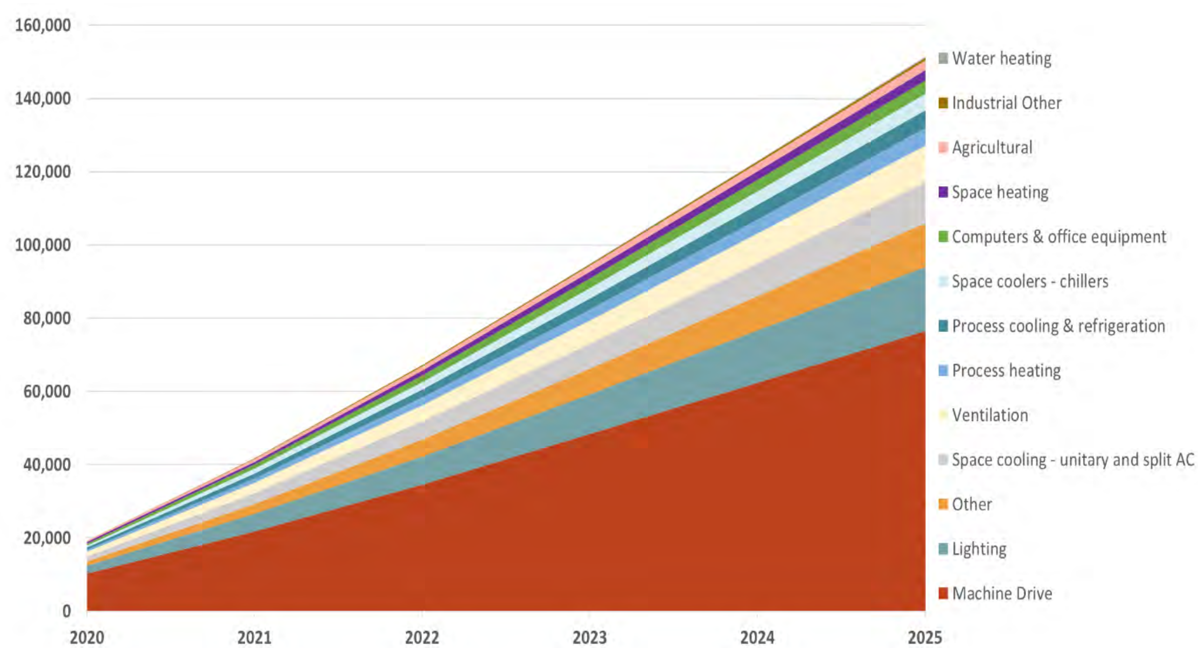


Table F-6 provides the incremental and cumulative annual RAP across the 2020-2025 timeframe. The incremental RAP ranges from 0.8% to 1.6% of forecasted sales across the six-year timeframe. Cumulative annual RAP rises to 6.4% by 2025.

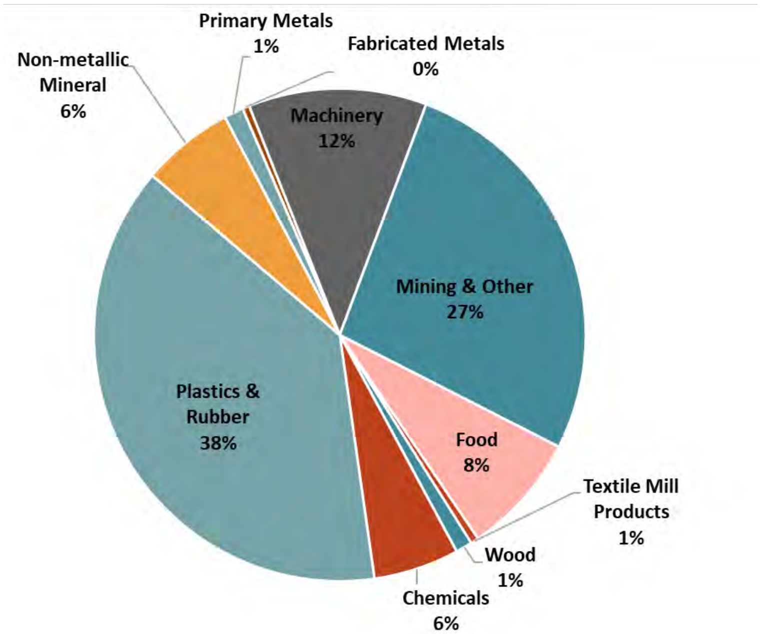
TABLE F-6 INDUSTRIAL ELECTRIC RAP BY END-USE

End Use	2020	2021	2022	2023	2024	2025
Incremental Annual MWh						
Computers & office equipment	512	616	716	810	894	1,062
Water heating	20	27	35	45	55	64
Ventilation	1,246	1,488	1,713	1,858	1,935	1,938
Space coolers - chillers	564	675	777	850	952	980
Space cooling - unitary and split AC	1,385	1,664	1,924	2,100	2,379	2,440
Lighting	2,156	2,621	3,073	3,450	3,738	3,895
Space heating	352	424	492	540	613	630
Other	1,204	1,547	1,939	2,351	2,780	3,281
Machine Drive	10,213	12,370	14,581	16,581	18,298	19,856
Process cooling & refrigeration	625	823	1,031	1,250	1,473	1,689
Process heating	589	796	1,019	1,235	1,446	1,643
Industrial Other	97	121	149	179	212	247
Agricultural	362	404	431	446	444	424
Total	19,324	23,576	27,883	31,695	35,218	38,149
% of Forecasted Sales	0.8%	1.0%	1.2%	1.3%	1.5%	1.6%
Incremental Annual MW						
Total	3	4	5	6	6	7
% of Forecasted Demand	0.9%	1.0%	1.2%	1.4%	1.5%	1.6%
Cumulative Annual MWh						
Computers & office equipment	512	1,127	1,843	2,654	3,164	3,652
Water heating	20	47	83	128	182	245
Ventilation	1,246	2,725	4,418	6,243	8,128	9,996
Space coolers - chillers	564	1,236	2,007	2,847	3,729	4,536
Space cooling - unitary and split AC	1,385	3,023	4,890	6,893	8,957	11,005
Lighting	2,156	4,711	7,639	10,846	14,223	17,623
Space heating	352	769	1,248	1,765	2,302	2,837
Other	1,204	2,751	4,690	7,039	9,365	11,987
Machine Drive	10,213	21,783	34,604	48,291	62,398	76,424
Process cooling & refrigeration	625	1,348	2,156	3,032	3,950	4,876
Process heating	589	1,293	2,108	3,001	3,940	4,886
Industrial Other	97	205	326	458	600	750
Agricultural	362	766	1,197	1,642	2,086	2,509
Total	19,324	41,785	67,208	94,837	123,025	151,326
% of Forecasted Sales	0.8%	1.8%	2.9%	4.0%	5.2%	6.4%
Cumulative Annual MW						

End Use	2020	2021	2022	2023	2024	2025
Total	3	7	12	17	21	26
% of Forecasted Demand	0.9%	1.8%	2.9%	4.1%	5.2%	6.4%

Figure F-5 illustrates a market segmentation of the RAP in the industrial sector by 2025. Plastics & rubber, Mining & Other, and Machinery are the leading market segments.

FIGURE F-5 2025 INDUSTRIAL ELECTRIC ENERGY (CUMULATIVE ANNUAL) RAP POTENTIAL BY MARKET SEGMENT[1]



RAP Benefits & Costs

Table F-6**Error! Reference source not found.** provides the net present value benefits and cost, as calculated using the UCT, across the 2020-2025 timeframe for the RAP scenario. Machine Drive is the most cost-effective end-use. Facility HVAC and Facility Lighting also provide significant NPV benefits.

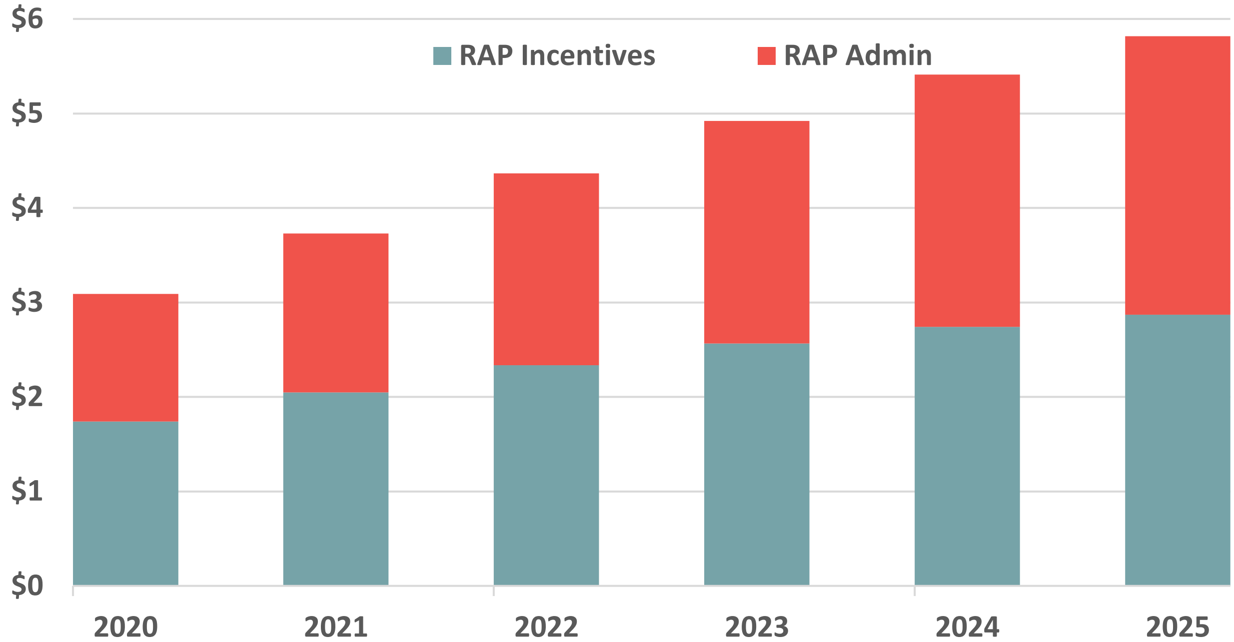
TABLE F-7 INDUSTRIAL NPV BENEFITS AND COSTS RAP BY END-USE ($ IN MILLIONS)

End Use	NPV Benefits	NPV Costs	UCT Ratio
Machine Drive	$49.7	$8.4	5.90
Facility HVAC	$14.4	$3.6	2.81
Facility Lighting	$11.1	$6.0	2.64
Other Facility Support	$5.4	$2.2	1.53
Process Cooling and Refrigeration	$2.7	$0.7	3.64
Process Heating	$2.0	$0.5	4.59
Other	$6.8	$2.2	3.04
Total	92.1	23.5	3.91

Figure F-6 provides the budget for the RAP scenario. The budget is broken into incentive and admin budgets for each year of the 2020-2025 timeframe. The incentives rise from $1.7 million to $2.9 million, and overall budgets rise from $3.1 million to $5.8 million by 2025.

[1] "Wholesale/Retail" and "Services" industrial types include industrial buildings that devote a minority percentage of floor space to commercial activities like wholesale and retail trade, and construction, healthcare, education and accommodation & food service. Automotive related industries are divided between plastics, rubber, and machinery based on their NAICS codes.

FIGURE F-6 ANNUAL BUDGETS FOR INDUSTRIAL RAP ($ IN MILLIONS)



APPENDIX G *Demand Response Methodology*

G.1 DEMAND RESPONSE PROGRAM OPTIONS

Table G-1 provides a brief description of the demand response program options considered and identifies the eligible customer segment for each demand response program that was considered in this study.

TABLE G-1 DEMAND RESPONSE PROGRAM OPTIONS AND ELIGIBLE MARKETS

DR Program Option	Program Description	Eligible Markets
DLC AC (Switch)	The compressor of the air conditioner is remotely shut off (cycled) by the system operator for periods that may range from 7 ½ to 15 minutes during every 30-minute period (i.e., 25%-50% duty cycle)	Residential and Commercial Customers
DLC AC (Smart Thermostat)	The system operator can remotely raise the AC's thermostat set point during peak load conditions, lowering AC load.	Residential and Commercial Customers
DLC Pool Pumps	The swimming pool pump is remotely shut off by the system operator for periods normally ranging from 2 to 4 hours.	Residential Customers
DLC Water Heaters	The water heater is remotely shut off by the system operator for periods normally ranging from 2 to 8 hours.	Residential and Commercial Customers
Critical Peak Pricing with Enabling Technology	A retail rate in which an extra-high price for electricity is provided during a limited number of critical periods (e.g. 100 hours) of the year. Market-based prices are typically provided on a day-ahead basis, or an hour-ahead basis. Includes enabling technology that connects technologies within building. Only for customers with AC.	Residential and Commercial Customers
Critical Peak Pricing without Enabling Technology	A retail rate in which an extra-high price for electricity is provided during a limited number of critical periods (e.g. 100 hours) of the year. Market-based prices are typically provided on a day-ahead basis, or an hour-ahead basis.	Residential and Commercial Customers
Real Time Pricing	Real Time Pricing reflects the current conditions and is calculated for each hour in the billing period.	Commercial Customers

DR Program Option	Program Description	Eligible Markets
Peak Time Rebate	Instead of charging a higher rate during critical events, participants are paid for load reductions (estimated relative to forecast of what the customer would otherwise have consumed). If customers don't want to participate, they pay the existing rate.	Residential and Commercial Customers
Time of Use Rate	A retail rate with different prices for usage during different blocks of time. Daily pricing blocks could include on-peak, mid-peak, and off-peak periods. Pricing is pre-defined, and once established do not vary with actual cost conditions.	Residential and Commercial Customers

G.2 DEMAND RESPONSE POTENTIAL ASSESSMENT APPROACH

The analysis for this study was conducted using the GDS DR Model. The GDS DR Model is an Excel spreadsheet tool that allows the user to determine the achievable potential for a demand response program based on the following two basic equations that can be chosen to be the model user.

TECHNICAL POTENTIAL ● All technically feasible demand reductions are incorporated to provide a measure of the theoretical maximum demand response potential. This assumes 100% of eligible customers will participate in all programs regardless of cost-effectiveness.

ECONOMIC POTENTIAL ● Economic potential is a subset of technical potential. Only cost-effective demand response program options are included in the economic potential. The cost-effectiveness test applied in this study is the UCT test. Only programs whose net present value of benefits exceed its costs will pass the economic screening.

ACHIEVABLE POTENTIAL ● The cost-effective demand response potential that can practically be attained in a real-world program delivery scenario, if a certain level of market penetration can be attained are included in this scenario. Achievable potential takes into account real-world barriers to convincing customers to participate in cost-effective demand response programs. Achievable savings potential savings is a subset of economic potential.

If the model user chooses to base the estimated potential demand reduction on a per customer CP load reduction value, then:

$$\textit{Achievable DR Potential} = \textit{Potentially Eligible Customers} \times \textit{Eligible Customer Participation Rate} \times \textit{CP kW Load Reduction Per Participant}$$

The framework for assessing the cost-effectiveness of demand response programs is based on *A Framework for Evaluating the Cost-Effectiveness of Demand Response*, prepared for the National Forum on the National Action

Plan (NAPA) on Demand Response.[1] Additionally, GDS reviewed the May 2017 National Standard Practice Manual published by the National Efficiency Screening Project.[2] GDS utilized this guide to define avoided ancillary services and energy and/or capacity price suppression benefits. Appendix A contains a table from the report summarizing the energy efficiency cost and benefits including in all five major benefit cost tests.

The GDS Demand Response Model determines the estimated savings for each demand response program by performing an extensive review of all benefits and cost associated with each program. GDS developed the model such that the value of future programs could be determined and to help facilitate demand response program planning strategies. The model contains approximately 50 required inputs for each program including: expected life, CP kW load reductions, proposed rebate levels, program related expenses such as vendor service fees, marketing and evaluation cost and on-going O&M expenses. This model and future program planning features can be used to standardize the cost-effectiveness screening process between Vectren departments interested in the deployment of demand response resources.

For this study, the Utility Cost Test (UCT) test was used to determine the cost-effectiveness of each demand response program. Benefits are based on avoided demand, energy (including load shifting), wholesale cost reductions and T&D costs. Costs include incremental program equipment costs (such as control switches or smart thermostats), fixed program capital costs (such as the cost of a central controller), program administrative, marketing, and evaluation costs. Incremental equipment program costs are included for both new and replacement units (such as control switches) to account for units that are replaced at the end of their useful life.

Achievable potential is broken into maximum and realistic achievable potential in this study:

MAP represents an estimate of the maximum cost-effective demand response potential that can be achieved over the 20-year study period. For this study, this is defined as customer participation in demand response program options that reflect a "best practices" estimate of what could eventually be achieved. MAP assumes no barriers to effective delivery of programs.

RAP represents an estimate of the amount of demand response potential that can be realistically achieved over the 20-year study period. For this study, this is defined as achieving customer participation in demand response program options that reflect a realistic estimate of what could eventually be achieved assuming typical or "average" industry experience. RAP is a discounted MAP, by considering program barriers that limit participation, therefore reducing savings that could be achieved.

This potential study evaluated DR potential for two achievable potential scenarios:

1 ***Utility Incentivized Scenario:*** The utility incentivized scenario assumes that all cost-effective DR programs will be implemented by Vectren and smart thermostats will be paid for and installed by the utility. Since Vectren already has a smart thermostat energy efficiency program, GDS assumed that the customers participating in this program would already have smart thermostats installed and there would be no additional cost to the utility.
2 ***BYOT Scenario:*** The bring your own thermostat (BYOT) scenario also assumes that all cost-effective DR programs will be implemented, but in this scenario smart thermostats will be used purchased and installed by the customer. GDS assumed there would be a one-time $75 credit[3].

[1] Study was prepared by Synapse Energy Economics and the Regulatory Assistance Project, February 2013.
[2] National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources, May 18, 2017, Prepared by The National Efficiency Screening Project
[3] Vectren South 2018 Electric DSM Operating Plan

Demand savings estimates were assumed to be the same for both scenarios, but the costs are different.

G.3 AVOIDED COSTS & OTHER ECONOMIC ASSUMPTIONS

The avoided costs used to determine utility benefits were provided by Vectren. Avoided electric generation capacity refers to the demand response program benefit resulting from a reduction in the need for new peaking generation capacity. Demand response can also produce energy related benefits. If the demand response option is considered "load shifting", such as direct load control of electric water heating, the consumption of energy is shifted from the control period to the period immediately following the period of control. For this study, GDS assumed that the energy is shifted with no loss of energy. For power suppliers, this shift in the timing of energy use can produce benefits from either the production of energy from lower cost resources or the purchase of energy at a lower rate. If the program is not considered to be "load shifting" the measure is turned off during peak control hours, and the energy is saved altogether. Demand response programs can also potentially delay the construction of new transmission and distribution lines and facilities, which is reflected in avoided T&D costs.

The discount rate used in this study is 7.29%. A peak demand line loss factor of 6.33% and a reserve margin of 8.4 % (for firm load reduction such as direct load control) were also applied to demand reductions at the customer meter. These values were provided by Vectren.

The useful life of a smart thermostat is assumed to be 15 years[4]. Load control switches have a useful life of 15 years[5]. This life was used for all direct load control measures in this study.

The number of control units per participant was assumed to be 1 for all direct load control programs using switches (such as water heaters and air conditioning switches), because load control switches can control up to two units. However, for controllable thermostats, some participants have more than one thermostat. The average number of residential thermostats per single family home was assumed to be 1.72[6].

G.4 CUSTOMER PARTICIPATION

The assumed level of customer participation for each demand response program option is a key driver of achievable demand response potential estimates. Customer participation rates reflect the total number of eligible customers that are likely to participate in a demand response program. An eligible customer is defined as a customer that is eligible to participate in a demand response program. For DLC programs, eligibility is determined by whether a customer has the end use equipment that will be controlled[7]. The eligible customers for each program is shown in Table G-2 and Table G-3.

TABLE G-2 ELIGIBLE RESIDENTIAL CUSTOMERS IN EACH DEMAND RESPONSE PROGRAM OPTION

DR Program Option	Saturation	Source / Description
DLC AC (Switch)	62% of residential customers	Vectren 2016 Electric Baseline Survey - % of residential homes with central AC
DLC AC (Thermostat)	62% of residential customers	Vectren 2016 Electric Baseline Survey - % of residential homes with central AC

4 Indiana TRM
5 Provided by Comverge
6 EIA RECS table HC6.1

DR Program Option	Saturation	Source / Description
DLC Pool Pumps	6% of residential customers	Vectren 2016 Electric Baseline Survey - % of residential homes with swimming pool pumps
DLC Water Heaters	35% of residential customers	Vectren 2016 Electric Baseline Survey - % of residential homes with electric water heaters
Critical Peak Pricing with Enabling Technology	62% of residential customers	Vectren 2016 Electric Baseline Survey - % of residential homes with central AC
Critical Peak Pricing without Enabling Technology	100% of residential customers	GDS Assumption
Peak Time Rebate	100% of residential customers	GDS Assumption
Time of Use	100% of residential customers	GDS Assumption

TABLE G-3 ELIGIBLE NON-RESIDENTIAL CUSTOMERS IN EACH DEMAND RESPONSE PROGRAM OPTION

DR Program Option	Saturation	Source / Description
DLC AC (Switch)	81.5% of commercial customers	GDS Survey of Vectren C&I Customers - % of C&I customers with central AC
DLC AC (Thermostat)	81.5% of commercial customers	GDS Survey of Vectren C&I Customers - % of C&I customers with central AC
DLC Water Heaters	40% of commercial customers	CBECS 2015 - % of commercial customers in East North Central region with electric water heaters
Critical Peak Pricing with Enabling Technology	81.5% of commercial customers	GDS Survey of Vectren C&I Customers - % of C&I customers with central AC
Critical Peak Pricing without Enabling Technology	100% of commercial customers	GDS Assumption
Real Time Pricing	100% of commercial customers	GDS Assumption
Peak Time Rebate	100% of commercial customers	GDS Assumption
Time of Use	100% of commercial customers	GDS Assumption

G.4.1 Existing Demand Response Programs

Vectren and its owner-member cooperatives have offered their Direct Load Control program for many years. This program offers incentives to members who enroll central AC and electric water heaters. However, Vectren plans to transition the DLC AC switch program to be controlled with smart thermostats instead. The DLC water heating and pool pump programs are being phased out. GDS assumed that all DLC programs controlled with switches would be ended by 2023. A cost-effective analysis was still run for these programs, with the assumption that no new switches would be installed and participation would steadily decline until 2023.

