CAfS Cumbria Action for Sustainability
Towards Zero Carbon Cumbria

The potential for green jobs in Cumbria

Report by

CAfS
Green House Think Tank
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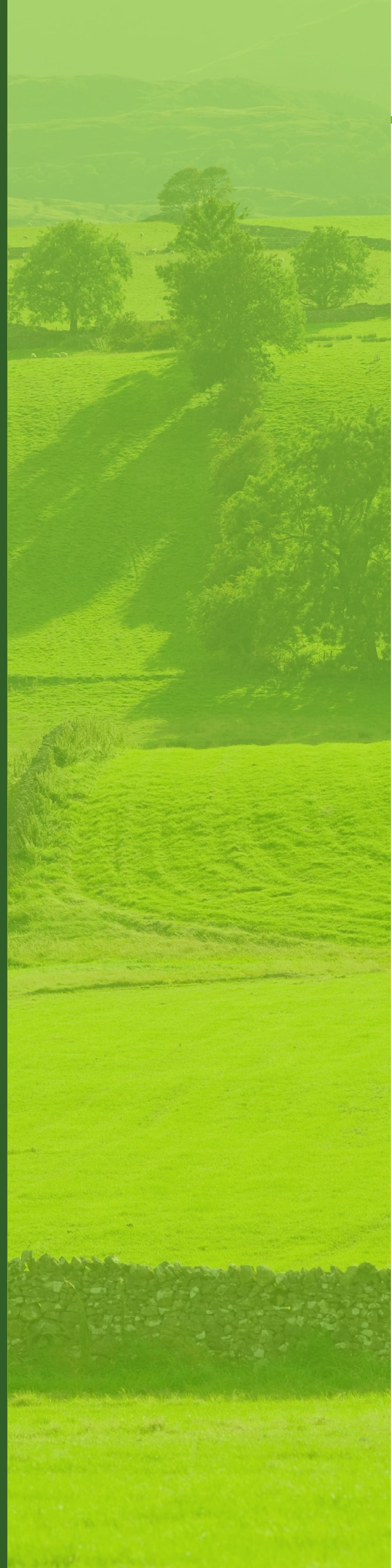
PROJECT PARTNERS:

- **Cumbria Action for Sustainability** is a charity with a vision for a net zero carbon Cumbria. It promotes and facilitates low-carbon living that is socially, environmentally and economically beneficial for Cumbrians. It delivers several projects per year: ranging from home energy efficiency to securing EV chargepoints for communities to developing low-carbon and sustainability action plans for whole villages and towns. CAfS also co-chairs the **Zero Carbon Cumbria Partnership (ZCCP)** with Cumbria County Council. Over 70 Cumbrian public, private and third sector organisations are members of the Partnership, which has recommended 2037 as the target year for net zero carbon emissions for the county.
- **Opal Research and Consulting Ltd** has more than 15 years' experience of research and consulting on environment and sustainability projects for government, business, NGOs and communities, as well as in writing and editing reports, papers and journals.
- **Green House Think Tank**, founded in 2011, aims to lead the development of green thinking in the UK, to challenge the ideas that have created the world we live in now, and offer positive alternatives. It aims to communicate clearly the complex and interconnected systemic changes that need to be made and is a member of the Rapid Transition Alliance.



Contents

1. Executive Summary

This report addresses two major issues that Cumbria faces: climate change, and the low incomes and high unemployment suffered by many rural communities.

The climate emergency has been recognised by all the local authorities in Cumbria and a target year for achieving net zero carbon of 2037 recommended by the countywide Zero Carbon Cumbria Partnership (ZCCP). Cumbria would need to reduce its carbon emissions by 18% each year to achieve this, which would require a rapid transition from our fossil fuel dependant high-carbon economy to a low or no carbon one. Doing so offers multiple benefits alongside lowered emissions: reduced air pollution, health benefits from active travel, cost savings for organisations and individuals, improved public transport, homes that are warm, dry and cheap to heat, and more efficient resource use. It also reduces the key, direct climate change risks to Cumbria of flooding, sea level rise and wildfires and offers the opportunity for good, 'green' jobs in areas of deprivation.

Our research focuses on greenhouse gas (GHG) emissions from two types of sources: fossil fuels used directly in Cumbria and GHGs from other sources such as landfill sites or industry (Scope 1); and the electricity used in Cumbria (Scope 2).

By 2037 Cumbria's Scope 1 and 2 emissions will have fallen by around 54% from 2000 levels, taking into account the ongoing decarbonisation of electricity through the grid, and population and economic growth. Over the same period, expenditure on energy will have grown from £1.35 billion in 2019 to £1.6 billion a year. This 'business as usual' scenario would result in annual emissions of around 3.8 MtCO2e which would need to be reduced.

Using available date, we initially focused on identifying the costs, savings and impact on emissions and jobs of adopting around 130 existing proven measures in:

households and other public/ commercial buildings
(including better insulation, improved heating, more efficient appliances, some small-scale renewables);

transport
(including more walking and cycling, enhanced public transport, electric and more fuel-efficient vehicles); and

industry
(including better lighting, improved process efficiencies and a wide range of other energy efficiency measures).

Cumbria could adopt a combination of cost-effective measures (which would more than pay for themselves through reduced energy expenditure), cost-neutral measures, and options which have technical potential but the costs of which are not presently covered by the direct benefits. Altogether, investments of £8.88 billion could put in place measures that would reduce Cumbria's annual energy bill by £854 million and the county's carbon emissions by 57% compared to the 'business as usual' scenario. Around 1,400 net jobs would be created over 20 years.

Cumbria would need to put in place additional innovative or 'stretch' options to fill the remaining 43% gap to net zero. These could include zero-carbon heavy goods vehicles, electrification of industrial heating and cooling, and of domestic and commercial heating and cooking and carbon sequestration from tree planting and peatland management. Ambitious investment in and implementation of all of these options could potentially secure net-zero carbon in Cumbria by 2033 and further jobs.

Additional green jobs can be created when renewable energy and waste and resource management are added into the mix of measures being adopted. For example, if the potential identified for renewable electricity generation from wind (offshore and onshore), hydro, PV, tidal and anaerobic digestion were fully realised, then over 5,700 jobs in the first 15-year 'transition' and 1,709 in the longer term would be created, of which 5,000 would be in west Cumbria. Furthermore, Cumbria could provide all its own electricity from onshore renewables, even with a doubling of consumption, and still provide a substantial contribution to the national demand. Similarly, for waste management, best practice authorities across Europe are already achieving household waste recycling rates approaching 90%. If reuse, repair and recycling equivalent to increasing recycling from 47% to 90% were introduced in Cumbria there could be a net gain of around 1000 long-term jobs.

Overall, we calculate that around 9,000 net jobs could be created during a 15-year 'transition period' and 3,800 jobs supported in the long term in transport, industry, the retrofit of buildings to improve energy efficiency, renewable heat, renewable electricity and waste.

Over half of these jobs are in renewable electricity and just under half of the 9,000 are in west Cumbria (Allerdale and Copeland). Many of them could be in servicing offshore renewables which could be from the ports at both Workington and Whitehaven could be used.

In conclusion, by reducing carbon emissions, we can achieve net zero by 2037 in Cumbria and also secure energy savings – for households, transport, business operating costs, waste disposal – as well as generating thousands of good jobs.

Urgent action and government support is needed to scope, plan, resource and implement the transition from a high-carbon economy and jobs to low carbon in a way that ensures funding is included for workforce capacity and skills development and supports more isolated and vulnerable communities. Local authorities and key businesses can lead by example.

2. Introduction

In the 18 months before Covid-19 there was an extraordinary upsurge in public and political awareness of climate change and the urgent need to tackle it nationally, regionally and locally. Many local authorities in Cumbria declared climate emergencies and set ambitious target dates for achieving zero-carbon emissions. The level of concern and momentum to tackle climate breakdown remains high despite the pandemic, as many Cumbrian communities have experienced firsthand the devastating impact of flood events, which are exacerbated by the rural isolation, fuel poverty, rural depopulation, limited employment opportunities and low incomes experienced here.

The science is clear[1] that in order to avoid exacerbating the climate crisis, we must rapidly shift away from extracting and using fossil fuels. We are currently highly dependent on fossil fuels in all aspects of our lives - from the way we move around, to how we heat our homes, to the products we consume. This means reducing fossil fuel use has significant implications for local people, communities and businesses, and, in particular, on jobs. However, decent jobs and tackling climate change are not mutually exclusive.

> **Coronavirus has put into perspective the scale of the effort needed to reduce carbon emissions.**

It has been estimated that, due to Covid lockdowns, global carbon emissions may have been around 8% lower in 2020 than 2019.[2] That is a significant figure but in order to have any hope of keeping the rise in global average temperature to 1.5 degrees, we need to reduce carbon emissions by a similar amount year on year for the next 10 years.

The coronavirus crisis has also shown us that fast and comprehensive changes, informed by science, are possible. Polls have shown a large majority of people agree that climate change is as big a threat as Covid 19[3] and also that the majority of people support a green economic recovery[4]. The #buildbackbetter movement has momentum. Influential businesses and institutions are calling for recovery plans that prioritise the environment.[5]

We have heard from the Local Government Association that there could be 700,000 new green jobs by 2030.[6] Greenpeace predicts that £100 billion investment could create 1.8 million new green jobs.[7] The low-carbon economy has been predicted to grow four times faster than the rest of the economy over this decade. The Institute for Public Policy Research has estimated 1.6 million green jobs could be created in the recovery from Covid[8]. The Prime Minister's *10 Point Plan for a Green Industrial Revolution* aims to[9] provide 250,000 jobs with £12 billion of investment. The 2020 Energy White Paper [10] predicts 40,000 new jobs in zero[11] emission vehicles. The UK Energy Research Centre has found that renewable electricity could have a considerable positive long-term employment effect. The Treasury's *Net Zero Review: interim report* published in December 2020[12] states that "reaching zero carbon is essential for long term prosperity".

We wanted to find out what these predictions and opportunities could mean for Cumbria. With the help of funding from Quadrature Climate Foundation (QCF) CAfS brought together two research teams to identify the potential in Cumbria for jobs that contribute to reduced carbon emissions across a range of sectors.

1 IPCC (2018) Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, IPCC
2 https://www.globalcarbonproject.org/news/TemporaryReductionInCO2EmissionsDuringCOVID-19.html
3 https://www.pewresearch.org/fact-tank/2020/10/16/many-globally-are-as-concerned-about-climate-change-as-about-the-spread-of-infectious-diseases/
4 https://www.cen.uk.com/polling
5 https://www.aldersgategroup.org.uk/asset/1697
6 https://www.ecuity.com/wp-content/uploads/2020/06/Local-green-jobs-accelerating-a-sustainable-economic-recovery_final.pdf
7 https://www.greenpeace.org.uk/news/new-greenpeace-report-green-recovery-could-create-a-1-8-million-jobs-revolution/#:~:text=A%20green%20economic%20recovery%20package,by%20Greenpeace%20UK%20has%20found.
8 https://www.ippr.org/research/publications/transforming-the-economy-after-covid19
9 https://www.gov.uk/government/news/pm-outlines-his-ten-point-plan-for-a-green-industrial-revolution-for-250000-jobs
10 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf
11 https://ukerc.ac.uk/news/green-industrial-revolution-and-the-long-term-effect-of-renewable-electricity-on-uk-employment/?utm_source=UKERC+subscribers+2018+post+GDPR&utm_campaign=ebf06f919b-EMAIL_CAMPAIGN_2020_05_20_11_04_COPY_01&utm_medium=email&utm_term=0_2886c4f7af-ebf06f919b-155380537
12 https://www.gov.uk/government/publications/net-zero-review-interim-report

3. Project approach

Two different methods were applied to estimate the impact on carbon emissions and number of jobs that could be created by the transition to a zero-carbon economy.

3.1 METHOD 1

Opal Research & Consulting identified 130 energy-saving/low-carbon measures for homes, public/commercial buildings, transport and industry. They assessed the costs and benefits of the different low-carbon measures, and analysed the scope for their adoption across Cumbria in the next 15 years. From this, they estimated the number of 'job years' that could be created by investing in different low-carbon measures (where one job for ten years equals ten job years). Opal's estimates for jobs in retrofitting buildings are based on installing all the recommendations in energy performance certificates (EPCs), scaled up to cover the whole building stock.

(Full report in Appendix 1). The report includes a league table of the most cost- and carbon-effective options that could be implemented in Cumbria, along with the investment needed to put these options into effect.

This research has also identified the gap between the levels of carbon reduction achievable through cost-effective, cost-neutral and technically viable options, and the zero-carbon target date of 2037, which was adopted by the Zero Carbon Cumbria Partnership in 2020. It proposes some more innovative measures that could close this gap.

3.2 METHOD 2

Green House Think Tank considered the opportunities in renewable electricity generation, renewable heat, transport and waste (full report in Appendix 2). They identified both 'transition jobs' – required, for example, to install new infrastructure – and 'long-term jobs', such as in maintenance of systems, recycling or operation of public transport. The activities for which jobs have been estimated are those that necessarily take place in Cumbria -for example, the installation of renewable energy systems but not their manufacture. Where jobs that will be lost in the transition to zero carbon can be identified these have been subtracted from the job numbers.

Results are presented for Cumbria overall and broken down by local authority area where the data allows.

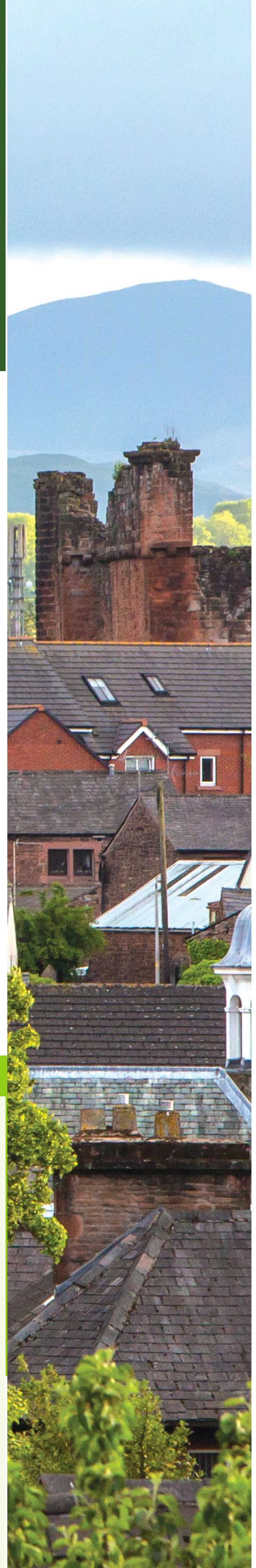
3.3 EXCLUSIONS

There are some sectors that have not been included in our research and analysis, although they may offer potential for green jobs:

NUCLEAR Cumbria Local Enterprise Partnership's report, *Cumbria: Nuclear Prospectus*,[13] has looked at this potential.

AGRICULTURE AND OTHER LAND MANAGEMENT SECTORS There need to be changes to the agriculture sector over the next ten to twenty years to address climate change and restore natural ecosystems and, more immediately, there will be changes resulting from Brexit. The impact these might have on jobs in Cumbria is complex and would require comprehensive treatment beyond the resources of this project. Work created by forestry or peatland restoration, natural flood defence provision or nature conservation projects are not included.

13 https://www.copeland.gov.uk/sites/default/files/attachments/cumbria_nuclear_prospectus.pdf



4. Carbon emissions reduction

SUMMARY OF FINDINGS

Dividing the remaining global carbon budget up by population gives Cumbria a maximum total carbon budget of 26 million tonnes from 2020. Based only on the fuel and electricity used within its boundaries, Cumbria currently emits about 5 million tonnes of carbon a year, meaning that it would use up its share of the global carbon budget in just over five years' time (see Appendix 1).

Carbon emissions in Cumbria have fallen by 42% since 2000. Without further action, it's projected that Cumbria's emissions will have fallen by a total of 54% from 2020 levels by 2037, taking into account the ongoing decarbonisation of electricity and growth in population and the economy. (Section 3, Appendix 1)

For Cumbria to reach net zero by 2037 it would need to reduce its emissions by 18% year on year (Section 4, Appendix 1).

> **Cumbria could close the gap between its projected emissions in 2037 and net zero by 41% through the adoption of cost-effective, low-carbon options in houses, public and commercial buildings, transport and industry** (Section 5, Appendix 1)**. These would more than pay for themselves directly through the energy savings that they generate.**

Adopting these options would reduce Cumbria's total projected energy bill in 2037 by £792 million each year whilst also creating over 11,811 years of extra employment across the region, which is equivalent to 592 full-time jobs each year over a period of 20 years (Section 5, Appendix 1).

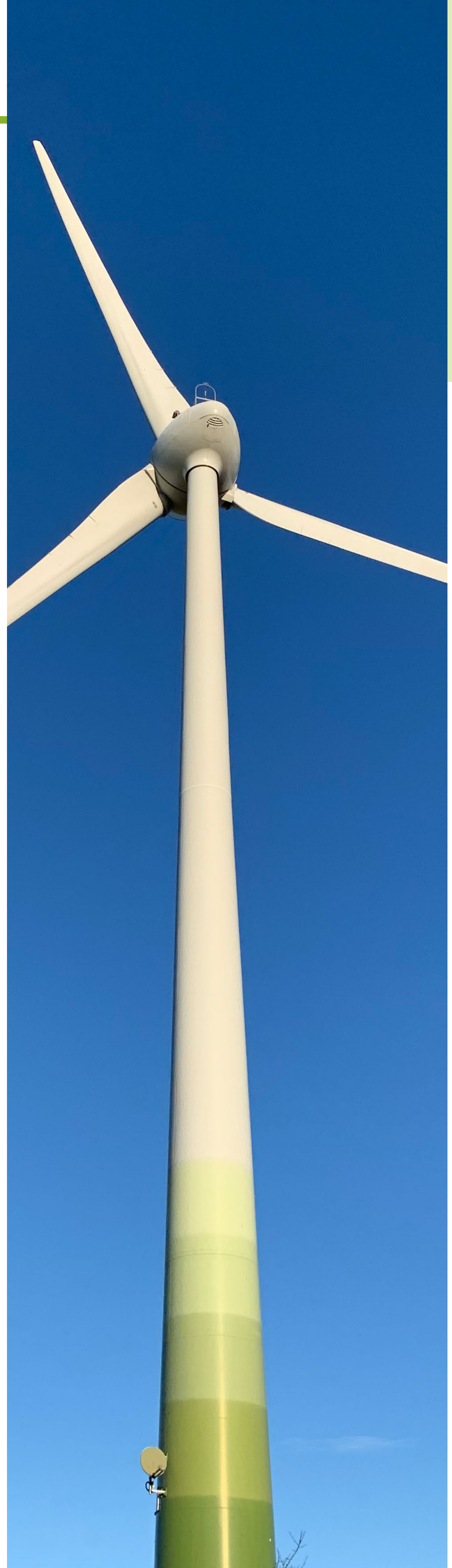
The most carbon-effective options that could be applied to deliver these carbon cuts include improved heating, lighting and insulation in houses, cooling and insulation in offices, shops and restaurants, shifting journeys to non-motorised transport and the wider uptake of electric vehicles (Table 5, Section 5, Appendix 1).

Cumbria could go further and close the gap between projected emissions and net zero in 2037 by 57%, by adopting options that are already available but that may not pay for themselves directly through the energy they save. However, many of these options would generate indirect benefits, for example, reduced congestion and air pollution, and improved public health (Section 5, Appendix 1).

The potential to reduce emissions for each district has been identified, along with accompanying economic measures in five-year periods. These show the investment that would be needed, the reductions in energy expenditure in each scenario and job creation estimates. The potential to deploy each intervention varies between districts, but the typical productivity of each measure (in energy, emissions and cost savings) remains fairly stable across the region (Section 8, Appendix 1).

Cumbria needs to identify some other more innovative options that could deliver the last 43% of the gap between its projected emissions in 2037 and net zero. This could include zero-carbon heavy goods vehicles and electrifying heating, cooling and cooking. With the ambitious roll-out of such initiatives, the analysis suggests that Cumbria would still have some residual emissions after 2037 (Section 9, Appendix 1).

Some of these residual emissions could be sequestered through nature-based approaches, such as tree planting or peatland conservation or restoration. These can also make important contributions to protecting biodiversity, enhancing flood protection and improving public health and wellbeing. To have significant impact on the residual emissions through tree planting alone would require an additional 3% of Cumbria to be afforested. The scale of this highlights the need to address emissions at source (Section 9, Appendix 1).



5. Green jobs opportunities

SUMMARY OF FINDINGS

For more detail see Appendix 2

5.1 RENEWABLE ELECTRICITY GENERATION

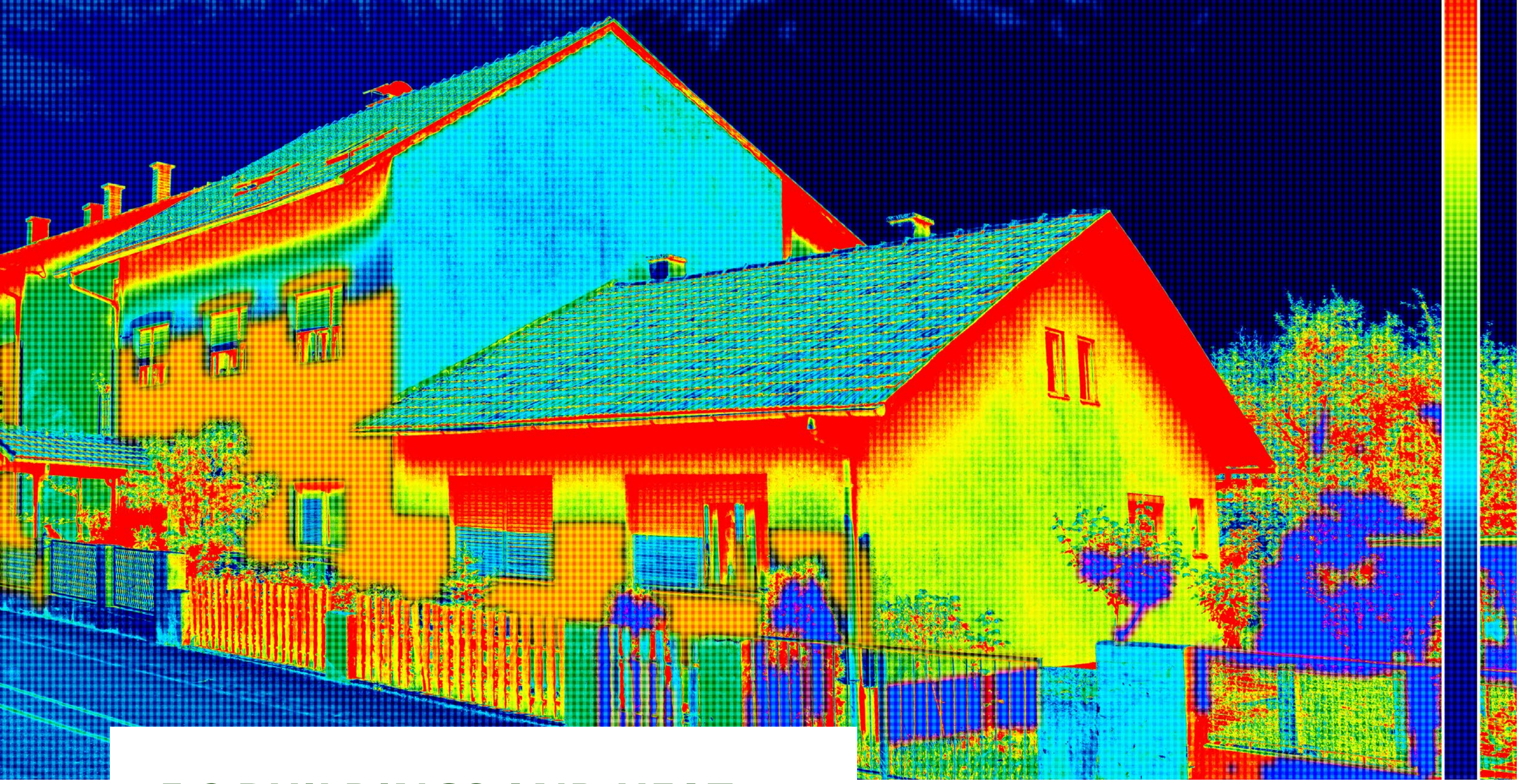
The potential for increasing the amount of renewable electricity generated in Cumbria from onshore wind, solar PV, hydro and anaerobic digestion has been estimated for each district, along with the number of new jobs that would be created (Section 3, Appendix 2).

It is estimated that a further 14,802GWh a year could be generated in addition to the existing 5,165GWh (in 2019). This includes an assumed 1,200GWh from tidal lagoon proposals. To build and maintain this new capacity would require an average of 5,747 full-time equivalent jobs over the first 15-year 'transition' period, with around 3,500 of those in west Cumbria (Allerdale and Copeland). In the longer term beyond the transition period there could be 1,709 jobs with around 1,500 of these being in west Cumbria. An assumed loss of 400 jobs in offshore gas in Barrow have been subtracted but Barrow would still have a net increase in jobs in offshore energy, assuming an additional 1GW of offshore wind is installed and maintained from Barrow.

TABLE 1: Generation from existing and proposed renewable capacity.

TECHNOLOGY	In 2019 [1] (GWh)	From new capacity (GWh)	Total (GWh)
Onshore wind	462	3,118	3,580
Solar PV	101	2,214	2,315
Hydro	20	185	205
Anaerobic digestion	47	459	506
Plant biomass	364		364
Landfill gas	19		19
Offshore wind [2]	4,151	7,626	11,778
Tidal lagoon		1,200	1,200
TOTAL GENERATION	**5,165**	**14,802**	**19,967**
Cumbria electricity consumption 2018 [3]	2,637		
Total UK electricity generation 2018 [4]	333,080		

[1] From Renewable Electricity by Local Authority - https://www.gov.uk/government/statistics/regional-renewable-statistics
[2] Note the tables in [1] attribute the generation from offshore wind off Barrow to Lancaster district, as it comes ashore at Heysham, and the generation from the Robin Rigg Wind farm in the Solway Firth to Dumfries and Galloway.
[3] From sub-national electricity consumption statistics 2005-2018, available at https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics
[4] UK generation plus imports from DUKES 5.1.2 - https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes



5.2 BUILDINGS AND HEAT

Assuming that new house building continues at the same rate as between 2015 and 2018, nearly 90% of the homes that will exist in 2037 in Cumbria already exist. Of the 55% of domestic properties with an energy performance certificate, only 0.2% are rated A, 8.6% B and 23.4% C. Almost 70% are D or below. Achieving net zero in Cumbria by 2037 requires upgrading at least 220 properties a week to band C or better (Section 4, Appendix 2).

The job estimates made by Opal Research and Consulting (method 1) include those required to install all the measures recommended in domestic and commercial EPCs, scaled up for all properties. In their 'technical potential' scenario this was 1,350 jobs over 15 years. These measures include fitting heat pumps to just 1.6% of homes in Cumbria but to get to net zero almost all homes will need low- or zero-carbon heating. Therefore, Green House estimated the jobs created from the retrofitting of air-source heat pumps to an assumed 90% of the 2025 housing stock (after which new builds will have to be fitted with renewable heating systems).

Around 630 jobs could be created from this activity during the 15 year transition phase and around 180 in the long term.

5.3 TRANSPORT

Following the scenario set out in the *Zero Carbon Britain* report produced by the Centre for Alternative Technology, achieving zero carbon transport would require a shift from driving private vehicles to walking, cycling and public transport, with the remaining private vehicle travel shifting from internal combustion engine (ICE) to electric vehicles (EV), as shown in Table 2.

TABLE 2: Proposed changes in distance travelled by car, bus and train

	Current distance travelled per person	Proposed distance travelled per person
Car – EV	Not available	6,204
Car – ICE	10,550	104
Bus	548	761
Train	702	1,722

[Derived from Appendix 2, Table 5.3]

These shifts in travel behaviour will require installation of EV chargepoints, upgrading of the railways (lines and rolling stock), improvement and integration of bus and train services, adoption of electric or hydrogen buses, affordable ticket prices and improved cycling and walking infrastructure – all of which create jobs.

Assumptions were made on the number of public, workplace and home EV chargepoints that would be required in 2037 and on that basis it is calculated that an additional 4,080 public, 17,797 workplace and 10,915 home chargepoints would need to be installed. This would create around 130 jobs in Cumbria over the 15-year transition period (Appendix 2, Fig. 5.1).

Research carried out for the TUC has suggested that upgrading and expanding the rail network could result in 908 jobs in Cumbria, with a further 532 jobs installing cycling and walking facilities. Green House has estimated that there could be a gain of 370 jobs in transport across the county. The jobs lost in the maintenance of petrol and diesel vehicles (because these require more maintenance than electric vehicles) would be more than compensated for by the gains in jobs in public transport (Appendix 2, Fig 5.2).

5.4 RECYCLING, REUSE AND REPAIR OF WASTE

It is estimated that the overall recycling rate for all household waste in Cumbria is 47% (kerbside collection and material taken to Household Waste Recycling Centres). Local authorities are already achieving 80% recycling of household waste in various locations across Europe so reducing residual waste, equivalent to recycling, reusing and repairing 90% of all types of waste, should be achievable. This would lead to a net gain of around 1000 long-term jobs (Section 6, Appendix 2).

In addition to these jobs, Cumbria could play a role in helping to create a more circular UK economy, in which more products are repaired and reused, and recovered waste materials are used to make new products in the UK, as opposed to being exported.

Four opportunities have been identified:

- **the coordinated expansion of local reuse/repair centres across Cumbria** to deliver reuse at significantly greater scale than currently;
- **the development of electric arc furnace steel production in Workington from scrap steel**, most of which is currently exported, and renewable electricity from offshore generation. There are at least two operational electric arc furnaces in the UK, each employing several hundred staff directly and as sub-contractors.
- **building on existing Cumbrian expertise in papermaking** to produce office-grade paper from recycled paper – of which there is currently no UK production;
- **the development of plastics reprocessing capacity in Cumbria** to use segregated plastic waste.

In total around **9,000** green jobs could be created during the transition period and **3,800** in the long term.

6. Combined green jobs estimates

The results of the two different methods to estimate the number of jobs that could be created by the transition to a zero carbon economy have been combined and duplications removed.

In the Green House report the transition period is considered to be over 15 years: 2022 to 2037. Over this period the average number of jobs will be the average number of transition jobs plus half of the long-term jobs. However, as various elements of the transition are likely to grow over time, the actual number of jobs will be much greater at the end than the start of the period – so the job numbers are an underestimate of the number of people needed.

The estimates of job years in the 'technical potential' scenario of the Opal report have been divided by 15 to give an average number of jobs over a 15-year transition period and they have been assumed to all be 'transition jobs'.

In total around 9,000 jobs could be created during the transition period (Fig. 1) and 3,800 in the long term (Fig. 2). Over half of these are in renewable electricity. Just under half of the estimated jobs are in west Cumbria (Allerdale and Copeland). We have shown the jobs in these two districts together because many of them are in offshore renewables and ports could be used at both Workington and Whitehaven.