G.4.2 Hierarchy

Double-counting savings from demand response programs that affect the same end uses is a common issue that must be addressed when calculating the demand response savings potential. For example, a direct load control program of air conditioning and a rate program both assume load reduction of the customers' air conditioners. For this reason, it is typically assumed that customers cannot participate in programs that affect the same end uses. This hierarchy where direct load control programs come before rate programs was chosen by Vectren. The order of the rest of the programs is based on savings. Programs with higher savings per customer are ranked as higher in the hierarchy.

TABLE *G-4* DEMAND RESPONSE HIERARCHY

DR Program Option	Applicable Sector
DLC Programs	Residential, Commercial
Critical Peak Pricing with Enabling Technology	Residential, Commercial
Critical Peak Pricing without Enabling Technology	Residential, Commercial
Real Time Pricing	Commercial
Peak Time Rebates	Residential, Commercial
Time of Use	Residential, Commercial

G.4.3 Participation Rates

The assumed "steady state" participation rates used in this potential study and the sources upon which each assumption is based are shown in Table G-5 for residential and non-residential customers, respectively. The steady state participation rate represents the enrollment rate once the fully achievable participation has been reached. Participation rates are expressed as a percentage of eligible customers. Program participation and impacts (demand reductions) are assumed to begin in 2020. The main sources of participant rates are several studies completed by the Brattle Group. Additional detail about participation rates and sources are shown in Table G-5.

TABLE *G-5* STEADY STATE PARTICIPATION RATES FOR DEMAND RESPONSE PROGRAM OPTIONS

DR Program Options	MAP Steady State Participation Rate	RAP Steady State Participation Rate	Source
RESIDENTIAL			
DLC AC (Switch)	0% (existing program declining to 0 participants)	0% (existing program declining to 0 participants)	Vectren
DLC AC (Thermostat)	36%	25%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Participation in BYOD programs is estimated to be 5% higher than in DLC programs.
DLC Pool Pumps	0% (existing program declining to 0 participants)	0% (existing program declining to 0 participants)	Vectren
DLC Water Heaters	0% (existing program declining to 0 participants)	0% (existing program declining to 0 participants)	Vectren

DR Program Options	MAP Steady State Participation Rate	RAP Steady State Participation Rate	Source
Critical Peak Pricing with Enabling Technology	91%	22%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Opt-Out for MAP, Opt-In for RAP)
Critical Peak Pricing without Enabling Technology	82%	17%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Opt-Out for MAP, Opt-In for RAP)
Peak Time Rebate	93%	21%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Opt-Out for MAP, Opt-In for RAP)
Time of Use	85%	28%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Opt-Out for MAP, Opt-In for RAP)
NON-RESIDENTIAL			
DLC AC (Switch)	0% (existing program declining to 0 participants)	0% (existing program declining to 0 participants)	Vectren
DLC AC (Thermostat)	19%	8%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Participation in BYOD programs is estimated to be 5% higher than in DLC programs.
DLC Water Heaters	0% (existing program declining to 0 participants)	0% (existing program declining to 0 participants)	Vectren
Critical Peak Pricing with Enabling Technology	69%	20%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Opt-Out for MAP, Opt-In for RAP)
Critical Peak Pricing without Enabling Technology	63%	18%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Opt-Out for MAP, Opt-In for RAP)
Real Time Pricing	3%	3%	PACIFICORP DEMAND-SIDE RESOURCE POTENTIAL ASSESSMENT FOR 2015-2034

DR Program Options	MAP Steady State Participation Rate	RAP Steady State Participation Rate	Source
Peak Time Rebate	71%	22%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Opt-Out for MAP, Opt-In for RAP)
Time of Use	74%	13%	Demand Response Market Research: Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (Opt-Out for MAP, Opt-In for RAP)

Customer participation in new demand response programs is assumed to reach the steady state take rate over a five-year period. The path to steady state customer participation follows an "S-shaped" curve, in which participation growth accelerates over the first half of the five-year period, and then slows over the second half of the period (see Figure G-1). Existing programs have already gone through this ramp-up period, so they were escalated linearly to the final participation rate.

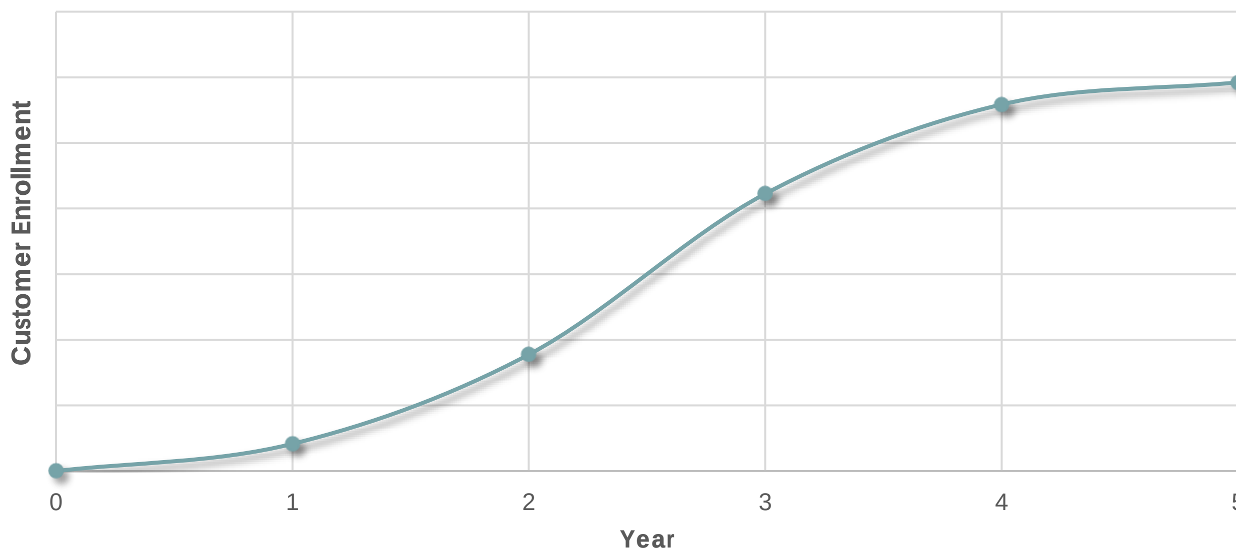


FIGURE G-1 ILLUSTRATION OF S-SHAPED MARKET ADOPTION CURVE

G.5 LOAD REDUCTION ASSUMPTIONS

Table G-6 presents the residential and non-residential per participant CP demand reduction impact assumptions for each demand response program option at the customer meter. Demand reductions were based on load reductions found in Vectren's existing demand response programs, and various secondary data sources including the FERC and other industry reports, including demand response potential studies.

TABLE *G-6* PER PARTICIPANT CP DEMAND REDUCTION ASSUMPTIONS

DR Program Options	Per Participant CP Demand Reduction	Source
RESIDENTIAL		
DLC AC (Switch)	1 kW	2012 FERC Demand Response Survey Data (Reported realized savings data for 20 utility programs, adjusted to account for peak summer temperature differences using NOAA Normal Max Summer Temperature Data, 1981-2010)
DLC AC (Thermostat)	0.87 kW	87% of Load Switch Control. Sources: Smart Thermostats: An Alternative to Load Control Switches? Trends and Strategic Options to Consider for Residential Load Control Programs; 2016 Demand Response Potential Study Conducted by GDS for several Michigan utilities (Confidential pilot program report)
DLC Pool Pumps	1.36 kW	Southern California Edison Pool Pump Demand Response Potential Report, 2008.
DLC Water Heaters	0.4 kW Summer	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
Critical Peak Pricing with Enabling Technology	31% of coincident peak load	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
Critical Peak Pricing without Enabling Technology	11.7% of coincident peak load	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
Peak Time Rebate	12.9% of coincident peak load	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
Time of Use	5.2% of coincident peak load	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
NON-RESIDENTIAL		
DLC AC (Switch)	1.6 kW	2012 FERC Demand Response Survey Data (Reported realized savings data for 14 utility programs, adjusted to account for peak summer temperature differences using NOAA Normal Max Summer Temperature Data, 1981-2010)

DR Program Options	Per Participant CP Demand Reduction	Source
DLC AC (Thermostat)	1.39 kW	87% of Load Switch Control. Sources: Smart Thermostats: An Alternative to Load Control Switches? Trends and Strategic Options to Consider for Residential Load Control Programs; 2016 Demand Response Potential Study Conducted by GDS for several Michigan utilities (Confidential pilot program report)
DLC Water Heaters	1.2 kW Summer	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
Critical Peak Pricing with Enabling Technology	21.5% of coincident peak load	Dynamic Pricing: Transitioning from Experiments to Full Scale Deployments, Michigan Retreat on Peak Shaving to Reduce Wasted Energy, The Brattle Group, August 06, 2014.
Critical Peak Pricing without Enabling Technology	4.2% of coincident peak load	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (avg of small, med, lrg C&I)
Real Time Pricing	8.4% of coincident peak load	Pacificorp Demand-Side Resource Potential Assessment for 2015-2034
Peak Time Rebate	0.7% of coincident peak load	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016.
Time of Use	1.97% of coincident peak load	Demand Response Market Research:Portland General Electric, 2016 to 2035, The Brattle Group, January 2016. (avg of small, med, lrg C&I)

G.6 PROGRAM COSTS

One-time program development costs of $40,000[8] were included in the first year of the analysis for new programs. No program development costs are assumed for programs that already exist. It was assumed that there would be a cost of $50[9] per new participant for marketing. Marketing costs are assumed to be 33.3% higher for MAP. There was assumed to be an annual administrative cost of $30,000 per program[10]. All program costs were escalated each year by the general rate of inflation assumed for this study.[11] Table G-7 shows the equipment cost assumptions.

[8] TVA Potential Study Volume III: Demand Response Potential, Global Energy Partners, December 2011; $400,000 split between 10 rate programs
[9] TVA Potential Study Volume III: Demand Response Potential, Global Energy Partners, December 2011
[10] Calculated based on the contract labor and Vectren South Expenses in the 2016 DLC Annual Report. GDS divided this cost by the 6 existing programs and assumed a $30,000 cost per program.
[11] The general rate of inflation used for this study was 1.6%. This was provided by Vectren.

TABLE *G-7* EQUIPMENT COST ASSUMPTIONS

Device	Cost	Applicable DR Programs	Source
Two-way communicating load control switch using Wi-Fi	$95	DLC programs controlled by switches	Comverge
Load control switch installation	$200	All DLC programs controlled by switches	Comverge
Smart controllable thermostat (such as Nest or Ecobee)	$249	DLC AC Thermostat	Nest / Ecobee

APPENDIX H *Action Plan Combined Gas & Electric Portfolio Summary*

The following tables provide combined electric and gas portfolio targets for all programs for the years 2020-2025, with individual tables for each year.

TABLE H-1 2020 COMBINED PORTFOLIO TARGETS

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Residential			ELECTRIC							GAS			
Residential Lighting	239,866	8,088,914	905.24	$101,000	$186,419	$463,014	$750,433	[redacted]					
Residential Prescriptive	7,966	2,465,148	691.22	$40,400	$347,608	$632,065	$1,020,073	15,750	1,438,213	$29,600	$1,090,398	$2,456,695	$3,576,693
Residential New Construction	86	188,624	121.46	$5,050	$50,000	$16,775	$71,825	704	305,150	$3,700	$286,083	$379,375	$669,158
Home Energy Assessment	300	519,393	55.48	$5,050	$240,000	-	$245,050	300	20,924	$3,700	$55,000	-	$58,700
Income-Qualified Weatherization	539	778,285	443.32	$20,200	$1,275,176	-	$1,295,376	513	56,971	$14,800	$872,202	-	$887,002
Energy-Efficient Schools	2,600	1,149,200	136.50	$20,200	$113,589	-	$133,789	2,600	38,480	$22,200	$28,397	-	$50,597
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$40,400	$323,803	-	$364,203	34,778	375,933	$37,000	$108,182	-	$145,182
Appliance Recycling	1,251	1,179,811	171.20	$40,400	$143,657	$61,000	$245,057	[redacted]					
CVR Residential	-	1,461,047	430	$30,300	$218,023	-	$248,323	[redacted]					
Smart Cycle (DLC Change Out)	1,000	-	1,015.00	$20,200	$516,000	$96,000	$632,200	[redacted]					
BYOT (Bring Your Own Thermostat)	300	-	240.00	$20,200	$22,280	$52,280	$94,760	[redacted]					
Food Bank	-	-	-	-	-	-	-	-	-	-	-	-	-
Home Energy Management Systems	-	-	-	$10,100	$70,000	-	$80,100	-	-	$11,100	$130,000	-	$141,100
Multi-Family Direct Install	[redacted]							1,700	68,591	$14,800	$397,115	-	$411,915
Targeted Income	[redacted]							46	15,022	$29,600	$74,470	-	$104,070
Home Energy House Call-Integrated	[redacted]							1,122	49,144	$29,600	$179,527	-	$209,127
Neighborhood Program-Integrated	[redacted]							1,000	134,440	$29,600	$185,910	-	$215,510
Residential Subtotal	**302,908**	**22,879,629**	**5,783.70**	**$353,500**	**$3,506,555**	**$1,321,134**	**$5,181,189**	**58,513**	**2,502,868**	**$225,700**	**$3,407,285**	**$2,836,070**	**$6,469,055**
Commercial & Industrial			ELECTRIC							GAS			
Commercial Prescriptive	42,431	14,490,335	3,807.71	$55,550	$622,327	$1,370,010	$2,047,886	1,112	298,228	$66,600	$442,240	$251,057	$759,897
Commercial Custom	196	6,107,234	740.00	$60,600	$344,162	$491,537	$896,299	71	472,810	$74,000	$493,803	$489,600	$1,057,403
Small Business	381	2,940,932	213.00	$5,050	$215,618	$548,167	$768,835	592	16,788	$3,700	$3,096	$5,886	$12,682

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
CVR Commercial	-	1,032,656	214	$30,300	$148,233	-	$178,533	[redacted]					
Commercial & Industrial Subtotal	**43,008**	**24,571,158**	**4,974.71**	**$151,500**	**$1,330,340**	**$2,409,714**	**$3,891,554**	**1,775**	**787,826**	**$144,300**	**$939,139**	**$746,543**	**$1,829,982**
Indirect Costs				**ELECTRIC**						**GAS**			
Contact Center							$63,000						$132,080
Online Audit							$42,911						$200,564
Outreach							$410,000						$534,863
Portfolio Costs Subtotal							**$515,911**						**$867,508**
Subtotal (Before Evaluation)							**$9,588,653**						**$9,166,544**
Evaluation							$490,728						$482,414
DSM Portfolio Total							**$10,079,381**						**$9,648,958**
Other Costs				**ELECTRIC**						**GAS**			
Emerging Markets							$ 200,000						$ 200,000
Market Potential Study							-						-
Other Costs Subtotal							**$ 200,000**						**$ 200,000**
DSM Portfolio Total including Other Costs							**$10,279,381**						**$9,848,958**

TABLE H -2 2021 COMBINED PORTFOLIO TARGETS

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Residential				**ELECTRIC**							**GAS**		
Residential Lighting	262,832	8,704,288	875.28	$102,616	$189,402	$455,001	$747,018	[redacted]					
Residential Prescriptive	8,276	2,618,629	661.70	$41,046	$353,169	$645,510	$1,039,726	16,021	1,456,999	$30,074	$1,107,845	$2,491,995	$3,629,913
Residential New Construction	77	168,932	108.81	$5,131	$57,249	$15,025	$77,405	857	369,380	$3,759	$342,221	$452,875	$798,855
Home Energy Assessment	350	605,959	64.72	$5,131	$258,000	-	$263,131	350	24,412	$3,759	$55,880	-	$59,639
Income-Qualified Weatherization	566	823,215	467.28	$20,523	$1,293,527	-	$1,314,050	538	60,190	$15,037	$885,268	-	$900,304

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Energy-Efficient Schools	2,600	1,149,200	136.50	$20,523	$117,253	-	$137,776	2,600	38,480	$22,555	$29,313	-	$51,868
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$20,523	$328,984	-	$349,507	34,778	375,933	$22,555	$109,913	-	$132,468
Appliance Recycling	1,344	1,285,473	172.83	$41,046	$159,415	$66,625	$267,086	[redacted]					
CVR Residential	-	-	-	$30,785	$197,378	-	$228,163	[redacted]					
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$20,523	$536,000	$116,000	$672,523	[redacted]					
BYOT (Bring Your Own Thermostat)	300	-	240.00	$20,523	$30,280	$60,280	$111,083	[redacted]					
Food Bank	6,312	1,564,332	172.21	$20,523	$92,517	-	$113,041	6,312	41,628	$15,037	$4,626	-	$19,663
Home Energy Management Systems	1,000	515,000	80.00	$10,262	$212,900	-	$223,162	1,000	54,400	$11,278	$194,100	-	$205,378
Multi-Family Direct Install	[redacted]							1,700	68,591	$15,037	$403,469	-	$418,506
Targeted Income	[redacted]							46	15,022	$30,074	$75,662	-	$105,735
Home Energy House Call-Integrated	[redacted]							1,122	49,144	$30,074	$182,399	-	$212,473
Neighborhood Program-Integrated	[redacted]							1,000	134,440	$30,074	$188,885	-	$218,959
Residential Subtotal	**333,657**	**24,682,235**	**5,568.60**	**$359,156**	**$3,826,074**	**$1,358,441**	**$5,543,671**	**66,324**	**2,688,619**	**$229,311**	**$3,579,580**	**$2,944,870**	**$6,753,761**
Commercial & Industrial				**ELECTRIC**						**GAS**			
Commercial Prescriptive	48,449	15,981,655	4,131.23	$56,439	$682,432	$1,424,756	$2,163,627	1,193	315,496	$67,666	$487,528	$266,357	$821,550
Commercial Custom	196	6,107,234	740.00	$61,570	$349,669	$491,537	$902,775	71	472,810	$75,184	$501,704	$489,600	$1,066,488
Small Business	382	2,944,615	213.00	$5,131	$219,172	$539,573	$763,876	1,025	18,516	$3,759	$3,209	$6,006	$12,975
CVR Commercial	-	-	-	$30,785	$133,547	-	$164,332	[redacted]					
Commercial & Industrial Subtotal	**49,027**	**25,033,504**	**5,084.23**	**$153,924**	**$1,384,820**	**$2,455,867**	**$3,994,610**	**2,289**	**806,822**	**$146,609**	**$992,441**	**$761,963**	**$1,901,012**
Indirect Costs				**ELECTRIC**						**GAS**			
Contact Center							$64,008						$134,193
Online Audit							$43,598						$203,774
Outreach							$416,560						$543,421

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participa nts	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Portfolio Costs Subtotal							**$524,166**						**$881,388**
Subtotal (Before Evaluation)							**$10,062,446**						**$9,536,161**
Evaluation							$522,653						$507,425
DSM Portfolio Total							**$10,585,099**						**$10,043,586**
Other Costs	**ELECTRIC**							**GAS**					
Emerging Markets							200,000						200,000
Market Potential Study							300,000						300,000
Other Costs Subtotal							**500,000**						**500,000**
DSM Portfolio Total including Other Costs							**$11,085,099**						**$10,543,586**

TABLE H-3 2022 COMBINED PORTFOLIO TARGETS

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Residential	**ELECTRIC**							**GAS**					
Residential Lighting	91,708	3,259,915	255.83	$104,258	$144,380	$346,846	$595,484	[redacted]					
Residential Prescriptive	8,303	2,722,283	737.22	$41,703	$358,820	$680,160	$1,080,683	9,522	579,226	$30,555	$535,505	$858,470	$1,424,530
Residential New Construction	75	164,892	106.37	$5,213	$53,186	$14,675	$73,074	1,075	462,060	$3,819	$424,689	$561,725	$990,233
Home Energy Assessment	420	727,151	77.67	$5,213	$263,225	-	$268,438	420	29,294	$3,819	$56,774	-	$60,593
Income-Qualified Weatherization	594	869,076	492.09	$20,852	$1,312,171	-	$1,333,023	564	63,502	$15,277	$980,165	-	$995,443
Energy-Efficient Schools	2,600	670,800	93.60	$20,852	$92,229	-	$113,080	2,600	38,480	$22,916	$30,743	-	$53,659
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$20,852	$334,248	-	$355,099	34,778	375,933	$22,916	$111,671	-	$134,587
Appliance Recycling	1,425	1,360,636	184.89	$41,703	$171,385	$70,500	$283,589	[redacted]					
CVR Residential	-	-	-	$31,277	$190,034	-	$221,311	[redacted]					
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$20,852	$556,000	$136,000	$712,852	[redacted]					

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
BYOT (Bring Your Own Thermostat)	300	-	240.00	$20,852	$38,280	$68,280	$127,412	[redacted]					
Food Bank	6,312	816,353	69.09	$20,852	$18,800	-	$39,651	6,312	41,628	$15,278	$4,700	-	$19,977
Home Energy Management Systems	1,000	515,000	80.00	$10,426	$219,900	-	$230,326	1,000	54,400	$11,458	$187,100	-	$198,558
Multi-Family Direct Install	[redacted]							1,700	68,591	$15,277	$409,925	-	$425,202
Targeted Income	[redacted]							46	15,022	$30,555	$76,872	-	$107,427
Home Energy House Call-Integrated	[redacted]							1,122	49,144	$30,555	$185,318	-	$215,872
Neighborhood Program-Integrated	[redacted]							1,000	134,440	$30,555	$191,907	-	$222,462
Residential Subtotal	**162,737**	**18,353,314**	**4,926.04**	**$364,902**	**$3,752,658**	**$1,316,461**	**$5,434,021**	**60,139**	**1,911,720**	**$232,980**	**$3,195,369**	**$1,420,195**	**$4,848,544**
Commercial & Industrial				**ELECTRIC**							**GAS**		
Commercial Prescriptive	52,971	17,154,963	4,383.05	$57,342	$733,558	$1,448,274	$2,239,173	1,312	338,606	$68,748	$541,210	$286,137	$896,095
Commercial Custom	196	6,107,234	740.00	$62,555	$355,263	$491,537	$909,355	71	472,810	$76,387	$509,731	$489,600	$1,075,718
Small Business	382	2,949,771	213.00	$5,213	$222,721	$530,824	$758,758	1,135	21,540	$3,819	$3,375	$6,216	$13,410
CVR Commercial	-	-	-	$31,277	$128,261	-	$159,538	[redacted]					
Commercial & Industrial Subtotal	**53,549**	**26,211,968**	**5,336.05**	**$156,387**	**$1,439,803**	**$2,470,635**	**$4,066,825**	**2,518**	**832,956**	**$148,955**	**$1,054,315**	**$781,953**	**$1,985,223**
Indirect Costs				**ELECTRIC**							**GAS**		
Contact Center							$65,032						$136,340
Online Audit							$44,295						$207,034
Outreach							$423,225						$552,116
Portfolio Costs Subtotal							**$532,552**						**$895,490**
Subtotal (Before Evaluation)							**$10,033,398**						**$7,729,257**
Evaluation							$518,856						$415,538
DSM Portfolio Total							**$10,552,254**						**$8,144,795**
Other Costs				**ELECTRIC**							**GAS**		
Emerging Markets							200,000						200,000

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Market Potential Study							$						$
Other Costs Subtotal							**200,000**						**200,000**
DSM Portfolio Total including Other Costs							**$10,752,254**						**$8,344,795**

TABLE H -4 2023 COMBINED PORTFOLIO TARGETS

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Residential				**ELECTRIC**						**GAS**			
Residential Lighting	12,231	807,282	19.16	$105,926	$32,756	$78,689	$217,370	[redacted]					
Residential Prescriptive	8,140	2,793,920	812.09	$42,370	$364,561	$707,135	$1,114,066	9,565	580,541	$31,044	$544,073	$863,520	$1,438,637
Residential New Construction	73	160,852	103.94	$5,296	$50,202	$14,325	$69,824	1,253	537,581	$3,880	$491,921	$650,275	$1,146,077
Home Energy Assessment	504	872,581	93.20	$5,296	$267,437	-	$272,733	504	35,153	$3,880	$57,682	-	$61,563
Income-Qualified Weatherization	623	917,290	518.75	$21,185	$1,331,114	-	$1,352,299	591	66,991	$15,522	$1,060,825	-	$1,076,347
Energy-Efficient Schools	2,600	670,800	93.60	$21,185	$98,274	-	$119,460	2,600	38,480	$23,283	$32,758	-	$56,041
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$21,185	$339,596	-	$360,781	34,778	375,933	$23,283	$113,458	-	$136,741
Appliance Recycling	1,435	1,366,149	188.46	$42,370	$174,745	$70,750	$287,865	[redacted]					
CVR Residential	-	1,461,047	430	$31,778	$270,252	-	$302,029						
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$21,185	$576,000	$156,000	$753,185						
BYOT (Bring Your Own Thermostat)	300	-	240.00	$21,185	$46,280	$76,280	$143,745						
Food Bank	3,156	649,158	46.71	$21,185	$9,550	-	$30,735	3,156	20,814	$15,522	$4,775	-	$20,297
Home Energy Management Systems	1,000	515,000	80.00	$10,593	$234,900	-	$245,493	1,000	54,400	$11,641	$172,100	-	$183,741
Multi-Family Direct Install	[redacted]							1,700	68,591	$15,522	$416,484	-	$432,005
Targeted Income								46	15,022	$31,044	$78,102	-	$109,146
Home Energy House Call-Integrated								1,122	49,144	$31,044	$188,283	-	$219,326

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Neighborhood Program-Integrated	[redacted]							1,000	134,440	$31,044	$194,978	-	$226,021
Residential Subtotal	**80,062**	**17,461,286**	**5,215.19**	**$370,741**	**$3,795,666**	**$1,103,179**	**$5,269,586**	**57,315**	**1,977,090**	**$236,708**	**$3,355,439**	**$1,513,795**	**$5,105,942**
Commercial & Industrial				**ELECTRIC**							**GAS**		
Commercial Prescriptive	55,283	17,821,076	4,524.43	$58,259	$769,435	$1,434,660	$2,262,354	1,479	365,992	$69,848	$598,626	$307,777	$976,251
Commercial Custom	196	6,107,234	740.00	$63,556	$360,948	$491,537	$916,040	71	472,810	$77,609	$517,886	$489,600	$1,085,096
Small Business	382	2,952,715	213.00	$5,296	$226,003	$521,287	$752,586	1,260	24,996	$3,880	$3,561	$6,456	$13,898
CVR Commercial	-	1,032,656	214	$31,778	$184,861	-	$216,639	[redacted]					
Commercial & Industrial Subtotal	**55,861**	**27,913,681**	**5,691.43**	**$158,889**	**$1,541,248**	**$2,447,483**	**$4,147,620**	**2,810**	**863,798**	**$151,338**	**$1,120,073**	**$803,833**	**$2,075,244**
Indirect Costs				**ELECTRIC**							**GAS**		
Contact Center							$66,073						$138,522
Online Audit							$45,004						$210,346
Outreach							$429,997						$560,949
Portfolio Costs Subtotal							**$541,073**						**$909,818**
Subtotal (Before Evaluation)							**$9,958,279**						**$8,091,004**
Evaluation							$512,192						$431,543
DSM Portfolio Total							**$10,470,471**						**$8,522,547**
Other Costs				**ELECTRIC**							**GAS**		
Emerging Markets							200,000						$200,000
Market Potential Study							$						-
Other Costs Subtotal							**200,000**						**$200,000**
DSM Portfolio Total including Other Costs							**$10,670,471**						**$8,722,547**

TABLE H-5 2024 COMBINED PORTFOLIO TARGETS

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Residential				ELECTRIC						GAS			
Residential Lighting	14,089	977,297	19.66	$107,621	$38,416	$92,287	$238,324	[redacted]					
Residential Prescriptive	7,892	2,860,501	889.35	$43,048	$370,394	$732,410	$1,145,852	9,584	579,541	$31,540	$552,778	$864,995	$1,449,314
Residential New Construction	71	156,812	101.51	$5,381	$48,144	$13,975	$67,500	1,428	612,092	$3,943	$558,080	$737,775	$1,299,797
Home Energy Assessment	504	840,768	89.03	$5,381	$271,716	-	$277,097	504	35,153	$3,943	$58,605	-	$62,548
Income-Qualified Weatherization	653	967,302	546.35	$21,524	$1,350,360	-	$1,371,884	619	70,571	$15,770	$1,120,207	-	$1,135,977
Energy-Efficient Schools	2,600	670,800	93.60	$21,524	$106,392	-	$127,916	2,600	38,480	$23,655	$35,464	-	$59,119
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$21,524	$345,029	-	$366,554	34,778	375,933	$23,655	$115,273	-	$138,929
Appliance Recycling	1,372	1,300,910	183.54	$43,048	$168,946	$67,325	$279,320	[redacted]					
CVR Residential	-	-	-	$32,286	$315,241	-	$347,528						
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$21,524	$596,000	$176,000	$793,524						
BYOT (Bring Your Own Thermostat)	300	-	240.00	$21,524	$54,280	$84,280	$160,084						
Food Bank	3,156	649,158	46.71	$21,524	$9,703	-	$31,227	3,156	20,814	$15,770	$4,851	-	$20,622
Home Energy Management Systems	1,000	515,000	80.00	$10,762	$245,940	-	$256,702	1,000	54,400	$11,828	$198,260	-	$210,088
Multi-Family Direct Install	[redacted]							1,700	68,591	$15,770	$423,147	-	$438,918
Targeted Income								46	15,022	$31,540	$79,352	-	$110,892
Home Energy House Call-Integrated								1,122	49,144	$31,540	$191,295	-	$222,835
Neighborhood Program-Integrated								1,000	134,440	$31,540	$198,097	-	$229,638
Residential Subtotal	**81,637**	**16,185,755**	**4,879.02**	**$376,673**	**$3,920,561**	**$1,166,277**	**$5,463,511**	**57,537**	**2,054,181**	**$240,495**	**$3,535,411**	**$1,602,770**	**$5,378,676**
Commercial & Industrial				ELECTRIC						GAS			
Commercial Prescriptive	55,739	18,058,503	4,572.95	$59,191	$791,792	$1,394,674	$2,245,657	1,712	402,215	$70,966	$611,299	$335,962	$1,018,227
Commercial Custom	196	6,107,234	740.00	$64,572	$366,723	$491,537	$922,832	71	472,810	$78,851	$526,173	$489,600	$1,094,624
Small Business	383	2,957,870	213.00	$5,381	$229,663	$512,537	$747,582	1,369	28,020	$3,943	$3,736	$6,666	$14,344

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
CVR Commercial	-	-	-	$32,286	$216,561	-	$248,848	[redacted]					
Commercial & Industrial Subtotal	**56,318**	**27,123,608**	**5,525.95**	**$161,431**	**$1,604,739**	**$2,398,748**	**$4,164,919**	**3,152**	**903,045**	**$153,759**	**$1,141,208**	**$832,228**	**$2,127,195**
Indirect Costs	**ELECTRIC**							**GAS**					
Contact Center							$67,130						$140,738
Online Audit							$45,724						$213,712
Outreach							$436,877						$569,925
Portfolio Costs Subtotal							**$549,730**						**$924,375**
Subtotal (Before Evaluation)							**$10,178,160**						**$8,430,246**
Evaluation							$520,077						$446,225
DSM Portfolio Total							**$10,698,237**						**$8,876,471**
Other Costs	**ELECTRIC**							**GAS**					
Emerging Markets							200,000						200,000
Market Potential Study							300,000						300,000
Other Costs Subtotal							**500,000**						**500,000**
DSM Portfolio Total including Other Costs							**$11,198,237**						**$9,376,471**

TABLE H -6 2025 COMBINED PORTFOLIO TARGETS

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Residential	**ELECTRIC**							**GAS**					
Residential Lighting	15,913	1,146,410	274.12	$109,343	$44,005	$105,714	$259,061						
Residential Prescriptive	8,136	2,974,980	961.29	$43,737	$376,320	$767,435	$1,187,492	9,591	577,456	$32,045	$561,623	$864,845	$1,458,513
Residential New Construction	70	154,792	100.29	$5,467	$46,909	$13,800	$66,176	1,592	681,668	$4,006	$620,174	$819,500	$1,443,680
Home Energy Assessment	504	790,845	83.15	$5,467	$276,063	-	$281,530	504	35,153	$4,006	$59,543	-	$63,549

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Income-Qualified Weatherization	685	1,018,544	575.34	$21,869	$1,369,913	-	$1,391,782	649	74,337	$16,022	$1,156,992	-	$1,173,014
Energy-Efficient Schools	2,600	670,800	93.60	$21,869	$117,023	-	$138,891	2,600	38,480	$24,034	$39,008	-	$63,041
Residential Behavioral Savings	49,000	7,049,208	1,574.28	$21,869	$350,550	-	$372,418	34,778	375,933	$24,034	$117,118	-	$141,151
Appliance Recycling	1,253	1,180,913	171.99	$43,737	$155,651	$61,050	$260,438						
CVR Residential	-	-	-	$32,803	$282,073	-	$314,876						
Smart Cycle (DLC Change Out)	1,000	198,000	1,015	$21,869	$616,000	$196,000	$833,869						
BYOT (Bring Your Own Thermostat)	300	-	240.00	$21,869	$62,280	$92,280	$176,429						
Food Bank	3,156	649,158	46.71	$21,869	$9,858	-	$31,727	3,156	20,814	$16,023	$4,929	-	$20,952
Home Energy Management Systems	1,000	515,000	80.00	$10,934	$266,980	-	$277,914	1,000	54,400	$12,017	$214,420	-	$226,437
Multi-Family Direct Install								1,700	68,591	$16,022	$429,918	-	$445,940
Targeted Income								46	15,022	$32,045	$80,621	-	$112,666
Home Energy House Call-Integrated								1,122	49,144	$32,045	$194,356	-	$226,401
Neighborhood Program-Integrated								1,000	134,440	$32,045	$201,267	-	$233,312
Residential Subtotal	**83,617**	**16,348,650**	**5,215.76**	**$382,700**	**$3,973,626**	**$1,236,279**	**$5,592,604**	**57,738**	**2,125,438**	**$244,343**	**$3,679,968**	**$1,684,345**	**$5,608,656**
Commercial & Industrial	**ELECTRIC**							**GAS**					
Commercial Prescriptive	53,882	17,825,085	4,513.77	$60,139	$797,128	$1,331,794	$2,189,060	1,964	439,398	$72,101	$737,459	$363,357	$1,172,917
Commercial Custom	196	6,107,234	740.00	$65,606	$372,590	$491,537	$929,733	71	472,810	$80,112	$534,591	$489,600	$1,104,304
Small Business	383	2,963,026	213.00	$5,467	$233,383	$503,787	$742,637	1,479	31,044	$4,006	$3,915	$6,876	$14,797
CVR Commercial	-	-	-	$32,803	$193,019	-	$225,821	-	-	-	-	-	-
Commercial & Industrial Subtotal	**54,461**	**26,895,345**	**5,466.77**	**$164,014**	**$1,596,120**	**$2,327,118**	**$4,087,252**	**3,514**	**943,252**	**$156,219**	**$1,275,965**	**$859,833**	**$2,292,017**
Indirect Costs	**ELECTRIC**							**GAS**					
Contact Center							$68,204						$142,990
Online Audit							$46,456						$217,131

	Electric							Gas					
	Number of Participants	Total kWh Savings	Total kW (Demand)	Admin.	Implementation	Incentives	Total Budget	Number of Participants	Total Therms Savings	Admin.	Implementation	Incentives	Total Budget
Outreach							$443,867						$579,043
Portfolio Costs Subtotal							**$558,526**						**$939,165**
Subtotal (Before Evaluation)							**$10,238,382**						**$8,839,838**
Evaluation							$520,203						$464,552
DSM Portfolio Total							**$10,758,585**						**$9,304,390**
Other Costs				**ELECTRIC**							**GAS**		
Emerging Markets							200,000						200,000
Market Potential Study													
Other Costs Subtotal							**200,000**						**200,000**
DSM Portfolio Total including Other Costs							**$10,958,585**						**$9,504,390**

APPENDIX I *Action Plan Combined Gas & Electric Costs Summary*

The following tables present combined gas and electric costs for all residential programs for the years 2020-2025, with individual tables for each year. This is immediately followed by a table presenting the combined gas and electric costs for all commercial and industrial programs.

TABLE I-1 2020 COMBINED GAS AND ELECTRIC COSTS – RESIDENTIAL

Residential	Admin. (ELECTRIC)	Implementation (ELECTRIC)	Incentives (ELECTRIC)	Total Budget (ELECTRIC)	Admin. (GAS)	Implementation (GAS)	Incentives (GAS)	Total Budget (GAS)
Residential Lighting	$101,000	$186,419	$463,014	$750,433				
Residential Prescriptive	$40,400	$347,608	$632,065	$1,020,073	$29,600	$1,090,398	$2,456,695	$3,576,693
Residential New Construction	$5,050	$50,000	$16,775	$71,825	$3,700	$286,083	$379,375	$669,158
Home Energy Assessment	$5,050	$240,000	-	$245,050	$3,700	$55,000	-	$58,700
Income-Qualified Weatherization	$20,200	$1,275,176	-	$1,295,376	$14,800	$872,202	-	$887,002
Energy-Efficient Schools	$20,200	$113,589	-	$133,789	$22,200	$28,397	-	$50,597
Residential Behavioral Savings	$40,400	$323,803	-	$364,203	$37,000	$108,182	-	$145,182
Appliance Recycling	$40,400	$143,657	$61,000	$245,057				
CVR Residential	$30,300	$218,023	-	$248,323				
Smart Cycle (DLC Change Out)	$20,200	$516,000	$96,000	$632,200				
BYOT (Bring Your Own Thermostat)	$20,200	$22,280	$52,280	$94,760				
Food Bank	-	-	-	-	-	-	-	-
Home Energy Management Systems	$10,100	$70,000	-	$80,100	$11,100	$130,000	-	$141,100
Multi-Family Direct Install					$14,800	$397,115	-	$411,915
Targeted Income					$29,600	$74,470	-	$104,070
Home Energy House Call- Integrated					$29,600	$179,527	-	$209,127
Neighborhood Program- Integrated					$29,600	$185,910	-	$215,510
Residential Subtotal	**$353,500**	**$3,506,555**	**$1,321,134**	**$5,181,189**	**$225,700**	**$3,407,285**	**$2,836,070**	**$6,469,055**

TABLE I -2 2020 COMBINED GAS AND ELECTRIC COSTS – COMMERCIAL & INDUSTRIAL

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Commercial & Industrial	ELECTRIC				GAS			
Commercial Prescriptive	$55,550	$622,327	$1,370,010	$2,047,886	$66,600	$442,240	$251,057	$759,897
Commercial Custom	$60,600	$344,162	$491,537	$896,299	$74,000	$493,803	$489,600	$1,057,403
Small Business	$5,050	$215,618	$548,167	$768,835	$3,700	$3,096	$5,886	$12,682
CVR Commercial	$30,300	$148,233	-	$178,533				
Commercial & Industrial Subtotal	**$151,500**	**$1,330,340**	**$2,409,714**	**$3,891,554**	**$144,300**	**$939,139**	**$746,543**	**$1,829,982**

TABLE I -3 2021 COMBINED GAS AND ELECTRIC COSTS – RESIDENTIAL

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Residential	ELECTRIC				GAS			
Residential Lighting	$102,616	$189,402	$455,001	$747,018				
Residential Prescriptive	$41,046	$353,169	$645,510	$1,039,726	$30,074	$1,107,845	$2,491,995	$3,629,913
Residential New Construction	$5,131	$57,249	$15,025	$77,405	$3,759	$342,221	$452,875	$798,855
Home Energy Assessment	$5,131	$258,000	-	$263,131	$3,759	$55,880	-	$59,639
Income-Qualified Weatherization	$20,523	$1,293,527	-	$1,314,050	$15,037	$885,268	-	$900,304
Energy-Efficient Schools	$20,523	$117,253	-	$137,776	$22,555	$29,313	-	$51,868
Residential Behavioral Savings	$20,523	$328,984	-	$349,507	$22,555	$109,913	-	$132,468
Appliance Recycling	$41,046	$159,415	$66,625	$267,086				
CVR Residential	$30,785	$197,378	-	$228,163				
Smart Cycle (DLC Change Out)	$20,523	$536,000	$116,000	$672,523				
BYOT (Bring Your Own Thermostat)	$20,523	$30,280	$60,280	$111,083				
Food Bank	$20,523	$92,517	-	$113,041	$15,037	$4,626	-	$19,663
Home Energy Management Systems	$10,262	$212,900	-	$223,162	$11,278	$194,100	-	$205,378

Residential	Admin. (Electric)	Implementation (Electric)	Incentives (Electric)	Total Budget (Electric)	Admin. (Gas)	Implementation (Gas)	Incentives (Gas)	Total Budget (Gas)
Multi-Family Direct Install					$15,037	$403,469	-	$418,506
Targeted Income					$30,074	$75,662	-	$105,735
Home Energy House Call- Integrated					$30,074	$182,399	-	$212,473
Neighborhood Program- Integrated					$30,074	$188,885	-	$218,959
Residential Subtotal	**$359,156**	**$3,826,074**	**$1,358,441**	**$5,543,671**	**$229,311**	**$3,579,580**	**$2,944,870**	**$6,753,761**

TABLE I -4 2021 COMBINED GAS AND ELECTRIC COSTS – COMMERCIAL & INDUSTRIAL

Commercial & Industrial	Admin. (Electric)	Implementation (Electric)	Incentives (Electric)	Total Budget (Electric)	Admin. (Gas)	Implementation (Gas)	Incentives (Gas)	Total Budget (Gas)
Commercial Prescriptive	$56,439	$682,432	$1,424,756	$2,163,627	$67,666	$487,528	$266,357	$821,550
Commercial Custom	$61,570	$349,669	$491,537	$902,775	$75,184	$501,704	$489,600	$1,066,488
Small Business	$5,131	$219,172	$539,573	$763,876	$3,759	$3,209	$6,006	$12,975
CVR Commercial	$30,785	$133,547	-	$164,332				
Commercial & Industrial Subtotal	**$153,924**	**$1,384,820**	**$2,455,867**	**$3,994,610**	**$146,609**	**$992,441**	**$761,963**	**$1,901,012**

TABLE I -5 2022 COMBINED GAS AND ELECTRIC COSTS – RESIDENTIAL

Residential	Admin. (Electric)	Implementation (Electric)	Incentives (Electric)	Total Budget (Electric)	Admin. (Gas)	Implementation (Gas)	Incentives (Gas)	Total Budget (Gas)
Residential Lighting	$104,258	$144,380	$346,846	$595,484				
Residential Prescriptive	$41,703	$358,820	$680,160	$1,080,683	$30,555	$535,505	$858,470	$1,424,530
Residential New Construction	$5,213	$53,186	$14,675	$73,074	$3,819	$424,689	$561,725	$990,233
Home Energy Assessment	$5,213	$263,225	-	$268,438	$3,819	$56,774	-	$60,593
Income-Qualified Weatherization	$20,852	$1,312,171	-	$1,333,023	$15,277	$980,165	-	$995,443
Energy-Efficient Schools	$20,852	$92,229	-	$113,080	$22,916	$30,743	-	$53,659

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Residential	ELECTRIC				GAS			
Residential Behavioral Savings	$20,852	$334,248	-	$355,099	$22,916	$111,671	-	$134,587
Appliance Recycling	$41,703	$171,385	$70,500	$283,589				
CVR Residential	$31,277	$190,034	-	$221,311				
Smart Cycle (DLC Change Out)	$20,852	$556,000	$136,000	$712,852				
BYOT (Bring Your Own Thermostat)	$20,852	$38,280	$68,280	$127,412				
Food Bank	$20,852	$18,800	-	$39,651	$15,278	$4,700	-	$19,977
Home Energy Management Systems	$10,426	$219,900	-	$230,326	$11,458	$187,100	-	$198,558
Multi-Family Direct Install					$15,277	$409,925	-	$425,202
Targeted Income					$30,555	$76,872	-	$107,427
Home Energy House Call- Integrated					$30,555	$185,318	-	$215,872
Neighborhood Program- Integrated					$30,555	$191,907	-	$222,462
Residential Subtotal	**$364,902**	**$3,752,658**	**$1,316,461**	**$5,434,021**	**$232,980**	**$3,195,369**	**$1,420,195**	**$4,848,544**

TABLE I -6 2022 COMBINED GAS AND ELECTRIC COSTS – COMMERCIAL & INDUSTRIAL

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Commercial & Industrial	ELECTRIC				GAS			
Commercial Prescriptive	$57,342	$733,558	$1,448,274	$2,239,173	$68,748	$541,210	$286,137	$896,095
Commercial Custom	$62,555	$355,263	$491,537	$909,355	$76,387	$509,731	$489,600	$1,075,718
Small Business	$5,213	$222,721	$530,824	$758,758	$3,819	$3,375	$6,216	$13,410
CVR Commercial	$31,277	$128,261	-	$159,538				
Commercial & Industrial Subtotal	**$156,387**	**$1,439,803**	**$2,470,635**	**$4,066,825**	**$148,955**	**$1,054,315**	**$781,953**	**$1,985,223**