Figure 1: Jobs in the transition period, 2022 to 2037

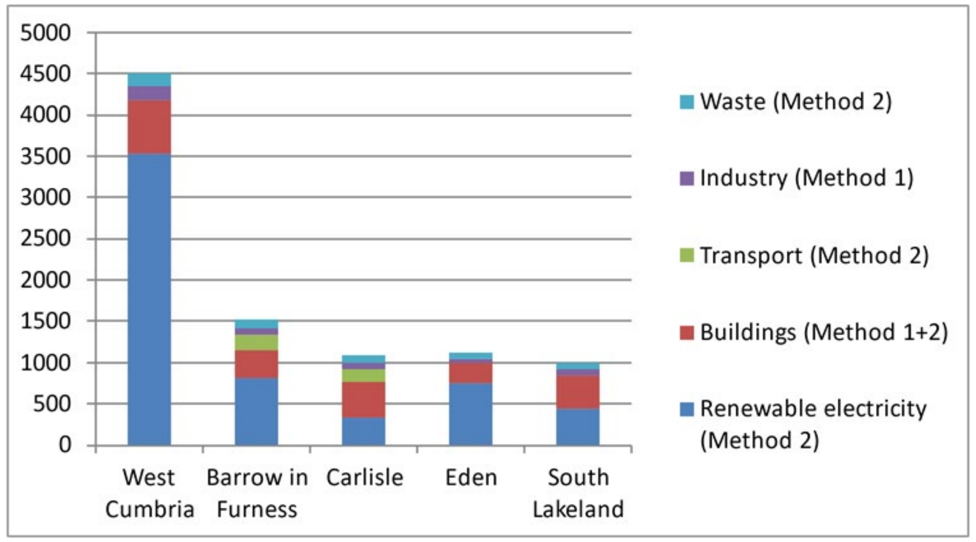
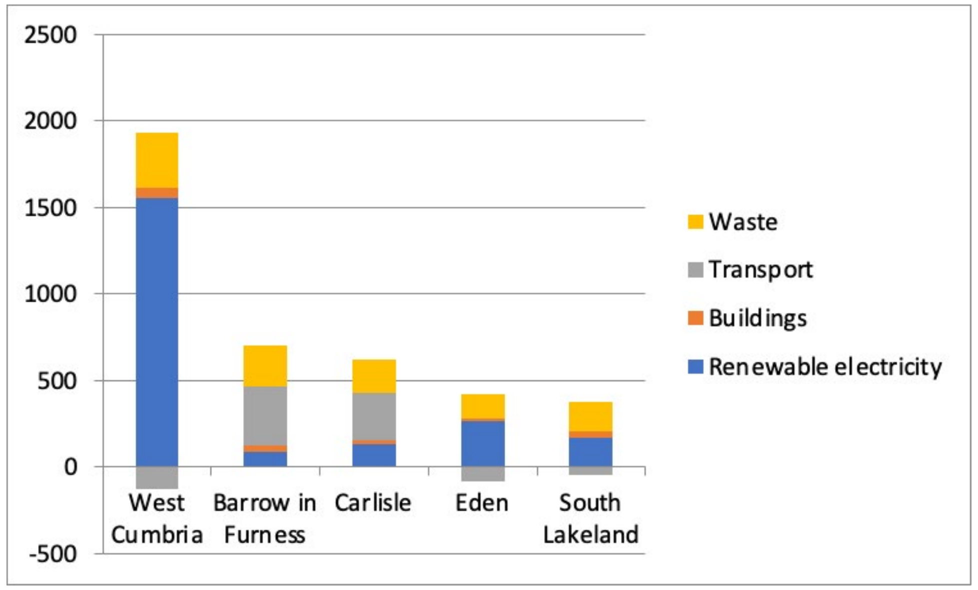


Figure 2: Long-term jobs



In addition to these jobs, Green House has suggested ways in which Cumbria could play a role in helping to create a more circular UK economy, in which more products are repaired and reused and recovered waste materials used to make new products in the UK, as opposed to being exported (Section 6, Appendix 2). The opportunities discussed are in:

- **expanding current salvage, repair and reuse activities to create local clusters**
- **the production of 'green steel' from steel scrap using renewable electricity**
- **production of office-grade recycled paper**
- **plastics reprocessing.**

7. Barriers to transition to low-carbon jobs

In order to sense check the assumptions being made in our research, three consultation events were held in November and December 2020 at which preliminary findings from the two approaches outlined above were presented. A total of 44 participants from local authorities, businesses, community groups and trade unions were asked to identify existing activities or plans to develop green jobs and the barriers to green jobs (see Appendix 3 for a full report).

Attendees highlighted several existing initiatives to reduce carbon emissions, which are being delivered by community sustainability groups such as Ambleside Action for a Future and Sustainable Brampton, as well as CAfS' work. Local authorities and other organisations such as Kendal Futures have developed or are developing various plans and strategies for reducing carbon emissions. The trade unions are raising awareness of climate change and promoting a just transition to a green economy with employees, employers and policy makers.

Key barriers to measures to reduce carbon emissions and grow green jobs identified by participants included:

a. Poor public transport provision for isolated communities.

b. The challenges of achieving modal shifts in transport, especially for work and shopping journeys.

c. Lack of safe infrastructure for cycling/walking.

d. The complexity and technical nature of whole house retrofit and lack of integrated support to householders.

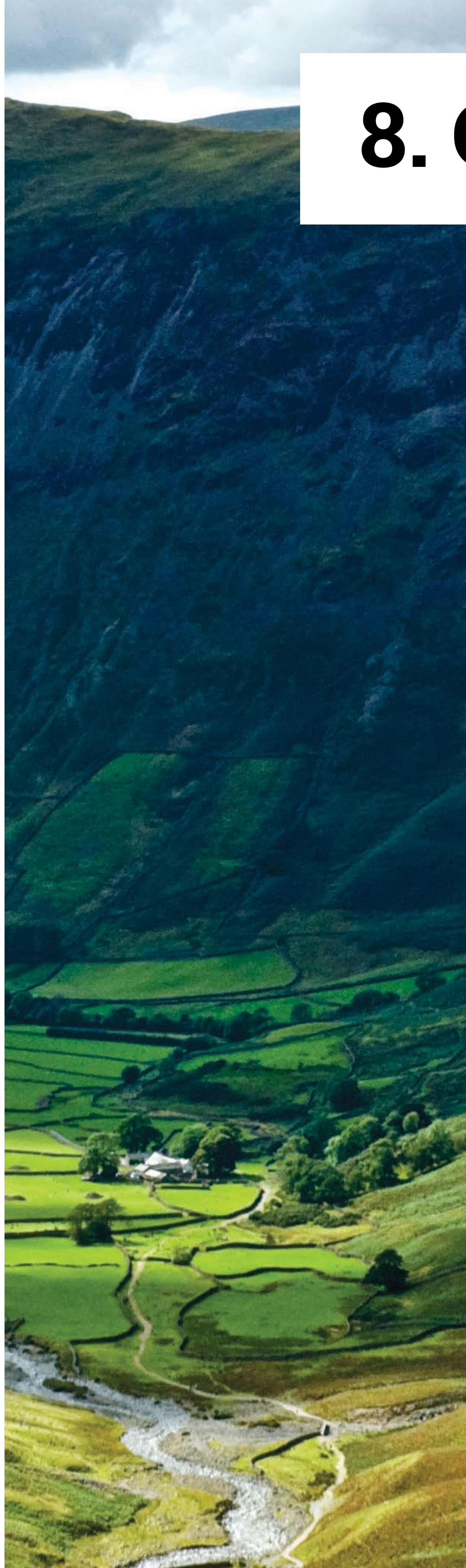
e. Workforce and skills shortages, particularly with regard to retrofitting buildings.

f. The upfront investment needed, whether for businesses to introduce new low-carbon measures or individuals buying an electric car.

g. The short-term nature of government support or sudden withdrawal of support, which damages business confidence and leads to boom-and-bust cycles.

h. Planning barriers to renewable energy development, particularly onshore wind.

i. The lack of plastic and food waste reprocessing facilities in Cumbria.



8. Conclusions

It is clear from this research that by reducing carbon emissions not only can we achieve net zero but we can also secure energy savings on the cost of energy bills – for households, transport, business operating costs, waste disposal – as well as generate thousands of good jobs.

Cumbria has significant motivation to achieve net zero carbon emissions as a rural county that can be hard hit by extreme weather events and is under threat from sea level rise. Cumbria also has strong motivation to create new employment opportunities in its several areas of rural deprivation where marginalised groups are hardest hit by both climate change and the coronavirus crisis. It has active communities, local authorities that have recognised the climate emergency, natural assets in the form of wind, water and tide, and a county-wide Zero Carbon Cumbria Partnership (ZCCP) that brings together more than 70 diverse organisations to plan the county's pathway to net zero.

Existing trade union activity in the green jobs arena is already extensive: many unions have green representatives in the workplace and are currently educating and supporting members around climate change and green issues. Trade unions are actively pursuing a 'just transition' to green jobs. Unions are also playing a role in policy development – for example, lobbying to change infrastructure funding rules and for a higher priority for climate friendly policies.

These opportunities, strengths and assets provide the springboard to accelerate action to a net zero carbon economy and to overcome the barriers, such as the upfront costs, skills gaps, resistance to change, and lack of local control over national policy areas.

8.1 RECOMMENDATIONS

Action is needed to scope, plan, resource and implement a transition from a high-carbon economy and jobs to low carbon, including:

- **Taking full opportunity for funding from existing initiatives** such as Borderlands, which is developing an Energy Masterplan. A commitment is being made in the Borderlands growth deal for there to be a capital fund of up to £31million to invest in energy projects across the Borderlands area. This could help facilitate the optimisation of renewable energy generation in Cumbria.
- **Local authorities in Cumbria leading the way** by integrating climate change into all of their activities and by requiring new strategies, policy proposals and planning applications to assess and communicate their contributions to and impacts on the zero carbon target.
- **Businesses supported to cut emissions across supply chains, to adopt new technologies, create demand for workforce and skills and provide training opportunities.** Large organisations and businesses in the county could be encouraged to match the 2037 target and report back on progress.
- **Further work undertaken to identify the skills levels required** for the kinds of green jobs highlighted through this research, the investment and support needed to develop training schemes and apprenticeships to secure those skills and potential sources of funding.
- **Exploration of the potential and role of public and private finance** in accelerating the transition, and 'just transition' investment plans developed for priority areas such as west Cumbria.
- **An assessment of Cumbria's mining heritage** could identify potential additional options for reducing carbon emissions, such as through district heating systems, or sequestering carbon by carbon capture and storage.
- **The contribution that changes to land management could present** both to reduce carbon emissions, sequester carbon, mitigate flood risk and their impact on jobs should be identified to complement this research.
- **Cumbria could look to the experience of Scotland's Just Transition Commission**, which engages workers, communities, NGOs, business and industry leaders and specifically seeks and considers the views of young people as part of its work to advise the Scottish government on how to grow an inclusive, net zero economy.
- **Consider the wider, non-employment related, induced or indirect impacts of the different options assessed here**, along with the likely trends in jobs that are low carbon, such as care, nursing and teaching.
- **Finally any further theoretical analysis of green job opportunities must be sense checked with the people whose lives would be most affected to ensure the findings have credibility and take account of skills, social welfare, individual wellbeing and the financial sustainability of employees, communities and the businesses involved.** Vulnerable communities in particular must be supported through a transition to a lower carbon economy.

Appendices

Appendix 1

A NET ZERO CARBON ROADMAP FOR CUMBRIA

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Contents

1. Introduction

Climate science has proven the connection between the concentration of greenhouse gases (GHG) in the atmosphere and the extent to which the atmosphere traps heat and so leads to global warming.

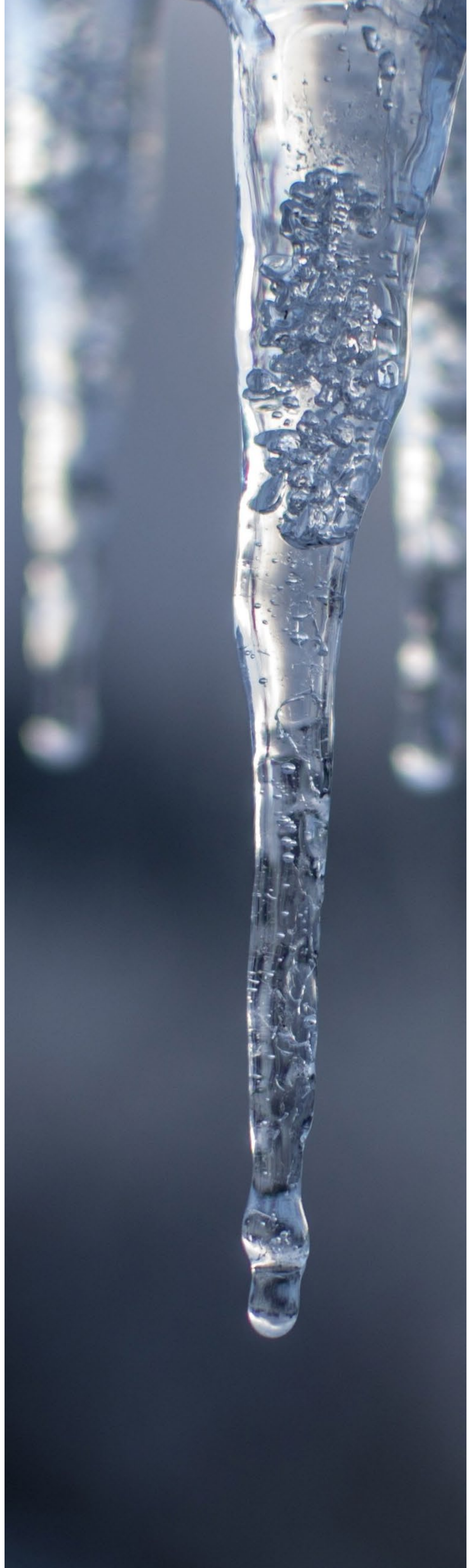
The science tells us – with a very high level of confidence – that such warming will lead to increasingly severe disruption to our weather patterns and water and food systems, and to ecosystems and biodiversity. Perhaps most worryingly, the science predicts that there may be a point where this process becomes self-fuelling, for example where warming leads to the thawing of permafrosts such that they release significant quantities of greenhouse gases leading to further warming. Beyond this point or threshold, the evidence suggests that we may lose control of our future climate and become subject to what has been referred to as dangerous or 'runaway' climate change.

Until recently, scientists felt that this threshold existed at around 2 degrees C of global warming, measured as a global average of surface temperatures. However, more recent scientific assessments (especially by the Intergovernmental Panel on Climate Change or IPCC in 2018[1]) have suggested that the threshold should instead be set at 1.5 degrees C. This change in the suggested threshold from 2 degrees to 1.5 degrees C has led to calls for targets for decarbonisation to be made both stricter (e.g. for the UK to move from an 80% decarbonisation target to a net zero target), and to be brought forward (e.g. from 2050 to 2030). At the time of writing, the UK Parliament (but not yet the UK Government) has endorsed the adoption of a net zero target for 2050.

Globally, the IPCC suggests that from 2020 we can only emit 344 billion tonnes of carbon dioxide if we want to give ourselves a 66% chance of avoiding dangerous climate change. We are currently emitting over 37 billion tonnes of carbon dioxide every year, which means that we will have used up our global carbon budget within a decade. It is this realisation – and the ever-accumulating science on the scale of the impacts of climate change – that led to calls for organisations and areas to declare a climate emergency and to develop and implement plans to rapidly reduce GHG emissions.

In this report, we examine how the global carbon budget translates into a local carbon budget for Cumbria, and assess what needs to be done within the county for it to stay within this carbon budget and also achieve net zero emissions by 2037.

1 IPCC (2018) Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, IPCC.



2. Our approach

2.1 MEASURING AN AREA'S CARBON FOOTPRINT

Any area's carbon footprint – measured in terms of the total impact of all of its greenhouse gas emissions – can be divided into three types of emissions.

- **Those coming from the fuel** (e.g. petrol, diesel or gas) that is directly used within an area and from other sources such as landfill sites or industry within the area. These are known as Scope 1 emissions.
- **Those coming from the electricity that is used within the area, even if it is generated somewhere else.** These are known as Scope 2 emissions. Together Scope 1 and 2 emissions are sometimes referred to as territorial emissions.
- **Those associated with the goods and services that are produced elsewhere but imported and consumed within the area.** After taking into account the carbon footprint of any goods and services produced in the area but that are exported and consumed elsewhere, these are known as Scope 3 or consumption-based emissions.

In this report we focus on Scope 1 and 2 emissions, and exclude consideration of long-distance travel and of Scope 3 or consumption-based emissions. We do this because Scope 1 and 2 emissions are more directly under the control of actors within an area, and because the carbon accounting and management options for these emissions are better developed. We stress though that emissions from longer distance travel (especially aviation) and consumption are very significant, and also need to be addressed. If we took these Scope 3 emissions into account, then the rates of change required to stay within Cumbria's share of the global carbon budget and meet a net zero target would need to be more ambitious still.

2.2 DEVELOPING A BASELINE OF PAST, PRESENT AND FUTURE EMISSIONS

Having a baseline of carbon emissions is key to tracking progress over time. We use local authority emissions data to chart changes in emissions from 2005 to 2018. We also break this down to show the share of emissions that can be attributed to households, public and commercial buildings, transport and industry.

We then project current emissions levels for the period through to 2037 and then on to 2050. To do this, we assume ongoing decarbonisation of electricity in line with government commitments and a continuation of background trends in *a*) economic and population growth, and *b*) energy use and energy efficiency. Specific numbers for the key variables taken into account in the forecasts are presented below. As with all forecasts, the level of uncertainty attached increases as the time period in question extends. Even so, it is useful to look into the future to gauge the scale of the challenge to be addressed in each area, especially as it relates to the projected gap between the forecasted emissions levels and those that are required if an area's emissions are to be consistent with a global strategy to limit average warming to 1.5 degrees C.

2.3 SETTING SCIENCE-BASED CARBON REDUCTION TARGETS

To set science-based carbon reduction targets for an area, we take the total global level of emissions that the IPCC (2018) suggests gives us a 66% chance of limiting average levels of warming to 1.5 degrees C, and divide it according to the share of the global population living in the area in question. This enables us to set the total carbon budget for an area that is consistent with a global budget. To set science-based targets for carbon reduction, we then calculate the annual percentage reductions from the current level that are required to enable an area to meet its net zero targets.

2.4 IDENTIFYING AND EVALUATING CARBON REDUCTION OPPORTUNITIES

Our analysis then includes assessment of the potential contribution of c.130[2] energy saving or low carbon measures for:

- households and other public/commercial buildings (including better insulation, improved heating, more efficient appliances, some small-scale renewables);
- transport (including more walking and cycling, enhanced public transport, electric and more fuel efficient vehicles); and
- industry (including better lighting, improved process efficiencies and a wide range of other energy efficiency measures).

We stress that the list of options that is assessed may not be exhaustive; other options may be available and the list could potentially be expanded.

For the options included, we assess the costs of their purchase, installation and maintenance, the direct benefits (through energy and fuel savings) of their adoption in different settings and their viable lifetimes. We also consider the scope for and potential rates of deployment of each option. This allows us to generate league tables of the most carbon- and cost-effective options that could be deployed within an area. We note that, as well as financial aspects, some of the options (e.g. relating to changing travel patterns and modes) may require significant behavioural changes.

It is important to note that we base the analysis on current capital costs, although future costs and benefits are adjusted for projected levels of inflation and interest/discount rates. Like all forecasts, there are various sensitivities that could influence the actual outcomes – for example, the economic benefits are likely to be larger if costs fall and benefits increase as some options become more widely adopted, or smaller if the costs increase as the rates of deployment increase. While these are limitations of our work, they allow this analysis to provide a clear picture of what is possible today.

It is also important to note that, although we consider the direct and indirect employment generation potential of different options, we do not consider the possible wider (i.e. non-employment related) induced or indirect impacts of the different options, although these can be considered in wider consultations.

Beyond the range of currently available options, we also consider the need for more innovative or 'stretch' options to be developed and adopted within the area if it is to meet its carbon reduction targets. These need to be developed in each area, but some of the ideas for innovative options identified elsewhere include targeting zero carbon heavy transport vehicles, the electrification of heating, cooling and cooking in all buildings and the potential for offsetting through UK-based tree planting. Again we stress that this list of 'stretch' options is not exhaustive and other options are also likely to be available.

2 We evaluate over 130 separate low-carbon technologies/interventions applied across sectors, with variable place-specific data on how their productivity and economics will change by application. This results in over 1,000 unique data points customised to Cumbria's economy, infrastructures and demography

2.5 AGGREGATING UP TO SEE THE BIGGER PICTURE

Based on this bottom-up analysis of the potential for different options to be adopted within the area, we then aggregate up to assess the potential for decarbonisation within that area, and the costs and benefits of different levels of decarbonisation. We then merge the aggregated analysis of the scope for decarbonisation with the baseline projections of future emissions to highlight the extent to which the gap between the projected and required emissions levels can be met through different levels and forms of action.

To break this gap down, we merge interventions into three broader groupings:

- **Cost-effective (CE)** options where the direct costs of adoption are outweighed by the direct benefits that they generate through the energy savings they secure, meaning the portfolio of measures as a whole has a positive economic impact in present value. These options may also generate indirect benefits – for example, through job creation, fuel poverty and improved air quality and public health.
- **Cost-neutral (CN)** options where the portfolio of interventions mentioned above is expanded to consider investments that may not be as cost effective on their own terms, but where the range of measures as a whole will have near-zero net cost.
- **Technical potential (TP)** options where the direct costs are not (at present) covered by the direct benefits. However, the cost of many low-carbon options is falling quickly, and again these options could generate important indirect benefits such as those listed above.

As it is unlikely that adopting all of the cost-effective or even technically viable options will enable an area to reach net zero emissions, we also highlight the need for a fourth group of measures:

- **Innovative or 'stretch' options** that include low-carbon measures that are not yet widely adopted. Some of the options within this group may well be cost and carbon effective, and they may also generate significant indirect benefits, but whilst we can predict their carbon saving potential, data on their costs and benefits is not yet available. Included in these measures are carbon offsetting opportunities related to afforestation and reforestation.

2.6 DEVELOPING TARGETS AND PERFORMANCE INDICATORS

Linked to the analysis detailed above, we extend our evaluation of potential emissions reductions across Cumbria's economy to substantive, real-life indicators for the levels of investment and deployment required to achieve targets. Termed 'KPIs', these illustrate the scale of ambition required to reach the emissions savings presented in the Technical Potential scenario and are disaggregated by sector.

2.7 FOCUSING ON KEY SECTORS

As well as presenting an aggregated picture, we also focus on the emissions saving potential in the housing, public and commercial buildings, transport, industry and waste sectors. We focus in on overall investment needs and returns, and present more detailed league tables of the most carbon- and cost-effective options that could be adopted in each sector.

3. Developing a baseline of past, present and future emissions for Cumbria

Analysis shows that Cumbria's baseline (Scope 1 and 2) emissions have fallen by 42% since 2000, due to a combination of increasingly decarbonised electricity supply, structural change in the economy, and the gradual adoption of more efficient buildings, vehicles and businesses.

With full decarbonisation of UK electricity by 2045, and taking into account economic growth (assumed at 1.5% a year), population growth (assumed at 0.1% a year) and ongoing improvements in energy and fuel efficiency, we project that Cumbria's baseline (Scope 1 and 2) emissions in 2037 will be 54% lower than their 2000 levels, leaving 3.8Mt CO$_2$e of annual emissions that need to be addressed.

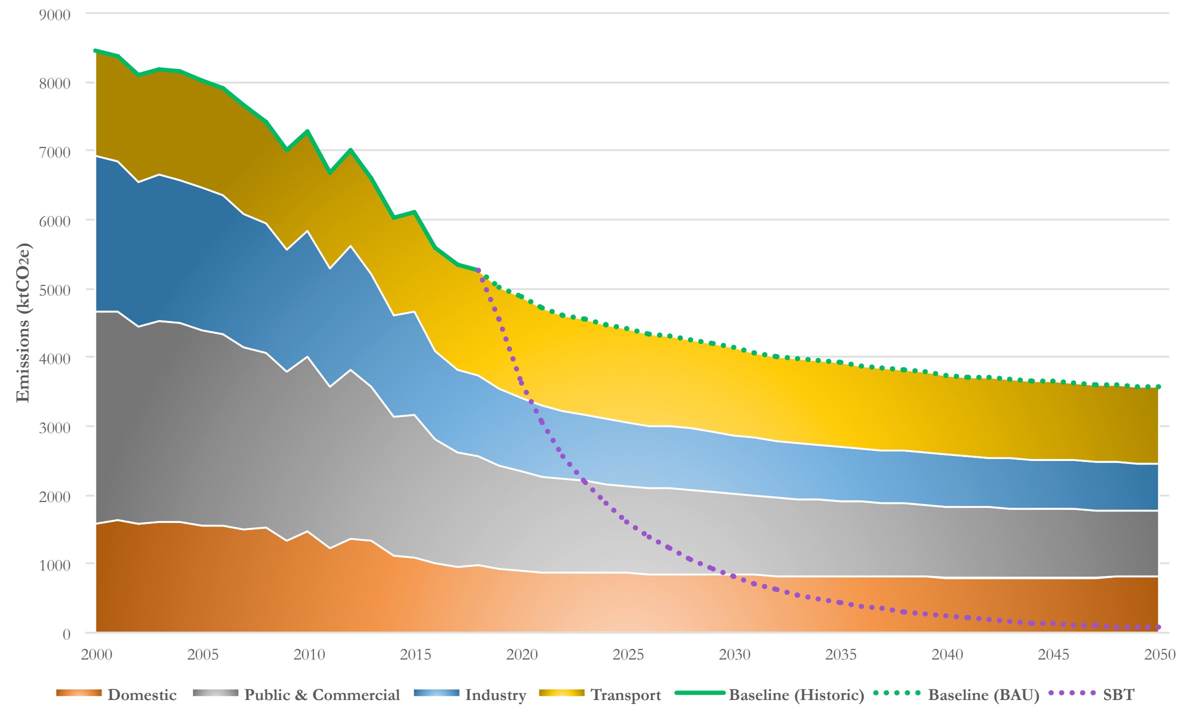


Figure 1: Cumbria's Scope 1 and 2 GHG emissions (2000-2050)

At present, 30% of Cumbria's emissions come from the transport sector, 30% from public and commercial buildings, 22% from industry (including energy use in and process emissions from buildings and facilities) and 18% from homes. By 2037, we project emissions from transport will increase very slightly (approximately 1%) with a 3% increase in the proportion of emissions from housing. Decreases are forecast in the proportion of emissions from public and commercial buildings and industry, largely a result of the projected expansion in the domestic buildings sector over this period.

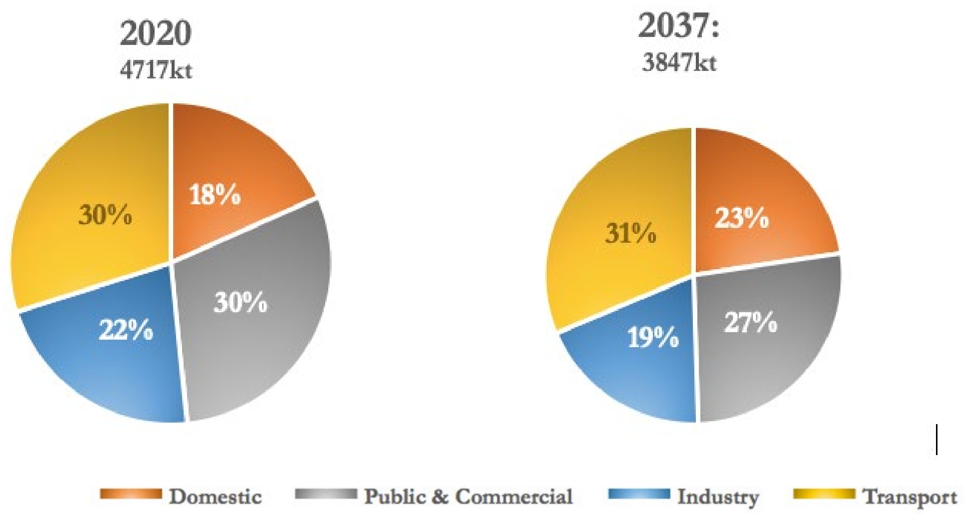


Figure 2: Cumbria's present and projected emissions by sector

Related to this emissions baseline, after evaluating the range of energy sources that Cumbria consumes (spanning electricity, gas, all solid and liquid fuels), we find that in 2019 £1.35 billion was spent on energy across the county. Transport fuels generated the majority of this expenditure (55%), followed by domestic buildings (22%) then public and commercial buildings and industry (19% and 4% respectively). By projecting demand and energy prices into the future, assuming population growth (based on BEIS estimates) and a continuation of recent trends on inflation and efficiency improvements, we find that Cumbria's business-as-usual energy expenditure will likely grow to £1.6 billion a year in 2037, retaining approximately the same sectoral proportions as the present (see Figure 3 below). Importantly, we find that energy expenditure across all composite district authorities in the Cumbria region is expected to grow (see Figure 4 below).

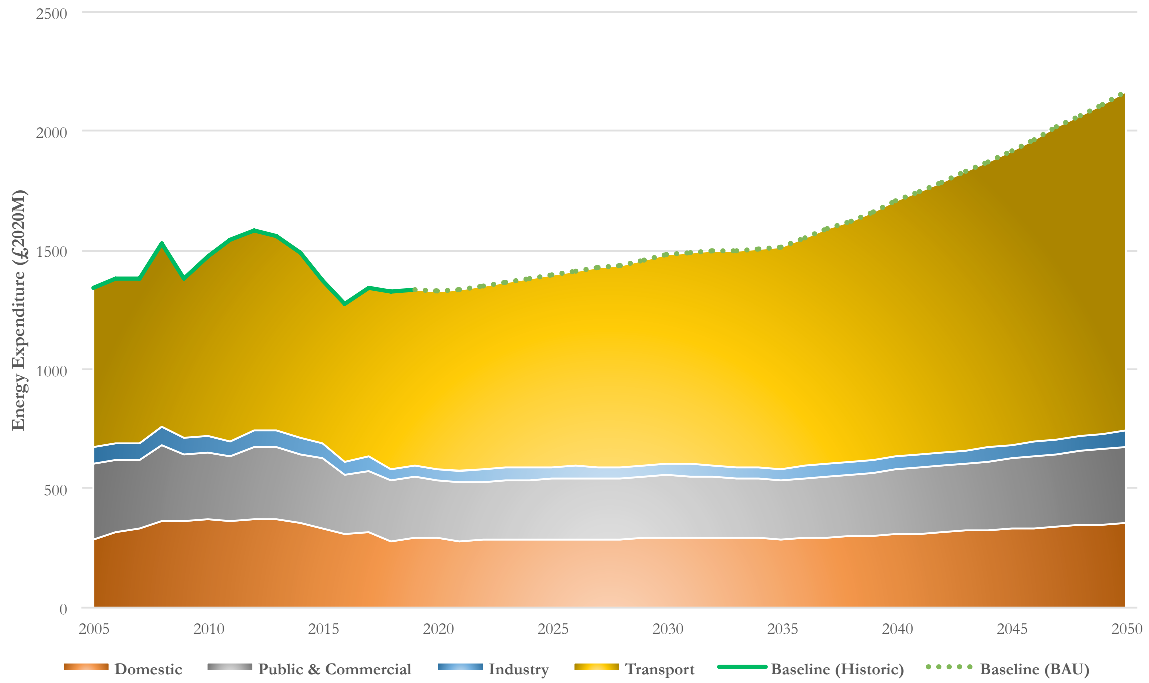


Figure 3: Cumbria's present and future energy expenditure by sector

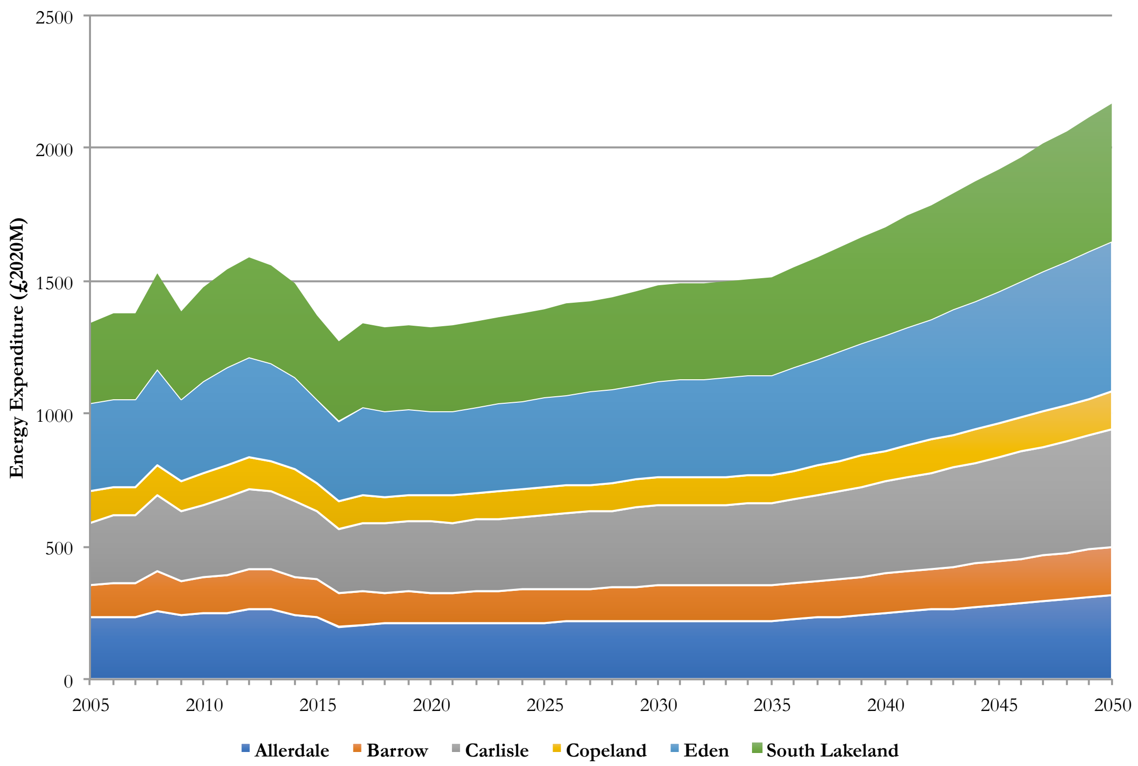


Figure 4: Cumbria's present and future energy expenditure by district

4. Setting science-based carbon reduction targets for Cumbria

The Intergovernmental Panel on Climate Change (IPCC) has argued that, from 2020, keeping within a global carbon budget of 344 gigatonnes (i.e. 344 billion tonnes) of CO_2 emissions would give us a 66% chance of limiting average warming to 1.5 degrees and therefore avoiding dangerous levels of climate change. If we divide this global figure up on an equal basis by population, and adjust to consider other GHGs as well as CO_2, this gives Cumbria a total carbon budget of 26 megatonnes.

At current rates of emissions output, Cumbria would use up this budget in just over five years, or during the later months of 2026. If Cumbria matches the current UK target and seeks to reach net zero by 2050, to stay within its carbon budget it would need to reduce its emissions by around 12.4% year on year. To reach a more ambitious target of reaching net zero by 2037 would require Cumbria to reduce its emissions by 18% a year.

5. Aggregating up: the bigger picture for Cumbria

Our analysis predicts that the gap between the Cumbria's business-as-usual emissions in 2037 and the net zero target could be closed by 41% through the adoption of cost-effective (CE) options, by over 51% through the adoption of cost-neutral (CN) options at no net cost, and 57% through the adoption of all technically viable (TP) options. This means that Cumbria still has to identify the innovative or stretch options that could deliver the last 43% of the gap between the business-as-usual scenario and net zero in 2037.

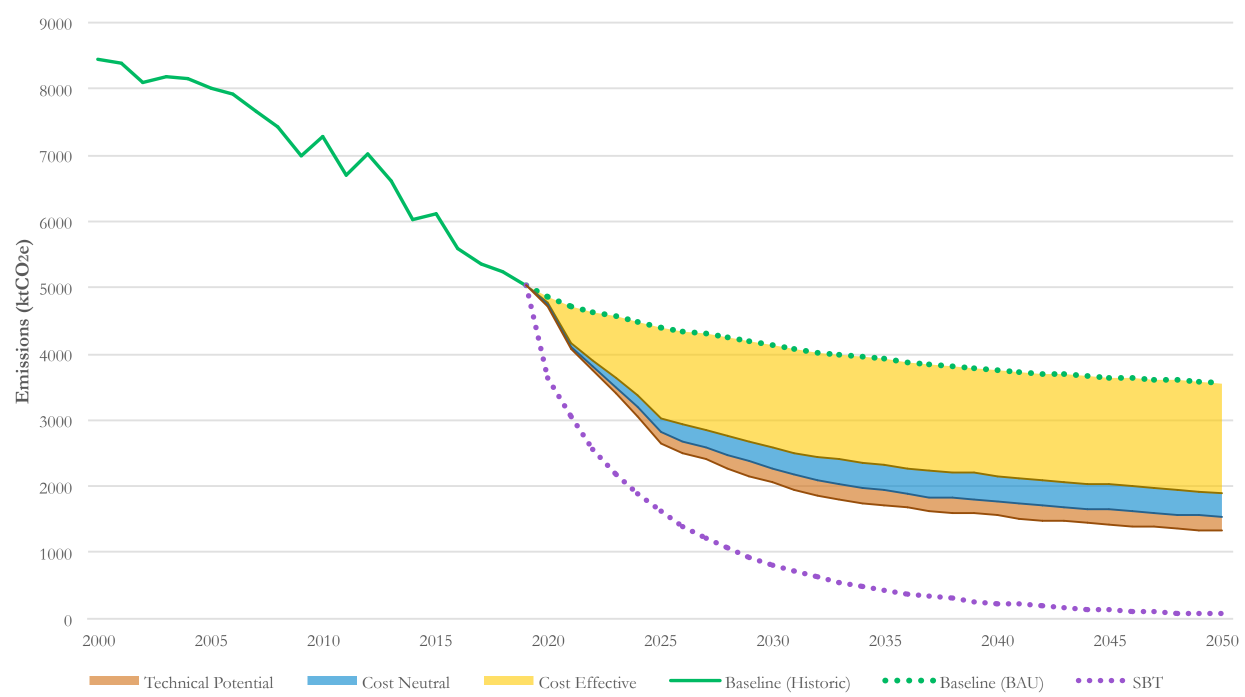


Figure 6: Cumbria's BAU baselines with cost-effective, cost-neutral, and technical potential options

		2025	2030	2035	2040	2045	2050
Reduction on BAU baseline	CE	31%	37%	41%	42%	45%	47%
	CN	36%	45%	50%	53%	55%	57%
	TP	40%	50%	56%	59%	61%	63%
Reduction on present emissions	CE	28%	32%	33%	33%	33%	34%
	CN	33%	38%	41%	41%	41%	42%
	TP	36%	43%	45%	45%	46%	46%

Table 1: Cumbria's potential 5-year emissions reduction percentages

Appendix 1A outlines an explicit league table of measures and their potential emissions savings over this period. Figure 7 below similarly highlights groups of investments and emissions reductions at full technical potential in Cumbria. Across Cumbria, the portfolio of measures evaluated here has the potential to accumulate reductions of nearly 31 $MtCO_2e$ by 2037 and 60$MtCO_2e$ by 2050. (A full breakdown of absolute emissions reductions by measure is provided in Appendix 1B).

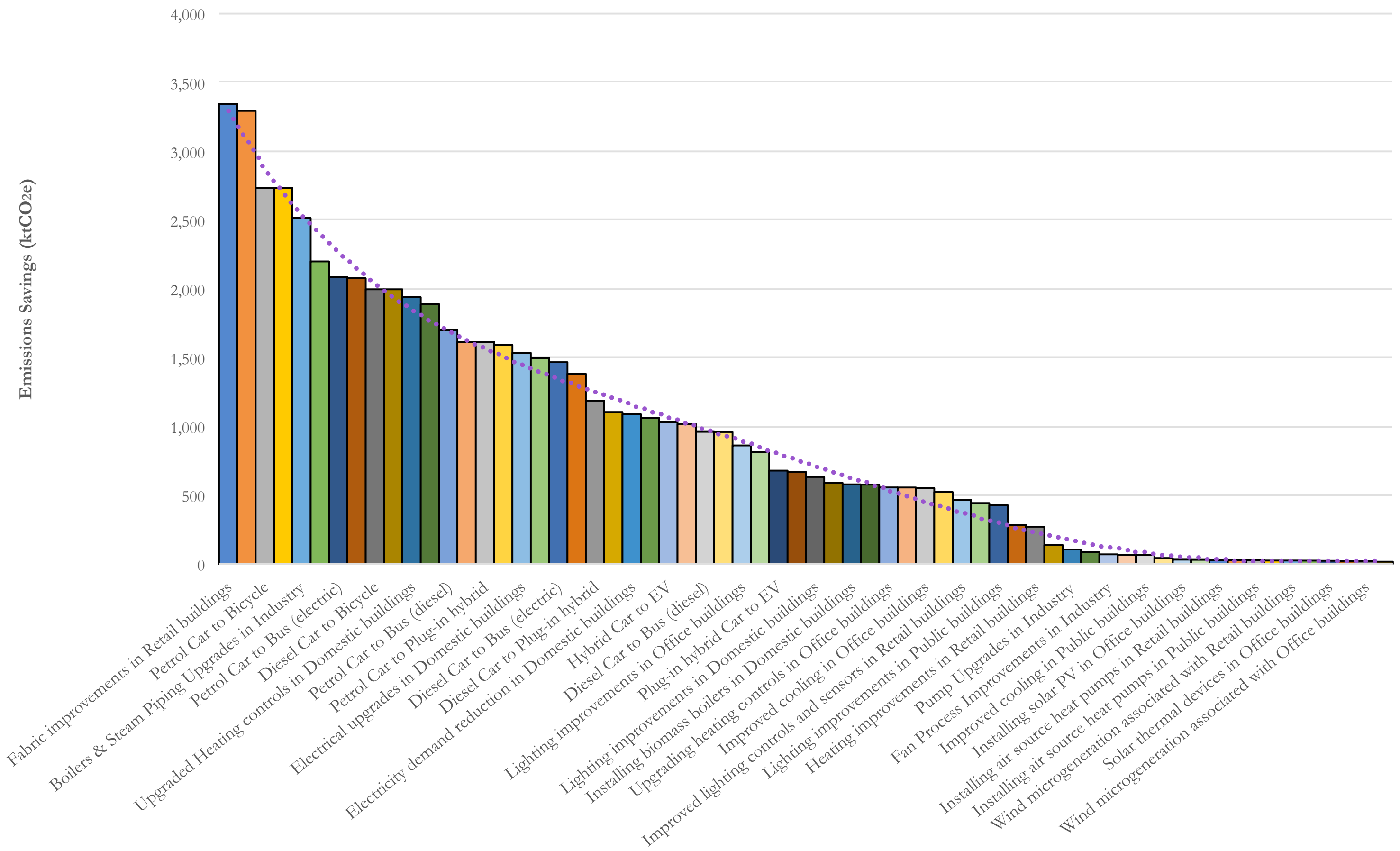


Figure 7: Simplified emissions reduction potential by measure for Cumbria 2020-50

Exploiting the cost-effective options in households, public and commercial buildings, transport, and industry could be economically beneficial. Although such measures would require investments of £3.83 billion, once adopted they would reduce Cumbria's total annual energy bill by £790 million in 2037 whilst also creating 11,811 years of employment – nearly 600 jobs for 20 years. By expanding this portfolio of measures at no net cost to Cumbria's economy (the cost-neutral scenario), investments of £5.77 billion would reduce Cumbria's total annual energy bill by £770 million, generate 17,651 years of employment whilst reducing Cumbria's emissions to nearly half of today's levels. Exploiting all the technically viable options would be more expensive but would realise further emissions savings – eliminating 57% of the projected shortfall in Cumbria's 2037 emissions, whilst saving £850 million annually.

	Cumulative total	Domestic	Industry	Transport	Commercial
CE	591	178	52	31	329
CN	883	235	84	66	498
TP	1,399	342	321	66	670

Table 2: Net jobs created over a 20-year period

		2025	2030	2035	2040	2045	2050
Cumulative investment (£2020m)	CE	2,794	3,728	3,829	3,829	3,829	3,829
	CN	4,035	5,597	5,765	5,765	5,765	5,765
	TP	5,645	8,301	8,885	8,885	8,885	8,885
Annual energy expenditure savings (£2020m)	CE	697	787	784	725	693	717
	CN	553	664	772	725	698	712
	TP	463	561	854	811	767	780

Table 3: Potential 5-year investments and energy expenditure savings

Sector	Scenario	Investment (£2020M)
Domestic	CE	1,667
	CN	2,198
	TP	3,201
Public and commercial	CE	1,397
	CN	2,118
	TP	2,850
Industry	CE	305
	CN	490
	TP	1,875
Transport	CE	460
	CN	960
	TP	960

Table 4: Potential investments by sector and economic scenarios

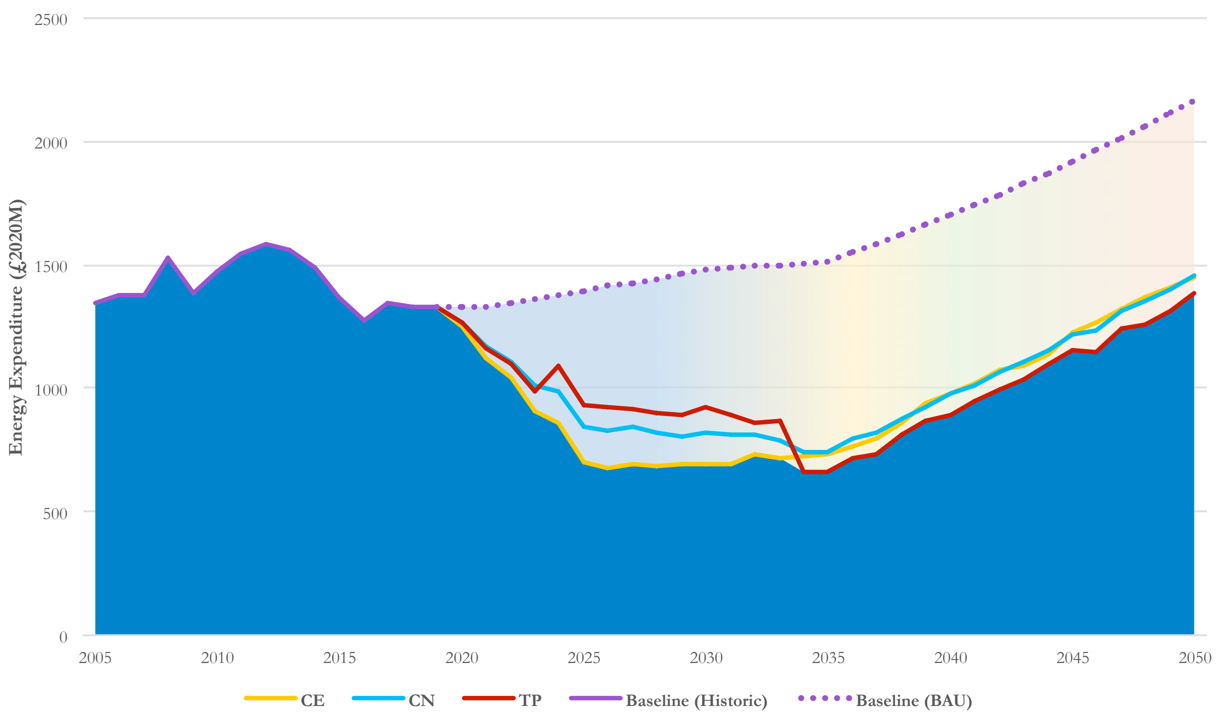


Figure 8: Cumbria's potential reductions in energy expenditure by economic scenario 2020-50

Simplified league tables of the most cost- and carbon-effective options in Cumbria are presented below. For cost effectiveness, figures are expressed as the number of £ per tonne of carbon saving, with a negative number indicating a cost saving per tonne. For carbon effectiveness, the emissions saving potential is over the lifetime of the low-carbon measure in question. More detailed league tables are presented in Appendices 1A and 1B.

Rank	Measure	Cost effectiveness (£/tCO_2e)
1	Fabric upgrades and improvements in retail buildings	-576
2	Diesel car to bus (diesel) journey shifts	-458
3	Improved cooling in commercial buildings	-431
4	Petrol car to bus (diesel) journey shifts	-373
5	Compressed air system upgrades in industry	-360
6	Diesel car to bicycle journey shifts	-345
7	Diesel car to walk journey shifts	-345
8	Petrol car to bicycle journey shifts	-323
9	Petrol car to walk journey shifts	-323
10	Fabric upgrades and improvements in public buildings	-269

Table 5: Cumbria's top-10 most cost-effective emission reduction options

Rank	Measure	Emissions reduction potential (ktCO_2e)
1	Fabric upgrades and improvements in retail buildings	3,344
2	Improved furnace processes and heaters in industry	3,293
3	Petrol car to bicycle journey shifts	2,733
4	Petrol car to walk journey shifts	2,733
5	Boilers and steam piping upgrades in industry	2,515
6	Fabric improvements in public buildings	2,198
7	Petrol car to bus (electric) journey shifts	2,084
8	Insulating domestic buildings (various forms)	2,076
9	Diesel car to bicycle journey shifts	1,996
10	Diesel car to walk journey shifts	1,996

Table 6: Cumbria's top ten most carbon-effective emission reduction options

Some of the ideas for innovative options identified elsewhere that could also be considered for Cumbria include targeting a full transition to net zero homes and public/commercial buildings by 2030, promoting the rapid acceleration of active travel (e.g. walking and cycling), tackling food waste, reducing meat and dairy consumption and reducing concrete and steel consumption/promoting adoption of green infrastructure. These are highlighted in section nine.

6. Developing key performance indicators

To give an indication of how far the investments detailed in this report translate into levels of practical intervention, the tables below detail total and annual levels of deployment of key measures through to 2050. These lists are not exhaustive, and also apply by measure; any one building or industrial facility will usually require the application of several measures over the period. The key performance indicators (KPIs) below are provided for the domestic, commercial and transport sectors, where both the challenge, and opportunity for action, are concentrated.

Domestic:

Measure	Total Homes Applied	Average annual installations (homes)
Thermostats and heating controls	307,162	32,333
Loft insulation (new and top-up)	259,986	27,367
Boiler upgrades and improvements	165,946	17,468
Draughtproofing and fabric upgrades	165,946	17,468
Low-energy lighting	162,063	17,059
Floor insulations	125,532	13,214
Solar PV	97,079	10,219
Wall insulation	72,887	7,672
Window upgrades	72,131	7,593
External/internal wall insulation	17,142	1,804
Heat pumps	4,087	430

Public and commercial buildings:

Measure	Floorspace Applied (m^2)	Annual Rate of Installation (m^2)
Heating system upgrades and controls	5,203,622	612,191
Lighting upgrades and sensors	4,747,225	558,497
Solar PV	2,402,930	282,698
Wind turbines	1,255,244	147,676
Fabric improvements	1,231,674	144,903
Solar thermal systems	592,664	69,725
Heat pumps	424,400	49,929

Transport:

Measure	Total (2030)	Average annual increase
EVs replacing conventional cars annually through 2030	26,868	2,985
Annual increase in public transport ridership through 2030 (trips)	4,278,386	475,376
Electric buses purchased annually through 2030	71	8
High quality protected cycling highway built annually through 2030 (kms)	40	4

7. Focusing on key sectors in Cumbria

At full deployment (technical potential) across Cumbria, we calculate that there is potential to avoid over 31MtCO_2e in emissions that will otherwise be produced in the region between 2020 and 2037. The transport sector will contribute most significantly toward this total, with a decarbonisation potential of between 21MtCO_2e (cost-effective scenario) and 26MtCO_2e (technical potential) in the period. However, the role of the built environment in Cumbria's progress towards its climate targets should not be understated; domestic, public and commercial buildings combined could reduce emissions by up to 18MtCO_2e over the same period at full technical potential. In the following section summaries of the emissions reduction potential and economic implications of investment are presented for the four main sectors comprising this analysis.

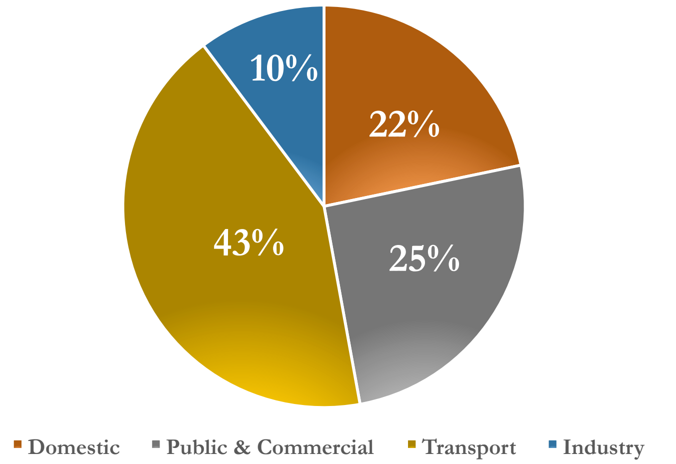


Figure 9: Cumbria's emissions reduction potential (2020-2050) by sector

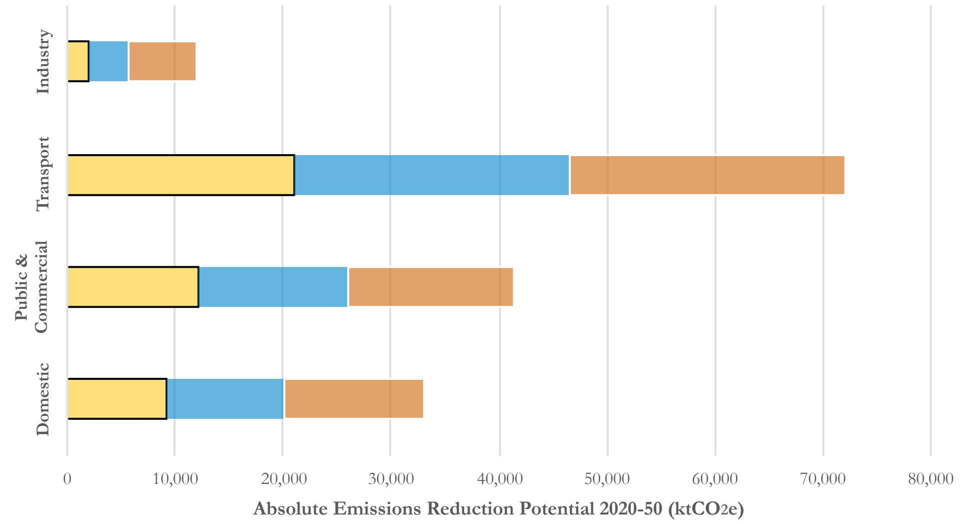
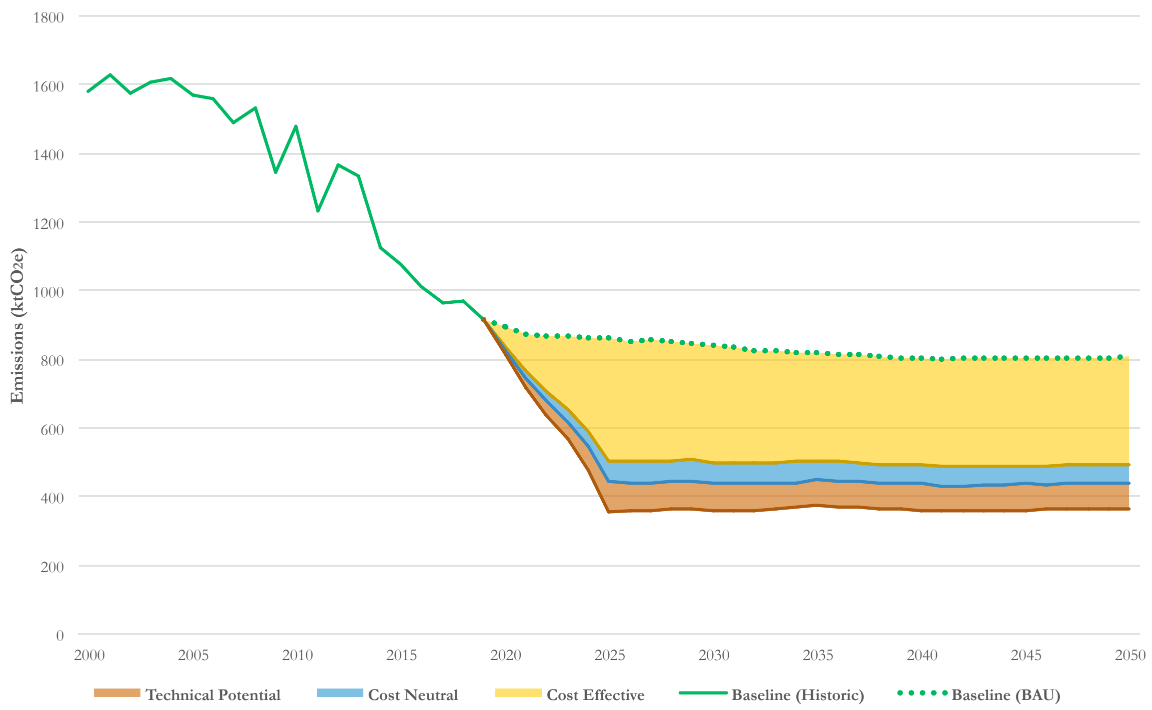


Figure 10: Cumbria's emissions reduction potential (2020-2037) by sector and economic scenario

For display and continuity purposes, each sector is displayed with a summary of the same metrics: (*1*) emissions reduction potential over time in the three economic scenarios; (*2*) five year totals for emissions savings, investment requirements and energy expenditure reductions; and (*3*) a simplified table of the most cost-effective low-carbon measures applied in each sector across Cumbria.

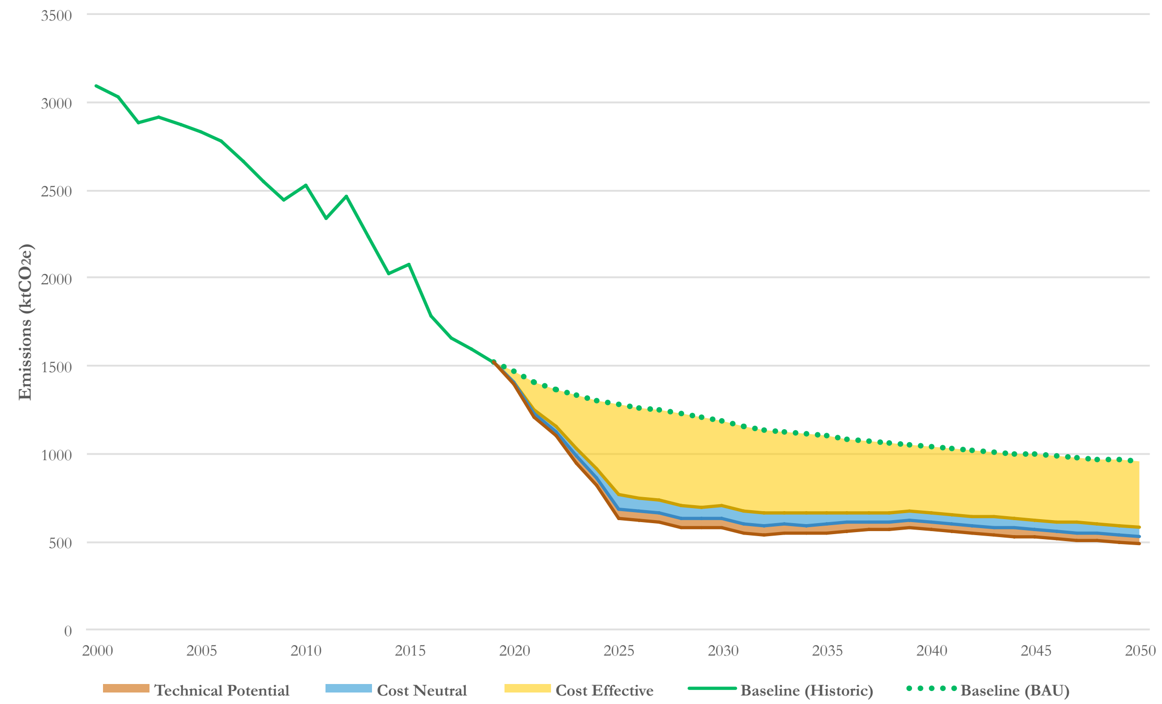
7.1 HOUSING



		2025	2030	2035	2040	2045	2050
Reduction on baseline emissions	CE	41%	41%	38%	39%	39%	39%
	CN	48%	48%	45%	46%	46%	46%
	TP	59%	57%	54%	55%	55%	55%
Reduction on present emissions	CE	40%	38%	35%	35%	35%	35%
	CN	47%	45%	41%	41%	41%	41%
	TP	57%	54%	49%	49%	49%	49%
Annual energy expenditure savings (£2020M)	CE	214	245	245	250	226	263
	CN	286	314	312	304	291	319
	TP	238	239	259	252	243	255
Cumulative investment (£2020M)	CE	1,280	1,667	1,667	1,667	1,667	1,667
	CN	1,688	2,198	2,198	2,198	2,198	2,198
	TP	2,458	3,201	3,201	3,201	3,201	3,201

Rank	Measure	Cost Effectiveness (£/ tCO_2e)
1	Electrical and appliance upgrades	-215
2	Electricity demand reduction	-138
3	Lighting improvements and upgrades	-135
4	Insulating homes	-74
5	Draughtproofing and fabric upgrades	-48
6	Installing heat pumps	-38
7	Upgraded heating controls and inputs	-30
8	Glazing improvements and upgrades	-28
9	Installing biomass boilers	-22
10	Solar thermal installations	-19

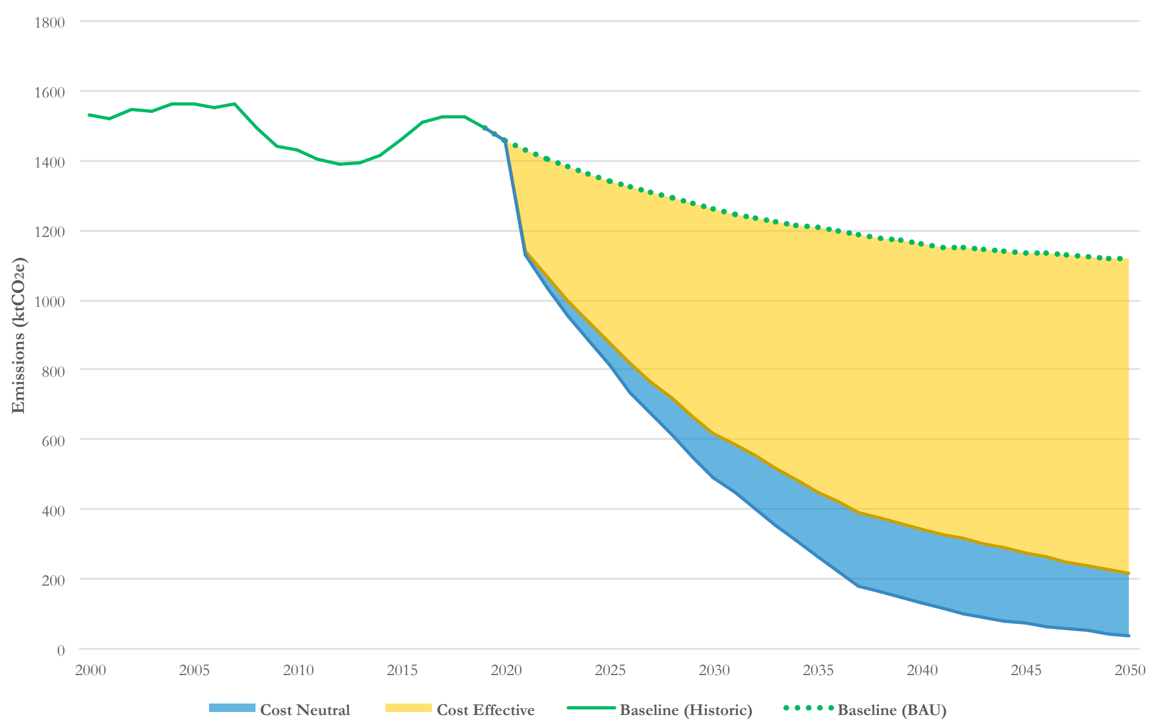
7.2 PUBLIC AND COMMERCIAL BUILDINGS



		2025	2030	2035	2040	2045	2050
Reduction on baseline emissions	CE	40%	41%	40%	36%	38%	39%
	CN	46%	47%	46%	41%	43%	45%
	TP	50%	51%	50%	45%	47%	49%
Reduction on present emissions	CE	35%	33%	30%	26%	26%	26%
	CN	40%	38%	34%	29%	29%	29%
	TP	44%	41%	37%	32%	32%	32%
Annual energy expenditure savings (£2020M)	CE	429	418	363	307	318	322
	CN	216	213	240	209	220	229
	TP	308	310	356	329	318	342
Cumulative investment (£2020M)	CE	1,073	1,397	1,397	1,397	1,397	1,397
	CN	1,626	2,118	2,118	2,118	2,118	2,118
	TP	2,189	2,850	2,850	2,850	2,850	2,850