TABLE I -7 2023 COMBINED GAS AND ELECTRIC COSTS – RESIDENTIAL

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Residential	ELECTRIC				GAS			
Residential Lighting	$105,926	$32,756	$78,689	$217,370				
Residential Prescriptive	$42,370	$364,561	$707,135	$1,114,066	$31,044	$544,073	$863,520	$1,438,637
Residential New Construction	$5,296	$50,202	$14,325	$69,824	$3,880	$491,921	$650,275	$1,146,077
Home Energy Assessment	$5,296	$267,437	-	$272,733	$3,880	$57,682	-	$61,563
Income-Qualified Weatherization	$21,185	$1,331,114	-	$1,352,299	$15,522	$1,060,825	-	$1,076,347
Energy-Efficient Schools	$21,185	$98,274	-	$119,460	$23,283	$32,758	-	$56,041
Residential Behavioral Savings	$21,185	$339,596	-	$360,781	$23,283	$113,458	-	$136,741
Appliance Recycling	$42,370	$174,745	$70,750	$287,865				
CVR Residential	$31,778	$270,252	-	$302,029				
Smart Cycle (DLC Change Out)	$21,185	$576,000	$156,000	$753,185				
BYOT (Bring Your Own Thermostat)	$21,185	$46,280	$76,280	$143,745				
Food Bank	$21,185	$9,550	-	$30,735	$15,522	$4,775	-	$20,297
Home Energy Management Systems	$10,593	$234,900	-	$245,493	$11,641	$172,100	-	$183,741
Multi-Family Direct Install					$15,522	$416,484	-	$432,005
Targeted Income					$31,044	$78,102	-	$109,146
Home Energy House Call- Integrated					$31,044	$188,283	-	$219,326
Neighborhood Program- Integrated					$31,044	$194,978	-	$226,021
Residential Subtotal	**$370,741**	**$3,795,666**	**$1,103,179**	**$5,269,586**	**$236,708**	**$3,355,439**	**$1,513,795**	**$5,105,942**

TABLE I -8 2023 COMBINED GAS AND ELECTRIC COSTS – COMMERCIAL & INDUSTRIAL

Commercial & Industrial	Admin. (Electric)	Implementation (Electric)	Incentives (Electric)	Total Budget (Electric)	Admin. (Gas)	Implementation (Gas)	Incentives (Gas)	Total Budget (Gas)
Commercial Prescriptive	$58,259	$769,435	$1,434,660	$2,262,354	$69,848	$598,626	$307,777	$976,251
Commercial Custom	$63,556	$360,948	$491,537	$916,040	$77,609	$517,886	$489,600	$1,085,096
Small Business	$5,296	$226,003	$521,287	$752,586	$3,880	$3,561	$6,456	$13,898
CVR Commercial	$31,778	$184,861	-	$216,639				
Commercial & Industrial Subtotal	**$158,889**	**$1,541,248**	**$2,447,483**	**$4,147,620**	**$151,338**	**$1,120,073**	**$803,833**	**$2,075,244**

TABLE I -9 2024 COMBINED GAS AND ELECTRIC COSTS – RESIDENTIAL

Residential	Admin. (Electric)	Implementation (Electric)	Incentives (Electric)	Total Budget (Electric)	Admin. (Gas)	Implementation (Gas)	Incentives (Gas)	Total Budget (Gas)
Residential Lighting	$107,621	$38,416	$92,287	$238,324				
Residential Prescriptive	$43,048	$370,394	$732,410	$1,145,852	$31,540	$552,778	$864,995	$1,449,314
Residential New Construction	$5,381	$48,144	$13,975	$67,500	$3,943	$558,080	$737,775	$1,299,797
Home Energy Assessment	$5,381	$271,716	-	$277,097	$3,943	$58,605	-	$62,548
Income-Qualified Weatherization	$21,524	$1,350,360	-	$1,371,884	$15,770	$1,120,207	-	$1,135,977
Energy-Efficient Schools	$21,524	$106,392	-	$127,916	$23,655	$35,464	-	$59,119
Residential Behavioral Savings	$21,524	$345,029	-	$366,554	$23,655	$115,273	-	$138,929
Appliance Recycling	$43,048	$168,946	$67,325	$279,320				
CVR Residential	$32,286	$315,241	-	$347,528				
Smart Cycle (DLC Change Out)	$21,524	$596,000	$176,000	$793,524				
BYOT (Bring Your Own Thermostat)	$21,524	$54,280	$84,280	$160,084				
Food Bank	$21,524	$9,703	-	$31,227	$15,770	$4,851	-	$20,622
Home Energy Management Systems	$10,762	$245,940	-	$256,702	$11,828	$198,260	-	$210,088
Multi-Family Direct Install					$15,770	$423,147	-	$438,918

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Residential	ELECTRIC				GAS			
Targeted Income					$31,540	$79,352	-	$110,892
Home Energy House Call- Integrated					$31,540	$191,295	-	$222,835
Neighborhood Program- Integrated					$31,540	$198,097	-	$229,638
Residential Subtotal	**$376,673**	**$3,920,561**	**$1,166,277**	**$5,463,511**	**$240,495**	**$3,535,411**	**$1,602,770**	**$5,378,676**

TABLE I -10 2024 COMBINED GAS AND ELECTRIC COSTS – COMMERCIAL & INDUSTRIAL

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Commercial & Industrial	ELECTRIC				GAS			
Commercial Prescriptive	$59,191	$791,792	$1,394,674	$2,245,657	$70,966	$611,299	$335,962	$1,018,227
Commercial Custom	$64,572	$366,723	$491,537	$922,832	$78,851	$526,173	$489,600	$1,094,624
Small Business	$5,381	$229,663	$512,537	$747,582	$3,943	$3,736	$6,666	$14,344
CVR Commercial	$32,286	$216,561	-	$248,848				
Commercial & Industrial Subtotal	**$161,431**	**$1,604,739**	**$2,398,748**	**$4,164,919**	**$153,759**	**$1,141,208**	**$832,228**	**$2,127,195**

TABLE I -11 2025 COMBINED GAS AND ELECTRIC COSTS – RESIDENTIAL

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Residential	ELECTRIC				GAS			
Residential Lighting	$109,343	$44,005	$105,714	$259,061				
Residential Prescriptive	$43,737	$376,320	$767,435	$1,187,492	$32,045	$561,623	$864,845	$1,458,513
Residential New Construction	$5,467	$46,909	$13,800	$66,176	$4,006	$620,174	$819,500	$1,443,680
Home Energy Assessment	$5,467	$276,063	-	$281,530	$4,006	$59,543	-	$63,549
Income-Qualified Weatherization	$21,869	$1,369,913	-	$1,391,782	$16,022	$1,156,992	-	$1,173,014
Energy-Efficient Schools	$21,869	$117,023	-	$138,891	$24,034	$39,008	-	$63,041

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Residential	ELECTRIC				GAS			
Residential Behavioral Savings	$21,869	$350,550	-	$372,418	$24,034	$117,118	-	$141,151
Appliance Recycling	$43,737	$155,651	$61,050	$260,438				
CVR Residential	$32,803	$282,073	-	$314,876				
Smart Cycle (DLC Change Out)	$21,869	$616,000	$196,000	$833,869				
BYOT (Bring Your Own Thermostat)	$21,869	$62,280	$92,280	$176,429				
Food Bank	$21,869	$9,858	-	$31,727	$16,023	$4,929	-	$20,952
Home Energy Management Systems	$10,934	$266,980	-	$277,914	$12,017	$214,420	-	$226,437
Multi-Family Direct Install					$16,022	$429,918	-	$445,940
Targeted Income					$32,045	$80,621	-	$112,666
Home Energy House Call- Integrated					$32,045	$194,356	-	$226,401
Neighborhood Program- Integrated					$32,045	$201,267	-	$233,312
Residential Subtotal	**$382,700**	**$3,973,626**	**$1,236,279**	**$5,592,604**	**$244,343**	**$3,679,968**	**$1,684,345**	**$5,608,656**

TABLE I -12 2025 COMBINED GAS AND ELECTRIC COSTS – COMMERCIAL & INDUSTRIAL

	Admin.	Implementation	Incentives	Total Budget	Admin.	Implementation	Incentives	Total Budget
Commercial & Industrial	ELECTRIC				GAS			
Commercial Prescriptive	$60,139	$797,128	$1,331,794	$2,189,060	$72,101	$737,459	$363,357	$1,172,917
Commercial Custom	$65,606	$372,590	$491,537	$929,733	$80,112	$534,591	$489,600	$1,104,304
Small Business	$5,467	$233,383	$503,787	$742,637	$4,006	$3,915	$6,876	$14,797
CVR Commercial	$32,803	$193,019	-	$225,821				
Commercial & Industrial Subtotal	**$164,014**	**$1,596,120**	**$2,327,118**	**$4,087,252**	**$156,219**	**$1,275,965**	**$859,833**	**$2,292,017**

APPENDIX J *Action Plan Market Research*

RESIDENTIAL SURVEY RESULTS

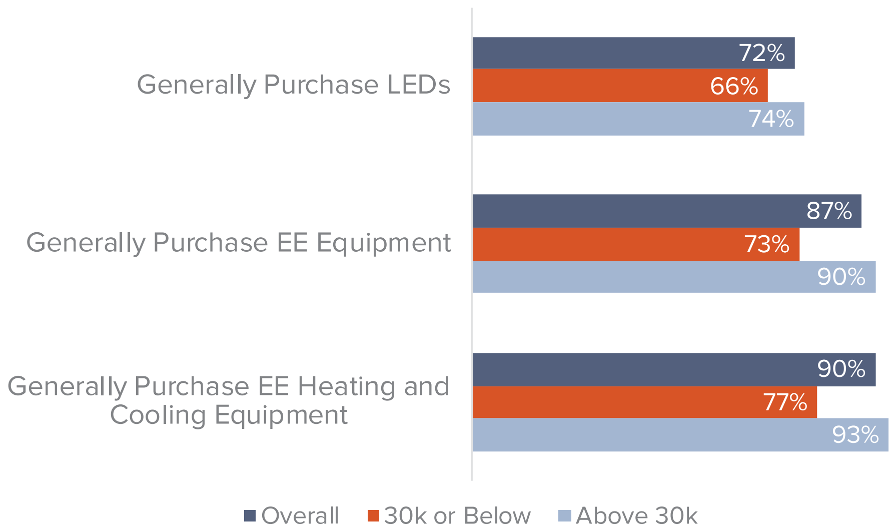
Background

The team completed an online survey of 466 residential customers in Vectren service territory. The survey was completed between June 25 and July 9, 2018. Vectren randomly sampled 4,000 residential customers and sent invitations to complete the survey by email. Customers were offered a$25 incentive upon completion of the survey.

Results

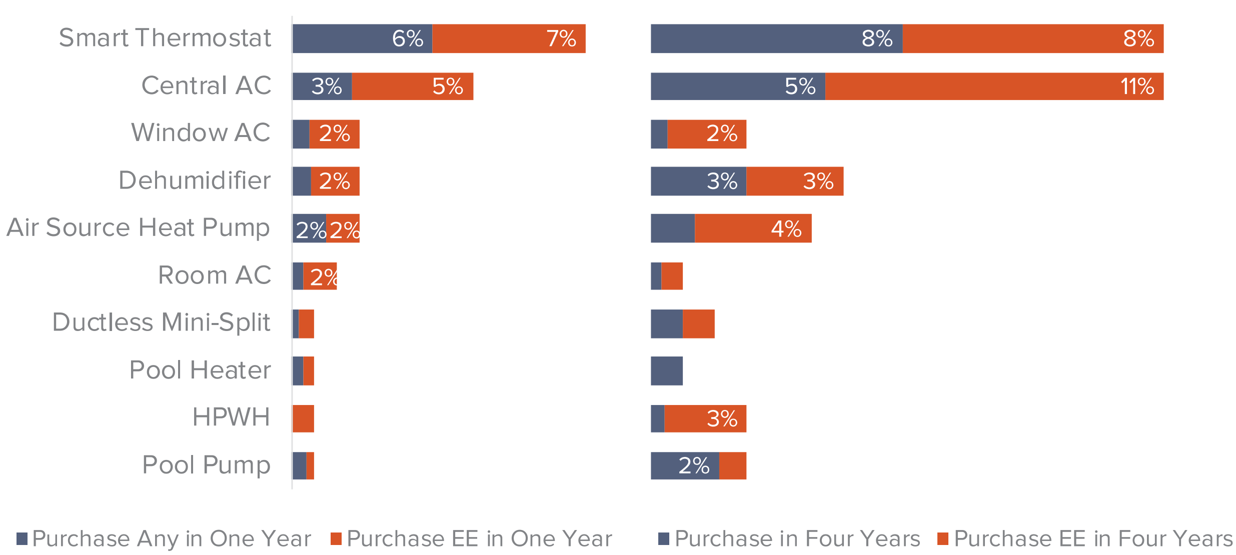
Customers generally reported purchasing energy-efficient equipment (72%, as seen below). As expected, fewer lower income customers (66%) reported purchasing energy-efficient equipment than those making higher incomes (74%).

FIGURE J-1GENERAL PURCHASING BEHAVIOR



Most electric customers did not plan on purchasing any of the equipment discussed in the survey over the next year (76%) or in the next four years (63%). Electric customers most often report planning on purchasing smart thermostats (16%) or central air conditioners (16%) in the next four years.

FIGURE J-2 PLANNED IMPROVEMENTS



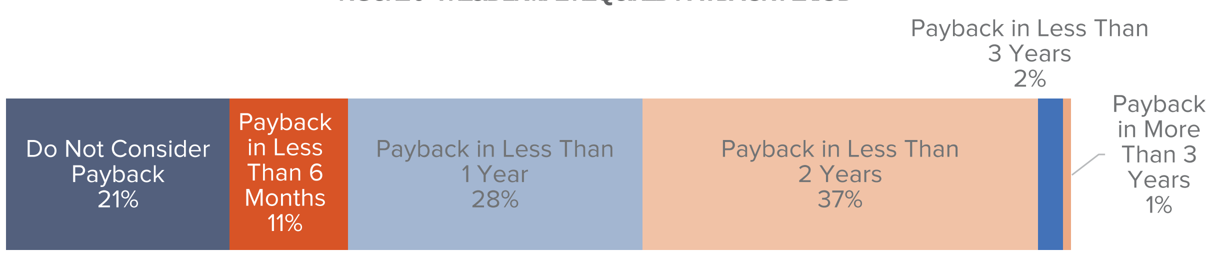
Generally customers reported a lower willingness to pay for weatherization measures and a higher willingness to pay for energy-efficient appliances, as seen in the table below.

FIGURE J-3 WILLINGNESS TO PAY AT VARYING REBATE LEVELS (PERCENT OF INCREMENTAL COST)

Sector	End-Use / Technology	25%	50%	75%	100%
Average Likelihood					
Residential	Appliances	75%	86%	91%	96%
Residential	Space Heating	76%	84%	90%	96%
Residential	Weatherization	61%	72%	82%	93%
Extreme Likelihood (% the responded "10")					
Residential	Appliances	31%	50%	61%	85%
Residential	Space Heating	27%	39%	53%	83%
Residential	Weatherization	16%	20%	29%	76%

Less than one quarter of customers do not consider the payback timeframe of their energy efficiency equipment (21%, as seen below). About three quarters require a payback of two years or less.

FIGURE J-4 RESIDENTIAL REQUIRED PAYBACK PERIOD



COMMERCIAL & INDUSTRIAL ONSITE VISIT RESULTS

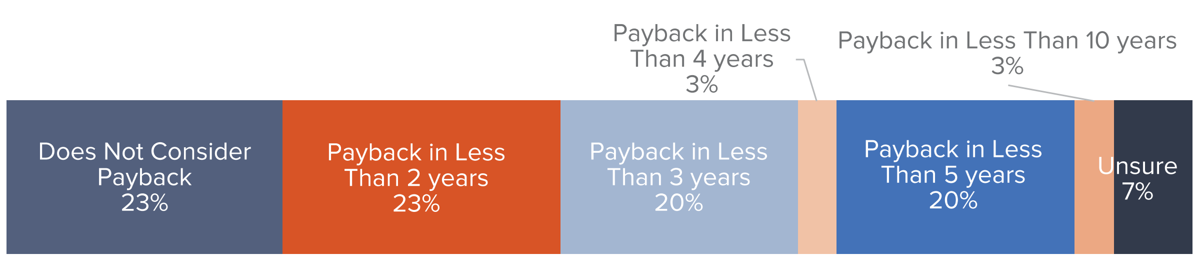
Background

The team completed an audit of 36 commercial and industrial sites in Vectren territory. During these audits, the team asked the company contact questions regarding their energy efficient product purchases and preferences.

Results

Similar to residential customers, about one-quarter of commercial and industrial customers do not consider the payback period of their energy efficiency equipment (23%, as seen below).

FIGURE J-5 COMMERCIAL & INDUSTRIAL REQUIRED PAYBACK PERIOD



Commercial and industrial customers most often reported receiving an incentive as a consideration when purchasing new energy efficient equipment (72%, as seen in the table below). Other regularly reported considerations included lowering monthly electric bills (67%) and increased employee comfort (58%).

TABLE J-6 IMPORTANT CONSIDERATIONS REGARDING ENERGY EFFICIENT EQUIPMENT

Response	Percent (n=36)
Receiving incentive	72%
Lower monthly electric bills	67%
Increased level of employee comfort	58%
Financing options	50%
Improving the image or value of business	36%
Recommendation of sales person, contractor, or consultant	28%
Helping to protect the environment	8%
Other	3%

Commercial and industrial customers most often reported that cost was a barrier to purchasing energy-efficient equipment (67%), followed by the performance of the equipment (44%).

TABLE J-7 BARRIERS TO PURCHASING ENERGY EFFICIENT EQUIPMENT

Response	Percent (n=36)
Cost	67%
Performance of the equipment	44%
Lack of product energy savings information	39%
Payback/ROI	31%
Lack of financing options	17%
Availability of equipment	11%
Other	6%

Commercial and industrial customers reported a higher willingness to purchase more expensive equipment at most levels of rebate incremental cost than residential customers, as seen in the table below.

TABLE J-8 WILLINGNESS TO PAY AT VARYING REBATE LEVELS (PERCENT OF INCREMENTAL COST)

Equipment Price	0%	25%	50%	75%
Equipment Priced Below $200	6%	3%	11%	77%
Equipment Priced Above $1,000	6%	11%	34%	97%

APPENDIX K *Action Plan Measure Library*

The following table provides a list of all the measures included in the Action Plan program concepts, broken up by year of the program.

TABLE K-1 MEASURE LIBRARY

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Lighting	Standard Units	Participation	159,553	180,887	-	-	-	-
Residential Lighting	Standard Units	Total Incentive Budget	$120,861	$128,882	-	-	-	-
Residential Lighting	Standard Units	Total Gross Incremental Savings (kwh)	5,143,874	5,862,548	-	-	-	-
Residential Lighting	Standard Units	NTG	0.84	0.79	-	-	-	-
Residential Lighting	Standard Units	Incremental Cost	$3.00	$3.00				
Residential Lighting	Specialty Units	Participation	64,893	73,570	81,379	-	-	-
Residential Lighting	Specialty Units	Total Incentive Budget	$259,896	$275,336	$281,978	-	-	-
Residential Lighting	Specialty Units	Total Gross Incremental Savings (kwh)	1,945,811	2,209,028	2,446,622	-	-	-
Residential Lighting	Specialty Units	NTG	0.84	0.79	0.74	-	-	-
Residential Lighting	Specialty Units	Incremental Cost	$4.00	$4.00	$4.00			
Residential Lighting	LED Fixtures	Participation	13,700	4,935	5,169	5,351	5,489	5,593
Residential Lighting	LED Fixtures	Total Incentive Budget	$69,356	$24,983	$26,168	$27,089	$27,788	$28,315

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Lighting	LED Fixtures	Total Gross Incremental Savings (kwh)	832,872	299,999	314,224	141,855	145,513	148,270
Residential Lighting	LED Fixtures	NTG	0.84	0.84	0.84	0.84	0.84	0.84
Residential Lighting	LED Fixtures	Incremental Cost	$20.00	$20.00	$20.00	$20.00	$20.00	$20.00
Residential Lighting	Exterior Lighting Controls	Participation	1,720	3,440	5,160	6,880	8,600	10,320
Residential Lighting	Exterior Lighting Controls	Total Incentive Budget	$12,900	$25,800	$38,700	$51,599	$64,499	$77,399
Residential Lighting	Exterior Lighting Controls	Total Gross Incremental Savings (kwh)	166,357	332,713	499,070	665,427	831,783	998,140
Residential Lighting	Exterior Lighting Controls	NTG	0.84	0.84	0.84	0.84	0.84	0.84
Residential Lighting	Exterior Lighting Controls	Incremental Cost	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00
Residential Prescriptive	Air Source Heat Pump 16 SEER	Participation	40	47	53	59	64	68
Residential Prescriptive	Air Source Heat Pump 16 SEER	Total Incentive Budget	$12,000	$14,100	$15,900	$17,700	$19,200	$20,400
Residential Prescriptive	Air Source Heat Pump 16 SEER	Total Gross Incremental Savings (kwh)	27,760	32,618	36,782	40,946	44,416	47,192
Residential Prescriptive	Air Source Heat Pump 16 SEER	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Air Source Heat Pump 16 SEER	Incremental Cost	$870.00	$870.00	$870.00	$870.00	$870.00	$870.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Air Source Heat Pump 18 SEER	Participation	13	16	18	20	23	25
Residential Prescriptive	Air Source Heat Pump 18 SEER	Total Incentive Budget	$7,800	$9,600	$10,800	$12,000	$13,800	$15,000
Residential Prescriptive	Air Source Heat Pump 18 SEER	Total Gross Incremental Savings (kwh)	16,822	20,704	23,292	25,880	29,762	32,350
Residential Prescriptive	Air Source Heat Pump 18 SEER	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Air Source Heat Pump 18 SEER	Incremental Cost	$870.00	$870.00	$870.00	$870.00	$870.00	$870.00
Residential Prescriptive	Attic Insulation - Elec Heated South (Electric Only)	Participation	16	17	13	10	7	5
Residential Prescriptive	Attic Insulation - Elec Heated South (Electric Only)	Total Incentive Budget	$7,200	$7,650	$5,850	$4,500	$3,150	$2,250
Residential Prescriptive	Attic Insulation - Elec Heated South (Electric Only)	Total Gross Incremental Savings (kwh)	12,836	13,638	10,429	8,023	5,616	4,011
Residential Prescriptive	Attic Insulation - Elec Heated South (Electric Only)	NTG	0.76	0.76	0.76	0.76	0.76	0.76
Residential Prescriptive	Attic Insulation - Elec Heated South (Electric Only)	Incremental Cost	$500.00	$500.00	$500.00	$500.00	$500.00	$500.00
Residential Prescriptive	Attic Insulation - Gas Heated South (Dual -- Gas & Electric)	Participation	36	8	6	5	4	3
Residential Prescriptive	Attic Insulation - Gas Heated South (Dual -- Gas & Electric)	Total Incentive Budget	$10,800	$2,400	$1,800	$1,500	$1,200	$900