Rank	Measure	Cost Effectiveness (£/ tCO_2e)
1	Fabric upgrades and improvements in retail buildings	-576
2	Improved cooling systems and monitoring in retail buildings	-431
3	Fabric improvements and upgrades in public buildings	-269
4	Lighting improvements and monitoring in public buildings	-214
5	Improved cooling systems and monitoring in office buildings	-180
6	Heating improvements and upgrades in public buildings	-142
7	Lighting improvements and monitoring in retail buildings	-126
8	Heating upgrades in office buildings	-90
9	Improved cooling in public buildings	-88
10	Lighting upgrades in office buildings	-51

7.3 TRANSPORT

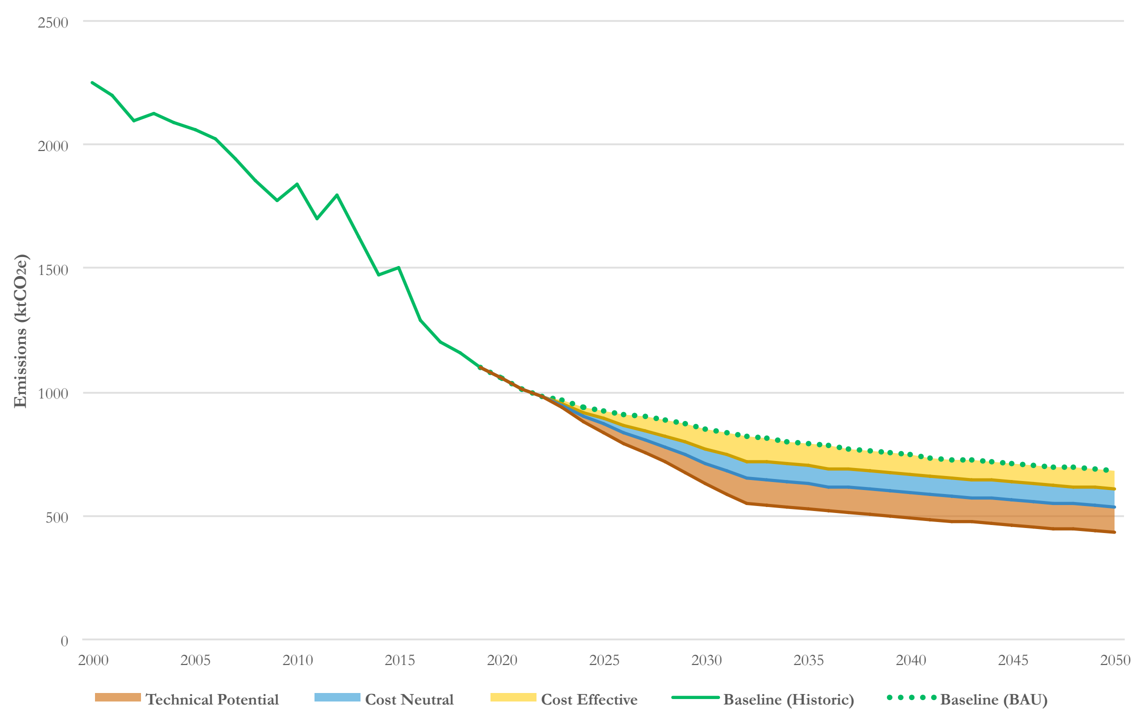


		2025	2030	2035	2040	2045	2050
Reduction on baseline reductions	CE	35%	51%	63%	70%	76%	81%
	CN	40%	61%	78%	89%	94%	97%
	TP	40%	61%	78%	89%	94%	97%
Reduction on present reductions	CE	32%	44%	52%	56%	59%	62%
	CN	36%	53%	65%	71%	73%	74%
	TP	36%	53%	65%	71%	73%	74%
Annual energy expenditure savings (£2020M)	CE	78	130	141	133	115	98
	CN	93	158	180	171	146	124
	TP	93	158	180	171	146	124
Cumulative investment (£2020M)	CE	380	451	460	460	460	460
	CN	623	938	960	960	960	960
	TP	623	938	960	960	960	960

Rank[3]	Measure	Cost Effectiveness (£/ tCO_2e)
1	Shift from diesel car to bus (diesel) journeys	-458
2	Shift from petrol car to bus (diesel) journeys	-373
3	Shift from diesel car to bicycle journeys	-345
4	Shift from diesel car to walk journeys	-345
5	Shift from petrol car to bicycle journeys	-323

3 Interventions in transport have been aggregated into five types reflecting different kinds of mode shift.

7.4 INDUSTRY



		2025	2030	2035	2040	2045	2050
Reduction on baseline reductions	CE	4%	10%	12%	11%	11%	11%
	CN	6%	16%	21%	21%	21%	21%
	TP	9%	26%	34%	34%	35%	36%
Reduction on present reductions	CE	3%	8%	9%	8%	7%	7%
	CN	5%	13%	15%	14%	14%	14%
	TP	8%	21%	25%	24%	24%	23%
Annual energy expenditure savings (£2020M)	CE	-24	-7	34	34	34	34
	CN	-41	-21	40	40	40	40
	TP	-176	-146	59	59	59	59
Cumulative investment (£2020M)	CE	61	214	305	305	305	305
	CN	98	343	490	490	490	490
	TP	375	1,312	1,875	1,875	1,875	1,875

Rank[4]	Measure	Cost Effectiveness (£/ tCO_2e)
1	Compressed air system upgrades in industry	-360
2	Fan process improvements in industry	-146
3	Boilers and steam piping upgrades in industry	21
4	Pump upgrades in industry	28
5	Improved furnace processes and heaters in industry	51
6	Upgrades to cooling and refrigeration in industry	662

4 For display purposes interventions in industry have been aggregated here into process type

8. Carbon reduction opportunities in Cumbria's districts

The emissions reduction potential for each of Cumbria's constituent districts is presented below, along with accompanying economic measures in five-year periods detailing investment requirements and energy expenditure reductions in each scenario. Five-year cumulative emissions savings for each district are also presented along with percentage reductions in emissions in relation to each district's business-as-usual baseline for a given year, and in relation to present (2020) emission outputs.

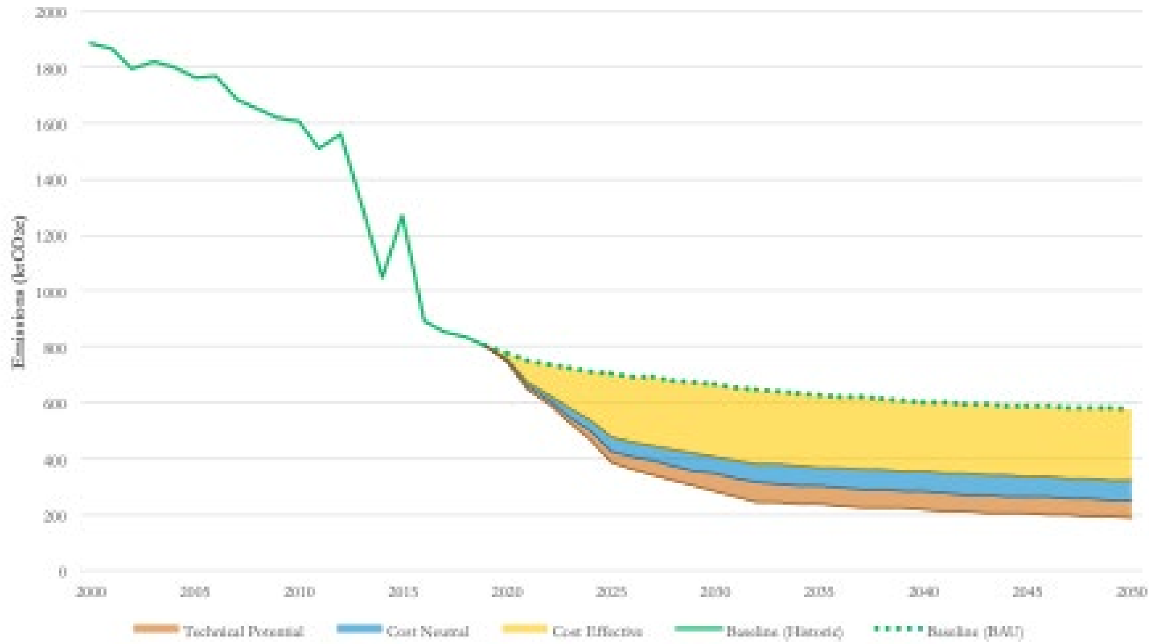
It is important to note that, although the potential for deployment for each separate intervention modelled varies between districts, the typical productivity of each measure (in energy, emissions and cost savings) remains fairly stable across the region. Varying economic and infrastructural characteristics between districts translate to different absolute emissions reductions potentials, but the districts as a whole accumulate to the same lifetime emissions reductions across the Cumbria region.

2050 District Totals		
Allerdale	Emissions savings (ktCO_2e)	10,583
	Investment (£2020M)	1,915
	Energy savings (£2020M)	152
Barrow-in-Furness	Emissions savings (ktCO_2e)	5,195
	Investment (£2020M)	1,192
	Energy savings (£2020M)	90
Carlisle	Emissions savings (ktCO_2e)	12,697
	Investment (£2020M)	1,931
	Energy savings (£2020M)	184
Copeland	Emissions savings (ktCO_2e)	5,611
	Investment (£2020M)	929
	Energy savings (£2020M)	77
Eden	Emissions savings (ktCO_2e)	13,011
	Investment (£2020M)	1,224
	Energy savings (£2020M)	107
South Lakeland	Emissions savings (ktCO_2e)	13,845
	Investment (£2020M)	1,695
	Energy savings (£2020M)	170

Table 5: Summary of Cumbria's district emissions and investment opportunities totals (to 2050)

8.1 ALLERDALE

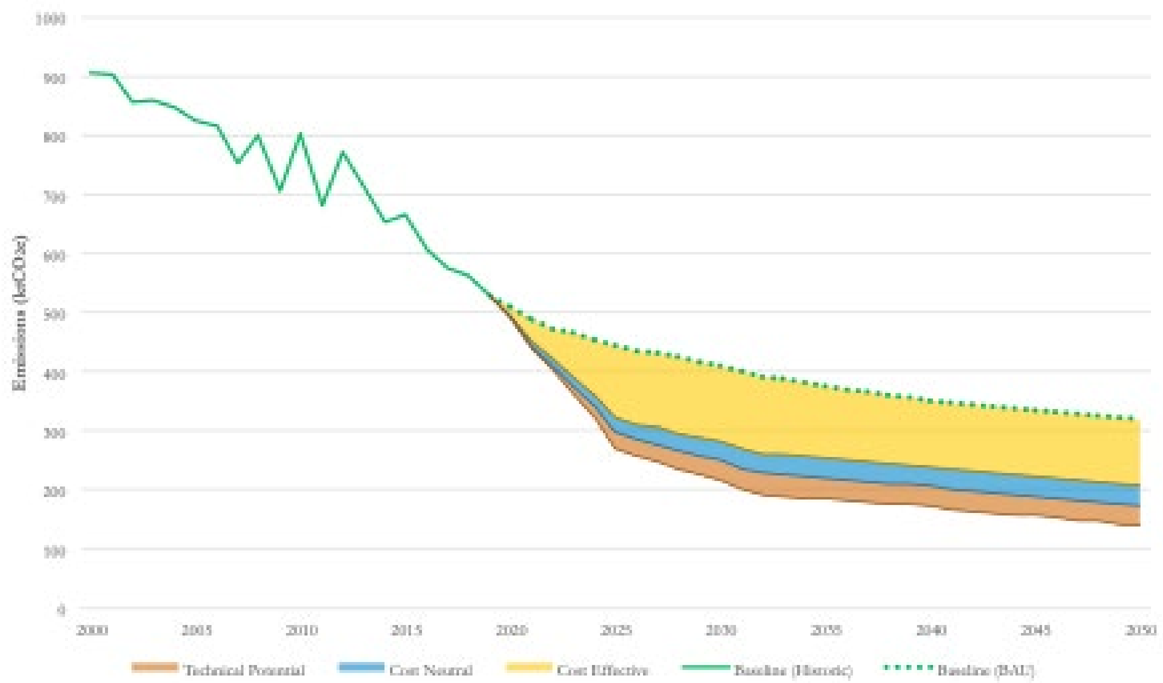
- Emissions fell by 58% between 2000 and 2020, and are projected to fall by 66% between 2000 and 2037.
- The gap between projected emissions in 2037 and net zero could be closed by 41% with investments of £676m that would more than pay for themselves by reducing the £231m annual energy bill by approximately £140m a year by 2037.
- This could create 2080 years of extra employment (or 104 jobs all running for a period of 20 years) within the district.



		2025	2030	2035	2040	2045	2050
Reduction on **baseline** reductions	CE	32%	38%	41%	41%	43%	44%
	CN	39%	48%	52%	53%	55%	57%
	TP	45%	57%	62%	64%	66%	67%
Reduction on **present** reductions	CE	29%	33%	33%	32%	32%	33%
	CN	36%	41%	42%	41%	42%	42%
	TP	41%	49%	51%	50%	50%	50%
Annual energy expenditure savings (£2020M)	CE	132	146	143	135	137	139
	CN	106	123	149	140	140	141
	TP	85	99	171	160	155	152
Cumulative investment (£2020M)	CE	479	651	676	676	676	676
	CN	844	1,176	1,216	1,216	1,216	1,216
	TP	1,180	1,768	1,915	1,915	1,915	1,915

8.2 BARROW-IN-FURNESS

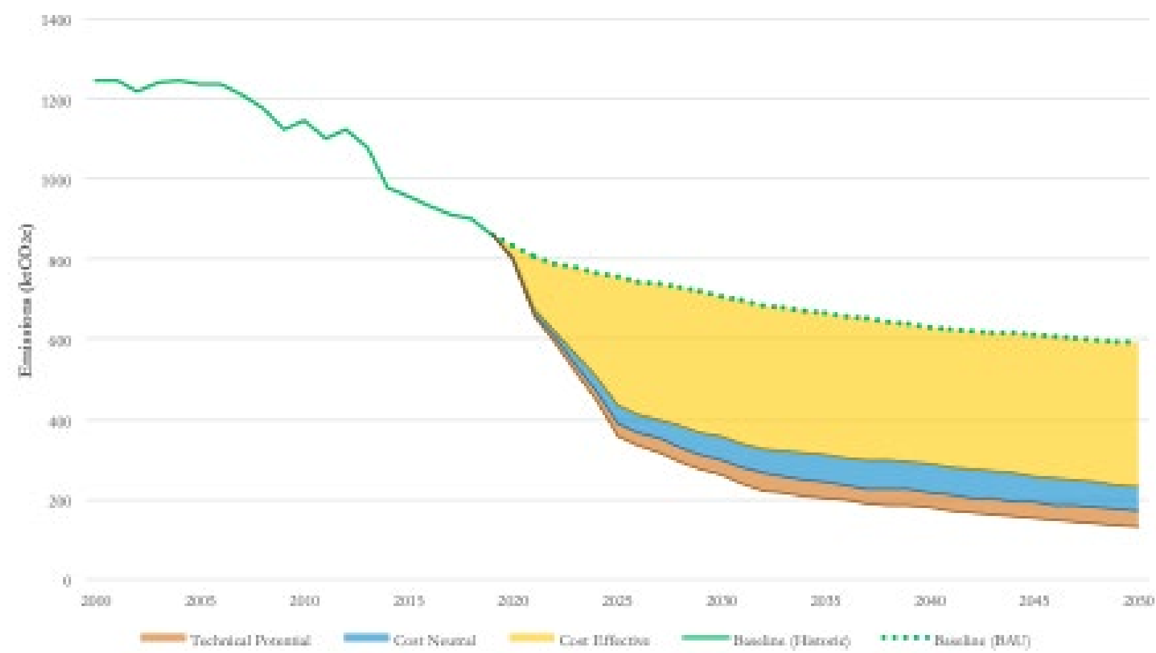
- Emissions fell by 43% between 2000 and 2020, and are projected to fall by 56% between 2000 and 2037.
- The gap between projected emissions in 2037 and net zero could be closed by 32% with investments of £427m that would more than pay for themselves by reducing the £139m annual energy bill by approximately £79m a year by 2037.
- This could create 1,317 years of extra employment (or 66 jobs all running for a period of 20 years) within the district.



		2025	2030	2035	2040	2045	2050
Reduction on **baseline** reductions	CE	28%	31%	33%	32%	34%	35%
	CN	33%	39%	42%	41%	44%	46%
	TP	39%	47%	51%	51%	53%	56%
Reduction on **present** reductions	CE	24%	25%	24%	22%	22%	22%
	CN	29%	31%	31%	29%	29%	29%
	TP	34%	38%	38%	35%	35%	35%
Annual energy expenditure savings (£2020M)	CE	74	85	93	79	78	81
	CN	60	70	88	79	81	84
	TP	43	51	100	92	90	90
Cumulative investment (£2020M)	CE	293	408	427	427	427	427
	CN	496	692	720	720	720	720
	TP	727	1,094	1,192	1,192	1,192	1,192

8.3 CARLISLE

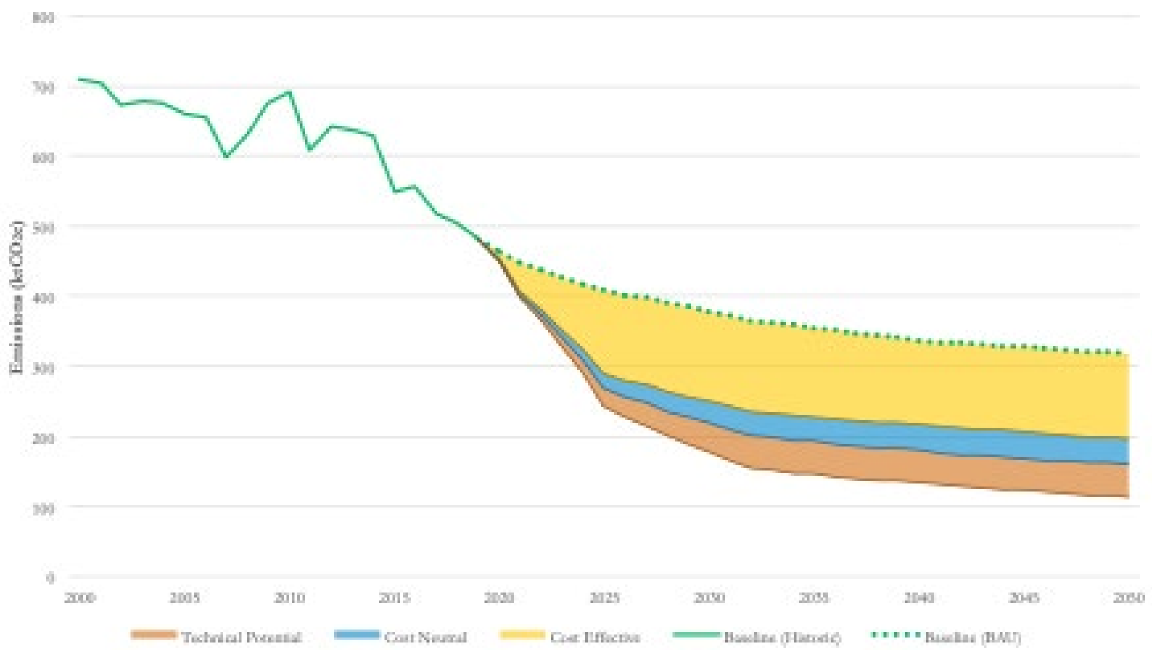
- Emissions fell by 32% between 2000 and 2020, and are projected to fall by 48% between 2000 and 2037.
- The gap between projected emissions in 2037 and net zero could be closed by 55% with investments of £922m that would more than pay for themselves by reducing the £323m annual energy bill by approximately £178m a year by 2037.
- This could create 2,843 years of extra employment (or 142 jobs all running for a period of 20 years) within the district.



		2025	2030	2035	2040	2045	2050
Reduction on **baseline** reductions	CE	43%	50%	53%	55%	58%	61%
	CN	49%	58%	63%	66%	69%	71%
	TP	53%	63%	69%	72%	75%	78%
Reduction on **present** reductions	CE	39%	42%	42%	41%	42%	43%
	CN	44%	49%	51%	50%	50%	51%
	TP	48%	54%	55%	54%	55%	55%
Annual energy expenditure savings (£2020M)	CE	180	203	182	173	160	165
	CN	133	153	168	164	154	156
	TP	110	141	190	184	174	184
Cumulative investment (£2020M)	CE	676	901	922	922	922	922
	CN	910	1,250	1,281	1,281	1,281	1,281
	TP	1,277	1,830	1,931	1,931	1,931	1,931

8.4 COPELAND

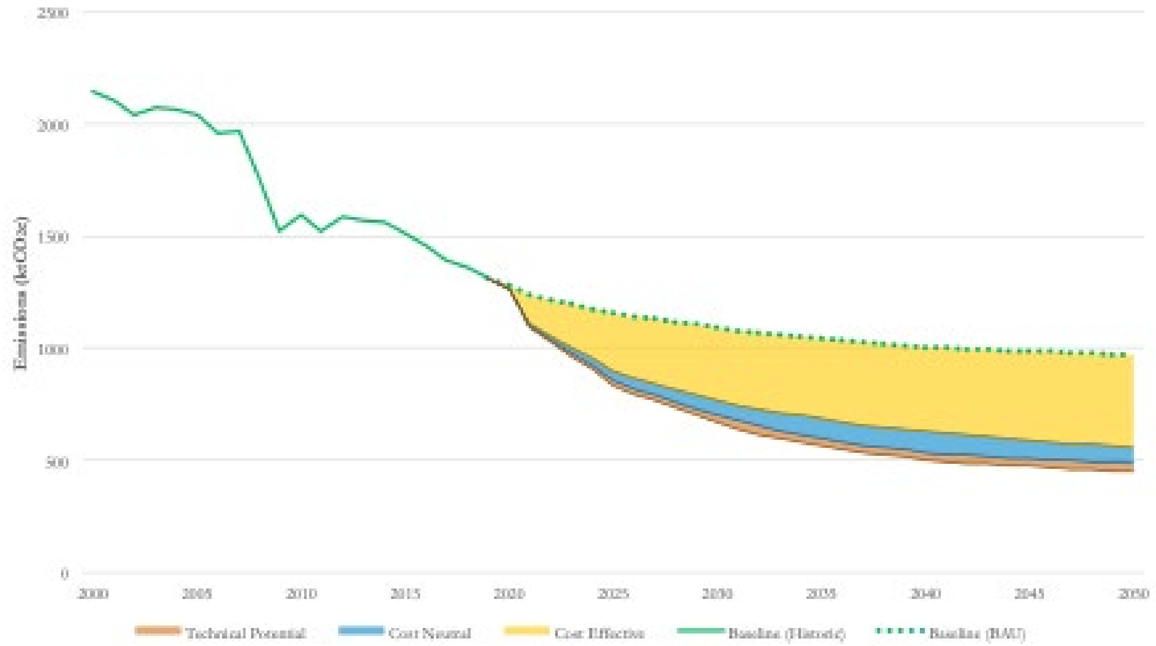
- Emissions fell by 34% between 2000 and 2020, and are projected to fall by 51% between 2000 and 2037.
- The gap between projected emissions in 2037 and net zero could be closed by 36% with investments of £922m that would more than pay for themselves by reducing the £323m annual energy bill by approximately £178m a year by 2037.
- This could create 2,843 years of extra employment (or 142 jobs all running for a period of 20 years) within the district.



		2025	2030	2035	2040	2045	2050
Reduction on **baseline** reductions	CE	29%	34%	36%	36%	37%	38%
	CN	34%	42%	46%	47%	48%	50%
	TP	41%	53%	59%	61%	62%	64%
Reduction on **present** reductions	CE	26%	28%	27%	26%	26%	26%
	CN	30%	34%	35%	34%	34%	34%
	TP	36%	43%	45%	44%	44%	44%
Annual energy expenditure savings (£2020M)	CE	71	77	77	74	68	75
	CN	57	68	79	76	72	73
	TP	46	50	83	78	77	77
Cumulative investment (£2020M)	CE	284	377	385	385	385	385
	CN	382	531	548	548	548	548
	TP	568	856	929	929	929	929

8.5 EDEN

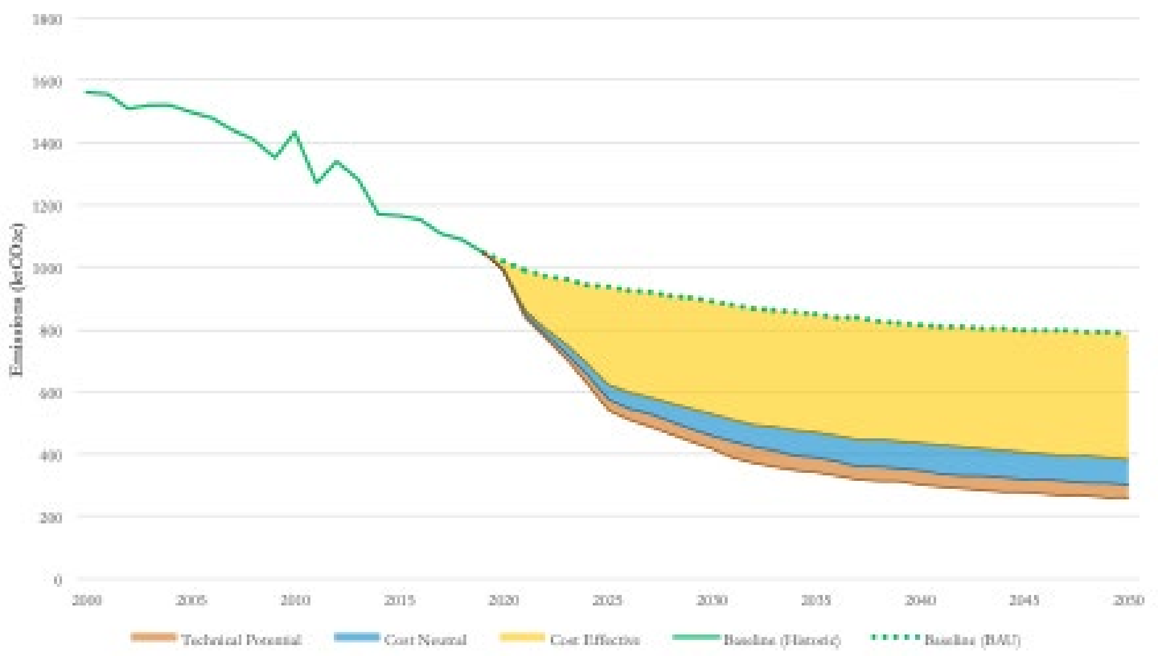
- Emissions fell by 43% between 2000 and 2020, and are projected to fall by 52% between 2000 and 2037.
- The gap between projected emissions in 2037 and net zero could be closed by 37% with investments of £596m that would more than pay for themselves by reducing the £401m annual energy bill by approximately £102m a year by 2037.
- This could create 1,838 years of extra employment (or 92 jobs all running for a period of 20 years) within the district.



		2025	2030	2035	2040	2045	2050
Reduction on **baseline** reductions	CE	23%	30%	34%	37%	40%	43%
	CN	26%	36%	43%	47%	49%	50%
	TP	28%	39%	46%	50%	52%	53%
Reduction on **present** reductions	CE	21%	25%	28%	30%	31%	33%
	CN	24%	31%	35%	37%	38%	38%
	TP	26%	33%	38%	39%	40%	41%
Annual energy expenditure savings (£2020M)	CE	90	106	106	99	97	98
	CN	76	100	115	105	101	99
	TP	65	89	125	115	106	107
Cumulative investment (£2020M)	CE	449	584	596	596	596	596
	CN	589	820	842	842	842	842
	TP	786	1,151	1,224	1,224	1,224	1,224

8.6 SOUTH LAKELAND

- Emissions fell by 32% between 2000 and 2020, and are projected to fall by 45% between 2000 and 2037.
- The gap between projected emissions in 2037 and net zero could be closed by 47% with investments of £824m that would more than pay for themselves by reducing the £382m annual energy bill by approximately £175m a year by 2037.
- This could create 2,541 years of extra employment (or 127 jobs all running for a period of 20 years) within the district.



		2025	2030	2035	2040	2045	2050
Reduction on **baseline** reductions	CE	33%	41%	45%	47%	49%	51%
	CN	38%	48%	54%	58%	60%	62%
	TP	42%	53%	60%	63%	65%	67%
Reduction on **present** reductions	CE	31%	35%	37%	37%	39%	40%
	CN	35%	42%	45%	46%	47%	48%
	TP	39%	46%	50%	50%	51%	52%
Annual energy expenditure savings (£2020M)	CE	151	169	183	164	154	159
	CN	120	150	173	161	150	158
	TP	114	130	186	182	163	170
Cumulative investment (£2020M)	CE	613	807	824	824	824	824
	CN	814	1,128	1,158	1,158	1,158	1,158
	TP	1,107	1,603	1,695	1,695	1,695	1,695

9. Innovative stretch measures in Cumbria

Even with full delivery of the broad programme of cross-sectoral, area-wide low-carbon investment described above, there remains an emissions shortfall of 43% between Cumbria's 2037 BAU baseline and the net zero target. Here we briefly consider the productivity of certain key technologies and interventions that may well be able to plug this gap into the future. Many of these so-called 'stretch options' are innovative by nature but they will be required to reach Cumbria's targets in future.

		2025	2030	2035
Annual emissions reduction potential ($ktCO_2e$)	Zero carbon heavy goods transport	111	250	250
	Electrification of industrial heating and cooling	267	600	600
	Electrification of domestic heating	222	500	500
	Electrification of domestic cooking	27	60	60
	Electrification of commercial/public heating	244	550	550
	3500 Ha. of tree planting annually 2020-29*	-144	-382	-573

Table 7: Stretch measures' decarbonising potential (* sequestration values)

Figure 12 below shows the impact that the adoption of these stretch measures would have on Cumbria's carbon emissions, with the red dotted line showing the business-as-usual baseline, the yellow dotted line showing emissions after adoption of all technically viable options and the blue dotted line showing emissions after all technically viable and stretch options in Table 7 other than tree planting. This indicates that Cumbria would still have some residual emissions until after 2037.

In theory at least, Cumbria could sequester these residual emissions and achieve carbon neutrality by 2033 through nature-based approaches such as tree planting or peatland conservation or restoration. As well as sequestering carbon emissions, such approaches can also make important contributions to the protection of biodiversity, the enhancement of flood protection and the improvement of public health and wellbeing. However, we should not underestimate the scale of the activities needed to make a significant impact on carbon emissions. For illustration, and as represented in the green shaded area in Figure 12, just to offset Cumbria's residual emissions (i.e. those left after ambitious levels of decarbonisation of housing, transport and industry in the county) would require the planting of 155 million trees. Even with the densest possible planting, this would require 35,000 hectares of land, equivalent to 3% of the total land area of Cumbria. The scale and extent of the tree planting required to sequester residual emissions could be reduced through peatland conservation or restoration, but this finding highlights the need for carbon emissions to be addressed at source rather than through any significant dependence on sequestering.

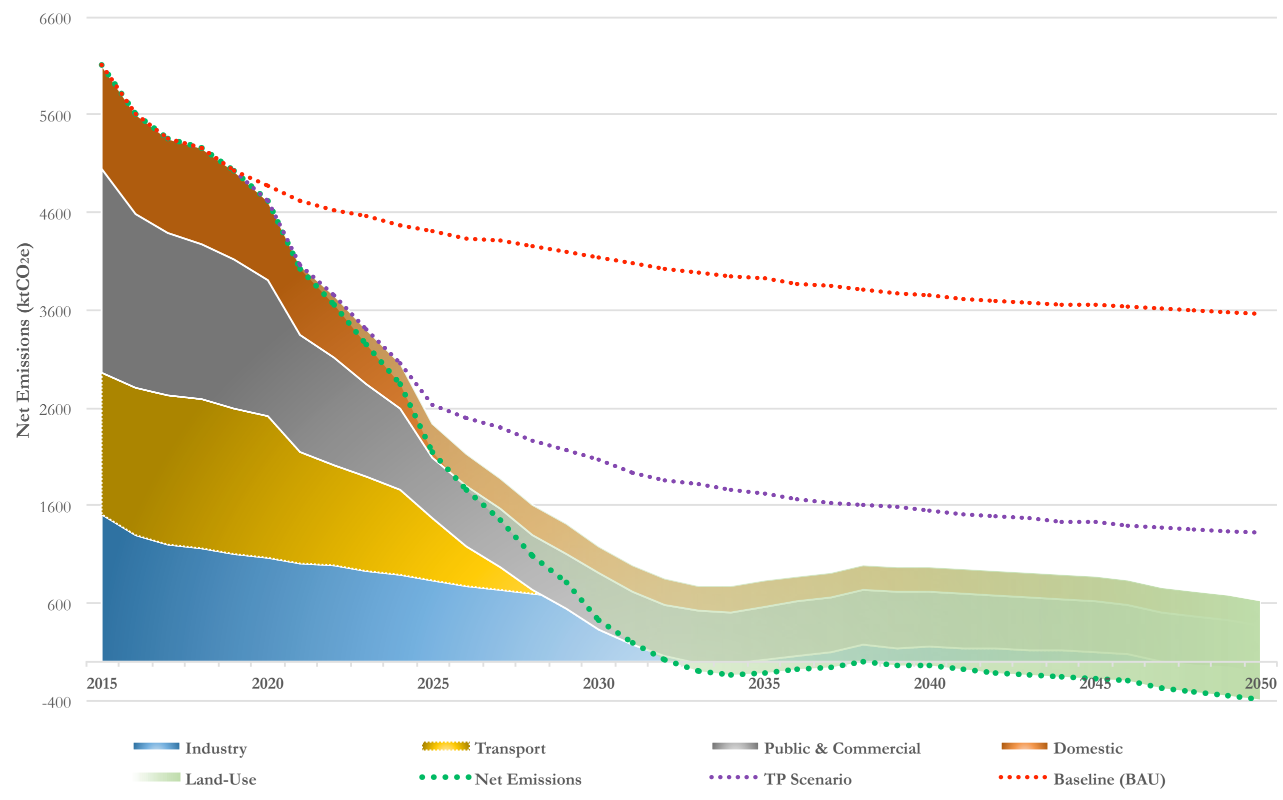


Figure 12: Sectoral emissions shortfall reduction with stretch measures

Appendices

APPENDIX 1A: League table of the most carbon-effective options for Cumbria

APPENDIX 1B: League table of the most cost-effective options for Cumbria

APPENDIX 1A.
League table of the most carbon-effective options for Cumbria

Measure[5]	Emissions Reduction Potential ($ktCO_2e$)
Fabric improvements in retail buildings	3,344
Improved furnace processes and heaters in industry	3,293
Petrol car to bicycle	2,733
Petrol car to walk	2,733
Boilers and steam piping upgrades in industry	2,515
Fabric improvements in public buildings	2,198
Petrol car to bus (electric)	2,084
Insulating domestic buildings	2,076
Diesel car to bicycle	1,996
Diesel car to walk	1,996
Upgraded heating controls in domestic buildings	1,939
Petrol car to EV	1,888
Petrol car to bus (diesel)	1,698
Petrol car to plug-in hybrid	1,614
Petrol car to hybrid	1,614
Diesel car to EV	1,592
Electrical upgrades in domestic buildings	1,535
Installing heat pumps in domestic buildings	1,497
Diesel car to bus (electric)	1,466
Heating improvements in public buildings	1,383
Diesel car to plug-in hybrid	1,187
Upgraded boilers in domestic buildings	1,104
Electricity demand reduction in domestic buildings	1,089
Installing air source heat pumps in office buildings	1,061
Hybrid car to EV	1,032
Installing solar PV in domestic buildings	1,018
Diesel car to bus (diesel)	961
Solar thermal devices in public buildings	960
Lighting improvements in office buildings	861
Solar thermal devices in retail buildings	815
Plug-in hybrid car to EV	678
Wind microgeneration associated with public buildings	669
Lighting improvements in domestic buildings	632
Draught-proofing in domestic buildings	589
Installing biomass boilers in domestic buildings	578
Improved lighting controls and sensors in public buildings	576
Upgrading heating controls in office buildings	556
Improved lighting controls and sensors in office buildings	556
Improved cooling in office buildings	552
Glazing improvements in domestic buildings	523
Improved lighting controls and sensors in retail buildings	466
Solar thermal devices in domestic buildings	442
Lighting improvements in public buildings	428

5 Measures listed here have been grouped and summed across multiple applications for display purposes

Diesel car to hybrid	284
Heating improvements in retail buildings	271
Compressed air system upgrades in industry	137
Pump upgrades in industry	105
Installing solar PV in public buildings	85
Fan process improvements in industry	70
Fabric improvements in office buildings	66
Improved cooling in public buildings	64
Improved cooling in retail buildings	43
Installing solar PV in office buildings	31
Heating improvements in office buildings	30
Installing air source heat pumps in retail buildings	29
Upgraded heating controls in retail buildings	26
Installing air source heat pumps in public buildings	26
Lighting improvements in retail buildings	25
Wind microgeneration associated with retail buildings	25
Upgraded heating controls in public buildings	24
Solar thermal devices in office buildings	23
Installing solar PV in retail buildings	22
Wind microgeneration associated with office buildings	20
Upgrades to cooling and refrigeration in industry	16
TOTAL	59,946

APPENDIX 1B.
League table of the most cost-effective options for Cumbria

Measure[6]	Cost Effectiveness (£/tCO_2e)
Fabric improvements in retail buildings	-576
Diesel car to bus (diesel)	-458
Improved cooling in retail buildings	-431
Petrol car to bus (diesel)	-373
Compressed air system upgrades in industry	-360
Diesel car to bicycle	-345
Diesel car to walk	-345
Petrol car to bicycle	-323
Petrol car to walk	-323
Fabric improvements in public buildings	-269
Electrical upgrades in domestic buildings	-215
Petrol car to plug-in hybrid	-214
Lighting improvements in public buildings	-214
Improved cooling in office buildings	-180
Fan process improvements in industry	-146
Petrol car to EV	-145
Heating improvements in public buildings	-142
Electricity demand reduction in domestic buildings	-138
Diesel car to plug-in hybrid	-136
Lighting improvements in domestic buildings	-135
Petrol car to bus (electric)	-134
Lighting improvements in retail buildings	-126
Petrol car to hybrid	-114
Heating improvements in office buildings	-90
Improved cooling in public buildings	-88
Insulating domestic buildings	-74
Diesel car to bus (electric)	-71
Diesel car to EV	-55
Lighting improvements in office buildings	-51
Heating improvements in retail buildings	-48
Draughtproofing in domestic buildings	-48
Fabric improvements in office buildings	-41
Installing heat pumps in domestic buildings	-38
Upgraded heating controls in domestic buildings	-30
Glazing improvements in domestic buildings	-28
Upgrading heating controls in office buildings	-28
Installing biomass boilers in domestic buildings	-22
Solar thermal devices in domestic buildings	-19
Hybrid car to EV	-18
Upgraded heating controls in public buildings	-12
Diesel car to hybrid	-12
Upgraded boilers in domestic buildings	-11
Upgraded heating controls in retail buildings	-8
Installing air source heat pumps in retail buildings	-1
Installing solar PV in domestic buildings	3
Installing air source heat pumps in public buildings	11
Solar thermal devices in retail buildings	18
Boilers and steam piping upgrades in industry	21
Pump upgrades in industry	28
Improved lighting controls and sensors in retail buildings	29
Installing air source heat pumps in office buildings	33
Installing solar PV in public buildings	37
Installing solar PV in office buildings	50
Improved furnace processes and heaters in industry	51
Installing solar PV in retail buildings	52
Solar thermal devices in public buildings	73
Improved lighting controls and sensors in office buildings	77
Solar thermal devices in office buildings	114
Wind microgeneration associated with office buildings	150
Improved lighting controls and sensors in public buildings	177
Wind microgeneration associated with public buildings	190
Wind microgeneration associated with retail buildings	316
Plug-in hybrid car to EV	425
Upgrades to cooling and refrigeration in industry	662

6 Measures listed here have been grouped and summed across multiple applications for display purposes. The cost per tonne of emissions reduction displayed here are mean values across applications.

Appendix 2

ESTIMATES OF GREEN JOBS IN CUMBRIA

Anne Chapman
Jonathan Essex

February 2021

Green House Think Tank

Contact:
www.greenhousethinktank.org

Contents

1. Introduction

Since 2016, Green House has been carrying out work on estimating the number of jobs that would be created by a transition to a zero carbon economy; an economy where we take climate change seriously and reduce emissions of greenhouse gases in line with the aspiration to limit global warming to 1.5 degrees.[1] We have taken a location specific approach, combining data on population, buildings, transport and land use for particular locations, a vision of where we want to be in terms of buildings insulated, or renewable energy systems installed, with information about the amount of work involved in getting there. This has enabled us to estimate the number of jobs in particular localities. We started by looking at the Isle of Wight (Essex and Sims, 2017) then the Sheffield City Region (Essex and Sims 2018) then the whole of the UK by local authority area (Chapman, Essex and Sims 2018). These reports were produced with the Green European Foundation.[2]

For this project we have revised the results of our 2018 work for Cumbria, including changing from a 12 year (2018-2030) to a 15 year transition period – from 2022 to 2037.

1 See IPCC (2018) Special Report: Global Warming of 1.5°C. https://www.ipcc.ch/sr15/

2 The first two reports were part of a project on Ecological Production in a Post-Growth Society (https://gef.eu/project/ecopro) and the third Strengthening Climate Targets, Creating Local Climate Jobs (https://gef.eu/project/local-climate-jobs). The Green European Foundation projects were carried out with the financial support of the European Parliament to the Green European Foundation.

2. Methodology

Our model combines:

- **A zero carbon vision** and how this would impact on each sector in practical terms;
- **Published data** about the geographic area of interest, such as land area, population, waste generation, renewable energy potential *etc.*; and
- **'Job metrics'** – hours of work and hence numbers of jobs per activity, derived from published sources.

These are combined in a spreadsheet to give an estimate for the number of jobs in each sector during a 15-year transition period (2022 to 2037) and in the longer term. The transition and long-term jobs are estimated separately as they are for essentially different activities (*e.g.* installing and then maintaining renewable energy systems). In calculating the number of transition period jobs we have assumed that the activities required to bring about the transition, such as installing renewable energy systems or insulating homes, are spread equally throughout the 15-year transition period. This is unlikely to be the case in many sectors where it takes time to train people and build up the workforce required. In reality the number of jobs will be lower in the first year and a lot higher towards the end of the transition period, so more people will be required than indicated by the average number of full-time equivalent jobs.

Long-term jobs will not just start from the end of the transition period, but grow as the transition is implemented. If half the transition has happened halfway through the transition period, half of the long-term jobs will, on average, exist in the transition period.

Many of the jobs created by a transition to zero carbon in Cumbria will not necessarily be located in Cumbria – for example, jobs manufacturing low-carbon heating systems or solar photovoltaic panels could be elsewhere in the country or abroad. These jobs have not been included in our estimates. Rather we have estimated the jobs involved in installing heat pumps or solar panels; in driving and maintaining buses but not the manufacture of electric buses. We have allocated these jobs to districts where the work will take place. This does not mean that the jobs will necessarily be based there as companies may set up elsewhere and travel to do the work.

The sectors included in this report are:

- **Renewable electricity generation**
- **Buildings and heat**
- **Transport**
- **Reuse and recycling of waste**

Our 2018 work also included modelling of jobs in agriculture and forestry, but that is not included here.

Where information is available, we have subtracted the jobs that will be lost in current fossil fuel dependent activities, such as in the maintenance of internal combustion engine vehicles, or offshore gas extraction. Many people will need training or support of some kind to take up the new jobs so we have included an estimate for such 'support jobs', calculated from the total number of jobs.

An overview of our method is given in Figure 2.1. A map of Cumbria is shown in Figure 2.2, and information about population and land area in Table 2.1.

Figure 2.1 Overview of methodology

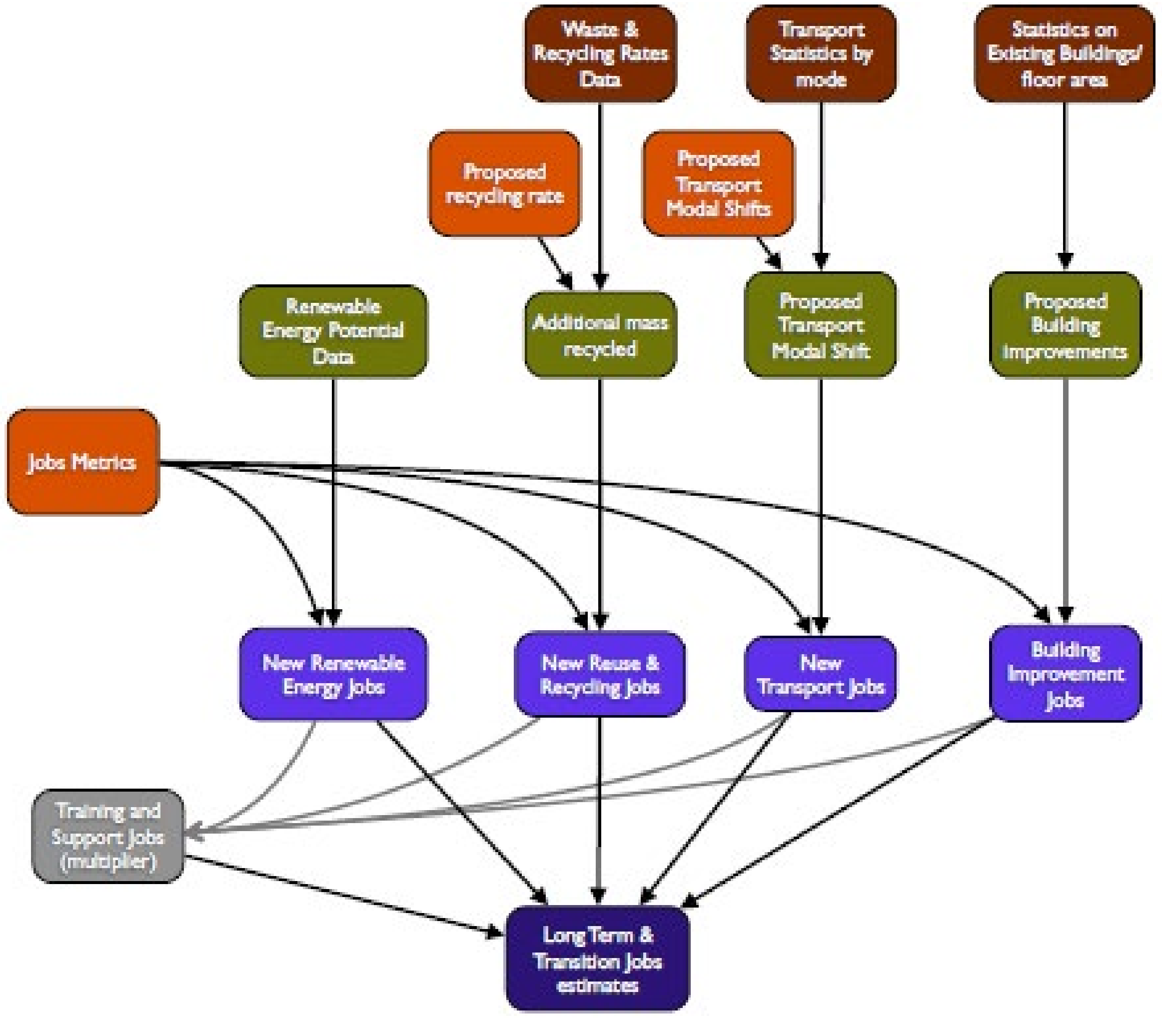


Table 2.1 Cumbria population and land area

District	Population 2020 [1]	Population 2037 [2]	Area km²	Population density people per km²
Allerdale	97,761	98,998	1,242	79
Copeland	68,183	63,585	7,321	93
Barrow-in-Furness	67,049	63,405	12	5,541
Carlisle	108,678	108,334	1,040	104
Eden	53,253	54,490	2,142	25
South Lakeland	105,088	109,650	1,534	69
Cumbria Total	**500,012**	**498,462**	**6,702**	**75**

[1] From ONS mid 2019-April 2020 population estimates
[2] From ONS 2018-based population projections (published March 2020)

Figure 2.2 Cumbria

Source: https://www.cumbria.gov.uk/roads-transport/public-transport-road-safety/transport/publictransport/busserv/timetables/

3. Renewable Electricity Generation

VISION: An energy system powered by renewable energy, where electricity is used for most transport and heating as well as its current uses.

This section considers the potential for increasing the amount of renewable electricity generated in Cumbria and estimates the number of new jobs that would create. Decarbonising our energy system means moving away from fossil fuels – such as petrol and diesel in vehicles, as well as fuel oil and gas to heat our homes and other buildings – and instead using electricity generated from renewable sources.[3] Because most renewable generation is intermittent, dependent on the wind, sun or flow of water, we also need to be smarter at using it by managing demand so that it more closely matches supply, and to find ways of storing it, such as batteries, or by using it to create hydrogen from water by electrolysis (termed 'green hydrogen'). The hydrogen could then be used as a transport or heating fuel or to produce 'synthetic fuels', both liquid and gas. These could be used to generate electricity (using existing gas generation capacity) at times where there is a shortage of supply, or be used as a fuel for vehicles that cannot easily be electrified, such as heavy goods vehicles, aircraft and shipping.[4]

The latest annual review by the Association for Renewable Energy and Clean Technology (REA), published in 2020 but covering the financial year 2017/18, says that in the UK as a whole there were 128,954 people employed in over 6,600 companies in the renewable energy sector (not just electricity generation) (REA, 2020, p.8). REA considers that this number could almost double by 2030 if the right policies were put in place (ibid p.27).

3.1 EXISTING AND POTENTIAL RENEWABLE GENERATION IN CUMBRIA

Cumbria has plentiful renewable energy resources and currently generates a little over 1 GWh of electricity each year from onshore renewables. In addition, there are a substantial number of offshore wind turbines in the Irish Sea west of Barrow. These offshore turbines are serviced from Barrow, where Dong Energy, who operate them, employs 180 people.[5] In addition, there is the Robin Rigg wind farm in the Solway Firth, which is serviced from Workington, where E.ON employs 40 people,[6] though some boats servicing it are based in Whitehaven.[7]

Onshore renewables in Cumbria currently generate nearly 40% of the electricity used within the county. If offshore renewables are included, Cumbria generates almost twice what is needs (see Table 3.2). However, as a very rural county with plenty of wind resource in particular, Cumbria should be a net exporter of renewable energy if the UK as a whole is to be self-sufficient.

3 This follows the scenario set out in the Zero Carbon Britain reports, see CAT, 2019
4 Royal Society, 2019
5 http://fedf.co.uk/supply-chain/how-to-supply-to/dong-energy
6 https://en.wikipedia.org/wiki/Robin_Rigg_Wind_Farm
7 Information from consultation. We do not know how many people are employed on offshore wind in Whitehaven.

The potential for renewable energy in Cumbria was investigated in 2011 by SQW and Land Use Consultants. Their report was intended to assist with planning policies for renewable energy, so, in identifying capacity, the Lake District National Park and the part of the Yorkshire Dales National Park that is in Cumbria were treated separately, whereas data on current installed capacity is for the districts, including the areas within them that are part of a national park. Tables A1 to A5 (in Appendix 2A) show the capacity identified in the SQW report compared with that which had been installed by the end of 2018 for onshore wind, hydro, anaerobic digestion, plant biomass and landfill gas. Subtracting the installed capacity from the capacity identified in 2011 gives a 'remaining capacity'. In some cases more capacity has been installed than expected, which results in a negative remaining capacity for a district, though this may be because the identified capacity was in a national park.

More generating capacity using plant biomass and landfill gas has been installed than predicted in 2011. Much of the plant biomass capacity is accounted for by a 50MW combined heat and power (CHP) plant installed at the Iggesund paper mill in Workington (in Allerdale) in 2013. This uses wastes from the paper production process, which imports wood from outside Cumbria, though they are attempting to increase the local supply of biomass.[8]

Since 2011 wind turbines have become much larger. Larger turbines are able to generate much more electricity as the amount that can be generated is proportional to the area swept by the blades, so increases fourfold if the length of the blades are doubled. Three wind farms in Cumbria have already been repowered,[9] increasing their capacity from 6.62 to 18.86MW. If all the other existing wind farms in Cumbria were repowered this could create an additional 361MW of generating capacity (see Table A6).

The solar capacity predicted in 2011 (of 150.5MW) was all small-scale microgeneration. Since 2011 the price of solar panels has fallen substantially and large-scale solar farms are now viable. Table A7 shows the number of solar installations registered for the feed-in tariff (and therefore <5MW) in each district, on domestic properties and non-domestic installations, at the end of 2019. Comparison with the total installed capacity of solar PV in 2019 suggests there are 58MW of solar PV in Cumbria, 27MW of that in Allerdale,[10] which is not registered for FITs, presumably because it consists of large-scale solar farms, though some smaller systems may have been installed after the end of the FIT scheme in March 2019.

We propose a possible scenario for what further solar PV could be installed in Cumbria, set out in Box 3.1.

8 See p.45 of Carbon Trust, 2018 and https://www.iggesund.com/sustainability/raw-material/fossil-free-energy/
9 Great Orton (Allerdale), Harlock Hill (South Lakeland) and Haverigg III (Copeland). See RenewableUK, 2019.
10 Much of this will be the Aspatria Solar farm, which consists of 19MW of solar PV on 34.8ha (http://www.renewables-map.co.uk/project.asp?pageid=3759)

Box 3.1 Solar PV proposed scenario

Domestic Solar PV		
Percentage of properties with solar PV increased to	20%	
Average capacity per installation	3.5	kWp
Public and community buildings rooftop		
Number of systems equivalent to number of buildings with Display Energy Certificates		
Average capacity per installation	20	kWp
Industrial/commercial buildings rooftop		
Percentage land area that is suitable roof space [1]	5%	
Area of roof space required for 1kWp of roof-mounted PV [2]	10	Sq m
Ground mounted solar		
Percentage of mineral extraction site land (once these cease operation) [1]	10%	
Percentage of pastureland [1]	1%	
Land required for 1MW of ground mounted solar PV [3]	1.62	Ha

[1] Land areas obtained from: https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=metadata. Pastureland with solar PV panels can still be used for sheep grazing, so is not taken out of permanent pasture. The pastureland category does not include 'moors and heathland' or 'natural grasslands'.

[2] A solar buyers' guide produced by the Energy Managers Association says between 6.5m2 on a pitched roof and 12m2 on a flat roof is required for each kW of power. From https://www.lowcarbonenergy.co/wp-content/uploads/2016/03/solar-buyers-guide.pdf

[3] https://www.solar-trade.org.uk/solar-farms/

The percentage of domestic properties currently with solar PV ranges from 1% in Barrow to 5% in Eden (see Table A8). Increasing this to 20% of properties with an average of 3.5kW per property (less than the current average) results in just over 47,000 new solar PV systems, with a total capacity of 166MW. At the rate of new house building between 2015 and 2018, around 10% of the properties in 2037 will have been built between 2019 and 2037 and planning policies can require that renewable energy systems such as solar PV be installed on them during the build.

For commercial-scale solar, the assumptions in Box 3.1 result in more than 2GW of additional solar PV capacity, as shown in Table A9 in Appendix 2A.

The potential capacity for renewable electricity generation in each district by technology is shown in Table 3.1.

Table 3.1 Potential additional capacity in each district by technology

	Onshore Wind	Solar PV	Hydro	Anaerobic digestion
	MW	MW	MW	MW
Allerdale	575	481	12	19
Copeland	97	236	10	9
Barrow in Furness	22	75	0	1
Carlisle	188	402	1	18
Eden	662	603	20	22
South Lakeland	260	484	19	15
Cumbria total	**1804**	**2281**	**62**	**84**

Note: Capacity identified in 2011 by SQW and Land Use Consultants in the Lake District National park has been split equally between Allerdale, Copeland, Eden and South Lakeland. Capacity in the Yorkshire Dales National Park has been split between South Lakeland and Eden.

For anaerobic digestion, untapped potential in Cumbria includes the production of biogas from sewage sludge at sewage treatment works (none in Cumbria have anaerobic digestion at present[11]) or from food waste, when this is collected from households across Cumbria (see section 6). This biogas could be used for vehicle fuel, or burned in combined heat and power plants to produce heat as well as electricity, perhaps when other renewables are in short supply.

In addition to these onshore renewables there is capacity for further development of offshore wind and tidal power. The Irish Sea currently has just under 30% of the UK's offshore wind but, despite there being ample room for more turbines (see Appendix 2B), there are currently no new projects under construction or development. In the current Offshore Wind Leasing Round 4, launched in September 2019,[12] there is up to 3.5GW available in the Irish Sea, including in an area west of Workington/Whitehaven and one further south, off Millom/Barrow.[13] For the purposes of this report we have assumed 18GW (ten times the size of the current Robin Rigg wind farm) in the former area and 1GW in the latter area. Clearly, if the maximum allocation of 3.5GW is made to the Irish Sea area in this and subsequent bidding rounds, and if this is all serviced from Cumbria, then this figure could be greater.

Proposals have also been put forward by Ecotricity and Tidal Electric for two offshore tidal lagoons.[14] Each would have a capacity of 380MW, and produce 600GWh of electricity a year. It is likely that both would be serviced from Workington. We do not know how viable these proposals are.

The amount of electricity that could be generated from this proposed new generation capacity, in addition to that identified in Table 3.1 from the SQW work in 2011, is shown in Table 3.2.

Table 3.2 Generation from existing and proposed renewable capacity

Technology	In 2019 [1] GWh	From new capacity GWh	Total GWh
Onshore wind	462	3,118	3,580
Solar PV	101	2,214	2,315
Hydro	20	185	205
Anaerobic digestion	47	459	506
Plant biomass	364		364
Landfill gas	19		19
Offshore wind [2]	4,151	7,626	11,778
Tidal lagoon		1,200	1,200
Total generation	**5,165**	**14,802**	**19,967**
Cumbria electricity consumption 2018 [3]	2,637		
Total UK electricity generation 2018 [4]	333,080		

[1] From Renewable Electricity by Local Authority - https://www.gov.uk/government/statistics/regional-renewable-statistics

[2] Note the tables in [1] attribute the generation from offshore wind off Barrow to Lancaster District, as it comes ashore at Heysham and the generation from the Robin Rigg wind farm in the Solway Firth to Dumfries and Galloway.

[3] From sub-national electricity consumption statistics 2005-2018, available at https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics

[4] UK generation plus imports from DUKES 5.1.2 - https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

11 Response from United Utilities to our question to them, November 2020

12 https://www.thecrownestate.co.uk/en-gb/what-we-do/on-the-seabed/offshore-wind-leasing-round-4/

13 https://www.windenergynetwork.co.uk/wp-content/uploads/2020/01/A1-Map_Issue-52.pdf

14 https://www.ecotricity.co.uk/news/news-archive/2018/english-scottish-tidal-lagoon-schemes-emerge-on-morning-of-swansea-bay-review and https://www.dropbox.com/s/a7owm80c9pumh9i/20180508_Swansea_tidal.pdf?dl=0

Electricity demand is expected to increase significantly, even as overall energy use falls, because both heating and transport need to be switched from fossil fuels to electricity. Getting to net zero is likely to require a doubling of electricity generation.[15] However, Table 3.2 shows that Cumbria could provide all its own electricity from onshore renewables, even with a doubling of consumption and still provide a substantial contribution to the national demand. To do this, though, will require a combination of:

- **upgrading of the local grid** to enable the connection of new generation capacity; and
- **provision of local storage and balancing**, for example the 10MW battery storage park installed at Cleator Moor in 2016[16] and the installation of batteries with solar PV systems in domestic and other properties.[17]

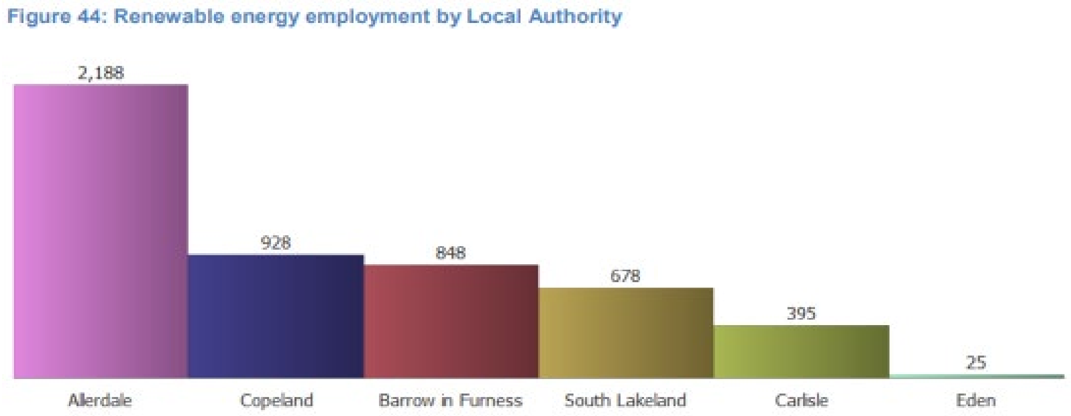
In addition, there is the opportunity to use the electricity generated, when it is in excess of demand, to produce hydrogen from water by electrolysis. This hydrogen can then be used as a transport fuel, particularly for vehicles that are too energy demanding to make an electric battery feasible, such as heavy goods vehicles, buses, trains and aircraft.

15 CCC, 2019
16 http://www.lowcarbon.com/our-portfolio/portfolio-overview/our-projects/cleator
17 Such systems are increasingly attractive, enabling the building to make use of much more of the electricity generated by the solar PV system as well as 'time of use' tariffs to charge the battery from the grid when electricity is cheap, such as in the middle of the night. For example, a recent quotation for a 3.25kWp east/west PV system plus an 8.2kWh battery storage in Lancaster was under £10,000.

3.2 JOBS FROM RENEWABLE ELECTRICITY GENERATION

In 2011/12 it is thought that there were 5063 jobs in renewable energy in Cumbria, 4,774 of which were in the wind sector (KMatrix Ltd and Gyron LL, 2013). 62% of renewable energy jobs were in Allerdale and Copeland (see Figure 3.1).

Figure 3.1 Distribution of jobs in renewable energy by district



From KMatrix Ltd and Gyron LL, 2013 p.68

Since 2012 many of these wind-sector jobs will have been lost, as it has become increasingly difficult to obtain planning permission for onshore wind turbines, though there will have been an increase in jobs in offshore wind, concentrated in Barrow (180 jobs)[18] and Workington (40 jobs),[19] from where the offshore wind farms are serviced. Similarly there will have been an increase in jobs in solar PV since 2012, followed by a fall as the feed-in tariff and other support mechanisms have been cut. The union Prospect claims that around 30% of UK jobs in renewable electricity were lost between 2014 and 2017 (Prospect, 2019) and REA (2020) states that 8,700 jobs have been lost in the solar PV sector in the UK since 2014/15. However, there is still a need for more renewable energy generation if we are going to achieve a zero-carbon economy, and much of it could be installed in Cumbria if policies were changed.

We have estimated the jobs involved in installation and maintenance of the wind, solar PV, tidal lagoons and hydro capacity shown in Table 3.2 plus the offshore capacity discussed in the previous section, assuming that it is installed over a 15-year period of 2022 to 2037 (the transition period). Long-term jobs are jobs in operation and maintenance of this renewable energy capacity. We have not estimated potential jobs from anaerobic digestion as we have not been able to find appropriate data on the number of jobs involved. This could include new jobs in the processing of future food waste collections from households across (see section 6) as well as in producing biogas from sewage treatment plants. The job numbers do not include ones in the manufacturing supply chain, though there is clearly potential for the latter in Cumbria, as in 2011/12 47% of the wind energy jobs were in manufacturing (KMatrix Ltd and Gyron LL, 2013, p.61). We have used published data on the number of jobs (full-time equivalents) per MW installed of each technology. The job numbers for the transition period are the average over that period, though in reality the number will be much lower to start with and then grow throughout the period. This means that the total number of people employed at the end of the period will be greater than the average number of jobs. We have not estimated the number of jobs required to facilitate this amount of renewable energy generation, such as upgrades to the grid, demand management and storage.

Our estimates can be found in Tables A10 and A11 of Appendix 2A and are presented below as bar charts. In total we estimate that there could be an average of 5,747 full-time equivalent jobs, over the transition period, with 3,300 of those in Allerdale. In the long term there could be 1,709 jobs, nearly

18 http://fedf.co.uk/supply-chain/how-to-supply-to/dong-energy
19 https://en.wikipedia.org/wiki/Robin_Rigg_Wind_Farm

1,500 of those being in Allerdale. Allerdale has a significant number of jobs because most of the jobs are associated with offshore renewables and we have assumed that for West Cumbria these will be serviced from Workington. However, it is likely that some work associated with offshore renewables will be based out of Whitehaven, as at present, plus, for many residents of Copeland, jobs in Allerdale are within easy travelling distance.