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Attic Insulation - Gas Heated South (Dual -- Gas & Electric)	Total Gross Incremental Savings (kwh)	8,602	1,912	1,434	1,195	956	717
Residential Prescriptive	Attic Insulation - Gas Heated South (Dual -- Gas & Electric)	NTG	0.76	0.76	0.76	0.76	0.76	0.76
Residential Prescriptive	Attic Insulation - Gas Heated South (Dual -- Gas & Electric)	Incremental Cost	$500.00	$500.00	$500.00	$500.00	$500.00	$500.00
Residential Prescriptive	Central Air Conditioner 16 SEER	Participation	708	528	632	736	834	923
Residential Prescriptive	Central Air Conditioner 16 SEER	Total Incentive Budget	$141,680	$105,600	$126,400	$147,200	$166,800	$184,600
Residential Prescriptive	Central Air Conditioner 16 SEER	Total Gross Incremental Savings (kwh)	212,326	158,255	189,427	220,598	249,971	276,647
Residential Prescriptive	Central Air Conditioner 16 SEER	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Central Air Conditioner 16 SEER	Incremental Cost	$400.00	$400.00	$400.00	$400.00	$400.00	$400.00
Residential Prescriptive	Central Air Conditioner 18 SEER	Participation	84	62	74	86	98	108
Residential Prescriptive	Central Air Conditioner 18 SEER	Total Incentive Budget	$41,800	$31,000	$37,000	$43,000	$49,000	$54,000
Residential Prescriptive	Central Air Conditioner 18 SEER	Total Gross Incremental Savings (kwh)	57,819	42,880	51,179	59,479	67,778	74,694
Residential Prescriptive	Central Air Conditioner 18 SEER	NTG	0.52	0.52	0.52	0.52	0.52	0.52

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Central Air Conditioner 18 SEER	Incremental Cost	$800.00	$800.00	$800.00	$800.00	$800.00	$800.00
Residential Prescriptive	Dual Fuel Air Source Heat Pump 16 SEER	Participation	37	44	51	57	64	70
Residential Prescriptive	Dual Fuel Air Source Heat Pump 16 SEER	Total Incentive Budget	$11,100	$13,200	$15,300	$17,100	$19,200	$21,000
Residential Prescriptive	Dual Fuel Air Source Heat Pump 16 SEER	Total Gross Incremental Savings (kwh)	12,136	14,432	16,728	18,696	20,992	22,960
Residential Prescriptive	Dual Fuel Air Source Heat Pump 16 SEER	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Dual Fuel Air Source Heat Pump 16 SEER	Incremental Cost	$1,000.00	$1,000.00	$1,000.00	$1,000.00	$1,000.00	$1,000.00
Residential Prescriptive	Duct Sealing Electric Heat Pump - South (Electric Only)	Participation	48	79	71	61	50	40
Residential Prescriptive	Duct Sealing Electric Heat Pump - South (Electric Only)	Total Incentive Budget	$14,400	$23,700	$21,300	$18,300	$15,000	$12,000
Residential Prescriptive	Duct Sealing Electric Heat Pump - South (Electric Only)	Total Gross Incremental Savings (kwh)	39,792	65,491	58,859	50,569	41,450	33,160
Residential Prescriptive	Duct Sealing Electric Heat Pump - South (Electric Only)	NTG	0.76	0.76	0.76	0.76	0.76	0.76
Residential Prescriptive	Duct Sealing Electric Heat Pump - South (Electric Only)	Incremental Cost	$400.00	$400.00	$400.00	$400.00	$400.00	$400.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Duct Sealing Electric Resistive Furnace - South (Electric Only)	Participation	38	64	57	49	40	32
Residential Prescriptive	Duct Sealing Electric Resistive Furnace - South (Electric Only)	Total Incentive Budget	$11,400	$19,200	$17,100	$14,700	$12,000	$9,600
Residential Prescriptive	Duct Sealing Electric Resistive Furnace - South (Electric Only)	Total Gross Incremental Savings (kwh)	51,642	86,976	77,463	66,591	54,360	43,488
Residential Prescriptive	Duct Sealing Electric Resistive Furnace - South (Electric Only)	NTG	0.76	0.76	0.76	0.76	0.76	0.76
Residential Prescriptive	Duct Sealing Electric Resistive Furnace - South (Electric Only)	Incremental Cost	$400.00	$400.00	$400.00	$400.00	$400.00	$400.00
Residential Prescriptive	Duct Sealing Gas Heating with A/C - South (Dual -- Gas & Electric)	Participation	232	384	346	297	245	196
Residential Prescriptive	Duct Sealing Gas Heating with A/C - South (Dual -- Gas & Electric)	Total Incentive Budget	$34,800	$57,600	$51,900	$44,550	$36,750	$29,400
Residential Prescriptive	Duct Sealing Gas Heating with A/C - South (Dual -- Gas & Electric)	Total Gross Incremental Savings (kwh)	38,365	63,500	57,216	49,113	40,514	32,411
Residential Prescriptive	Duct Sealing Gas Heating with A/C - South (Dual -- Gas & Electric)	NTG	0.76	0.76	0.76	0.76	0.76	0.76
Residential Prescriptive	Duct Sealing Gas Heating with A/C - South (Dual -- Gas & Electric)	Incremental Cost	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Ductless Heat Pump 17 SEER 9.5 HSPF	Participation	8	9	11	12	13	14
Residential Prescriptive	Ductless Heat Pump 17 SEER 9.5 HSPF	Total Incentive Budget	$4,000	$4,500	$5,500	$6,000	$6,500	$7,000
Residential Prescriptive	Ductless Heat Pump 17 SEER 9.5 HSPF	Total Gross Incremental Savings (kwh)	28,998	32,623	39,872	43,497	47,122	50,747
Residential Prescriptive	Ductless Heat Pump 17 SEER 9.5 HSPF	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Ductless Heat Pump 17 SEER 9.5 HSPF	Incremental Cost	$1,666.67	$1,666.67	$1,666.67	$1,666.67	$1,666.67	$1,666.67
Residential Prescriptive	Ductless Heat Pump 19 SEER 9.5 HSPF	Participation	18	21	24	26	29	31
Residential Prescriptive	Ductless Heat Pump 19 SEER 9.5 HSPF	Total Incentive Budget	$9,000	$10,500	$12,000	$13,000	$14,500	$15,500
Residential Prescriptive	Ductless Heat Pump 19 SEER 9.5 HSPF	Total Gross Incremental Savings (kwh)	66,147	77,172	88,196	95,546	106,571	113,920
Residential Prescriptive	Ductless Heat Pump 19 SEER 9.5 HSPF	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Ductless Heat Pump 19 SEER 9.5 HSPF	Incremental Cost	$2,333.33	$2,333.33	$2,333.33	$2,333.33	$2,333.33	$2,333.33
Residential Prescriptive	Ductless Heat Pump 21 SEER 10.0 HSPF	Participation	8	9	11	12	13	14
Residential Prescriptive	Ductless Heat Pump 21 SEER 10.0 HSPF	Total Incentive Budget	$6,000	$6,750	$8,250	$9,000	$9,750	$10,500
Residential Prescriptive	Ductless Heat Pump 21 SEER 10.0 HSPF	Total Gross Incremental Savings (kwh)	30,158	33,927	41,467	45,237	49,006	52,776

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Ductless Heat Pump 21 SEER 10.0 HSPF	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Ductless Heat Pump 21 SEER 10.0 HSPF	Incremental Cost	$2,833.33	$2,833.33	$2,833.33	$2,833.33	$2,833.33	$2,833.33
Residential Prescriptive	Ductless Heat Pump 23 SEER 10.0 HSPF	Participation	26	30	34	38	42	45
Residential Prescriptive	Ductless Heat Pump 23 SEER 10.0 HSPF	Total Incentive Budget	$19,500	$22,500	$25,500	$28,500	$31,500	$33,750
Residential Prescriptive	Ductless Heat Pump 23 SEER 10.0 HSPF	Total Gross Incremental Savings (kwh)	94,640	109,200	123,760	138,320	152,880	163,800
Residential Prescriptive	Ductless Heat Pump 23 SEER 10.0 HSPF	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Ductless Heat Pump 23 SEER 10.0 HSPF	Incremental Cost	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
Residential Prescriptive	Dual Fuel Air Source Heat Pump 18 SEER	Participation	12	16	21	26	32	39
Residential Prescriptive	Dual Fuel Air Source Heat Pump 18 SEER	Total Incentive Budget	$6,000	$8,000	$10,500	$13,000	$16,000	$19,500
Residential Prescriptive	Dual Fuel Air Source Heat Pump 18 SEER	Total Gross Incremental Savings (kwh)	10,680	14,240	18,690	23,140	28,480	34,710
Residential Prescriptive	Dual Fuel Air Source Heat Pump 18 SEER	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Dual Fuel Air Source Heat Pump 18 SEER	Incremental Cost	$1,666.67	$1,666.67	$1,666.67	$1,666.67	$1,666.67	$1,666.67
Residential Prescriptive	Heat Pump Water Heater	Participation	28	36	45	56	67	78

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Heat Pump Water Heater	Total Incentive Budget	$11,200	$14,400	$18,000	$22,400	$26,800	$31,200
Residential Prescriptive	Heat Pump Water Heater	Total Gross Incremental Savings (kwh)	66,304	85,248	106,560	132,608	158,656	184,704
Residential Prescriptive	Heat Pump Water Heater	NTG	0.63	0.63	0.63	0.63	0.63	0.63
Residential Prescriptive	Heat Pump Water Heater	Incremental Cost	$1,000.00	$1,000.00	$1,000.00	$1,000.00	$1,000.00	$1,000.00
Residential Prescriptive	Nest On-Line Store South (Electric Only)	Participation	64	64	64	64	64	64
Residential Prescriptive	Nest On-Line Store South (Electric Only)	Total Incentive Budget	$4,800	$4,800	$4,800	$4,800	$4,800	$4,800
Residential Prescriptive	Nest On-Line Store South (Electric Only)	Total Gross Incremental Savings (kwh)	58,455	58,455	58,455	58,455	58,455	58,455
Residential Prescriptive	Nest On-Line Store South (Electric Only)	NTG	0.55	0.55	0.55	0.55	0.55	0.55
Residential Prescriptive	Nest On-Line Store South (Electric Only)	Incremental Cost	$39.16	$39.16	$39.16	$39.16	$39.16	$39.16
Residential Prescriptive	Nest On-Line Store South (Dual -- Electric)	Participation	176	176	176	176	176	176
Residential Prescriptive	Nest On-Line Store South (Dual -- Electric)	Total Incentive Budget	$10,560	$10,560	$10,560	$10,560	$10,560	$10,560
Residential Prescriptive	Nest On-Line Store South (Dual -- Electric)	Total Gross Incremental Savings (kwh)	51,470	51,470	51,470	51,470	51,470	51,470
Residential Prescriptive	Nest On-Line Store South (Dual -- Electric)	NTG	0.55	0.55	0.55	0.55	0.55	0.55

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Nest On-Line Store South (Dual -- Electric)	Incremental Cost	$175.00	$175.00	$175.00	$175.00	$175.00	$175.00
Residential Prescriptive	Wifi Thermostat - South (Electric)	Participation	720	720	720	720	720	720
Residential Prescriptive	Wifi Thermostat - South (Electric)	Total Incentive Budget	$36,000	$36,000	$36,000	$36,000	$36,000	$36,000
Residential Prescriptive	Wifi Thermostat - South (Electric)	Total Gross Incremental Savings (kwh)	291,665	291,665	291,665	291,665	291,665	291,665
Residential Prescriptive	Wifi Thermostat - South (Electric)	NTG	0.73	0.73	0.73	0.73	0.73	0.73
Residential Prescriptive	Wifi Thermostat - South (Electric)	Incremental Cost	$20.64	$20.64	$20.64	$20.64	$20.64	$20.64
Residential Prescriptive	Smart Programmable Thermostat - South (Electric)	Participation	1,478	1,478	1,478	1,478	1,478	1,478
Residential Prescriptive	Smart Programmable Thermostat - South (Electric)	Total Incentive Budget	$110,850	$110,850	$110,850	$110,850	$110,850	$110,850
Residential Prescriptive	Smart Programmable Thermostat - South (Electric)	Total Gross Incremental Savings (kwh)	729,085	729,085	729,085	729,085	729,085	729,085
Residential Prescriptive	Smart Programmable Thermostat - South (Electric)	NTG	0.55	0.55	0.55	0.55	0.55	0.55
Residential Prescriptive	Smart Programmable Thermostat - South (Electric)	Incremental Cost	$39.16	$39.16	$39.16	$39.16	$39.16	$39.16

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Variable Speed Pool Pump	Participation	18	28	36	45	56	67
Residential Prescriptive	Variable Speed Pool Pump	Total Incentive Budget	$5,400	$8,400	$10,800	$13,500	$16,800	$20,100
Residential Prescriptive	Variable Speed Pool Pump	Total Gross Incremental Savings (kwh)	21,106	32,832	42,213	52,766	65,664	78,562
Residential Prescriptive	Variable Speed Pool Pump	NTG	0.63	0.63	0.63	0.63	0.63	0.63
Residential Prescriptive	Variable Speed Pool Pump	Incremental Cost	$750.00	$750.00	$750.00	$750.00	$750.00	$750.00
Residential Prescriptive	Wall Insulation - Elec Heated	Participation	5	5	5	5	5	5
Residential Prescriptive	Wall Insulation - Elec Heated	Total Incentive Budget	$2,250	$2,250	$2,250	$2,250	$2,250	$2,250
Residential Prescriptive	Wall Insulation - Elec Heated	Total Gross Incremental Savings (kwh)	4,447	4,447	4,447	4,447	4,447	4,447
Residential Prescriptive	Wall Insulation - Elec Heated	NTG	0.76	0.76	0.76	0.76	0.76	0.76
Residential Prescriptive	Wall Insulation - Elec Heated	Incremental Cost	$500.00	$500.00	$500.00	$500.00	$500.00	$500.00
Residential Prescriptive	Wall Insulation - Gas Heated - South (Electric)	Participation	32	32	32	32	32	32
Residential Prescriptive	Wall Insulation - Gas Heated - South (Electric)	Total Incentive Budget	$7,200	$7,200	$7,200	$7,200	$7,200	$7,200
Residential Prescriptive	Wall Insulation - Gas Heated - South (Electric)	Total Gross Incremental Savings (kwh)	1,876	1,876	1,876	1,876	1,876	1,876

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Wall Insulation - Gas Heated - South (Electric)	NTG	0.76	0.76	0.76	0.76	0.76	0.76
Residential Prescriptive	Wall Insulation - Gas Heated - South (Electric)	Incremental Cost	$500.00	$500.00	$500.00	$500.00	$500.00	$500.00
Residential Prescriptive	AC Tune Up	Participation	3,344	3,511	3,326	2,994	2,573	2,639
Residential Prescriptive	AC Tune Up	Total Incentive Budget	$83,600	$87,775	$83,150	$74,850	$64,325	$65,975
Residential Prescriptive	AC Tune Up	Total Gross Incremental Savings (kwh)	371,184	389,721	369,186	332,334	285,603	292,929
Residential Prescriptive	AC Tune Up	NTG	-	-	-	-	-	-
Residential Prescriptive	AC Tune Up	Incremental Cost	$64.00	$64.00	$64.00	$64.00	$64.00	$64.00
Residential Prescriptive	ASHP Tune Up	Participation	26	71	67	60	52	53
Residential Prescriptive	ASHP Tune Up	Total Incentive Budget	$1,300	$3,550	$3,350	$3,000	$2,600	$2,650
Residential Prescriptive	ASHP Tune Up	Total Gross Incremental Savings (kwh)	8,195	22,379	21,119	18,912	16,391	16,706
Residential Prescriptive	ASHP Tune Up	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Residential Prescriptive	ASHP Tune Up	Incremental Cost	$64.00	$64.00	$64.00	$64.00	$64.00	$64.00
Residential Prescriptive	Air Purifier	Participation	100	160	181	200	217	231

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Air Purifier	Total Incentive Budget	$2,500	$4,000	$4,525	$5,000	$5,425	$5,775
Residential Prescriptive	Air Purifier	Total Gross Incremental Savings (kwh)	48,800	78,080	88,328	97,600	105,896	112,728
Residential Prescriptive	Air Purifier	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	Air Purifier	Incremental Cost	$70.00	$70.00	$70.00	$70.00	$70.00	$70.00
Residential Prescriptive	ENERGY STAR Dehumidifier	Participation	368	368	368	368	368	368
Residential Prescriptive	ENERGY STAR Dehumidifier	Total Incentive Budget	$9,200	$9,200	$9,200	$9,200	$9,200	$9,200
Residential Prescriptive	ENERGY STAR Dehumidifier	Total Gross Incremental Savings (kwh)	70,766	70,766	70,766	70,766	70,766	70,766
Residential Prescriptive	ENERGY STAR Dehumidifier	NTG	0.52	0.52	0.52	0.52	0.52	0.52
Residential Prescriptive	ENERGY STAR Dehumidifier	Incremental Cost	$70.00	$70.00	$70.00	$70.00	$70.00	$70.00
Residential Prescriptive	ENERGY STAR Clothes Washer	Participation	56	56	70	76	81	84
Residential Prescriptive	ENERGY STAR Clothes Washer	Total Incentive Budget	$1,400	$1,400	$1,750	$1,900	$2,025	$2,100
Residential Prescriptive	ENERGY STAR Clothes Washer	Total Gross Incremental Savings (kwh)	6,272	6,272	7,840	8,512	9,072	9,408
Residential Prescriptive	ENERGY STAR Clothes Washer	NTG	0.68	0.68	0.68	0.68	0.68	0.68

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	ENERGY STAR Clothes Washer	Incremental Cost	$150.00	$150.00	$150.00	$150.00	$150.00	$150.00
Residential Prescriptive	Smart/CEE Tier3 Clothes Washer	Participation	78	78	141	184	238	299
Residential Prescriptive	Smart/CEE Tier3 Clothes Washer	Total Incentive Budget	$3,900	$3,900	$7,050	$9,200	$11,900	$14,950
Residential Prescriptive	Smart/CEE Tier3 Clothes Washer	Total Gross Incremental Savings (kwh)	16,302	16,302	29,469	38,456	49,742	62,491
Residential Prescriptive	Smart/CEE Tier3 Clothes Washer	NTG	0.68	0.68	0.68	0.68	0.68	0.68
Residential Prescriptive	Smart/CEE Tier3 Clothes Washer	Incremental Cost	$300.00	$300.00	$300.00	$300.00	$300.00	$300.00
Residential Prescriptive	ENERGY STAR Room Air Conditioner	Participation	121	121	121	121	121	121
Residential Prescriptive	ENERGY STAR Room Air Conditioner	Total Incentive Budget	$3,025	$3,025	$3,025	$3,025	$3,025	$3,025
Residential Prescriptive	ENERGY STAR Room Air Conditioner	Total Gross Incremental Savings (kwh)	4,979	4,979	4,979	4,979	4,979	4,979
Residential Prescriptive	ENERGY STAR Room Air Conditioner	NTG	0.80	0.80	0.80	0.80	0.80	0.80
Residential Prescriptive	ENERGY STAR Room Air Conditioner	Incremental Cost	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00
Residential Prescriptive	Clothes Dryer	Participation	28	38	51	67	86	108
Residential Prescriptive	Clothes Dryer	Total Incentive Budget	$1,400	$1,900	$2,550	$3,350	$4,300	$5,400

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Prescriptive	Clothes Dryer	Total Gross Incremental Savings (kwh)	5,519	7,483	10,031	13,159	16,860	21,125
Residential Prescriptive	Clothes Dryer	NTG	0.68	0.68	0.68	0.68	0.68	0.68
Residential Prescriptive	Clothes Dryer	Incremental Cost	$150.00	$150.00	$150.00	$150.00	$150.00	$150.00
Residential New Construction	Gold Star HERS Index Score 63	Participation	17	15	13	11	9	8
Residential New Construction	Gold Star HERS Index Score 63	Total Incentive Budget	$2,975	$2,625	$2,275	$1,925	$1,575	$1,400
Residential New Construction	Gold Star HERS Index Score 63	Total Gross Incremental Savings (kwh)	34,340	30,300	26,260	22,220	18,180	16,160
Residential New Construction	Gold Star HERS Index Score 63	NTG	0.50	0.50	0.50	0.50	0.50	0.50
Residential New Construction	Gold Star HERS Index Score 63	Incremental Cost	$2,038.73	$2,038.73	$2,038.73	$2,038.73	$2,038.73	$2,038.73
Residential New Construction	Platinum Star HERS Index Score 60	Participation	69	62	62	62	62	62
Residential New Construction	Platinum Star HERS Index Score 60	Total Incentive Budget	$13,800	$12,400	$12,400	$12,400	$12,400	$12,400
Residential New Construction	Platinum Star HERS Index Score 60	Total Gross Incremental Savings (kwh)	154,284	138,632	138,632	138,632	138,632	138,632
Residential New Construction	Platinum Star HERS Index Score 60	NTG	0.50	0.50	0.50	0.50	0.50	0.50
Residential New Construction	Platinum Star HERS Index Score 60	Incremental Cost	$2,428.73	$2,428.73	$2,428.73	$2,428.73	$2,428.73	$2,428.73

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Attic Insulation - Electric Resistance Heated	Participation	13	14	15	16	17	18
Income Qualified Weatherization	Attic Insulation - Electric Resistance Heated	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Attic Insulation - Electric Resistance Heated	Total Gross Incremental Savings (kwh)	10,764	11,592	12,420	13,248	14,076	14,904
Income Qualified Weatherization	Attic Insulation - Electric Resistance Heated	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Attic Insulation - Electric Resistance Heated	Incremental Cost	$1,412.60	$1,412.60	$1,412.60	$1,412.60	$1,412.60	$1,412.60
Income Qualified Weatherization	Attic Insulation - Gas Heated (Electric)	Participation	131	138	145	153	161	170
Income Qualified Weatherization	Attic Insulation - Gas Heated (Electric)	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Attic Insulation - Gas Heated (Electric)	Total Gross Incremental Savings (kwh)	18,209	19,182	20,155	21,267	22,379	23,630
Income Qualified Weatherization	Attic Insulation - Gas Heated (Electric)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Attic Insulation - Gas Heated (Electric)	Incremental Cost	$706.30	$706.30	$706.30	$706.30	$706.30	$706.30
Income Qualified Weatherization	Audit Recommendations - Dual (Electric)	Participation	340	357	374	392	411	431
Income Qualified Weatherization	Audit Recommendations - Dual (Electric)	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Audit Recommendations - Dual (Electric)	Total Gross Incremental Savings (kwh)	23,120	24,276	25,432	26,656	27,948	29,308