We have subtracted the 400 jobs in offshore gas in Barrow from our long-term jobs, but Barrow still has a net increase in jobs in offshore energy, assuming an additional 1GW of offshore wind is installed and maintained from Barrow.

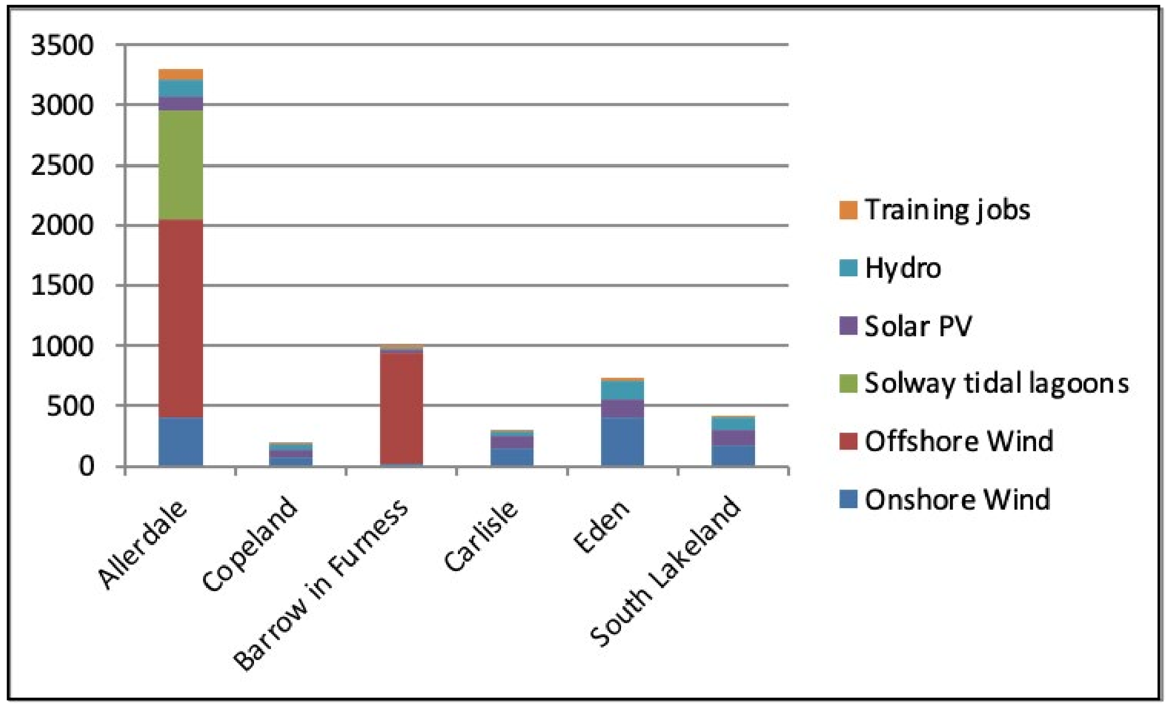


Figure 3.2 Transition jobs in renewable electricity generation

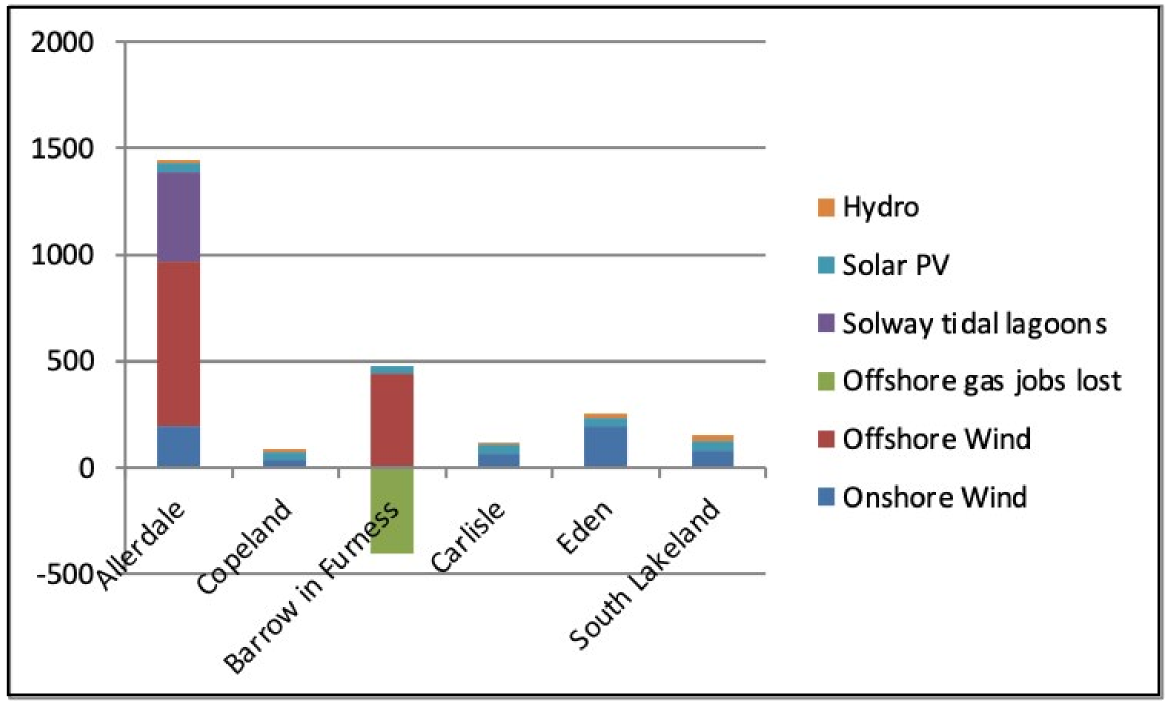
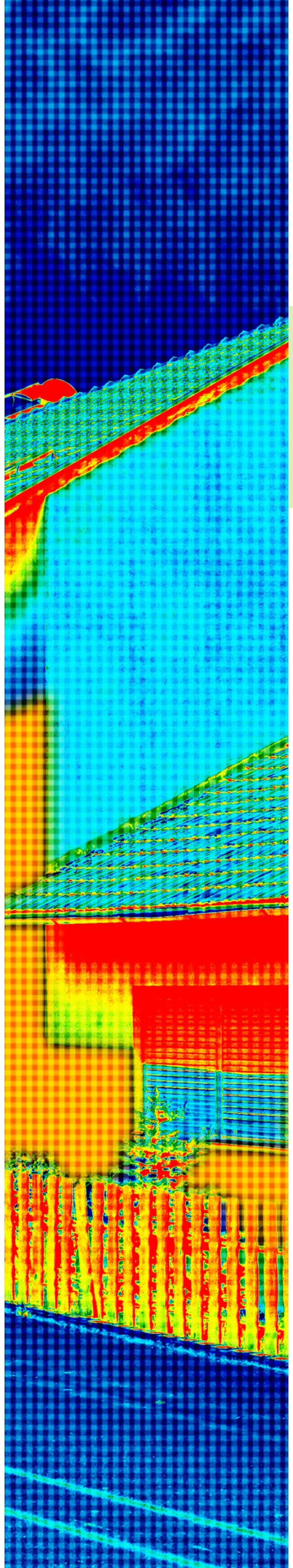


Figure 3.3 Long-term jobs in renewable electricity generation



4. Buildings and Heat

VISION: Buildings are energy efficient, so require little heating or cooling. The heat they do need is provided primarily by heat pumps with some use of local, sustainably produced biomass.

Achieving zero carbon requires reductions in the amount of energy we use, as well as the development of new renewable generating capacity. In the UK about 45% of energy is used in buildings, mainly to heat them, but also to provide hot water and to power lights and appliances (CAT, 2019 p.37). Much of this is in domestic buildings, which accounted for 29% of total UK energy consumption in 2019 (BEIS, 2019 p.10). In the Zero Carbon Britain scenario the energy used for heating buildings is reduced by around 50% through all new homes being built to Passivhaus standards (which require very little energy to heat them) and retrofitting existing buildings. Insulation of buildings needs to be improved to cut heat lost through walls, ceilings, floors and windows. Draughts need to be reduced and heat recovered from the air that leaves the building as controlled ventilation (CAT, 2019 p.42). Further reductions in energy demand could be made by better heating controls and reducing internal temperatures (which have increased in recent decades). The heat that is required is proposed to be provided mainly by heat pumps. These do not heat air, but pump heat energy from a source outside the building (such as the ground, water or air) into a building, thereby raising the temperature inside the building (even though it is higher than the outside temperature). In this way it is possible to get two to four times as much heat energy as the energy of the electricity used to power the pump. Heat pumps are also favoured as the way to decarbonise heat by the Committee on Climate Change (CCC, 2019).

Until recently, the carbon intensity of the grid (the amount of carbon dioxide emitted from burning fossil fuels per unit of electricity consumed) was so high that using mains gas for heating, where it was available, resulted in lower carbon emissions than using a heat pump. However, as the proportion of renewable energy generation has increased, and almost all coal-fired power stations closed,[20] heat pumps are now lower carbon. The net benefit of heat pumps over gas boilers will increase further in the future. This is reflected in the government's announcement that by 2025 new homes will not be allowed to use gas boilers.[21]

20 In 2019 just 2.1% of electricity was generated by coal, compared with 5.1% in 2018 and around 40% in 2005 Digest of UK Energy Statistics 2020 (DUKES) p.87 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/912023/DUKES_2020_MASTER.pdf and https://www.ofgem.gov.uk/data-portal/electricity-generation-mix-quarter-and-fuel-source-gb

21 https://www.gov.uk/government/speeches/spring-statement-2019-philip-hammonds-speech

An alternative to heat pumps would be to decarbonise the gas grid, allowing gas to continue to be used for some heating. A small part of this could be achieved by substituting fossil gas with biomethane, produced from the anaerobic digestion of biomass that is injected into the gas grid. The potential for this is limited by the availability of suitable biomass.[22] Another alternative could be to use hydrogen, produced from water by electrolysis, using electricity generated by renewables, or from the reaction of fossil natural gas (methane) with steam. The former could make use of electricity from solar, wind, hydro or tidal power when generation exceeds demand. This is termed green hydrogen. The latter, which is how most hydrogen is currently produced, produces carbon dioxide, which contributes to global warming. For that reason it is termed grey hydrogen (or blue hydrogen, if the carbon dioxide is captured and stored) though this is not yet the case. However, the Committee on Climate Change points out that hydrogen made from fossil fuels is not zero carbon, even when the carbon dioxide is captured and stored.[23] Either way, the hydrogen would be fed into the gas network, which will require upgrading, and used in boilers and cookers, which would have to be replaced.[24] However, it is not yet known whether this will to be viable and we need to start decarbonising properties that are on the gas grid before we know if hydrogen could be used (Rosenow, 2020 p.9). The electricity required to produce hydrogen by electrolysis is four times that required for a heat pump[25] and, if formed from natural gas (a fossil fuel), hydrogen will be more expensive in financial and energy terms than just using the natural gas. So installing heat pumps will be more efficient and affordable to consumers in the long term than converting the gas grid to hydrogen.

Heat pumps are best suited to well-insulated buildings. They are not good at quickly heating up buildings, and often cannot provide all the heat needed in old, poorly insulated buildings. In these situations biomass boilers, wood-burning stoves or direct forms of electrical heating may be more appropriate, or hybrid systems that use a back-up system to top up the heat provided by a heat pump. In some places, district heating systems, for example using waste heat from industry, or to pump heat from former mine workings (ground source heat pumps), may be more appropriate than installing heat pumps in individual dwellings. For example, the draft local energy plan says that there are opportunities to develop a local heat network associated with the Iggesund Paper Mill in Workington (Carbon Trust, 2018).

22 For example, the Committee on Climate Change estimate that the available biomass resource is 20TWh, against an estimated 2030 gas demand (from industry, buildings and power) of 700TWh (CCC 2016 p.3).
23 See https://www.theccc.org.uk/2018/11/22/hydrogen-is-a-credible-option-for-the-future-the-uk-must-now-prepare-for-the-key-decisions-on-zero-carbon-energy/
24 The H21 project, which is looking at converting the grid and boilers to hydrogen is constructing a bespoke testing facility at DNV-GL Spadeadam, near Brampton. https://www.h21.green/about/
25 See https://theconversation.com/hydrogen-isnt-the-key-to-britains-green-recovery-heres-why-143059?utm

4.1 ENERGY EFFICIENCY OF BUILDINGS IN CUMBRIA

It is important that new homes and other buildings are built to as high an energy efficiency standard as possible. Proposed zero-carbon developments such as at Burneside[26] are welcome, but zero-carbon new homes should be the rule. Requiring new housing to be zero carbon, and strict enforcement to ensure that completed buildings do actually perform as predicted,[27] can help develop local skills in building airtight homes (which requires many changes to standard practices) and stimulate the supply chain for low-carbon technologies such as heat pumps. However the real challenge is the existing building stock as nearly 90% of the homes that will exist in 2037 already exist (assuming that house building continues at the same rate as between 2015 and 2018),

Information on the energy efficiency of buildings in Cumbria has been obtained from the national database of energy performance certificates (EPCs).[28] EPCs were introduced in 2008 and rate properties as A to G on the basis of their construction, levels of insulation, heating systems, efficiency of lighting, *etc.* In theory, band D properties use about four times as much energy per m^2 as band A properties and band G properties at least six times as much.[29] EPCs have to be provided when buildings are sold (including new builds), rented out or to obtain feed-in tariff or renewable heat incentive payments for renewable energy systems. The 55% of domestic properties in Cumbria[30] with an EPC are therefore likely to be more energy efficient, on average, than the properties for which an EPC has not been obtained, as they will include all new homes and all homes with renewable energy systems.

The EPC rating of domestic and non-domestic properties in each district is shown in Figures 4 and 5. Only 0.2% of homes are rated A, 8.6% B and 23.4% C. Almost 70% are D or below.

Of the non-domestic properties with an EPC (it is not known what proportion of the total stock of such properties this is), 1.1% are rated A, but the number at the other end of the scale, in band G is also high at 9.1 %, (only 2.1 % of homes in band G). Sixty-six percent of non-domestic properties with EPCs are band D or below.

Many public buildings[31] must have a display energy certificate (DEC). This also gives an A-G rating for the building, but it is based on actual energy use (heating fuel and electricity consumption) not just on inspection of the building. The breakdown of DECs in each district of Cumbria is shown in Figure 6. Just over 10% are A or B rated, with 55% D to G.

It is considered that homes need to be at least C rated if we are going to achieve net zero carbon. It is likely, therefore, that over 70% of homes and a similar proportion of non-domestic buildings will need to be retrofitted to improve their energy performance, given that, on average, properties with EPCs will be more energy efficient than those without.

The current government aspiration is *'for as many homes as possible to be EPC band C by 2035'*.[32] For Cumbria to achieve net zero by 2037 this target needs to be exceeded. The UK Energy Research Centre has recently said:

> Almost all of the UK's 29 million homes will require upgrading by 2050, that is about 1 million homes per year, and is equivalent to more than 19,000 homes per week. Current retrofit rates are inadequate for achieving even a significant portion of the required level of decarbonisation to meet the 2050 targets.[33]

Achieving net zero in Cumbria over a 15-year period requires upgrading at least 220 properties a week to band C or better.

26 See https://www.enwl.co.uk/globalassets/zero-carbon/community-and-local-energy/documents/event-presentations/burneside-community-energy-feb-2019.pdf
27 New builds frequently do not perform as well with regard to energy efficiency as predicted – see de Wilde, 2014.
28 https://epc.opendatacommunities.org
29 http://energyrating.org.uk/energy_performance_certificate1.html
30 The total number of domestic properties in Cumbria was obtained from www.gov.uk/government/statistics/council-tax-stock-of-properties-2018, to which two years' worth of new-build properties were added, assuming the number per year is the average number of new dwellings per year, 2015-2018 (From p.111 of Cumbria Intelligence Observatory and Nicol Economics, 2019). The 84 dwellings per year for the Lake District NP split equally between Allerdale, Copland, Eden and South Lakeland.
31 Those with a total useful floor area greater than 250m2 , occupied by a public authority and frequently visited by the public (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/452481/DEC_Guidance__rev_July_2015_.pdf)
32 P.141 of Committee on Climate Change, 2019.
33 https://ukerc.ac.uk/publications/net-zero-heating/

Figure 4.1 Domestic EPCs by district

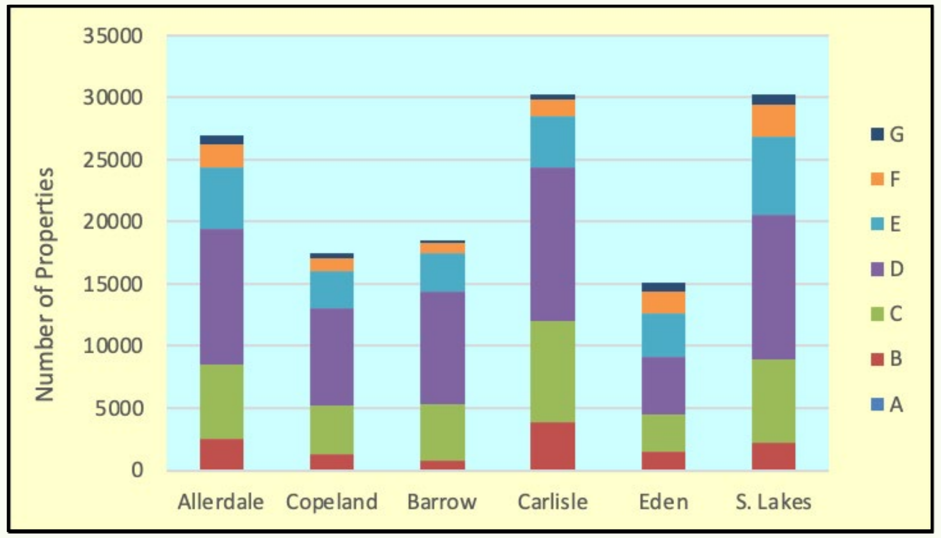


Figure 4.2 Non-domestic EPCs by district

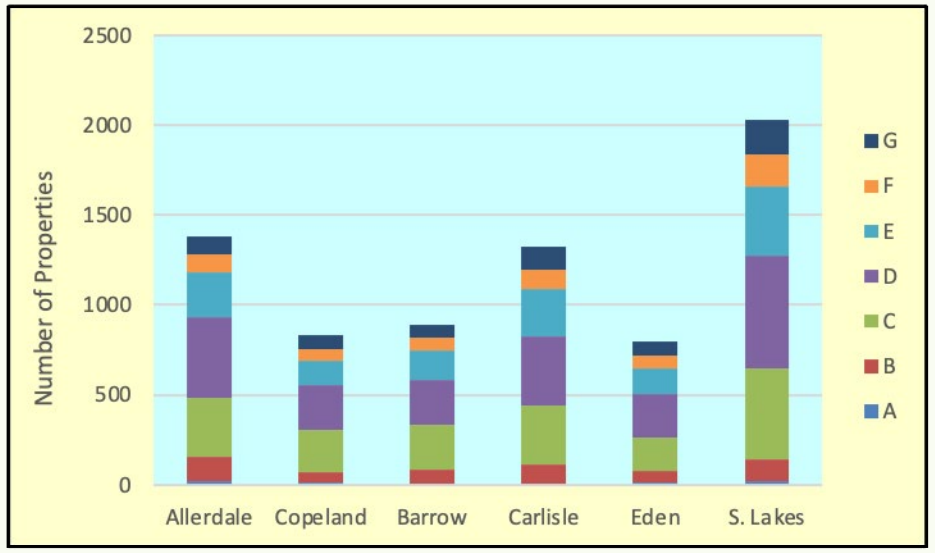
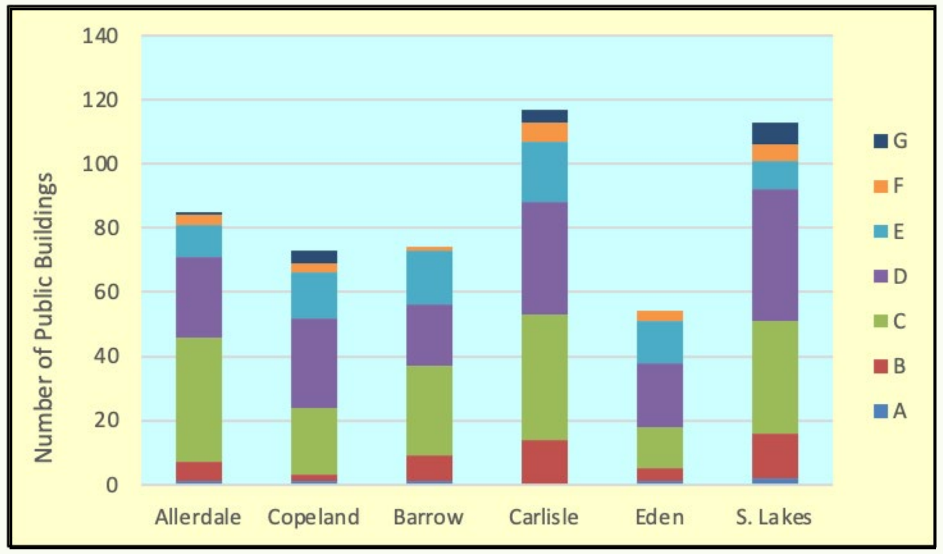


Figure 4.3 Display energy certificates by district



4.2 RENEWABLE HEAT IN CUMBRIA

Information about the use of renewable heat in Cumbria has been obtained from data on accreditations for the renewable heat incentive (RHI). The non-domestic RHI was introduced in 2011 and the domestic RHI in 2014. The RHI covers biomass boilers, heat pumps and solar thermal (water heating), but not wood-burning stoves. The number of accreditations for each district is shown in Table 4.1 and the breakdown between the technologies (only available for the North West as a whole) in Figures 4.4 and 4.5. As can be seen, the proportion of domestic properties with low-carbon heating systems is less than 0.5%, except in South Lakes (0.9%) and Eden (2.12%). This will reflect the high number of properties in these rural districts that are off the gas grid (57% in Eden and 24% in South Lakeland[34]), for whom other forms of heating, such as fuel oil, is very expensive, as well as the relative wealth of these areas compared with other parts of Cumbria.

Table 4.1 Number of RHI accredited installations

	Domestic RHI		Non-Domestic RHI	
	Number of accredited installations	% of housing stock	Number of accredited installations	Capacity MW
Allerdale	215	0.48%	215	40
Barrow-in-Furness	14	0.05%	10	5
Carlisle	214	0.42%	171	28
Copeland	133	0.43%	60	9
Eden	514	2.12%	302	39
South Lakeland	446	0.92%	146	19
Cumbria total	**1,536**	**0.67%**	**904**	**139**

Source: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-december-2019-annual-edition

Nearly half of domestic renewable heat installations in North West England are ground source heat pumps, whereas 85% of non-domestic installations are biomass boilers and only 8% are heat pumps. Solar thermal only accounts for 10% of domestic installations and 2% of non-domestic installations. The usefulness of solar thermal is limited by the need to use the hot water when it is produced and many households use little hot water if they have dishwashers and washing machines that take a cold fill (as most newer ones do) and use electric showers. In contrast, the electricity from a solar PV system can be exported to the grid, stored in a battery or used to heat water.

Decarbonisation of heat requires a massive increase in the rate at which heat pumps are installed. At the current rate of deployment UK-wide, it would take more than 700 years to reach the 19 million heat pumps that the Committee on Climate Change (CCC) suggests are needed in the UK.[35]

34 From https://www.gov.uk/government/statistics/sub-national-estimates-of-households-not-connected-to-the-gas-network

35 Rosenow, 2020, p.4.

Figure 4.4 Domestic RHI accreditations, Split between technologies in North West England

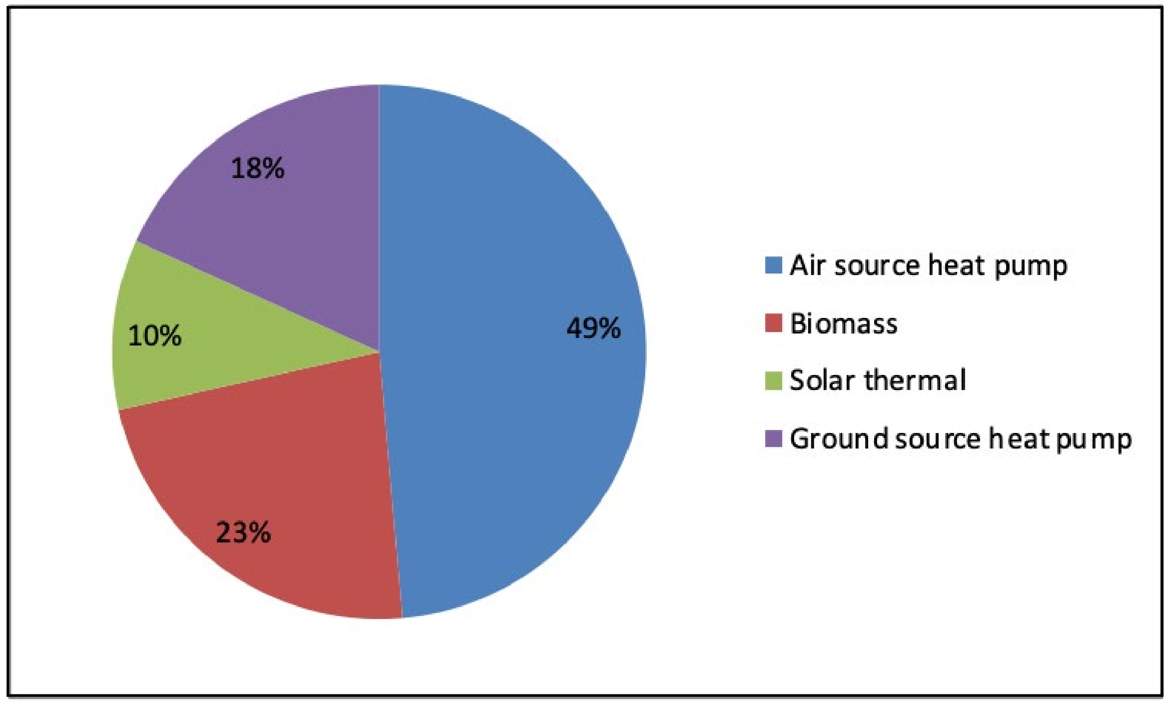
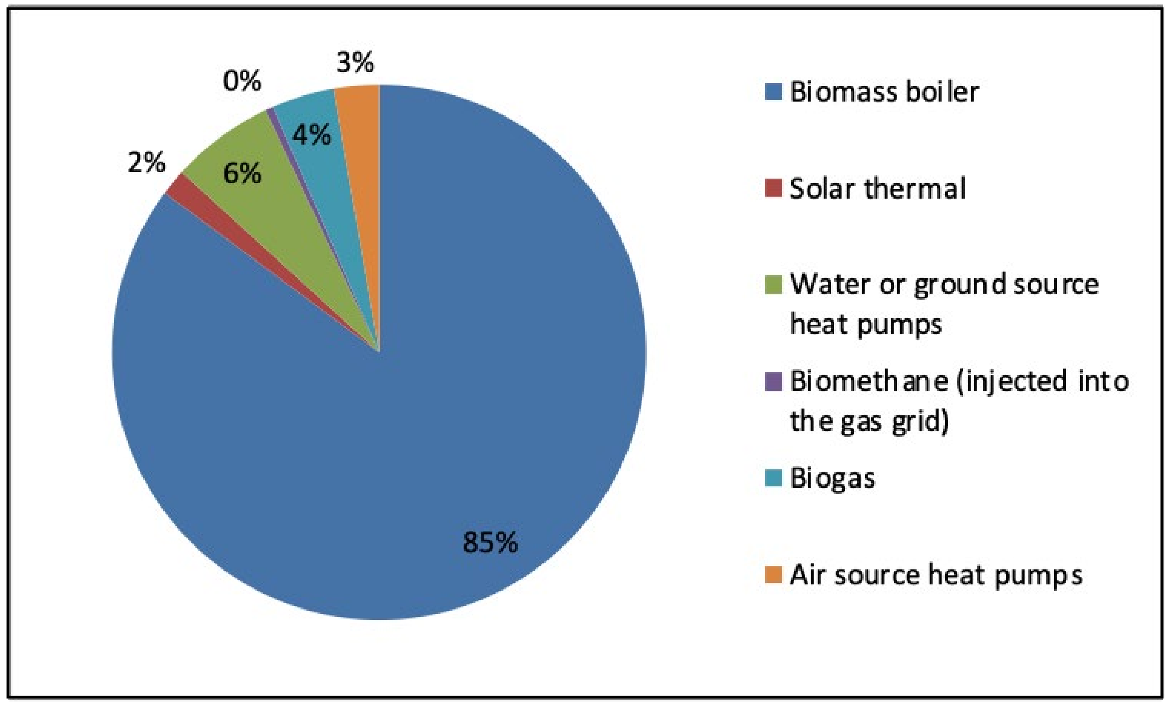


Figure 4.5 Non-domestic RHI, split between technologies in Great Britain (number of installations, November 2011 – December 2019)

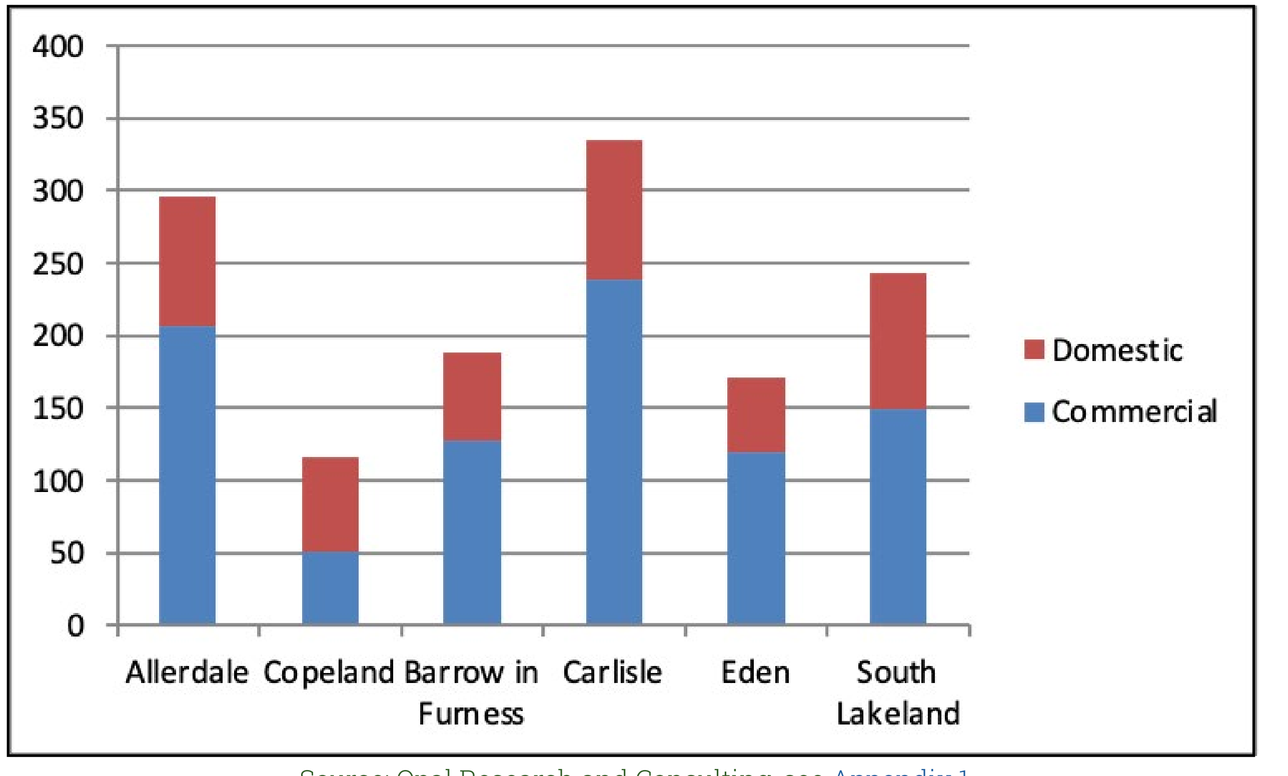


4.3 JOBS IN RETROFIT AND RENEWABLE HEAT

In 2017 there were just over 150,000 people in the UK employed in trades relevant to retrofit, which is a reduction from the 250,000 in this workforce in 2008.[36] Parity Projects, specialists in housing retrofit, estimates that there needs to be an increase of 139% in employment in the domestic refurbishment sector to retrofit all UK homes to an EPC band C by 2030.[37]

Opal Research and Consulting has estimated the number of jobs that would be created by installing all the measures recommended in EPCs (for their report see Appendix 1). Converting their job years to a 15-year transition period and using their 'technical potential' scenario, this equates to 1,350 jobs in the retrofit of domestic and commercial buildings - see Figure 4.6.

Figure 4.6 Transition jobs in retrofit of buildings



Source: Opal Research and Consulting, see Appendix 1

EPC recommendations do not generally include the retrofit of heat pumps, and the job estimates in Figure 4.6 include the fitting of only around 4,000 heat pumps. This is just 1.6% of the 250,000 homes in Cumbria, and an even lower percentage of all buildings. But, as discussed in the introduction to this section, replacement of existing fossil fuel based heating systems will be needed to achieve net zero. We have therefore calculated the jobs that would be created from retrofitting air source heat pumps to 90% of the housing stock that will be in existence in 2025 (assuming current rates of house building continue). After 2025 new build housing will have to be fitted with renewable heating systems and we have assumed that the work involved in installing these will not be additional to that required to build houses with gas heating systems.

The RHI data (see Figure 4.4) shows air source heat pumps are the most common form of low-carbon domestic heating. Although they are not suitable for all properties, installing the alternatives, such as ground or water source heat pumps, biomass boilers and heat networks, are likely to involve similar if not more work, so an estimate based on air source heat pumps gives a conservative baseline of the number of jobs created. There will also be a need to decarbonise heat in non-domestic buildings, so the job estimates here are a minimum of the amount of work involved for all buildings. In total,

36 https://parityprojects.com/net-zero-housing-workforce, accessed 22/09/20
37 Ibid

including jobs in training, we estimate that an average of 630 jobs would be created during the 15-year transition phase and around 180 in the long term. These jobs would, to some extent, replace those that are currently involved in fitting and maintaining gas boilers and other existing heating systems. However, a great deal more work is involved in fitting a heat pump than replacing a gas boiler (which can take just 4-6 hours[38]) so heat pumps will require an increase in the workforce fitting heating systems.

Table 4.3 Jobs in the installation of air source heat pumps

			Transition jobs - average over 15 years			Long-term jobs
	Properties	New-build properties	Retrofit of pre-2018 properties	Retrofit of 2018-2025 homes	Total	Replacement of 5% of pumps every year
	2018 [1]	2018-2025 [2]			[3]	[3] [4]
Allerdale	46,970	2751	113	5	121	35
Copeland	33,470	1106	80	2	85	24
Barrow-in-Furness	52,150	595	125	1	130	37
Carlisle	33,610	3612	81	7	90	26
Eden	26,360	1652	63	3	68	19
South Lakeland	53,330	2268	128	4	136	39
Cumbria total	**245,890**	**11,984**	**590**	**22**	**630**	**179**

Working days for installation of heat pumps from Heat Pump Association, 2019:

pre-2018 properties	8 working days
2018-2025 properties	6 working days
replacements	3 working days

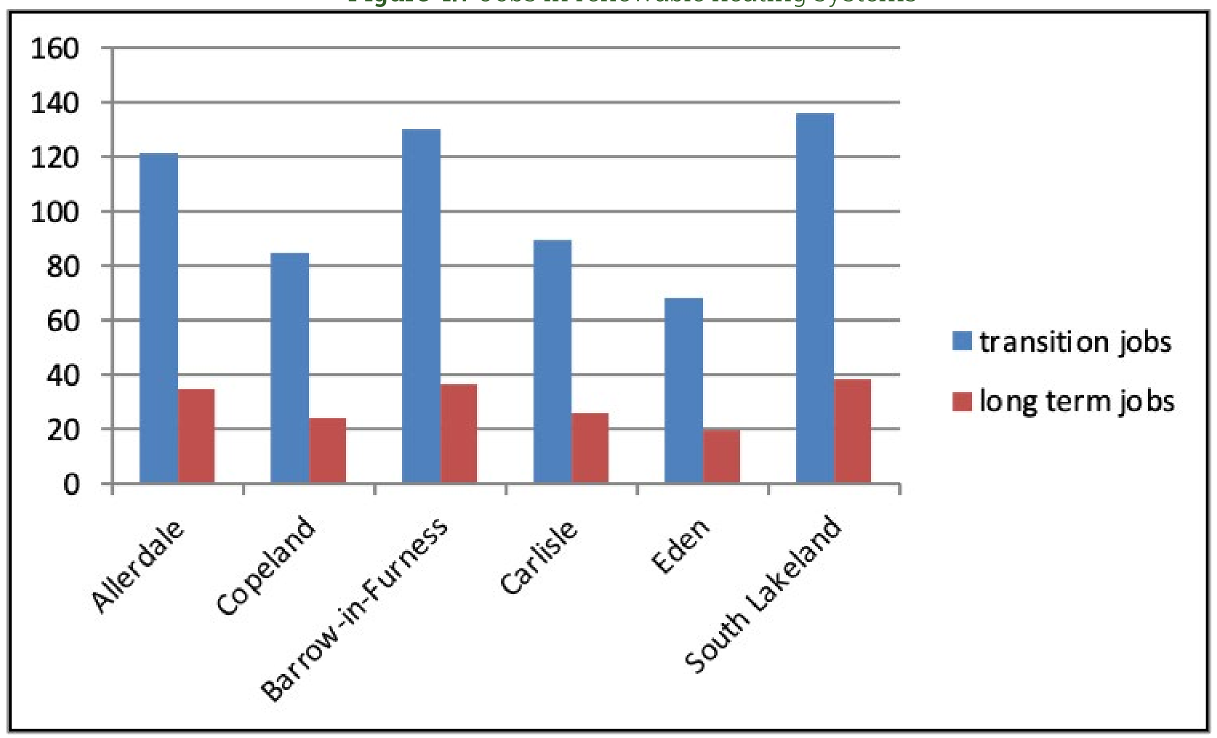
[1] From https://www.gov.uk/government/statistics/council-tax-stock-of-properties-2018

[2] Assuming average number of new dwelling per year the same as in 2015-18 (Cumbria Intelligence Observatory and Nicol Economics , 2019) and that the 84 new dwellings per year in the Lake District NP are split equally between Allerdale, Copeland, South Lakeland and Eden.

[3] Includes training jobs (3% other jobs)

[4] As heat pumps last, on average, for 20 years (https://www.evergreenenergy.co.uk/heat-pumps/how-long-do-heat-pumps-last/)

Figure 4.7 Jobs in renewable heating systems



38 See https://idealheating.com/tips-and-advice/how-long-does-it-take-to-fit-a-boiler

5. Transport

VISION: There is less need to travel and more of the journeys we do make are by walking, cycling or public transport rather than private car. Internal combustion engine (ICE) vehicles are replaced by electric vehicles (EVs) or, where this is not feasible, with vehicles that use hydrogen or biodiesel. The railways are electrified or use zero-carbon engines, using hydrogen or batteries.

5.1 TRANSPORT IN CUMBRIA

Transport accounts for 28% of Cumbria's territorial carbon dioxide emissions[39]. On a per capita basis Cumbria's transport emissions are 22% higher than the UK national average.[40] Almost all of this is due to road transport. However, on a consumption basis the biggest contribution to the greenhouse gas footprint is air travel by visitors to Cumbria (17% of the total). Visitor road travel by private vehicles to and within Cumbria makes up a further 15%.[41]

This section considers transport of people, not goods, though changes to freight transport are clearly needed. We need to reduce the amount and distance goods are transported and shift their transport to zero-carbon methods.

As a predominantly rural area with a dispersed population, transport in Cumbria is highly dependent on private cars. The 2011 census found that 74% of people travelled to work by private vehicles in Cumbria compared with a national (England) average of 67% (see Table 5.1). However, more people than nationally walk to work, suggesting that more people live within walking distance of where they work. Commuting by car was highest, and cycling and walking lowest, in Allerdale and Copeland. This may reflect the extent of commuting to concentrations of employment outside urban centres, such as Sellafield and West Lakes Science Park. Use of public transport is low. The main places where trains were used for travel to work are Barrow, South Lakeland and Copeland. For Copeland this may reflect rail travel to Sellafield. This has a station on the Cumbria Coast line and the timetable takes account of the shift changes at Sellafield.

39 See p.15 of Small World Consulting, 2020.
40 Ibid, p.15.
41 Ibid, p.21

Table 5.1 Method of travel to work in 2011

	Car/van/ motorbike	Bus	Train	Bicycle	On foot	Other
Allerdale	77%	4%	1.0%	1.6%	15%	0.7%
Barrow	68%	5%	1.8%	5.4%	18%	0.8%
Carlisle	71%	7%	0.7%	2.8%	17%	0.6%
Copeland	80%	5%	1.7%	1.8%	11%	0.6%
Eden	75%	2%	1.0%	1.4%	19%	0.9%
South Lakeland	72%	2%	1.7%	3.0%	20%	0.9%
Cumbria	74%	5%	1.3%	2.7%	17%	0.7%
North West	73%	9%	3.6%	2.3%	11%	0.6%
England	67%	8%	10.0%	3.1%	11%	0.7%

Source: Table QS701EW, Method of Travel to Work, Local Authorities in England and Wales, ONS, 2011 Census.

Almost all the bus services in Cumbria are run by Stagecoach, which has depots in Barrow, Carlisle, Kendal and Workington. Stagecoach Cumbria and North Lancashire (they also operate in the Lancaster District, where they have a depot in Morecambe) employs 600 drivers, 106 maintenance staff and cleaners and 63 supervisors and managers running 11.9 million miles of bus services a year.[42] Walk-on ticket prices are high, particularly in the Lake District National Park,[43] where many users are visitors, many of whom have free bus passes, so there is little pressure on Stagecoach to reduce their prices to attract local, repeat custom. Cumbria County Council does not provide any funding to support non-commercial bus routes[44] and some parts of the county, such as the southern part of Copeland, have no bus services at all.

The west coast mainline railway goes through East Cumbria, with stops in Oxenholme, just outside Kendal, Penrith and Carlisle. This is the only line in Cumbria that is electrified. Other railway lines are:

- **Oxenholme to Windermere**;
- **the Settle to Carlisle line**, which runs through the Eden Valley to Carlisle;
- **the Furness line**, which runs from Lancaster around the edge of Morecambe Bay to Barrow;
- **the Cumbria Coast line**, from Barrow up to Carlisle (some but not all trains on the Furness line continue through Barrow); and
- **the Carlisle to Newcastle line.**

All these services still use diesel trains, which are often of very poor quality. Services are mostly hourly, but less frequent on the Settle to Carlisle line.

In our modelling work we have estimated the total miles currently travelled per person using data on vehicle numbers (private cars and buses) in Cumbria and the miles per person per vehicle travelled nationally. For bus travel we assumed occupancy rates based on the whole county being rural: an average of nine people per bus. For train travel our model uses the number of stations and the population density to scale down from national figures for train travel per person. The figures in Table 5.2 are therefore for bus travel within Cumbria, train travel starting or finishing in Cumbria, but car travel by people living in Cumbria. Table 5.2 also shows the percentage of travel by the various modes in the Transport for the North Strategic Plan.

42 Stagecoach Cumbria and North Lancashire, 2019.
43 For example the 4.5-mile, 15-minute bus journey from Windermere to Ambleside costs a family of four £17 (see https://www.stagecoachbus.com/plan-a-journey) compared to the £3 (£1.50 per adult) that journey would cost in London, where any bus journey is just £1.50 per adult.
44 https://www.in-cumbria.com/news/17246264.cumbria-transport-funding-shrinks-2m-zero-10-years/

We have not been able to estimate the current miles travelled by the active modes of walking and cycling. However, Transport for the North considers that these only account for 1% each of the total distance travelled.

Table 5.2 Travel by different modes

	Cumbria distance travelled [1]		Northern England [2]	
	distance travelled km/person/year	% of distance	% of trips	% of distance
Cars	10,550	89%	68%	81%
buses	548	5%	7%	7%
Trains	702	6%	1%	7%
walking			22%	1%
Cycling			1%	1%
Total	**11,801**			

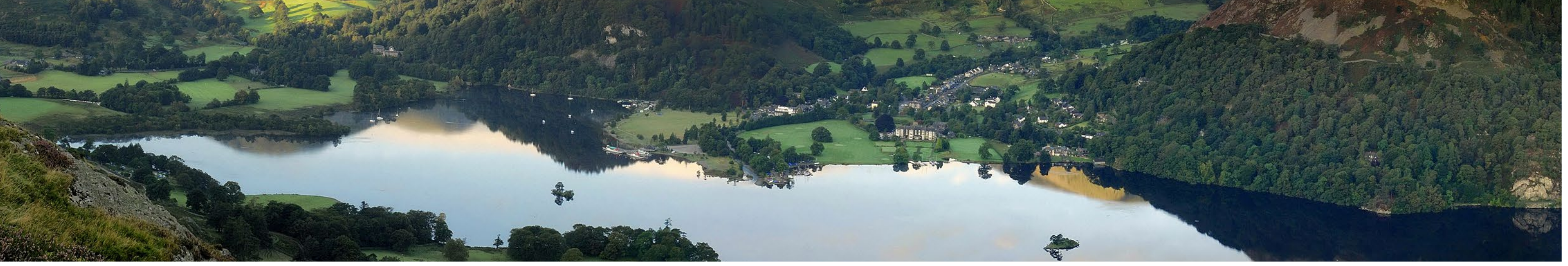
[1] For method see Box 5.1

[2] Transport for the North, 2019 p.65

Box 5.1 Calculation of distance travelled per person per year

Cars km travelled:	No. of cars in Cumbria in 2016 x passenger car miles in UK in 2012 no. of cars in UK 2016
Bus km per person:	No. of buses (2016) x passenger miles by bus in UK (2012) no buses in UK (2016) 50:50 weighted between population density & bus stocks x average occupancy, assumed to be 9 per bus (average for rural areas)
Train km per person:	Scaled down from UK figures for passenger km by train (in 2016), according to station density and population density

Source: All data from Eurostat (https://ec.europa.eu/eurostat)



5.2 PROPOSED CHANGES IN HOW WE TRAVEL

We have followed the scenario set out in *Zero Carbon Britain*[45] for the changes needed in transport to bring about a zero-carbon Cumbria. These are shown in Table 5.3. They involve firstly reducing the distance travelled by motorised transport, at least partly by a shift to walking and cycling. Then a shift from private vehicles to public transport (using zero-emissions technology), with almost all the remaining private vehicle travel using electric vehicles. Electric vehicles (EVs) are more energy efficient than internal combustion engine vehicles[46] and can use electricity generated from renewable sources. The proposed modal shift is a target, not something that will happen without active policies and local implementation to make it happen. For buses the increase in distance travelled is approximately 60% of the current distance travelled by buses operated by Stagecoach Cumbria and North Lancashire.[47]

Increased walking and cycling clearly have a key role to play in a zero-carbon future, not least because of the benefits to health of active travel. In many places increasing walking and cycling is likely to require improved facilities, such as segregated cycling and walking routes. Cycling should be made a viable option in rural as well as urban areas. Where a main road is the only road there is, such as on parts of the West Coast, or the A66 east of Brough, this will require new, segregated cycle routes.

Table 5.3 Assumed changes in modes of transport and vehicle occupancy by 2037

	Occupancy Persons per vehicle		Current distance travelled per person	Proposed distance travelled per person	Total increase in distance travelled by vehicles
	Current	Proposed	km/person/year	km/person/year	million km /year
Car- EV		1.74		6204	1757
Car – ICE	1.6	1.74	10,550	104	-2959
Bus (assume all rural)	9	10	548	761	11.6
Train	127	130	702	1,722	3.9

EV: electric vehicle. Currently less than 1% of cars in Cumbria are EVs.

ICE: internal combustion engine (i.e. petrol or diesel)

The transition to this new transport system will require a massive programme of installation of electric vehicle charging points. It will also require upgrading of the railway lines, rolling stock and services on the railway lines other than the west coast mainline so they use zero-emission trains (either electric or hydrogen-powered) and are of more use for everyday travel, including by commuters, as well as being more attractive to visitors. Better services on the Furness/Cumbria coast lines would facilitate visitor access to West Cumbria and the western Lake District, reducing visitor reliance on private cars. Bus services should be better integrated with the train services, made more affordable and provide a reasonable service in rural areas. They will also need to be electric, use hydrogen fuel cells, or combination of both.

45 See p.51 of CAT, 2019

46 A typical electric vehicle uses 19kWh of energy to travel 100km, while the average petrol vehicle uses 67kWh (European Commission Joint Research Centre, 2014).

47 Stagecoach Cumbria and North Lancashire, 2019.

There are currently around 130 chargepoints in Cumbria that are available for public use.[48] Barrow-in-Furness is particularly poorly served with only five public chargepoints (see Table 5.4). A report on the need for EV chargepoints in the UK, published in August 2020, considered that the number of chargepoints in 2019 is just 5% of what will be needed in 2030, assuming that by then EVs are 70% of new vehicle sales (Nicholas and Lutsey, 2020) which would give a figure of around 2,600 chargepoints needed in Cumbria by 2030. Since that report was written however the government has said it will ban the sale of petrol or diesel cars (other than hybrids) from 2030 so EVs would be 100% of new vehicle sales. An additional consideration is that Cumbria's net zero carbon target date is 2037 so in calculating the number of chargepoints needed by 2037 we have multiplied the current number of chargepoints by 30. This may overestimate the number needed in areas that currently have quite a few chargepoints, but underestimate the numbers in places that have very few.

In addition we have assumed that of the number of cars driven to work will be 60% of those who drove to work in the 2011 census, partly because of increased home working and partly because of a modal shift away from private cars. We have assumed that 20% of these will need to be charged at work on any one day, so this number of workplace chargepoints will be needed. Plus we have assumed that domestic chargepoints will be installed at 50% of domestic properties that are bungalows, semi-detached or detached (and therefore probably have off-street parking). Note that there is uncertainty about the impact of advancements in EV charging technology and practice, eg more fast chargers may mean fewer chargepoints are required, but the limitations of grid connections may mean slower chargers are more common which could lead to vehicles being plugged in for long periods and their batteries being used for short term grid balancing through vehicle to grid technology.

Table 5.4 Estimate of number of chargepoints needed

	Public chargepoints		Workplace chargepoints		Home chargepoints	
District	Estimated number of chargepoints 2020 [1]	Additional number needed [2]	Number driving to work [3]	Number needed for 20% to be charged at work	Number of properties [4]	Chargepoints for 28% of properties [5]
Allerdale	12	360	17,599	3,520	49,721	13,673
Copeland	16	480	13,012	2,602	37,222	10,236
Barrow-in-Furness	5	150	10,485	2,097	34,576	9,508
Carlisle	21	630	19,474	3,895	52,745	14,505
Eden	30	900	9,998	2,000	28,012	7,703
South Lakeland	52	1560	18,417	3,683	55,598	15,289
Cumbria Total	**136**	**4,080**	**88,985**	**17,797**	**257,874**	**70,915**

[1] From National Chargepoint Registry (www.gov.uk/guidance/find-and-use-data-on-public-electric-vehicle-chargepoints) and www.zap-map.com. Some of those on Zap map may be workplace chargepoints or only for use by customers of particular businesses.

[2] 30 times existing number

[3] 60% of numbers in Table QS701EW, ONS 2011 Census data

[4] Total from Table 4.3

[5] 55% of dwellings in Cumbria are detached, semi-detached or bungalows (see https://www.cumbriaobservatory.org.uk/housing/). It is assumed that half of these will have domestic chargepoints.

48 From National Chargepoint Registry (www.gov.uk/guidance/find-and-use-data-on-public-electric-vehicle-chargepoints) and www.zap-map.com. Some of those on Zap map may be workplace chargepoints or only for use by customers of particular businesses.

5.3 ESTIMATES OF JOBS IN TRANSPORT

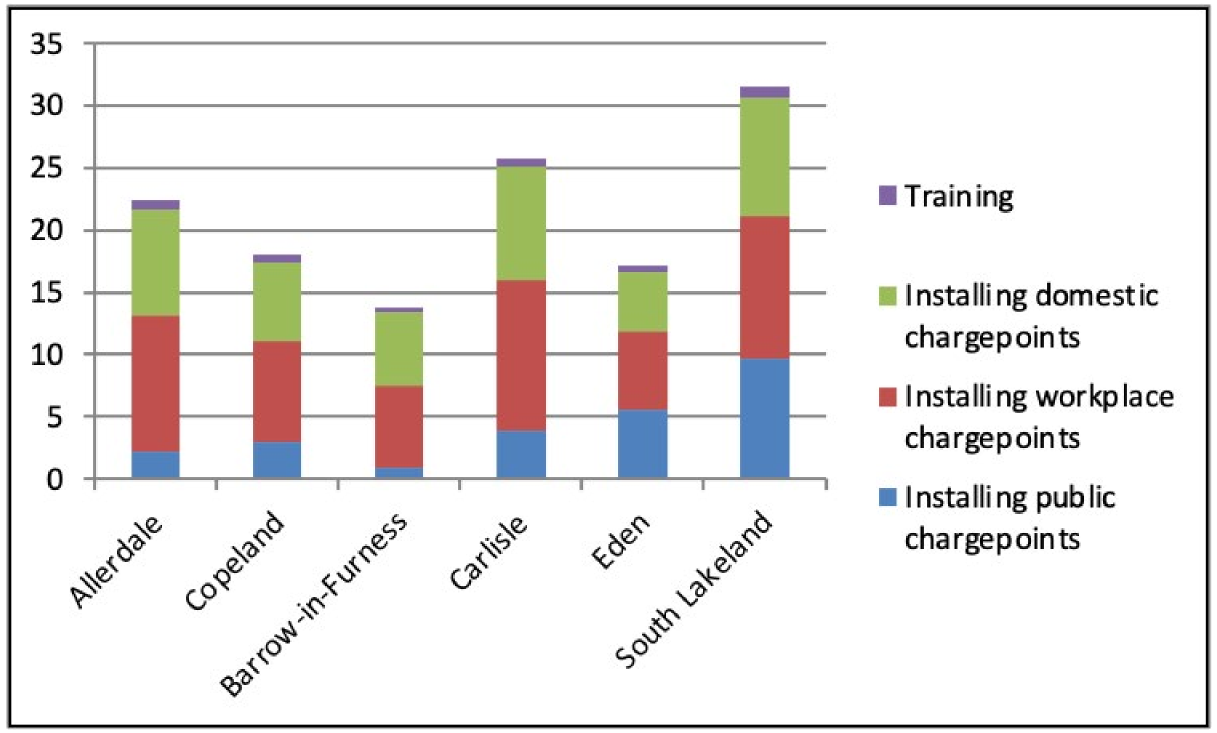
There will be transition jobs in:

- **installing cycling and walking infrastructure**
- **upgrading the railways**
- **installing EV chargepoints**

In work carried out for the TUC, Transition Economics has estimated employment creation from a clean infrastructure stimulus.[49] This included upgrading and expanding the rail network, building cycle lanes and pedestrianisation. Scaling down their estimates for the North West as a whole to Cumbria, according to relative population,[50] would result in 908 jobs in upgrading the railways and 532 jobs in building cycling and walking facilities.

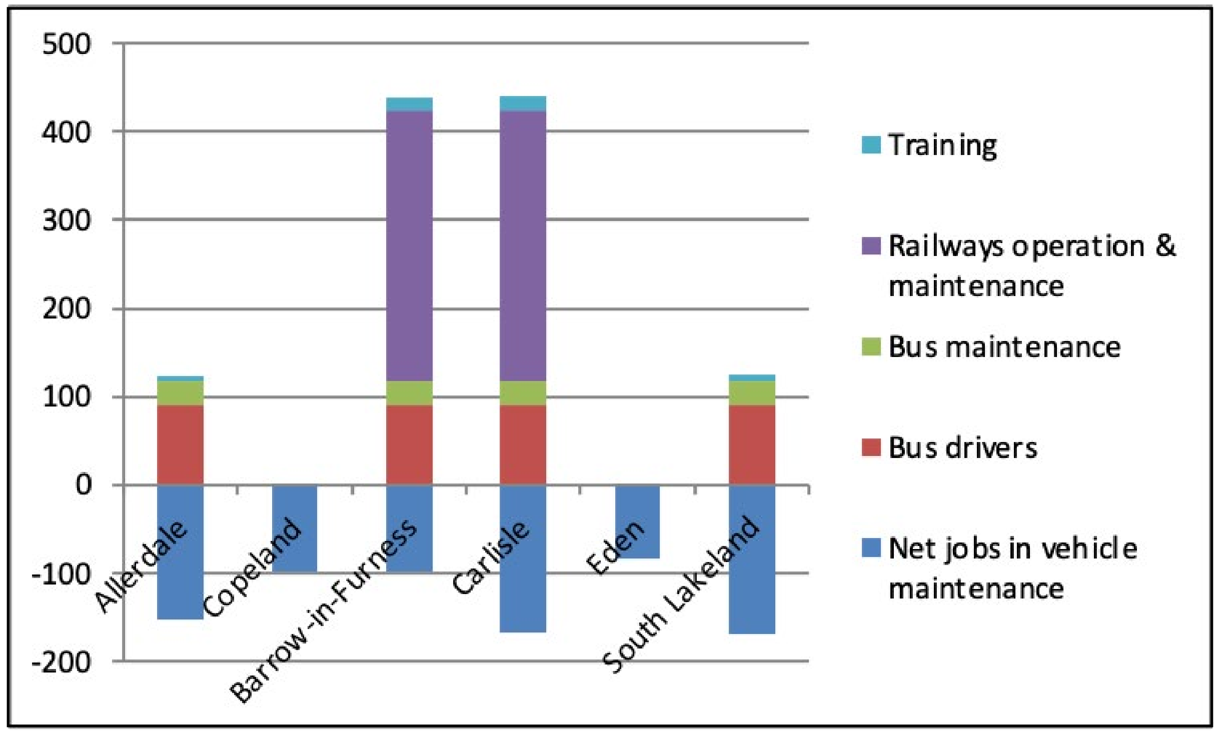
Here we have estimated the jobs involved in the installation of electric vehicle chargepoints using information obtained by Charge My Street, a local community benefit society engaged in installing chargepoints in Cumbria and Lancashire (see Appendix 2C). Installing the number of chargepoints in Table 5.4 would create, on average, around 130 jobs in the county over the 15-year transition period. These are shown in Figure 5.1.

Figure 5.1 Transition jobs in installing EV chargepoints



New long-term transport jobs are primarily in public transport. As electric vehicles require less maintenance than petrol/diesel cars, there will be a net loss of jobs in vehicle maintenance, which we have subtracted from the new jobs. The metrics used, of jobs per bus or train mile, are in Appendix 2C and the estimated number are shown in Figure 5.2. For vehicle maintenance jobs the number in each district is based on population in each district. Bus jobs are based on the modal shift for the county as a whole then split between the districts where there are bus stations (Allerdale, Barrow, Carlisle and South Lakeland). For train jobs we have doubled the number of people currently employed in railway-related occupations in Cumbria, then assumed that these jobs would be split between Barrow-in-Furness and Carlisle, though there may be some jobs based at stations elsewhere. Overall there would be a gain across Cumbria of around 370 jobs, but in all the districts except Barrow and Carlisle the net number of jobs is negative, because of the loss of jobs in repair of internal combustion engine vehicles, which in South Lakes and Allerdale is not fully compensated by increased numbers of jobs at the bus stations.

Figure 5.2 Long-term jobs in transport



There would also be long-term jobs generated by increased cycling. Long-distance cycle routes, such as the C2C and Hadrian's Cycle Way, bring tourists into West Cumbria. In 1997 cyclists on the C2C were thought to have spent £1.1million in local businesses.[51] Increased cycling will also support employment in local bicycle shops, particularly in cycle repair, as, while you can buy a bike online, you can't get it repaired online. For example, in Allerdale and Copeland there are currently 10 businesses selling or repairing bikes. If they each employ two people, doubling cycling, and thus the amount of work in cycle repair, could create 20 additional jobs.

49 Appendix 2 of TUC, 2020.
50 The population of Cumbria is just under 7% of the 7.3 million in the North West.
51 This is for the whole of the C2C route. £1.1 million in 1997 is equivalent to £1.7 million today (Cycling UK, 2020).

6. Reuse and Recycling of Waste

VISION: A society where products last longer, are repaired and reused much more than they are today, and we use less packaging, reducing the amount of waste we produce. Most of what does end up as waste is recycled, with new industries making use of that recycled material in the UK, reducing imports of raw materials and exports of waste.

6.1 AVAILABLE INFORMATION

The amount of waste generated and managed in Cumbria has been obtained from the Joint Cumbria Waste Needs Assessment (Cumbria County Council and the Lake District National Park Authority, 2019), which uses data from 2017. Waste arisings, excluding excavation waste and hazardous waste, are shown in Table 6.1. For industrial waste and construction and demolition (C&D) waste significant quantities are exported from and imported into Cumbria, so the final amount managed within the county is around 100,000 tonnes less of industrial waste and 150,000 tonnes more of C&D waste.

Table 6.1 Waste arisings in Cumbria

Type of waste	Tonnes
Local authority collected waste (LACW)	269,707
Commercial waste (C)	292,192
Industrial waste (I)	640,728
Construction and demolition waste (C&D)	203,617

From CCC and LDNPA, 2019

Local authority collected waste (LACW) is all waste collected by the county and district councils, including kerbside collections as well that taken to Household Waste Recycling Centres (HWRCs) and bring sites (*e.g.* bottle banks). It also includes waste from small businesses that choose to use the waste collection service provided by their local council plus street sweepings and collections from litter bins. Kerbside collections by the district councils include the separate collection of materials for recycling. This material is sold by the district councils and only the residual waste and material from the HWRCs are the responsibility of the county council.[52] Residual waste is taken to one of two mechanical biological treatment plants (at Hespin Wood near Carlisle and at Sowerby Woods, Barrow-in-Furness) where the waste is dried out, recyclable materials removed and most of the remainder turned into 'refuse derived fuel' (RDF).

52 See https://www.cumbria.gov.uk/planning-environment/waste-management/wasteissue/what.asp

In 2017 13% of LACW went to landfill; 27% was recycled; 20% composted; 24% was used to produce RDF or sent for incineration outside the county, with 16% lost in processing (loss of the mass of water during drying).

All the districts have separate, kerbside collection of glass bottles and containers; paper and card; plastic bottles; plastic pots, tubs and trays; steel and aluminium tins and cans. For some districts all these materials were not collected until 2020. Food waste is not collected but the government is requiring local authorities to provide weekly separate collection of food waste by 2023.[53] This is an opportunity to provide food waste composting facilities in Cumbria, or to use anaerobic digesters to produce methane from this waste.

Key organisations involved in the collection and treatment of waste by the public sector in Cumbria are shown in Box 6.1.

Box 6.1 Key organisations involved in public sector waste collection and treatment

District councils
Collection of household waste and some waste from small businesses, including segregated materials for recycling which they sell on directly to processors.

Cumbria County Council
Waste planning authority responsible for ensuring facilities for dealing with waste are available and that residual waste collected by district councils is treated/managed.

Cumbria Waste Group
Owned by Cumbria County Council. Operates 14 Household Waste & Recycling Centres and manages landfill sites (Hespin Wood and Lilyhall) (which generate 5MW of electricity from landfill gas). Produce recycled aggregates and soil products from C&D waste at their Hespin Wood site near Carlisle.

Renewi
Have a 25-year contract (signed in 2008) with Cumbria County Council to operate the mechanical biological treatment facilities at Carlisle and Barrow.

Table 6.2 shows the waste collected by each local authority (districts and county) in 2018-2019 and the proportion that is sent for recycling or composting and the amount of residual waste. This is predominantly household waste. The overall household waste recycling rate for Cumbria of 47% is a combination of the average rate of kerbside collections of 37% and the average for materials taken to HWRCs, of 78%.