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Audit Recommendations - Dual (Electric)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Audit Recommendations - Dual (Electric)	Incremental Cost	$26.00	$26.00	$26.00	$26.00	$26.00	$26.00
Income Qualified Weatherization	Bathroom Aerator 1.0 gpm - Elec DHW	Participation	112	118	124	131	138	145
Income Qualified Weatherization	Bathroom Aerator 1.0 gpm - Elec DHW	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Bathroom Aerator 1.0 gpm - Elec DHW	Total Gross Incremental Savings (kwh)	1,344	1,416	1,488	1,572	1,656	1,740
Income Qualified Weatherization	Bathroom Aerator 1.0 gpm - Elec DHW	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Bathroom Aerator 1.0 gpm - Elec DHW	Incremental Cost	$0.52	$0.52	$0.52	$0.52	$0.52	$0.52
Income Qualified Weatherization	9W LED	Participation	4,021	4,223	4,435	4,657	4,890	5,135
Income Qualified Weatherization	9W LED	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	9W LED	Total Gross Incremental Savings (kwh)	128,672	135,136	141,920	149,024	156,480	164,320
Income Qualified Weatherization	9W LED	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	9W LED	Incremental Cost	$3.21	$3.21	$3.21	$3.21	$3.21	$3.21
Income Qualified Weatherization	LED 5W Globe	Participation	274	288	303	319	335	352

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	LED 5W Globe	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	LED 5W Globe	Total Gross Incremental Savings (kwh)	2,740	2,880	3,030	3,190	3,350	3,520
Income Qualified Weatherization	LED 5W Globe	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	LED 5W Globe	Incremental Cost	$8.75	$8.75	$8.75	$8.75	$8.75	$8.75
Income Qualified Weatherization	LED R30 Dimmable	Participation	803	844	887	932	979	1,028
Income Qualified Weatherization	LED R30 Dimmable	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	LED R30 Dimmable	Total Gross Incremental Savings (kwh)	42,559	44,732	47,011	49,396	51,887	54,484
Income Qualified Weatherization	LED R30 Dimmable	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	LED R30 Dimmable	Incremental Cost	$11.54	$11.54	$11.54	$11.54	$11.54	$11.54
Income Qualified Weatherization	Exterior LED Lamps	Participation	157	165	174	183	193	203
Income Qualified Weatherization	Exterior LED Lamps	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Exterior LED Lamps	Total Gross Incremental Savings (kwh)	14,444	15,180	16,008	16,836	17,756	18,676
Income Qualified Weatherization	Exterior LED Lamps	NTG	1.00	1.00	1.00	1.00	1.00	1.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Exterior LED Lamps	Incremental Cost	$7.20	$7.20	$7.20	$7.20	$7.20	$7.20
Income Qualified Weatherization	Filter Whistle	Participation	105	111	117	123	130	137
Income Qualified Weatherization	Filter Whistle	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Filter Whistle	Total Gross Incremental Savings (kwh)	5,775	6,105	6,435	6,765	7,150	7,535
Income Qualified Weatherization	Filter Whistle	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Filter Whistle	Incremental Cost	$1.64	$1.64	$1.64	$1.64	$1.64	$1.64
Income Qualified Weatherization	Kitchen Flip Aerator 1.5 gpm - Elec DHW	Participation	38	40	42	45	48	51
Income Qualified Weatherization	Kitchen Flip Aerator 1.5 gpm - Elec DHW	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Kitchen Flip Aerator 1.5 gpm - Elec DHW	Total Gross Incremental Savings (kwh)	4,560	4,800	5,040	5,400	5,760	6,120
Income Qualified Weatherization	Kitchen Flip Aerator 1.5 gpm - Elec DHW	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Kitchen Flip Aerator 1.5 gpm - Elec DHW	Incremental Cost	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34
Income Qualified Weatherization	LED Nightlight	Participation	490	515	541	569	598	628
Income Qualified Weatherization	LED Nightlight	Total Incentive Budget	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	LED Nightlight	Total Gross Incremental Savings (kwh)	6,860	7,210	7,574	7,966	8,372	8,792
Income Qualified Weatherization	LED Nightlight	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	LED Nightlight	Incremental Cost	$2.75	$2.75	$2.75	$2.75	$2.75	$2.75
Income Qualified Weatherization	Low Flow Showerhead 1.5 gpm - Elec DHW	Participation	89	94	99	104	110	116
Income Qualified Weatherization	Low Flow Showerhead 1.5 gpm - Elec DHW	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Low Flow Showerhead 1.5 gpm - Elec DHW	Total Gross Incremental Savings (kwh)	26,700	28,200	29,700	31,200	33,000	34,800
Income Qualified Weatherization	Low Flow Showerhead 1.5 gpm - Elec DHW	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Low Flow Showerhead 1.5 gpm - Elec DHW	Incremental Cost	$3.32	$3.32	$3.32	$3.32	$3.32	$3.32
Income Qualified Weatherization	Pipe Wrap - Elec DHW (per home)	Participation	23	25	27	29	31	33
Income Qualified Weatherization	Pipe Wrap - Elec DHW (per home)	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Pipe Wrap - Elec DHW (per home)	Total Gross Incremental Savings (kwh)	3,404	3,700	3,996	4,292	4,588	4,884
Income Qualified Weatherization	Pipe Wrap - Elec DHW (per home)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Pipe Wrap - Elec DHW (per home)	Incremental Cost	$1.72	$1.72	$1.72	$1.72	$1.72	$1.72

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Refrigerator Replacement	Participation	35	37	39	41	44	47
Income Qualified Weatherization	Refrigerator Replacement	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Refrigerator Replacement	Total Gross Incremental Savings (kwh)	15,470	16,354	17,238	18,122	19,448	20,774
Income Qualified Weatherization	Refrigerator Replacement	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Refrigerator Replacement	Incremental Cost	$580.00	$580.00	$580.00	$580.00	$580.00	$580.00
Income Qualified Weatherization	Smart Thermostat (Electric)	Participation	26	28	30	32	34	36
Income Qualified Weatherization	Smart Thermostat (Electric)	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Smart Thermostat (Electric)	Total Gross Incremental Savings (kwh)	9,620	10,360	11,100	11,840	12,580	13,320
Income Qualified Weatherization	Smart Thermostat (Electric)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Smart Thermostat (Electric)	Incremental Cost	$77.00	$77.00	$77.00	$77.00	$77.00	$77.00
Income Qualified Weatherization	Water Heater Temperature Setback - Elec DHW	Participation	75	79	83	88	93	98
Income Qualified Weatherization	Water Heater Temperature Setback - Elec DHW	Total Incentive Budget	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Water Heater Temperature Setback - Elec DHW	Total Gross Incremental Savings (kwh)	6,450	6,794	7,138	7,568	7,998	8,428
Income Qualified Weatherization	Water Heater Temperature Setback - Elec DHW	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Water Heater Temperature Setback - Elec DHW	Incremental Cost	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50
Income Qualified Weatherization	Duct Sealing Gas Heating with A/C	Participation	316	332	349	367	386	406
Income Qualified Weatherization	Duct Sealing Gas Heating with A/C	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Duct Sealing Gas Heating with A/C	Total Gross Incremental Savings (kwh)	72,364	76,028	79,921	84,043	88,394	92,974
Income Qualified Weatherization	Duct Sealing Gas Heating with A/C	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Duct Sealing Gas Heating with A/C	Incremental Cost	$225.00	$225.00	$225.00	$225.00	$225.00	$225.00
Income Qualified Weatherization	Duct Sealing Electric Heat Pump	Participation	37	39	41	44	47	50
Income Qualified Weatherization	Duct Sealing Electric Heat Pump	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Duct Sealing Electric Heat Pump	Total Gross Incremental Savings (kwh)	30,673	32,331	33,989	36,476	38,963	41,450
Income Qualified Weatherization	Duct Sealing Electric Heat Pump	NTG	1.00	1.00	1.00	1.00	1.00	1.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Duct Sealing Electric Heat Pump	Incremental Cost	$450.00	$450.00	$450.00	$450.00	$450.00	$450.00
Income Qualified Weatherization	Duct Sealing Electric Resistive Furnace	Participation	45	48	51	54	57	60
Income Qualified Weatherization	Duct Sealing Electric Resistive Furnace	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Duct Sealing Electric Resistive Furnace	Total Gross Incremental Savings (kwh)	60,840	64,896	68,952	73,008	77,064	81,120
Income Qualified Weatherization	Duct Sealing Electric Resistive Furnace	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Duct Sealing Electric Resistive Furnace	Incremental Cost	$450.00	$450.00	$450.00	$450.00	$450.00	$450.00
Income Qualified Weatherization	Air Sealing Gas Furnace w/ CAC	Participation	465	489	514	540	567	596
Income Qualified Weatherization	Air Sealing Gas Furnace w/ CAC	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Air Sealing Gas Furnace w/ CAC	Total Gross Incremental Savings (kwh)	65,100	68,460	71,960	75,600	79,380	83,440
Income Qualified Weatherization	Air Sealing Gas Furnace w/ CAC	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Air Sealing Gas Furnace w/ CAC	Incremental Cost	$100.00	$100.00	$100.00	$100.00	$100.00	$100.00
Income Qualified Weatherization	Air Sealing Heat Pump	Participation	48	51	54	57	60	63
Income Qualified Weatherization	Air Sealing Heat Pump	Total Incentive Budget	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Air Sealing Heat Pump	Total Gross Incremental Savings (kwh)	72,048	76,551	81,054	85,557	90,060	94,563
Income Qualified Weatherization	Air Sealing Heat Pump	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Air Sealing Heat Pump	Incremental Cost	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00
Income Qualified Weatherization	Air Sealing Electric Furnace w/ CAC	Participation	32	34	36	38	40	42
Income Qualified Weatherization	Air Sealing Electric Furnace w/ CAC	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Air Sealing Electric Furnace w/ CAC	Total Gross Incremental Savings (kwh)	150,016	159,392	168,768	178,144	187,520	196,896
Income Qualified Weatherization	Air Sealing Electric Furnace w/ CAC	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Air Sealing Electric Furnace w/ CAC	Incremental Cost	-	-	-	-	-	-
Income Qualified Weatherization	Air Source Heat Pump 16 SEER	Participation	2	3	4	5	6	7
Income Qualified Weatherization	Air Source Heat Pump 16 SEER	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Air Source Heat Pump 16 SEER	Total Gross Incremental Savings (kwh)	1,582	2,373	3,164	3,955	4,746	5,537
Income Qualified Weatherization	Air Source Heat Pump 16 SEER	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Air Source Heat Pump 16 SEER	Incremental Cost	$5,400.00	$5,400.00	$5,400.00	$5,400.00	$5,400.00	$5,400.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Central Air Conditioner 16 SEER	Participation	19	20	21	23	25	27
Income Qualified Weatherization	Central Air Conditioner 16 SEER	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Central Air Conditioner 16 SEER	Total Gross Incremental Savings (kwh)	5,700	6,000	6,300	6,900	7,500	8,100
Income Qualified Weatherization	Central Air Conditioner 16 SEER	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Central Air Conditioner 16 SEER	Incremental Cost	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00
Income Qualified Weatherization	Wall Insulation - Dual (gas heated)	Participation	19	21	23	25	27	29
Income Qualified Weatherization	Wall Insulation - Dual (gas heated)	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Wall Insulation - Dual (gas heated)	Total Gross Incremental Savings (kwh)	1,141	1,239	1,357	1,475	1,593	1,711
Income Qualified Weatherization	Wall Insulation - Dual (gas heated)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Wall Insulation - Dual (gas heated)	Incremental Cost	$877.00	$877.00	$877.00	$877.00	$877.00	$877.00
Income Qualified Weatherization	Water Heater Temperature Setback - Gas DHW	Participation	55	58	61	65	69	73
Income Qualified Weatherization	Water Heater Temperature Setback - Gas DHW	Total Incentive Budget	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Water Heater Temperature Setback - Gas DHW	Total Gross Incremental Savings (kwh)	(1,870)	(1,972)	(2,074)	(2,210)	(2,346)	(2,482)
Income Qualified Weatherization	Water Heater Temperature Setback - Gas DHW	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Water Heater Temperature Setback - Gas DHW	Incremental Cost	-	-	-	-	-	-
Income Qualified Weatherization	Mobile Home Audit (Dual)	Participation	173	181	190	199	208	218
Income Qualified Weatherization	Mobile Home Audit (Dual)	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Mobile Home Audit (Dual)	Total Gross Incremental Savings (kwh)	-	-	-	-	-	-
Income Qualified Weatherization	Mobile Home Audit (Dual)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Income Qualified Weatherization	Mobile Home Audit (Dual)	Incremental Cost	$26.00	$26.00	$26.00	$26.00	$26.00	$26.00
Income Qualified Weatherization	Mobile Home Audit (Electric)	Participation	26	28	30	32	34	36
Income Qualified Weatherization	Mobile Home Audit (Electric)	Total Incentive Budget	-	-	-	-	-	-
Income Qualified Weatherization	Mobile Home Audit (Electric)	Total Gross Incremental Savings (kwh)	-	-	-	-	-	-
Income Qualified Weatherization	Mobile Home Audit (Electric)	NTG	1.00	1.00	1.00	1.00	1.00	1.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Income Qualified Weatherization	Mobile Home Audit (Electric)	Incremental Cost	$106.00	$106.00	$106.00	$106.00	$106.00	$106.00
Energy Efficient Schools	15W LED	Participation	2,600	2,600	-	-	-	-
Energy Efficient Schools	15W LED	Total Incentive Budget	-	-	-	-	-	-
Energy Efficient Schools	15W LED	Total Gross Incremental Savings (kwh)	124,800	124,800	-	-	-	-
Energy Efficient Schools	15W LED	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Energy Efficient Schools	15W LED	Incremental Cost	-	-	-	-	-	-
Energy Efficient Schools	11W LED	Participation	5,200	5,200	-	-	-	-
Energy Efficient Schools	11W LED	Total Incentive Budget	-	-	-	-	-	-
Energy Efficient Schools	11W LED	Total Gross Incremental Savings (kwh)	353,600	353,600	-	-	-	-
Energy Efficient Schools	11W LED	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Energy Efficient Schools	11W LED	Incremental Cost	-	-	-	-	-	-
Energy Efficient Schools	Showerheads	Participation	2,600	2,600	2,600	2,600	2,600	2,600
Energy Efficient Schools	Showerheads	Total Incentive Budget	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Energy Efficient Schools	Showerheads	Total Gross Incremental Savings (kwh)	340,600	340,600	340,600	340,600	340,600	340,600
Energy Efficient Schools	Showerheads	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Energy Efficient Schools	Showerheads	Incremental Cost	-	-	-	-	-	-
Energy Efficient Schools	Kitchen Aerators	Participation	2,600	2,600	2,600	2,600	2,600	2,600
Energy Efficient Schools	Kitchen Aerators	Total Incentive Budget	-	-	-	-	-	-
Energy Efficient Schools	Kitchen Aerators	Total Gross Incremental Savings (kwh)	145,600	145,600	145,600	145,600	145,600	145,600
Energy Efficient Schools	Kitchen Aerators	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Energy Efficient Schools	Kitchen Aerators	Incremental Cost	-	-	-	-	-	-
Energy Efficient Schools	Bathroom Aerators	Participation	5,200	5,200	5,200	5,200	5,200	5,200
Energy Efficient Schools	Bathroom Aerators	Total Incentive Budget	-	-	-	-	-	-
Energy Efficient Schools	Bathroom Aerators	Total Gross Incremental Savings (kwh)	114,400	114,400	114,400	114,400	114,400	114,400
Energy Efficient Schools	Bathroom Aerators	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Energy Efficient Schools	Bathroom Aerators	Incremental Cost	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Energy Efficient Schools	Filter Whistle	Participation	2,600	2,600	2,600	2,600	2,600	2,600
Energy Efficient Schools	Filter Whistle	Total Incentive Budget	-	-	-	-	-	-
Energy Efficient Schools	Filter Whistle	Total Gross Incremental Savings (kwh)	52,000	52,000	52,000	52,000	52,000	52,000
Energy Efficient Schools	Filter Whistle	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Energy Efficient Schools	Filter Whistle	Incremental Cost	-	-	-	-	-	-
Energy Efficient Schools	LED Night Light	Participation	2,600	2,600	2,600	2,600	2,600	2,600
Energy Efficient Schools	LED Night Light	Total Incentive Budget	-	-	-	-	-	-
Energy Efficient Schools	LED Night Light	Total Gross Incremental Savings (kwh)	18,200	18,200	18,200	18,200	18,200	18,200
Energy Efficient Schools	LED Night Light	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Energy Efficient Schools	LED Night Light	Incremental Cost	-	-	-	-	-	-
Residential Behavior Savings	Residential Behavior	Participation	35,298	35,298	35,298	35,298	35,298	35,298
Residential Behavior Savings	Residential Behavior	Total Incentive Budget	-	-	-	-	-	-
Residential Behavior Savings	Residential Behavior	Total Gross Incremental Savings (kwh)	5,600,000	5,600,000	5,600,000	5,600,000	5,600,000	5,600,000

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Residential Behavior Savings	Residential Behavior	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Residential Behavior Savings	Residential Behavior	Incremental Cost	-	-	-	-	-	-
Residential Behavior Savings	Low Income Refill Electric	Participation	13,702	13,702	13,702	13,702	13,702	13,702
Residential Behavior Savings	Low Income Refill Electric	Total Incentive Budget	-	-	-	-	-	-
Residential Behavior Savings	Low Income Refill Electric	Total Gross Incremental Savings (kwh)	1,449,208	1,449,208	1,449,208	1,449,208	1,449,208	1,449,208
Residential Behavior Savings	Low Income Refill Electric	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Residential Behavior Savings	Low Income Refill Electric	Incremental Cost	-	-	-	-	-	-
Appliance Recycling	Refrigerator Recycling	Participation	1,028	1,142	1,206	1,206	1,142	1,028
Appliance Recycling	Refrigerator Recycling	Total Incentive Budget	$51,400	$57,100	$60,300	$60,300	$57,100	$51,400
Appliance Recycling	Refrigerator Recycling	Total Gross Incremental Savings (kwh)	1,013,608	1,126,012	1,189,116	1,189,116	1,126,012	1,013,608
Appliance Recycling	Refrigerator Recycling	NTG	0.71	0.71	0.71	0.71	0.71	0.71
Appliance Recycling	Refrigerator Recycling	Incremental Cost	-	-	-	-	-	-
Appliance Recycling	Freezer Recycling	Participation	161	179	189	189	179	161

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Appliance Recycling	Freezer Recycling	Total Incentive Budget	$8,050	$8,950	$9,450	$9,450	$8,950	$8,050
Appliance Recycling	Freezer Recycling	Total Gross Incremental Savings (kwh)	132,020	146,780	154,980	154,980	146,780	132,020
Appliance Recycling	Freezer Recycling	NTG	0.71	0.71	0.71	0.71	0.71	0.71
Appliance Recycling	Freezer Recycling	Incremental Cost	-	-	-	-	-	-
Appliance Recycling	Room Air Conditioner Recycling	Participation	62	23	30	40	51	64
Appliance Recycling	Room Air Conditioner Recycling	Total Incentive Budget	$1,550	$575	$750	$1,000	$1,275	$1,600
Appliance Recycling	Room Air Conditioner Recycling	Total Gross Incremental Savings (kwh)	34,183	12,681	16,540	22,053	28,118	35,285
Appliance Recycling	Room Air Conditioner Recycling	NTG	0.57	0.57	0.57	0.57	0.57	0.57
Appliance Recycling	Room Air Conditioner Recycling	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Audit Education - All sites	Participation	300	350	420	504	504	504
Home Energy Assessment	Audit Education - All sites	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Audit Education - All sites	Total Gross Incremental Savings (kwh)	18,364	21,424	25,709	30,851	30,851	30,851
Home Energy Assessment	Audit Education - All sites	NTG	1.00	1.00	1.00	1.00	1.00	1.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Home Energy Assessment	Audit Education - All sites	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	LED 5W Globe	Participation	600	700	840	1,008	1,008	806
Home Energy Assessment	LED 5W Globe	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	LED 5W Globe	Total Gross Incremental Savings (kwh)	6,221	7,258	8,710	10,452	10,452	8,361
Home Energy Assessment	LED 5W Globe	NTG	0.96	0.96	0.96	0.96	0.96	0.96
Home Energy Assessment	LED 5W Globe	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	LED 9W Bulb	Participation	3,000	3,500	4,200	5,040	4,032	3,024
Home Energy Assessment	LED 9W Bulb	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	LED 9W Bulb	Total Gross Incremental Savings (kwh)	94,680	110,460	132,552	159,062	127,250	95,437
Home Energy Assessment	LED 9W Bulb	NTG	0.96	0.96	0.96	0.96	0.96	0.96
Home Energy Assessment	LED 9W Bulb	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	LED R30 Dimmable	Participation	900	1,050	1,260	1,512	1,512	1,210
Home Energy Assessment	LED R30 Dimmable	Total Incentive Budget	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Home Energy Assessment	LED R30 Dimmable	Total Gross Incremental Savings (kwh)	47,679	55,626	66,751	80,101	80,101	64,081
Home Energy Assessment	LED R30 Dimmable	NTG	0.96	0.96	0.96	0.96	0.96	0.96
Home Energy Assessment	LED R30 Dimmable	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	LED Night Light	Participation	300	350	420	504	504	504
Home Energy Assessment	LED Night Light	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	LED Night Light	Total Gross Incremental Savings (kwh)	4,091	4,773	5,727	6,873	6,873	6,873
Home Energy Assessment	LED Night Light	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Home Energy Assessment	LED Night Light	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Bathroom Aerator	Participation	600	700	840	1,008	1,008	1,008
Home Energy Assessment	Bathroom Aerator	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Bathroom Aerator	Total Gross Incremental Savings (kwh)	5,400	6,300	7,560	9,072	9,072	9,072
Home Energy Assessment	Bathroom Aerator	NTG	1.06	1.06	1.06	1.06	1.06	1.06
Home Energy Assessment	Bathroom Aerator	Incremental Cost	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Home Energy Assessment	Kitchen Aerator	Participation	300	350	420	504	504	504
Home Energy Assessment	Kitchen Aerator	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Kitchen Aerator	Total Gross Incremental Savings (kwh)	34,350	40,075	48,090	57,708	57,708	57,708
Home Energy Assessment	Kitchen Aerator	NTG	1.06	1.06	1.06	1.06	1.06	1.06
Home Energy Assessment	Kitchen Aerator	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Efficient Showerhead	Participation	300	350	420	504	504	504
Home Energy Assessment	Efficient Showerhead	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Efficient Showerhead	Total Gross Incremental Savings (kwh)	61,707	71,992	86,390	103,668	103,668	103,668
Home Energy Assessment	Efficient Showerhead	NTG	1.06	1.06	1.06	1.06	1.06	1.06
Home Energy Assessment	Efficient Showerhead	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Filter Whistle	Participation	300	350	420	504	504	504
Home Energy Assessment	Filter Whistle	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Filter Whistle	Total Gross Incremental Savings (kwh)	18,267	21,312	25,574	30,689	30,689	30,689

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Home Energy Assessment	Filter Whistle	NTG	1.15	1.15	1.15	1.15	1.15	1.15
Home Energy Assessment	Filter Whistle	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Pipe Wrap (Electric) (per home)	Participation	300	350	420	504	504	504
Home Energy Assessment	Pipe Wrap (Electric) (per home)	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Pipe Wrap (Electric) (per home)	Total Gross Incremental Savings (kwh)	19,620	22,890	27,468	32,962	32,962	32,962
Home Energy Assessment	Pipe Wrap (Electric) (per home)	NTG	1.09	1.09	1.09	1.09	1.09	1.09
Home Energy Assessment	Pipe Wrap (Electric) (per home)	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Water Heater Temperature Setback	Participation	300	350	420	504	504	504
Home Energy Assessment	Water Heater Temperature Setback	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Water Heater Temperature Setback	Total Gross Incremental Savings (kwh)	25,957	30,283	36,340	43,608	43,608	43,608
Home Energy Assessment	Water Heater Temperature Setback	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Home Energy Assessment	Water Heater Temperature Setback	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Wi-Fi Thermostat (Dual Fuel)	Participation	300	350	420	504	504	504

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Home Energy Assessment	Wi-Fi Thermostat (Dual Fuel)	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Wi-Fi Thermostat (Dual Fuel)	Total Gross Incremental Savings (kwh)	59,400	69,300	83,160	99,792	99,792	99,792
Home Energy Assessment	Wi-Fi Thermostat (Dual Fuel)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Home Energy Assessment	Wi-Fi Thermostat (Dual Fuel)	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Wi-Fi Thermostat (Electric)	Participation	300	350	420	504	504	504
Home Energy Assessment	Wi-Fi Thermostat (Electric)	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Wi-Fi Thermostat (Electric)	Total Gross Incremental Savings (kwh)	123,657	144,267	173,120	207,744	207,744	207,744
Home Energy Assessment	Wi-Fi Thermostat (Electric)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Home Energy Assessment	Wi-Fi Thermostat (Electric)	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Showerstart Device (TSV Valve)	Participation	-	-	-	-	-	-
Home Energy Assessment	Showerstart Device (TSV Valve)	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Showerstart Device (TSV Valve)	Total Gross Incremental Savings (kwh)	-	-	-	-	-	-
Home Energy Assessment	Showerstart Device (TSV Valve)	NTG	1.00	1.00	1.00	1.00	1.00	1.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Home Energy Assessment	Showerstart Device (TSV Valve)	Incremental Cost	-	-	-	-	-	-
Home Energy Assessment	Tier 1 Advanced Power Strip	Participation	300	350	420	504	504	504
Home Energy Assessment	Tier 1 Advanced Power Strip	Total Incentive Budget	-	-	-	-	-	-
Home Energy Assessment	Tier 1 Advanced Power Strip	Total Gross Incremental Savings (kwh)	-	-	-	-	-	-
Home Energy Assessment	Tier 1 Advanced Power Strip	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Home Energy Assessment	Tier 1 Advanced Power Strip	Incremental Cost	-	-	-	-	-	-
Food Bank	9W LED	Participation	-	25,248	-	-	-	-
Food Bank	9W LED	Total Incentive Budget	-	-	-	-	-	-
Food Bank	9W LED	Total Gross Incremental Savings (kwh)	-	747,979	-	-	-	-
Food Bank	9W LED	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Food Bank	9W LED	Incremental Cost	-	-	-	-	-	-
Food Bank	LED R30 Dimmable	Participation	-	3,156	3,156	-	-	-
Food Bank	LED R30 Dimmable	Total Incentive Budget	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Food Bank	LED R30 Dimmable	Total Gross Incremental Savings (kwh)	-	167,195	167,195	-	-	-
Food Bank	LED R30 Dimmable	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Food Bank	LED R30 Dimmable	Incremental Cost	-	-	-	-	-	-
Food Bank	Low Flow Showerhead 1.5 gpm - Elec DHW	Participation	-	3,156	3,156	3,156	3,156	3,156
Food Bank	Low Flow Showerhead 1.5 gpm - Elec DHW	Total Incentive Budget	-	-	-	-	-	-
Food Bank	Low Flow Showerhead 1.5 gpm - Elec DHW	Total Gross Incremental Savings (kwh)	-	649,158	649,158	649,158	649,158	649,158
Food Bank	Low Flow Showerhead 1.5 gpm - Elec DHW	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Food Bank	Low Flow Showerhead 1.5 gpm - Elec DHW	Incremental Cost	-	-	-	-	-	-
Bring Your Own Thermostat	BYOT (Bring Your Own Device)	Participation	300	300	300	300	300	300
Bring Your Own Thermostat	BYOT (Bring Your Own Device)	Total Incentive Budget	-	-	-	-	-	-
Bring Your Own Thermostat	BYOT (Bring Your Own Device)	Total Gross Incremental Savings (kwh)	-	-	-	-	-	-
Bring Your Own Thermostat	BYOT (Bring Your Own Device)	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Bring Your Own Thermostat	BYOT (Bring Your Own Device)	Incremental Cost	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Smart Cycle	Smart Cycle (DLC Change Out)	Participation	1,000	1,000	1,000	1,000	1,000	1,000
Smart Cycle	Smart Cycle (DLC Change Out)	Total Incentive Budget	$96,000	$116,000	$136,000	$156,000	$176,000	$196,000
Smart Cycle	Smart Cycle (DLC Change Out)	Total Gross Incremental Savings (kwh)	-	198,000	198,000	198,000	198,000	198,000
Smart Cycle	Smart Cycle (DLC Change Out)	NTG	-	1.00	1.00	1.00	1.00	1.00
Smart Cycle	Smart Cycle (DLC Change Out)	Incremental Cost	-	-	-	-	-	-
C&I Prescriptive	Smart Thermostats	Participation	72	91	118	148	177	205
C&I Prescriptive	Smart Thermostats	Total Incentive Budget	$1,080	$1,365	$1,770	$2,220	$2,655	$3,075
C&I Prescriptive	Smart Thermostats	Total Gross Incremental Savings (kwh)	34,137	43,298	56,214	70,552	84,379	97,979
C&I Prescriptive	Smart Thermostats	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Smart Thermostats	Incremental Cost	$39.16	$39.16	$39.16	$39.16	$39.16	$39.16
C&I Prescriptive	Refrigerator Strip Curtains	Participation	18	42	77	122	178	247
C&I Prescriptive	Refrigerator Strip Curtains	Total Incentive Budget	$54	$126	$231	$366	$534	$741
C&I Prescriptive	Refrigerator Strip Curtains	Total Gross Incremental Savings (kwh)	4,198	9,796	17,958	28,454	41,514	57,607

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Refrigerator Strip Curtains	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Refrigerator Strip Curtains	Incremental Cost	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50
C&I Prescriptive	Agriculture - Livestock Waterer	Participation	1	1	1	1	1	1
C&I Prescriptive	Agriculture - Livestock Waterer	Total Incentive Budget	$33	$33	$33	$33	$33	$33
C&I Prescriptive	Agriculture - Livestock Waterer	Total Gross Incremental Savings (kwh)	266	266	266	266	266	266
C&I Prescriptive	Agriculture - Livestock Waterer	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Agriculture - Livestock Waterer	Incremental Cost	$787.50	$787.50	$787.50	$787.50	$787.50	$787.50
C&I Prescriptive	Agriculture - Poultry Farm Led Lighting	Participation	1	1	1	1	1	1
C&I Prescriptive	Agriculture - Poultry Farm Led Lighting	Total Incentive Budget	$0	$0	$0	$0	$0	$0
C&I Prescriptive	Agriculture - Poultry Farm Led Lighting	Total Gross Incremental Savings (kwh)	292	292	292	292	292	292
C&I Prescriptive	Agriculture - Poultry Farm Led Lighting	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Agriculture - Poultry Farm Led Lighting	Incremental Cost	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00
C&I Prescriptive	Agriculture - VSD Milk Pump	Participation	1	1	1	1	1	1

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Agriculture - VSD Milk Pump	Total Incentive Budget	$13	$13	$13	$13	$13	$13
C&I Prescriptive	Agriculture - VSD Milk Pump	Total Gross Incremental Savings (kwh)	34	34	34	34	34	34
C&I Prescriptive	Agriculture - VSD Milk Pump	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Agriculture - VSD Milk Pump	Incremental Cost	$4,000.00	$4,000.00	$4,000.00	$4,000.00	$4,000.00	$4,000.00
C&I Prescriptive	Agriculture - High Volume Low Speed Fans	Participation	1	1	1	1	1	1
C&I Prescriptive	Agriculture - High Volume Low Speed Fans	Total Incentive Budget	$250	$250	$250	$250	$250	$250
C&I Prescriptive	Agriculture - High Volume Low Speed Fans	Total Gross Incremental Savings (kwh)	8,543	8,543	8,543	8,543	8,543	8,543
C&I Prescriptive	Agriculture - High Volume Low Speed Fans	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Agriculture - High Volume Low Speed Fans	Incremental Cost	$4,180.00	$4,180.00	$4,180.00	$4,180.00	$4,180.00	$4,180.00
C&I Prescriptive	Agriculture - High Speed Fans	Participation	1	1	1	1	1	1
C&I Prescriptive	Agriculture - High Speed Fans	Total Incentive Budget	$250	$250	$250	$250	$250	$250
C&I Prescriptive	Agriculture - High Speed Fans	Total Gross Incremental Savings (kwh)	625	625	625	625	625	625
C&I Prescriptive	Agriculture - High Speed Fans	NTG	0.80	0.80	0.80	0.80	0.80	0.80

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Agriculture - High Speed Fans	Incremental Cost	$150.00	$150.00	$150.00	$150.00	$150.00	$150.00
C&I Prescriptive	Agriculture - Dairy Plate Cooler	Participation	1	1	1	1	1	1
C&I Prescriptive	Agriculture - Dairy Plate Cooler	Total Incentive Budget	$17	$17	$17	$17	$17	$17
C&I Prescriptive	Agriculture - Dairy Plate Cooler	Total Gross Incremental Savings (kwh)	76	76	76	76	76	76
C&I Prescriptive	Agriculture - Dairy Plate Cooler	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Agriculture - Dairy Plate Cooler	Incremental Cost	$16.67	$16.67	$16.67	$16.67	$16.67	$16.67
C&I Prescriptive	Agriculture - Heat Mat	Participation	1	1	1	1	1	1
C&I Prescriptive	Agriculture - Heat Mat	Total Incentive Budget	$22	$22	$22	$22	$22	$22
C&I Prescriptive	Agriculture - Heat Mat	Total Gross Incremental Savings (kwh)	657	657	657	657	657	657
C&I Prescriptive	Agriculture - Heat Mat	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Agriculture - Heat Mat	Incremental Cost	$225.00	$225.00	$225.00	$225.00	$225.00	$225.00
C&I Prescriptive	Agriculture - Automatic Milker Take Off	Participation	1	1	1	1	1	1
C&I Prescriptive	Agriculture - Automatic Milker Take Off	Total Incentive Budget	$2	$2	$2	$2	$2	$2

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Agriculture - Automatic Milker Take Off	Total Gross Incremental Savings (kwh)	556	556	556	556	556	556
C&I Prescriptive	Agriculture - Automatic Milker Take Off	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Agriculture - Automatic Milker Take Off	Incremental Cost	$1.67	$1.67	$1.67	$1.67	$1.67	$1.67
C&I Prescriptive	Agriculture - Heat Reclaimer	Participation	1	1	1	1	1	1
C&I Prescriptive	Agriculture - Heat Reclaimer	Total Incentive Budget	$2	$2	$2	$2	$2	$2
C&I Prescriptive	Agriculture - Heat Reclaimer	Total Gross Incremental Savings (kwh)	153	153	153	153	153	153
C&I Prescriptive	Agriculture - Heat Reclaimer	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Agriculture - Heat Reclaimer	Incremental Cost	$1.67	$1.67	$1.67	$1.67	$1.67	$1.67
C&I Prescriptive	Air Compressor	Participation	1	1	1	1	1	1
C&I Prescriptive	Air Compressor	Total Incentive Budget	$75	$75	$75	$75	$75	$75
C&I Prescriptive	Air Compressor	Total Gross Incremental Savings (kwh)	34,068	34,068	34,068	34,068	34,068	34,068
C&I Prescriptive	Air Compressor	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Air Compressor	Incremental Cost	$250.00	$250.00	$250.00	$250.00	$250.00	$250.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Air Conditioners	Participation	125	125	125	125	125	125
C&I Prescriptive	Air Conditioners	Total Incentive Budget	$34,278	$34,278	$34,278	$34,278	$34,278	$34,278
C&I Prescriptive	Air Conditioners	Total Gross Incremental Savings (kwh)	899,750	899,750	899,750	899,750	899,750	899,750
C&I Prescriptive	Air Conditioners	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Air Conditioners	Incremental Cost	$100.00	$100.00	$100.00	$100.00	$100.00	$100.00
C&I Prescriptive	Anti-Sweat Heater Control	Participation	290	290	290	290	290	290
C&I Prescriptive	Anti-Sweat Heater Control	Total Incentive Budget	$19,366	$19,366	$19,366	$19,366	$19,366	$19,366
C&I Prescriptive	Anti-Sweat Heater Control	Total Gross Incremental Savings (kwh)	263,610	263,610	263,610	263,610	263,610	263,610
C&I Prescriptive	Anti-Sweat Heater Control	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Anti-Sweat Heater Control	Incremental Cost	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00
C&I Prescriptive	Barrel Wrap Insulation	Participation	1	1	1	1	1	1
C&I Prescriptive	Barrel Wrap Insulation	Total Incentive Budget	$30	$30	$30	$30	$30	$30
C&I Prescriptive	Barrel Wrap Insulation	Total Gross Incremental Savings (kwh)	360	360	360	360	360	360

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Barrel Wrap Insulation	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Barrel Wrap Insulation	Incremental Cost	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00
C&I Prescriptive	Chilled Water Reset Control	Participation	3	3	3	3	3	3
C&I Prescriptive	Chilled Water Reset Control	Total Incentive Budget	$716	$716	$716	$716	$716	$716
C&I Prescriptive	Chilled Water Reset Control	Total Gross Incremental Savings (kwh)	49,608	49,608	49,608	49,608	49,608	49,608
C&I Prescriptive	Chilled Water Reset Control	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Chilled Water Reset Control	Incremental Cost	$681.34	$681.34	$681.34	$681.34	$681.34	$681.34
C&I Prescriptive	Chiller	Participation	72	72	72	72	72	72
C&I Prescriptive	Chiller	Total Incentive Budget	$367,200	$367,200	$367,200	$367,200	$367,200	$367,200
C&I Prescriptive	Chiller	Total Gross Incremental Savings (kwh)	844,776	844,776	844,776	844,776	844,776	844,776
C&I Prescriptive	Chiller	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Chiller	Incremental Cost	$79.46	$79.46	$79.46	$79.46	$79.46	$79.46
C&I Prescriptive	Chiller Tune-Up	Participation	3	3	3	3	3	3

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Chiller Tune-Up	Total Incentive Budget	$3,816	$3,816	$3,816	$3,816	$3,816	$3,816
C&I Prescriptive	Chiller Tune-Up	Total Gross Incremental Savings (kwh)	29,082	29,082	29,082	29,082	29,082	29,082
C&I Prescriptive	Chiller Tune-Up	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Chiller Tune-Up	Incremental Cost	$1,272.00	$1,272.00	$1,272.00	$1,272.00	$1,272.00	$1,272.00
C&I Prescriptive	Clothes Washer	Participation	3	3	3	3	3	3
C&I Prescriptive	Clothes Washer	Total Incentive Budget	$180	$180	$180	$180	$180	$180
C&I Prescriptive	Clothes Washer	Total Gross Incremental Savings (kwh)	1,626	1,626	1,626	1,626	1,626	1,626
C&I Prescriptive	Clothes Washer	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Clothes Washer	Incremental Cost	$475.33	$475.33	$475.33	$475.33	$475.33	$475.33
C&I Prescriptive	Combination Oven	Participation	3	3	3	3	3	3
C&I Prescriptive	Combination Oven	Total Incentive Budget	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
C&I Prescriptive	Combination Oven	Total Gross Incremental Savings (kwh)	55,296	55,296	55,296	55,296	55,296	55,296
C&I Prescriptive	Combination Oven	NTG	0.80	0.80	0.80	0.80	0.80	0.80

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Combination Oven	Incremental Cost	$2,125.00	$2,125.00	$2,125.00	$2,125.00	$2,125.00	$2,125.00
C&I Prescriptive	Compressed Air Nozzles	Participation	2	2	2	2	2	2
C&I Prescriptive	Compressed Air Nozzles	Total Incentive Budget	$13	$13	$13	$13	$13	$13
C&I Prescriptive	Compressed Air Nozzles	Total Gross Incremental Savings (kwh)	1,776	1,776	1,776	1,776	1,776	1,776
C&I Prescriptive	Compressed Air Nozzles	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Compressed Air Nozzles	Incremental Cost	$14.00	$14.00	$14.00	$14.00	$14.00	$14.00
C&I Prescriptive	Convection Oven	Participation	3	3	3	3	3	3
C&I Prescriptive	Convection Oven	Total Incentive Budget	$1,050	$1,050	$1,050	$1,050	$1,050	$1,050
C&I Prescriptive	Convection Oven	Total Gross Incremental Savings (kwh)	9,705	9,705	9,705	9,705	9,705	9,705
C&I Prescriptive	Convection Oven	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Convection Oven	Incremental Cost	$1,113.00	$1,113.00	$1,113.00	$1,113.00	$1,113.00	$1,113.00
C&I Prescriptive	Commercial Dishwasher	Participation	2	2	2	2	2	2
C&I Prescriptive	Commercial Dishwasher	Total Incentive Budget	$2,325	$2,325	$2,325	$2,325	$2,325	$2,325

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Commercial Dishwasher	Total Gross Incremental Savings (kwh)	25,714	25,714	25,714	25,714	25,714	25,714
C&I Prescriptive	Commercial Dishwasher	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Commercial Dishwasher	Incremental Cost	$616.25	$616.25	$616.25	$616.25	$616.25	$616.25
C&I Prescriptive	Exterior LED	Participation	1,342	1,342	1,342	1,342	1,342	1,342
C&I Prescriptive	Exterior LED	Total Incentive Budget	$144,225	$144,225	$144,225	$144,225	$144,225	$144,225
C&I Prescriptive	Exterior LED	Total Gross Incremental Savings (kwh)	1,356,762	1,356,762	1,356,762	1,356,762	1,356,762	1,356,762
C&I Prescriptive	Exterior LED	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Exterior LED	Incremental Cost	$270.24	$270.24	$270.24	$270.24	$270.24	$270.24
C&I Prescriptive	Freezer	Participation	79	86	93	99	104	109
C&I Prescriptive	Freezer	Total Incentive Budget	$15,800	$17,200	$18,600	$19,800	$20,800	$21,800
C&I Prescriptive	Freezer	Total Gross Incremental Savings (kwh)	240,950	262,300	283,650	301,950	317,200	332,450
C&I Prescriptive	Freezer	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Freezer	Incremental Cost	$220.25	$220.25	$220.25	$220.25	$220.25	$220.25

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Fryer	Participation	1	1	1	1	1	1
C&I Prescriptive	Fryer	Total Incentive Budget	$80	$80	$80	$80	$80	$80
C&I Prescriptive	Fryer	Total Gross Incremental Savings (kwh)	1,526	1,526	1,526	1,526	1,526	1,526
C&I Prescriptive	Fryer	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Fryer	Incremental Cost	$500.00	$500.00	$500.00	$500.00	$500.00	$500.00
C&I Prescriptive	Griddle	Participation	3	3	3	3	3	3
C&I Prescriptive	Griddle	Total Incentive Budget	$1,650	$1,650	$1,650	$1,650	$1,650	$1,650
C&I Prescriptive	Griddle	Total Gross Incremental Savings (kwh)	30,099	30,099	30,099	30,099	30,099	30,099
C&I Prescriptive	Griddle	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Griddle	Incremental Cost	$2,090.00	$2,090.00	$2,090.00	$2,090.00	$2,090.00	$2,090.00
C&I Prescriptive	Heat Pump Water Heater	Participation	1	1	1	1	1	1
C&I Prescriptive	Heat Pump Water Heater	Total Incentive Budget	$500	$500	$500	$500	$500	$500
C&I Prescriptive	Heat Pump Water Heater	Total Gross Incremental Savings (kwh)	1,534	1,534	1,534	1,534	1,534	1,534

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Heat Pump Water Heater	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Heat Pump Water Heater	Incremental Cost	$433.00	$433.00	$433.00	$433.00	$433.00	$433.00
C&I Prescriptive	Heat Pump	Participation	135	135	135	135	135	135
C&I Prescriptive	Heat Pump	Total Incentive Budget	$26,758	$26,758	$26,758	$26,758	$26,758	$26,758
C&I Prescriptive	Heat Pump	Total Gross Incremental Savings (kwh)	166,320	166,320	166,320	166,320	166,320	166,320
C&I Prescriptive	Heat Pump	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Heat Pump	Incremental Cost	$143.64	$143.64	$143.64	$143.64	$143.64	$143.64
C&I Prescriptive	Hot Food Holding Cabinet	Participation	2	2	2	2	2	2
C&I Prescriptive	Hot Food Holding Cabinet	Total Incentive Budget	$457	$457	$457	$457	$457	$457
C&I Prescriptive	Hot Food Holding Cabinet	Total Gross Incremental Savings (kwh)	6,584	6,584	6,584	6,584	6,584	6,584
C&I Prescriptive	Hot Food Holding Cabinet	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Hot Food Holding Cabinet	Incremental Cost	$1,110.00	$1,110.00	$1,110.00	$1,110.00	$1,110.00	$1,110.00
C&I Prescriptive	Ice Machine	Participation	3	3	3	3	3	3

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Ice Machine	Total Incentive Budget	$510	$510	$510	$510	$510	$510
C&I Prescriptive	Ice Machine	Total Gross Incremental Savings (kwh)	2,670	2,670	2,670	2,670	2,670	2,670
C&I Prescriptive	Ice Machine	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Ice Machine	Incremental Cost	$1,333.60	$1,333.60	$1,333.60	$1,333.60	$1,333.60	$1,333.60
C&I Prescriptive	Interior LED - High-Bay (including LED troffer and LED linear tubes)	Participation	1,293	1,475	1,597	1,643	1,627	1,536
C&I Prescriptive	Interior LED - High-Bay (including LED troffer and LED linear tubes)	Total Incentive Budget	$87,717	$93,385	$93,877	$89,141	$80,905	$69,425
C&I Prescriptive	Interior LED - High-Bay (including LED troffer and LED linear tubes)	Total Gross Incremental Savings (kwh)	1,466,262	1,672,650	1,810,998	1,863,162	1,845,018	1,741,824
C&I Prescriptive	Interior LED - High-Bay (including LED troffer and LED linear tubes)	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Interior LED - High-Bay (including LED troffer and LED linear tubes)	Incremental Cost	$113.54	$113.54	$113.54	$113.54	$113.54	$113.54
C&I Prescriptive	Interior LED - Low-Bay (including LED troffer and LED linear tubes)	Participation	37,209	42,854	47,026	49,043	49,258	47,221

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Interior LED - Low-Bay (including LED troffer and LED linear tubes)	Total Incentive Budget	$530,228	$569,907	$580,659	$558,915	$514,512	$448,319
C&I Prescriptive	Interior LED - Low-Bay (including LED troffer and LED linear tubes)	Total Gross Incremental Savings (kwh)	7,367,382	8,485,092	9,311,148	9,710,514	9,753,084	9,349,758
C&I Prescriptive	Interior LED - Low-Bay (including LED troffer and LED linear tubes)	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Interior LED - Low-Bay (including LED troffer and LED linear tubes)	Incremental Cost	$78.04	$78.04	$78.04	$78.04	$78.04	$78.04
C&I Prescriptive	Lighting Control	Participation	906	906	906	906	906	906
C&I Prescriptive	Lighting Control	Total Incentive Budget	$16,317	$16,317	$16,317	$16,317	$16,317	$16,317
C&I Prescriptive	Lighting Control	Total Gross Incremental Savings (kwh)	557,190	557,190	557,190	557,190	557,190	557,190
C&I Prescriptive	Lighting Control	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Lighting Control	Incremental Cost	$98.75	$98.75	$98.75	$98.75	$98.75	$98.75
C&I Prescriptive	Lighting Power Density Reduction	Participation	10	10	10	10	10	10
C&I Prescriptive	Lighting Power Density Reduction	Total Incentive Budget	$49,958	$49,958	$49,958	$49,958	$49,958	$49,958
C&I Prescriptive	Lighting Power Density Reduction	Total Gross Incremental Savings (kwh)	317,320	317,320	317,320	317,320	317,320	317,320

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Lighting Power Density Reduction	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Lighting Power Density Reduction	Incremental Cost	$4,995.83	$4,995.83	$4,995.83	$4,995.83	$4,995.83	$4,995.83
C&I Prescriptive	Low Flow Pre-Rinse Sprayer	Participation	1	1	1	1	1	1
C&I Prescriptive	Low Flow Pre-Rinse Sprayer	Total Incentive Budget	$60	$60	$60	$60	$60	$60
C&I Prescriptive	Low Flow Pre-Rinse Sprayer	Total Gross Incremental Savings (kwh)	7,130	7,130	7,130	7,130	7,130	7,130
C&I Prescriptive	Low Flow Pre-Rinse Sprayer	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Low Flow Pre-Rinse Sprayer	Incremental Cost	$92.90	$92.90	$92.90	$92.90	$92.90	$92.90
C&I Prescriptive	Pellet Dryer Duct Insulation	Participation	1	1	1	1	1	1
C&I Prescriptive	Pellet Dryer Duct Insulation	Total Incentive Budget	$30	$30	$30	$30	$30	$30
C&I Prescriptive	Pellet Dryer Duct Insulation	Total Gross Incremental Savings (kwh)	198	198	198	198	198	198
C&I Prescriptive	Pellet Dryer Duct Insulation	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Pellet Dryer Duct Insulation	Incremental Cost	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00
C&I Prescriptive	Programmable Thermostat	Participation	1	1	1	1	1	1

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Programmable Thermostat	Total Incentive Budget	$50	$50	$50	$50	$50	$50
C&I Prescriptive	Programmable Thermostat	Total Gross Incremental Savings (kwh)	649	649	649	649	649	649
C&I Prescriptive	Programmable Thermostat	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Programmable Thermostat	Incremental Cost	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00
C&I Prescriptive	Refrigerated Case Cover	Participation	1	1	1	1	1	1
C&I Prescriptive	Refrigerated Case Cover	Total Incentive Budget	$10	$10	$10	$10	$10	$10
C&I Prescriptive	Refrigerated Case Cover	Total Gross Incremental Savings (kwh)	158	158	158	158	158	158
C&I Prescriptive	Refrigerated Case Cover	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Refrigerated Case Cover	Incremental Cost	$42.00	$42.00	$42.00	$42.00	$42.00	$42.00
C&I Prescriptive	Refrigerated LED	Participation	84	111	140	172	204	233
C&I Prescriptive	Refrigerated LED	Total Incentive Budget	$2,446	$3,232	$4,077	$5,009	$5,940	$6,785
C&I Prescriptive	Refrigerated LED	Total Gross Incremental Savings (kwh)	25,536	33,744	42,560	52,288	62,016	70,832
C&I Prescriptive	Refrigerated LED	NTG	0.80	0.80	0.80	0.80	0.80	0.80

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Refrigerated LED	Incremental Cost	$35.89	$35.89	$35.89	$35.89	$35.89	$35.89
C&I Prescriptive	Refrigerator	Participation	7	7	7	7	7	7
C&I Prescriptive	Refrigerator	Total Incentive Budget	$419	$419	$419	$419	$419	$419
C&I Prescriptive	Refrigerator	Total Gross Incremental Savings (kwh)	4,284	4,284	4,284	4,284	4,284	4,284
C&I Prescriptive	Refrigerator	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Refrigerator	Incremental Cost	$180.00	$180.00	$180.00	$180.00	$180.00	$180.00
C&I Prescriptive	Steam Cooker	Participation	1	1	1	1	1	1
C&I Prescriptive	Steam Cooker	Total Incentive Budget	$200	$200	$200	$200	$200	$200
C&I Prescriptive	Steam Cooker	Total Gross Incremental Savings (kwh)	2,210	2,210	2,210	2,210	2,210	2,210
C&I Prescriptive	Steam Cooker	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Steam Cooker	Incremental Cost	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00
C&I Prescriptive	Vending Machine Control	Participation	3	3	3	3	3	3
C&I Prescriptive	Vending Machine Control	Total Incentive Budget	$125	$125	$125	$125	$125	$125

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Vending Machine Control	Total Gross Incremental Savings (kwh)	3,162	3,162	3,162	3,162	3,162	3,162
C&I Prescriptive	Vending Machine Control	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Vending Machine Control	Incremental Cost	$179.67	$179.67	$179.67	$179.67	$179.67	$179.67
C&I Prescriptive	VFD-Fan	Participation	2	2	3	4	5	6
C&I Prescriptive	VFD-Fan	Total Incentive Budget	$1,725	$1,725	$2,588	$3,450	$4,313	$5,175
C&I Prescriptive	VFD-Fan	Total Gross Incremental Savings (kwh)	48,644	48,644	72,966	97,288	121,610	145,932
C&I Prescriptive	VFD-Fan	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	VFD-Fan	Incremental Cost	$3,638.33	$3,638.33	$3,638.33	$3,638.33	$3,638.33	$3,638.33
C&I Prescriptive	VFD-Pump	Participation	3	4	5	6	7	9
C&I Prescriptive	VFD-Pump	Total Incentive Budget	$2,475	$3,300	$4,125	$4,950	$5,775	$7,425
C&I Prescriptive	VFD-Pump	Total Gross Incremental Savings (kwh)	164,604	219,472	274,340	329,208	384,076	493,812
C&I Prescriptive	VFD-Pump	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	VFD-Pump	Incremental Cost	$3,059.00	$3,059.00	$3,059.00	$3,059.00	$3,059.00	$3,059.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Wifi-Enabled Thermostat	Participation	360	360	360	360	360	360
C&I Prescriptive	Wifi-Enabled Thermostat	Total Incentive Budget	$36,000	$36,000	$36,000	$36,000	$36,000	$36,000
C&I Prescriptive	Wifi-Enabled Thermostat	Total Gross Incremental Savings (kwh)	229,320	229,320	229,320	229,320	229,320	229,320
C&I Prescriptive	Wifi-Enabled Thermostat	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Wifi-Enabled Thermostat	Incremental Cost	$250.00	$250.00	$250.00	$250.00	$250.00	$250.00
C&I Prescriptive	Window Air Conditioner & PTAC	Participation	10	13	16	19	22	26
C&I Prescriptive	Window Air Conditioner & PTAC	Total Incentive Budget	$469	$609	$750	$890	$1,031	$1,218
C&I Prescriptive	Window Air Conditioner & PTAC	Total Gross Incremental Savings (kwh)	2,070	2,691	3,312	3,933	4,554	5,382
C&I Prescriptive	Window Air Conditioner & PTAC	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Window Air Conditioner & PTAC	Incremental Cost	$196.00	$196.00	$196.00	$196.00	$196.00	$196.00
C&I Prescriptive	High Efficiency Hand Dryer	Participation	47	63	88	116	144	179
C&I Prescriptive	High Efficiency Hand Dryer	Total Incentive Budget	$8,460	$11,340	$15,840	$20,880	$25,920	$32,220
C&I Prescriptive	High Efficiency Hand Dryer	Total Gross Incremental Savings (kwh)	36,132	48,432	67,651	89,176	110,701	137,608

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	High Efficiency Hand Dryer	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	High Efficiency Hand Dryer	Incremental Cost	$450.00	$450.00	$450.00	$450.00	$450.00	$450.00
C&I Prescriptive	Efficient low-temp compressor	Participation	-	1	2	3	4	6
C&I Prescriptive	Efficient low-temp compressor	Total Incentive Budget	-	$221	$442	$662	$883	$1,325
C&I Prescriptive	Efficient low-temp compressor	Total Gross Incremental Savings (kwh)	-	678	1,356	2,033	2,711	4,067
C&I Prescriptive	Efficient low-temp compressor	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Efficient low-temp compressor	Incremental Cost	$552.00	$552.00	$552.00	$552.00	$552.00	$552.00
C&I Prescriptive	Commercial Refrigeration Tune-Up	Participation	319	412	511	613	714	810
C&I Prescriptive	Commercial Refrigeration Tune-Up	Total Incentive Budget	$9,570	$12,360	$15,330	$18,390	$21,420	$24,300
C&I Prescriptive	Commercial Refrigeration Tune-Up	Total Gross Incremental Savings (kwh)	186,731	241,170	299,121	358,828	417,950	474,145
C&I Prescriptive	Commercial Refrigeration Tune-Up	NTG	0.80	0.80	0.80	0.80	0.80	0.80
C&I Prescriptive	Commercial Refrigeration Tune-Up	Incremental Cost	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00
C&I Prescriptive	Duct sealing	Participation	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Prescriptive	Duct sealing	Total Incentive Budget	-	-	-	-	-	-
C&I Prescriptive	Duct sealing	Total Gross Incremental Savings (kwh)	-	-	-	-	-	-
C&I Prescriptive	Duct sealing	NTG	-	-	-	-	-	-
C&I Prescriptive	Duct sealing	Incremental Cost	-	-	-	-	-	-
C&I Custom	C&I Custom	Participation	35	35	35	35	35	35
C&I Custom	C&I Custom	Total Incentive Budget	$395,191	$395,191	$395,191	$395,191	$395,191	$395,191
C&I Custom	C&I Custom	Total Gross Incremental Savings (kwh)	4,453,104	4,453,104	4,453,104	4,453,104	4,453,104	4,453,104
C&I Custom	C&I Custom	NTG	1.00	1.00	1.00	1.00	1.00	1.00
C&I Custom	C&I Custom	Incremental Cost	$26,185.00	$26,185.00	$26,185.00	$26,185.00	$26,185.00	$26,185.00
C&I Custom	C&I Custom Pilot	Participation	161	161	161	161	161	161
C&I Custom	C&I Custom Pilot	Total Incentive Budget	$96,347	$96,347	$96,347	$96,347	$96,347	$96,347
C&I Custom	C&I Custom Pilot	Total Gross Incremental Savings (kwh)	1,654,130	1,654,130	1,654,130	1,654,130	1,654,130	1,654,130
C&I Custom	C&I Custom Pilot	NTG	1.00	1.00	1.00	1.00	1.00	1.00

Program	Measure	Description	2020	2021	2022	2023	2024	2025
C&I Custom	C&I Custom Pilot	Incremental Cost	-	-	-	-	-	-
Small Business	Smart Thermostats	Participation	18	22	29	37	44	51
Small Business	Smart Thermostats	Total Incentive Budget	$270	$330	$435	$555	$660	$765
Small Business	Smart Thermostats	Total Gross Incremental Savings (kwh)	13,257	16,203	21,359	27,251	32,406	37,562
Small Business	Smart Thermostats	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Smart Thermostats	Incremental Cost	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00
Small Business	Anti-Sweat Heater Control	Participation	6	6	6	6	6	6
Small Business	Anti-Sweat Heater Control	Total Incentive Budget	$1,020	$1,020	$1,020	$1,020	$1,020	$1,020
Small Business	Anti-Sweat Heater Control	Total Gross Incremental Savings (kwh)	5,454	5,454	5,454	5,454	5,454	5,454
Small Business	Anti-Sweat Heater Control	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Anti-Sweat Heater Control	Incremental Cost	$170.00	$170.00	$170.00	$170.00	$170.00	$170.00
Small Business	EC Motors	Participation	-	-	-	-	-	-
Small Business	EC Motors	Total Incentive Budget	-	-	-	-	-	-

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Small Business	EC Motors	Total Gross Incremental Savings (kwh)	-	-	-	-	-	-
Small Business	EC Motors	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	EC Motors	Incremental Cost	$66.76	$66.76	$66.76	$66.76	$66.76	$66.76
Small Business	Exterior LED	Participation	4,263	4,263	4,263	4,263	4,263	4,263
Small Business	Exterior LED	Total Incentive Budget	$380,302	$380,302	$380,302	$380,302	$380,302	$380,302
Small Business	Exterior LED	Total Gross Incremental Savings (kwh)	1,922,613	1,922,613	1,922,613	1,922,613	1,922,613	1,922,613
Small Business	Exterior LED	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Exterior LED	Incremental Cost	$89.21	$89.21	$89.21	$89.21	$89.21	$89.21
Small Business	Faucet Aerator	Participation	3	3	3	3	3	3
Small Business	Faucet Aerator	Total Incentive Budget	$14	$14	$14	$14	$14	$14
Small Business	Faucet Aerator	Total Gross Incremental Savings (kwh)	1,512	1,512	1,512	1,512	1,512	1,512
Small Business	Faucet Aerator	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Faucet Aerator	Incremental Cost	$4.72	$4.72	$4.72	$4.72	$4.72	$4.72

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Small Business	Interior LED	Participation	3,948	3,948	3,948	3,948	3,948	3,948
Small Business	Interior LED	Total Incentive Budget	$132,653	$123,798	$114,944	$106,089	$97,235	$88,380
Small Business	Interior LED	Total Gross Incremental Savings (kwh)	852,768	852,768	852,768	852,768	852,768	852,768
Small Business	Interior LED	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Interior LED	Incremental Cost	$33.60	$33.60	$33.60	$33.60	$33.60	$33.60
Small Business	Lighting Control	Participation	9	9	9	9	9	9
Small Business	Lighting Control	Total Incentive Budget	$400	$400	$400	$400	$400	$400
Small Business	Lighting Control	Total Gross Incremental Savings (kwh)	2,115	2,115	2,115	2,115	2,115	2,115
Small Business	Lighting Control	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Lighting Control	Incremental Cost	$44.44	$44.44	$44.44	$44.44	$44.44	$44.44
Small Business	Low Flow Pre-Rinse Sprayer	Participation	3	3	3	3	3	3
Small Business	Low Flow Pre-Rinse Sprayer	Total Incentive Budget	$180	$180	$180	$180	$180	$180
Small Business	Low Flow Pre-Rinse Sprayer	Total Gross Incremental Savings (kwh)	21,390	21,390	21,390	21,390	21,390	21,390

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Small Business	Low Flow Pre-Rinse Sprayer	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Low Flow Pre-Rinse Sprayer	Incremental Cost	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00
Small Business	Programmable Thermostat	Participation	70	71	71	67	67	67
Small Business	Programmable Thermostat	Total Incentive Budget	$14,047	$14,248	$14,248	$13,445	$13,445	$13,445
Small Business	Programmable Thermostat	Total Gross Incremental Savings (kwh)	51,590	52,327	52,327	49,379	49,379	49,379
Small Business	Programmable Thermostat	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Programmable Thermostat	Incremental Cost	$200.67	$200.67	$200.67	$200.67	$200.67	$200.67
Small Business	Programmable Thermostat (Gas Heat, Electric Cooling)	Participation	27	27	27	27	27	27
Small Business	Programmable Thermostat (Gas Heat, Electric Cooling)	Total Incentive Budget	$4,424	$4,424	$4,424	$4,424	$4,424	$4,424
Small Business	Programmable Thermostat (Gas Heat, Electric Cooling)	Total Gross Incremental Savings (kwh)	19,899	19,899	19,899	19,899	19,899	19,899
Small Business	Programmable Thermostat (Gas Heat, Electric Cooling)	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Programmable Thermostat (Gas	Incremental Cost	$163.84	$163.84	$163.84	$163.84	$163.84	$163.84

Program	Measure	Description	2020	2021	2022	2023	2024	2025
	Heat, Electric Cooling)							
Small Business	Refrigerated Case Cover	Participation	30	30	30	30	30	30
Small Business	Refrigerated Case Cover	Total Incentive Budget	$285	$285	$285	$285	$285	$285
Small Business	Refrigerated Case Cover	Total Gross Incremental Savings (kwh)	1,590	1,590	1,590	1,590	1,590	1,590
Small Business	Refrigerated Case Cover	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Refrigerated Case Cover	Incremental Cost	$9.50	$9.50	$9.50	$9.50	$9.50	$9.50
Small Business	Refigerated LED	Participation	12	12	12	12	12	12
Small Business	Refigerated LED	Total Incentive Budget	$570	$570	$570	$570	$570	$570
Small Business	Refigerated LED	Total Gross Incremental Savings (kwh)	4,908	4,908	4,908	4,908	4,908	4,908
Small Business	Refigerated LED	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Refigerated LED	Incremental Cost	$47.50	$47.50	$47.50	$47.50	$47.50	$47.50
Small Business	Vending Machine Control	Participation	6	6	6	6	6	6
Small Business	Vending Machine Control	Total Incentive Budget	$1,590	$1,590	$1,590	$1,590	$1,590	$1,590

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Small Business	Vending Machine Control	Total Gross Incremental Savings (kwh)	8,460	8,460	8,460	8,460	8,460	8,460
Small Business	Vending Machine Control	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Vending Machine Control	Incremental Cost	$265.00	$265.00	$265.00	$265.00	$265.00	$265.00
Small Business	Wifi-Enabled Thermostat	Participation	6	6	6	6	6	6
Small Business	Wifi-Enabled Thermostat	Total Incentive Budget	$2,250	$2,250	$2,250	$2,250	$2,250	$2,250
Small Business	Wifi-Enabled Thermostat	Total Gross Incremental Savings (kwh)	4,422	4,422	4,422	4,422	4,422	4,422
Small Business	Wifi-Enabled Thermostat	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Wifi-Enabled Thermostat	Incremental Cost	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Small Business	Wifi-Enabled Thermostat (Gas Heat, Electric Cooling)	Participation	36	36	36	36	36	36
Small Business	Wifi-Enabled Thermostat (Gas Heat, Electric Cooling)	Total Incentive Budget	$10,031	$10,031	$10,031	$10,031	$10,031	$10,031
Small Business	Wifi-Enabled Thermostat (Gas Heat, Electric Cooling)	Total Gross Incremental Savings (kwh)	26,532	26,532	26,532	26,532	26,532	26,532
Small Business	Wifi-Enabled Thermostat (Gas Heat, Electric Cooling)	NTG	0.91	0.91	0.91	0.91	0.91	0.91

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Small Business	Wifi-Enabled Thermostat (Gas Heat, Electric Cooling)	Incremental Cost	$278.65	$278.65	$278.65	$278.65	$278.65	$278.65
Small Business	Program the Programmable Thermostat	Participation	3	3	3	3	3	3
Small Business	Program the Programmable Thermostat	Total Incentive Budget	$75	$75	$75	$75	$75	$75
Small Business	Program the Programmable Thermostat	Total Gross Incremental Savings (kwh)	2,211	2,211	2,211	2,211	2,211	2,211
Small Business	Program the Programmable Thermostat	NTG	0.91	0.91	0.91	0.91	0.91	0.91
Small Business	Program the Programmable Thermostat	Incremental Cost	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00
Small Business	Program the Programmable Thermostat (Gas Heat, Electric Cooling)	Participation	3	3	3	3	3	3
Small Business	Program the Programmable Thermostat (Gas Heat, Electric Cooling)	Total Incentive Budget	$56	$56	$56	$56	$56	$56
Small Business	Program the Programmable Thermostat (Gas Heat, Electric Cooling)	Total Gross Incremental Savings (kwh)	2,211	2,211	2,211	2,211	2,211	2,211
Small Business	Program the Programmable Thermostat (Gas Heat, Electric Cooling)	NTG	0.91	0.91	0.91	0.91	0.91	0.91

Program	Measure	Description	2020	2021	2022	2023	2024	2025
Small Business	Program the Programmable Thermostat (Gas Heat, Electric Cooling)	Incremental Cost	$18.75	$18.75	$18.75	$18.75	$18.75	$18.75
Home Energy Management Systems	Home Energy Management System	Participation	-	1,000	1,000	1,000	1,000	1,000
Home Energy Management Systems	Home Energy Management System	Total Incentive Budget	-	-	-	-	-	-
Home Energy Management Systems	Home Energy Management System	Total Gross Incremental Savings (kwh)	-	515,000	515,000	515,000	515,000	515,000
Home Energy Management Systems	Home Energy Management System	NTG	-	1.00	1.00	1.00	1.00	1.00
Home Energy Management Systems	Home Energy Management System	Incremental Cost	-	-	-	-	-	-
Residential CVR	Residential CVR	Participation						
Residential CVR	Residential CVR	Total Incentive Budget	-	-	-	-	-	-
Residential CVR	Residential CVR	Total Gross Incremental Savings (kwh)	1,461,047	-	-	1,461,047	-	-
Residential CVR	Residential CVR	NTG	1.00	1.00	1.00	1.00	1.00	1.00
Residential CVR	Residential CVR	Incremental Cost	-	-	-	-	-	-