53 https://www.gov.uk/government/consultations/waste-and-recycling-making-recycling-collections-consistent-in-england/outcome/consistency-in-recycling-collections-in-england-executive-summary-and-government-response

Table 6.2 Recycling by local authority

Authority	2018/19 recycling rank for English councils (of 345) [1]	% HH* waste sent for reuse, recycling or composting (Ex NI192)	Collected household waste per person kg	Total HH residual waste tonnes	Total non-HH residual waste tonnes	Total collected residual waste tonnes
Allerdale Borough Council	282	33%	422	28,499	4,877	33,377
Barrow-in-Furness Borough Council	344	19%	363	17,924	130	18,054
Carlisle City Council	196	41%	390	25,005	5	25,010
Copeland Borough Council	247	37%	372	16,385	2,213	18,598
Eden District Council	178	42%	398	12,050	1,715	13,765
South Lakeland District Council	145	44%	429	25,078	19	25,097
Cumbria County Council	119	47%	478	138,480	8,592	147,072

[1] From https://www.letsrecycle.com/councils/league-tables/2018-19-overall-performance/

*HH waste is Household waste.

Data from https://www.wastedataflow.org/reports/default.aspx

Information on the management of commercial, industrial and construction and demolition waste, taken from Tables 11 and 15 of the county council's Waste Needs Assessment report is shown in Table 6.3. This does not define what 'treatment' means or include information on the final destination of materials sent to materials recovery or transfer facilities.

Table 6.3 Management methods for commercial, industrial and construction and demolition wastes

	Commercial	Industrial	C&D
Recovery/re-use	0%	12.%	0.2%
Treatment	41%	48%	59%
Civic amenity site	8.%	0.5%	3%
Composting	9%	3%	1%
Materials recovery facility	2%	2%	1%
Metal recycling	4%	5%	2%
Inert landfill	0%	0.04%	0%
Non-hazardous landfill	12%	13%	2%
Hazardous landfill	0%	0.3%	0.3%
Transfer	24%	14.%	31%

From Table 11 and Table 15 of CCC and LDNPA, 2019

6.2 POTENTIAL FOR INCREASING RECYCLING

The latest local authority collected waste figures and recycling rates for councils across Cumbria, shown in Table 6.2, have been obtained from Waste Data Flow and are for 2018/19.[54] We have assumed the same current recycling rates for commercial and industrial waste (as no recycling rates are published either for Cumbria, or for England as a whole) and a 70% recycling rate for the construction sector. UK statistics on waste suggest that 92% of construction and demolition waste in England was 'recovered' in 2016.[55] However, this includes 'downcycling', in which demolition reduces buildings to rubble and then turns it into lower quality materials. For example, brickwork and blockwork are reduced to aggregate and then buried as land raising on a construction site or in an inert landfill. Similarly 'recycling' at construction sites tends to involve throwing things in skips and then mechanically sorting these at material recycling facilities/transfer stations, where, apart from recovery of metal for scrap, materials tend not to be recycled or reused because they are contaminated or broken. Instead of a recovery-led approach to recycling where most items are *downcycled* we need a reuse-led approach to construction and demolition where the value of materials is maximised.[56]

As explained above, currently Cumbria imports and exports waste from and to surrounding regions. The result is that Cumbria is a net importer of construction and demolition waste and exporter of commercial and industrial waste. The potential for job creation, though, has been based on the amounts of waste arising within the county itself.

In 2015 Green Alliance and WRAP modelled the potential for job creation through the creation of a circular economy in England and considered that a transformational shift equated to an 85% recycling rate.[57] Research by Zero Waste Europe[58] has found that some local authorities are already achieving recycling rates of around 80%.[59] Considering the economy-wide transformation required to bring about a zero-carbon economy, and best practice being demonstrated *already* in Europe, a 90% potential recycling rate is considered a reasonable target. Therefore, we propose that a 90% recycling rate for all types of waste would align with a zero-carbon future.

54 https://www.wastedataflow.org.
55 Government Statistical Service, 2020.
56 See for example Resource Futures (2011)
57 Morgan J and Mitchell J, 2015.
58 See https://zerowasteeurope.eu/about/principles-zw-europe/.
59 For example, Treviso in Italy currently achieves a recycling rate of 85%, with 53kg per person per year of residual waste. Its target is for 97% and 10kg/person residual waste by 2022. (https://zerowasteeurope.eu/library/the-story-of-contarina/). Palma in Italy has increased its recycling rate from 49% in 2012 to 76% in 2016 (https://www.livingcircular.veolia.com/en/city/four-european-waste-sorting-champions).

6.3 JOB CREATION POTENTIAL

A report by Friends of the Earth in 2010, *More Jobs Less Waste,* looked at the jobs that could be created across Europe by increasing rates of recycling. Their review of the available information suggested that recycling could increase the number of jobs ten-fold over landfill and incineration. They estimated that, across the different key recyclable materials, recycling could create an additional 4.9 jobs per 1,000 tonnes of material. This includes additional jobs in collection and sorting as well as subsequent remanufacturing using collected material. Table 11 from their report is shown below in Figure 6.1 and gives the jobs created per 1000 tonnes of key recyclable materials:

Figure 6.1 Jobs from recycling (Table 11 of FOE, 2010)

	Ratios of jobs/000 tonnes recycled material		
Key recyclable material	Jobs created per 000 tonnes (LEPU, 2004)	Jobs created from US studies (CASCADIA, 2009)	Assumed rates for EU27, 2020
Glass	0.75	2.6	0.75
Paper	3.5	1.8	1.8
Plastic	15.6	9.3	9.3
Iron and Steel	5.4	-	5.4
Aluminium	11	-	11
Wood	0.75	-	0.75
Textiles	5	8.5	5
Biowaste	1.3	0.4	0.4
Average all recycling	6.2	5.0	4.9

To estimate the jobs just from collection and sorting of waste for recycling we have used 2.9 jobs per 1,000 tonnes of waste, based on other information in the FoE report. We have assumed that the potential for job creation from reuse and recycling of commercial, industrial and construction waste will be half of that for household waste, because the greater scale of the collection and reprocessing of this waste. In reality some of these jobs may be in activities that reduce the volume of materials that become waste, such as repair and resale of household goods and clothing, or salvage of construction materials.

Our estimates of the number of jobs that could be created from increasing the rate of recycling, reuse and repair to 90% are shown in Table 6.4. We have subtracted the number of landfill jobs lost (considered to be 0.29 jobs 1000 tonnes, *i.e.* one tenth of the jobs created), assuming half of these to be at Lillyhall in Allerdale and half at Hespin Wood near Carlisle, giving a total of 547 jobs. The jobs created by recycling of waste collected by Cumbria County Council have been split between the districts, as shown in Table 6.4. Table 6.5 shows our estimates of the number of jobs that could be created from increased recycling of other waste.

Table 6.4 Jobs from increased recycling of household waste

Local Authority	Increase in waste recycled tonnes	jobs created [2]	Landfill jobs lost [1]	Net Jobs per district
Allerdale Borough Council	23,367	93	-30	63
Barrow-in-Furness Borough Council	17,197	150		150
Carlisle City Council	12,950	138	-30	108
Copeland Borough Council	21,519	87		87
Eden District Council	10,096	54		54
South Lakeland District Council	20,643	85		85
Cumbria County Council	103,425			
	209,198	**607**	**-60**	**547**

[1] Assumed to be at the landfill sites at Lillyhall in Allerdale and Hespin Wood, Carlisle

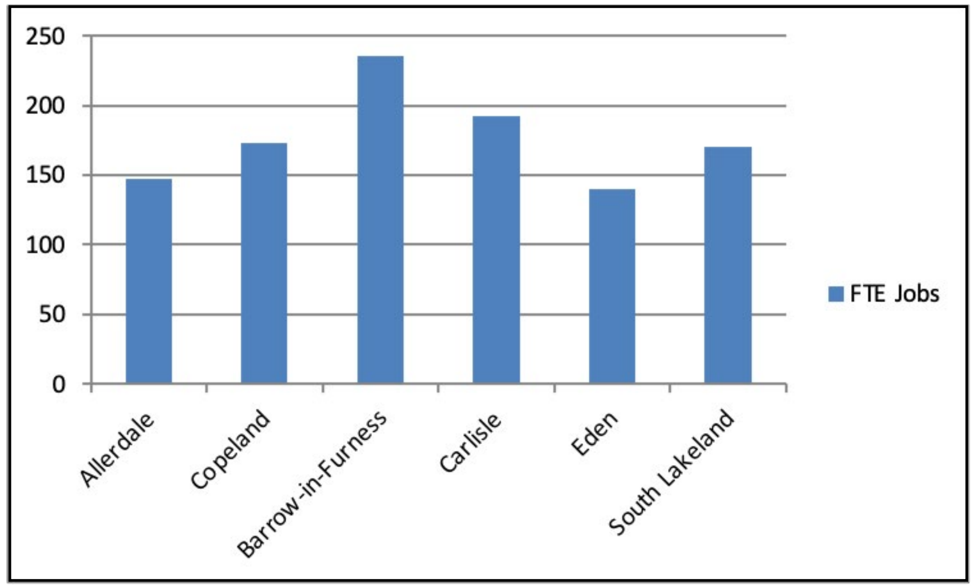
[2] Half of Cumbria County council jobs distributed equally between districts, other half split between Barrow and Carlisle where mechanical biological treatment plants are located.

Table 6.5 Jobs from increased recycling of other waste

	Waste generated tonnes	Assumed current recycling rate	Increase in amount recycled to get to 90% recycling rate tonnes	Jobs
LA collected non-HH residual waste	17,550	78%	2,194	2.6
Commercial waste	292,192	47%	126,519	151.8
Industrial waste	640,728	50%	256,291	307.5
Construction and demolition waste	203,617	70%	40,723	48.9
	1,154,087		**425,727**	**511**

We estimate that in total just over 1,000 long-term jobs could be created across Cumbria through increased high-value recycling of different waste streams. The number in each district is shown in Figure 6.1, assuming the jobs in Table 6.5 are split equally between the districts.

Figure 6.1 Jobs in recycling of waste by district[60]



60 Assumes that jobs in recycling of non-household waste, shown in Table 6.5, are split equally between the districts.

6.4 LOCAL CIRCULAR ECONOMY

Recycling and reuse would be facilitated by moving to a more local circular economy, in which goods were repaired for reuse, or recovered materials used to manufacture new products. In this section we briefly outline four opportunities for Cumbria to develop a more circular economy:

- Local reuse/repair clusters;
- 'Green steel' production;
- Production of office-grade recycled paper; and
- Plastics reprocessing.

We have not been able to estimate the number of jobs that could be created by these opportunities, as this depends on the scale at which each opportunity is taken up in Cumbria.

Opportunity 1: Local reuse/repair clusters

Reuse projects in the UK are typified by local third sector enterprises, often connected into the voluntary sector, but not operating at scale. Historically builders' yards enabled reuse from one construction site to the next, but these have tended to be replaced by skips, which lead to recycling not reuse. Small projects across the UK include furniture reuse stores, scrap stores, paint reuse projects and salvage enterprises.

There are a wide range of reuse enterprises already present in Cumbria including:

- **Furniture reuse** – Cumbria-wide Impact Furniture Services, with stores in Carlisle, Workington and Barrow.[61]
- **Waste Electrical and Electronic Equipment (WEEE)** – Cumbria Recycling Ltd, a social enterprise based at Lillyhall near Workington, collects white goods and other electrical equipment from waste recycling centres and from local businesses and schools, for testing, repair, reuse or deconstruction for recycling of materials.[62]
- **Community Scrapstore** – Ragtag Arts in Kendal.[63]
- **Reclamation and architecture salvage** – at least 12 reclamation and salvage businesses across Cumbria.[64]
- **Scrap metal merchants** – around 15 in Cumbria.
- **Community repaint schemes** in Barrow, Carlisle, Kendal and Wigton (North Allerdale).[65]
- **Bike repair/reuse in Carlisle** – Rebike Cumbria.[66]

These initiatives are significant in the communities they serve, but could be expanded and co-ordinated to provide coverage across all of Cumbria and scale up reclamation and reuse. This could take the form of a series of relatively small-scale "Social Enterprise Eco-Parks[67]" to cluster enterprises

61 https://www.impacthousing.org.uk/impact-furniture-services.
62 https://cumbriarecycling.co.uk/
63 https://www.ragtagarts.co.uk
64 https://www.salvoweb.com/salvo-directory/category/all/location/uk/region/cumbria
65 https://communityrepaint.org.uk/need-paint/find-your-nearest-scheme/#map-view
66 https://www.rebikecumbria.co.uk.
67 See Bioregional (2009) Social Enterprise Eco-Park for the East Midlands: Executive Summary. https://en.calameo.com/read/0005759535fbcf3bada47.

together.[68] These hubs/eco-parks could be co-located with other social enterprises, skills centres (needed to retrain for the green economy) and bases for community-based climate jobs, such as for the retrofit of homes. As well as increasing the reuse and repair of household items they could encourage a stronger salvage and deconstruction industry, working with architects to facilitate the use of 'second hand' steel,[69] for example, and with the demolition industry to increase reclamation and reuse, not just recycling of materials.[70]

Such 'reuse at scale' is common in the US, with its more favourable policies for corporate donations for reuse, for example:

- **Habitat Restores** across the US[71] are large warehouses that bring together reclamation and reuse from household deconstruction to furniture and so on. These are multi-million not-for-profit enterprises that build housing for the homeless with their surplus income.
- **St Vincent de Paul** in the US, runs reuse warehouses and deconstructs and recycles mattresses,[72] a product that is often disposed of in landfill sites in the UK.

Opportunity 2: UK 'green steel' production

The UK currently exports most of its scrap steel,[73] and then imports both new steel and iron ore and coal to make new steel in blast furnaces. Blast furnaces have high carbon emissions that currently cannot be decarbonised.[74] There is an opportunity for the UK to instead retain its scrap steel and use it to make new steel in electric arc furnaces. With the current carbon intensity of UK electricity such steel has only a third of the carbon emissions of the global average for primary steel and as renewable generation increases this will decrease further (Allwood et al, 2019).

The UK currently has at least two operational electric arc furnaces: in Cardiff, owned by Celsa Steel,[75] and in Rotherham, owned by Liberty Steel.[76] The latter has two furnaces each with a capacity of 400,000 tonnes a year and makes specialist steels for uses such as vehicle gearboxes and aircraft landing gear. The Celsa Steel site directly employs over 500 staff as well as using several hundred sub-contractors.[77]

68 For example, see http://www.nef.org.uk/themes/site_themes/agile_records/images/uploads/WP4A12_-_Community-Led_Reuse_of_Resources.pdf.
69 https://www.dunkerley.co.uk/news-blog/second-hand-steel/
70 For lessons on how to do this see Bioregional (2011)
71 For example see https://www.habitatmichigan.org/restores.
72 https://www.svdp.us/what-we-do/recycling-and-manufacturing/mattress-recycling/
73 For example, the UK currently exports more scrap steel to Turkey (alone) than is melted down into new steel in the UK. See Sims and Essex, 2020
74 A pilot of smelting iron ore using electricity and hydrogen is taking place in Sweden but does not expect to be brought to market until 2026. See-https://www.ssab.com/company/sustainability/sustainable-operations/hybrit
75 http://www.celsauk.com/ProductionProcess.mvc/Introduction
76 https://www.recyclingtoday.com/article/liberty-eaf-steel-furnace-uk-recycling/
77 http://www.celsauk.com/Company.mvc/CelsaSteelUK

The opportunity in Cumbria is probably for electric arc furnace steel production in Workington, a town with a long history of steel making until the closure of the rail-making plant in 2006.[78] This could make use of the considerable amount of electricity that can be generated offshore from Workington (see section 3.1) and provide steel for the local manufacture of wind turbines that could then be installed in the Irish Sea. A 400,000 tonnes a year furnace would provide enough steel for 1.2–1.9GW of new offshore wind each year,[79] more than is likely to be needed in the Irish Sea alone. There is also likely to be a demand for steel for making rails over the coming years, particularly for the construction of HS2.[80]

Increasing the quantity of UK scrap that is used to make steel in the UK would provide the opportunity for steel makers to work with scrap merchants to improve the quality of the scrap metal available. For example, motors, which have copper windings, could be removed from cars before they are shredded. Copper is the major problematic contaminant of scrap steel (Allwood, 2019 p.10).

Opportunity 3: UK production of office-grade recycled paper

The UK no longer produces its own office-grade recycling paper (although it still makes newsprint and cardboard products from recycled paper). Establishing a UK-based plant that makes high-quality paper from recycled paper in the UK would:

- reduce the UK's export of waste paper whilst simultaneously reducing our import of paper products from overseas;
- create jobs where this paper is produced; and
- create jobs in the segregation of waste paper for recycling, as demand for high-quality recyclate expands capture rates and improves waste segregation.[81]

Cumbria has expertise in paper making: James Cropper near Kendal makes speciality paper and uses some recycled fibres from coffee cups; Iggesund in Workington manufactures paperboard from wood pulp. This expertise could be used to produce recycled office paper.

Opportunity 4 – Plastics reprocessing

The government has said that in 2022 it will introduce a tax on plastic packaging that does not contain at least 30% recycled plastic. It has been estimated that to provide 30% of recycled content in plastic packaging the UK's plastics reprocessing capacity needs to be doubled (RECOUP, 2020). There is an opportunity for Cumbrian local authorities to work together to improve the quality of plastic waste collected and develop some plastics reprocessing capacity in Cumbria to use segregated plastic wastes.

78 https://www.timesandstar.co.uk/news/17057236.heartbreak-and-tears-as-rail-making-bids-farewell-to-workington/
79 The Government's Steel Procurement Pipeline (https://www.gov.uk/government/publications/steel-public-procurement-2020) suggests that there is a need for between 211-328 tonnes of steel per MW of installed offshore wind – a total of 0.6-1million tonnes over a three-year period (2021-2024) - based on three wind farms: Doggerbank (1200MW), Seagreen (454MW) and Sofia (1400MW). Estimates by IRENA (2019) are comparable, 117 tonnes of steel per MW onshore wind and 402 tonnes of steel for offshore wind construction.
80 Phase 1 is likely to require 1,300,000 metric tonnes of steel. (https://www.gov.uk/government/publications/steel-public-procurement-2020).
81 For example, ending the practice of co-mingled household waste recycling collections would allow paper to be reprocessed back into paper products and glass recycled back into new glass. Collecting these waste streams together cross-contaminates both. Demanding a high-quality stream of white paper could improve capture rates and value of UK recycling in offices and other workplaces.

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Appendices

APPENDIX 2A: Additional Tables

Table A1 Onshore wind energy resource and installed capacity

	Accessible energy resource (in MW) at 2030 estimated in 2011 [1]				Actual installed capacity at end of 2019 [2]	Remaining capacity	Generation in 2019 [2]
	commercial scale		Small scale	total			
Local planning authority	technical resource assessment	reduced to allow for landscape capacity			MW	MW	MWh
Allerdale	835	494	5.7	499	96	403	218,249
Barrow in Furness	20	15	0.5	16	7	9	11,188
Carlisle	213	141	6.1	147	49	97	90,251
Copeland	152	82	2.1	84	23	61	53,316
Eden	1181	657	4.6	661	1	660	3,102
South Lakeland	457	246	2.9	249	38	211	85,898
Lake District NP	0	0	5.2	5		5	
Yorkshire Dales NP	0	0	0.2	0		0	
Cumbria total	1656	1634	27.3	1661	214	1445	462,003

[1] From Tables 5-4 and 5-9 and 5-10 of SQW and LUC, 2011

[2] From Renewable Electricity by Local Authority - https://www.gov.uk/government/statistics/regional-renewable-statistics

Table A2 Hydro resource and installed capacity

Local planning authority	Accessible energy resource (in MW) at 2030 estimated in 2011 [1]	Actual installed capacity at end of 2019 [2]	Remaining capacity	Generation in 2019 [2]
	MW	MW	MW	MWh
Allerdale	2.10	0.86	1.2	2,595
Barrow in Furness	0.00	0.00	0.0	-
Carlisle	1.50	0.02	1.5	45
Copeland	0.00	0.66	-0.7	1,996
Eden	4.40	1.22	3.2	3,182
South Lakeland	6.60	4.12	2.5	12,403
Lake District NP	42.50		42.5	
Yorkshire Dales NP	12.60		12.6	
Cumbria total	69.70	6.88	62.8	20220

[1] From Table 5-4 of SQW and LUC, 2011

[2] From Renewable Electricity by Local Authority - https://www.gov.uk/government/statistics/regional-renewable-statistics

Table A3 Anaerobic digestion resource and installed capacity

Local planning authority	Accessible energy resource (in MW) at 2030 estimated in 2011 [1]	Actual installed capacity at end of 2019 [2]	Remaining capacity	Generation in 2019 [2]
	MW	MW	MW	MWh
Allerdale	18.7	3.6	15.1	19,656
Barrow in Furness	1.0	-	1.0	-
Carlisle	19.2	1.5	17.7	8,148
Copeland	6.2	0.5	5.7	2,475
Eden	21.5	2.9	18.6	16,153
South Lakeland	11.8	0.0	11.8	155
Lake District NP	14.2		14.2	
Yorkshire Dales NP	0.2		0.2	
Cumbria total	92.8	8.5	84.3	46,586

[1] From Table 5-5 of SQW and LUC, 2011 - figures for: Wet organic waste and Poultry litter

[2] From Renewable Electricity by Local Authority - https://www.gov.uk/government/statistics/regional-renewable-statistics

Table A4 Plant biomass resource and installed capacity

Local planning authority	Accessible energy resource (in MW) at 2030 estimated in 2011 [1]	Actual installed capacity at end of 2019 [2]	Remaining capacity	Generation in 2019 [2]
	MW	MW	MW	MWh
Allerdale	2.7	50.2	-47.55	360,888
Barrow in Furness	0.7	-	0.70	-
Carlisle	4.3	0.2	4.14	750
Copeland	1.1	-	1.10	-
Eden	3.9	1.4	2.52	2,728
South Lakeland	1.4	-	1.40	154
Lake District NP	3.4		3.40	
Yorkshire Dales NP	0.2		0.20	
Cumbria total	17.7	51.8	-34.09	364,367

[1] From Table 5-5 of SQW and LUC, 2011 - figures for: Under managed woodland (E) , Energy crops (E), Waste Wood (E)

[2] From Renewable Electricity by Local Authority - https://www.gov.uk/government/statistics/regional-renewable-statistics

Table A5 Landfill gas resource and installed capacity

Local planning authority	Accessible energy resource (in MW) at 2030 estimated in 2011 [1]	Actual installed capacity at end of 2019 [2]	Remaining capacity	Generation in 2019 [2]
	MW	MW	MW	MWh
Allerdale	0.8	2.0	-1.21	1,640
Barrow in Furness	0.5	2.3	-1.83	4,774
Carlisle	0.3	1.3	-1.03	8,846
Copeland	0.0	1.9	-1.93	2,303
Eden	0.1	0.8	-0.72	1,863
South Lakeland	0.0	-	0.00	-
Lake District NP	0.1		0.10	
Yorkshire Dales NP	0.0		0.00	
Cumbria total	1.8	8.4	-6.61	19,426

[1] From Table 5-5 of SQW and LUC, 2011

[2] From Renewable Electricity by Local Authority - https://www.gov.uk/government/statistics/regional-renewable-statistics

Table A6 Potential new generating capacity from repowering existing wind farms

District	Actual installed capacity at end of 2019 [1]	Capacity of non-repowered sites [2]	Potential new capacity through repowering [3]	Net new capacity
	MW	MW	MW	MW
Allerdale	96	92	263	171
Barrow in Furness	7	7	19	12
Carlisle	49	49	140	91
Copeland	23	20	56	36
Eden	1	1	4	3
South Lakeland	38	26	75	49
Cumbria total	214	196	557	361

[1] From Table

[2] Subtracting capacities of repowered wind farms at Great Orton (Allerdale), Harlock Hill (South Lakeland) and Haverigg III (Copeland).

[3] Assuming capacity increased by a factor of 2.85, as for already repowered sites - see RenewableUK, 2019

Table A7 FIT registered solar PV installations by district

District	Total installed capacity at end of 2019 [1] MW	Installed capacity of FIT registered solar PV installations at end of 2019 [2] (MW)			Number of FIT registered solar PV installations at end of 2019 [2]			Other PV installations
		Dom-estic	Non-domestic	Total	Dom-estic	Non-domestic	Total	Capacity MW
Allerdale	36.0	5.85	3.04	**8.89**	1,514	136	1,650	27
Barrow in Furness	14.5	1.69	5.79	**7.48**	473	30	503	7
Carlisle	17.5	6.17	2.69	**8.86**	1,707	88	1,795	9
Copeland	3.9	3.47	0.47	3.94	938	31	969	0
Eden	17.0	5.38	2.79	8.17	1,422	104	1,526	10
South Lakeland	12.5	6.34	1.91	8.25	1,927	88	2,015	5
Cumbria total	103.8	28.91	16.69	45.60	7,981	477	8,458	58

[1] From Renewable Electricity by Local Authority - https://www.gov.uk/government/statistics/regional-renewable-statistics

[2] From https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics

Table A8 Potential for domestic solar PV by district

District	Number of dwellings in 2019 [3]	Domestic PV at end of 2019 [1]				New domestic PV [2]	
		Installed capacity	No of systems	% of dwellings	Average size	Number	Capacity [4]
		kW			kWp		kW
Allerdale	47363	5,853	1,514	3%	3.87	9,298	32,542
Barrow-in-Furness	33,555	1,694	473	1%	3.58	6,544	22,904
Carlisle	52,666	6,173	1,707	3%	3.62	10,684	37,393
Copeland	33768	3,471	938	3%	3.70	6,305	22,066
Eden	26596	5,381	1,422	5%	3.78	4,667	16,335
South Lakeland	53654	6,337	1,927	4%	3.29	9,890	34,616
Cumbria Total	247,602	28,909	7,981	3%	3.62	47,388	165,857

[1] From sub-regional feed-in tariff confirmed on the CFR statistics, available at https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics

[2] To increase percentage of dwellings with PV to 20% of 2037 dwellings, assuming rate of house building is the same per year as the average for 2015-2018. Around 10% of dwellings in 2037 are likely to have been built since 2020 and therefore have renewable energy systems as a planning requirement.

[3] From www.gov.uk/government/statistics/council-tax-stock-of-properties-2018, plus one year of new-build properties, assuming the number per year is the average number of new dwellings per year, 2015-2018 shown on p.111 of Cumbria Intelligence Observatory and Nicol Economics, 2019. The 84 dwellings per year for the Lake District NP were split equally between Allerdale, Copland, Eden and South Lakeland.

[4] Assuming an average system size of 3.5kWp.

Table A9 Capacity for large-scale solar PV

District	Roof-top				Ground-mounted				Total capacity
	Public/ community buildings		Industrial/ commercial areas		Pasture land		Mineral extraction sites		
	Number [1]	Cap-acity MW	Area [2] Ha	Cap-acity MW	Area [2] Ha	Cap-acity MW	Area [2] Ha	Cap-acity MW	MW
Allerdale	85	1.7	1,055	53	62,778	388	110	7	449
Barrow-in-Furness	74	1.5	466	23	4,204	26	26	2	52
Carlisle	117	2.3	1,023	51	48,538	300	186	11	365
Copeland	73	1.5	717	36	27,165	168	140	9	214
Eden	54	1.1	179	9	90,108	556	328	20	586
South Lakeland	113	2.3	202	10	67,430	416	331	20	449
Cumbria Total	516	10	3,642	182	300,224	1,853	1,119	69	2,115

Table A10 Transition jobs in renewable electricity generation over 15 years (full-time equivalents)

District	Onshore wind	Offshore wind	Solway tidal lagoons	Solar PV	Hydro	Training jobs [1]	Total jobs
Allerdale	407	1647	893	145	135	97	**3324**
Barrow in Furness	17	915		52	4	17	**818**
Carlisle	145			132	39	9	**327**
Copeland	71			85	49	6	**211**
Eden	406			159	161	21	**748**
South Lakeland	175			148	104	12	**440**
Cumbria total	1222	2562	893	721	493	161	**6147**

Includes 50% of long-term jobs, as it is assumed that half the long-term jobs will exist halfway through the transition period.
[1] Some of the gas fields in the Irish Sea/Morecambe Bay link to the Rampside Gas Terminal at Barrow where about 400 people are employed by Centrica.
https://en.wikipedia.org/wiki/Rampside_Gas_Terminal

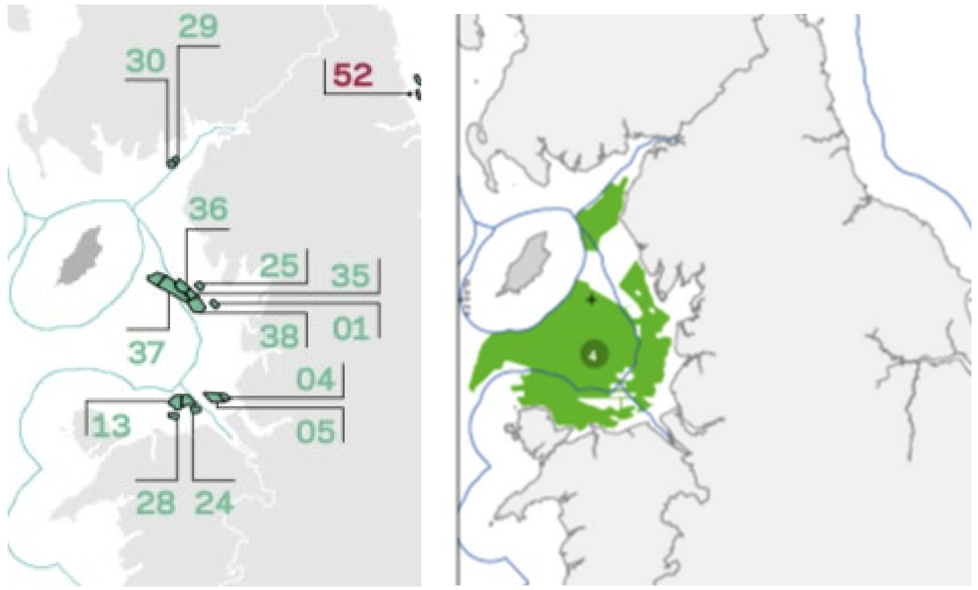
Table A11 Long-term jobs in renewable electricity generation (full-time equivalents)

	Onshore wind	Offshore wind	Solway tidal lagoons	Offshore gas jobs lost [1]	Solar PV	Hydro	Total jobs
Allerdale	193	774	89		56	16	**1459**
Barrow in Furness	8	430		-400	50	0	**88**
Carlisle	69				59	2	**130**
Copeland	34				49	13	**96**
Eden	193				45	27	**265**
South Lakeland	83				57	26	**166**
Cumbria total	580	1204		-400	317	84	**2204**

[1] Assumes training and support jobs equivalent to 3% of jobs.

APPENDIX 2B: Current and Potential Areas for Offshore Wind Farms in the Irish Sea

As can been seen from the figure and table below, the current wind farms commissioned in the Irish Sea off Cumbria total 2905MW, around 30% of current UK offshore wind capacity,[82] yet only take up a small part of the potential generation area.



Current offshore wind installed in the Irish Sea (left), and potential areas for new turbines (right).[83]

Ref.	Name	MW
1	Barrow	90
4-5	Burbo Bank, extension	349
13	Gwynt y Môr	576
24	North Hoyle	60
25	Ormonde	150
28	Rhyl Flats	90
29	Robin Rigg East	84
30	Robin Rigg West	90
35-37	Walney 1,2, extension[84]	1027
38	West of Duddon Sands	389
	Total (all fully commissioned)	2905

82 Crown Estate (2020) offshore wind operational report 2019 notes that the UK had 9701MW of offshore capacity fully commissioned as of 31 December 2019 and a further 9871MW under construction or with government contract secured.
83 Sources: Crown Estate (2020) Offshore wind operational report 2019. (https://www.thecrownestate.co.uk/en-gb/media-and-insights/stories/2020-the-crown-estate-2019-offshore-wind-operational-report-demonstrates-strength-and-maturity-of-the-uk-offshore-wind-industry/) and Crown Estate (2019) Offshore Wind Leasing Round 4: Regions Refinement Report. (https://www.thecrownestate.co.uk/media/3330/tce-r4-regions-refinement-report.pdf).
84 BEIS (2019) DUKES 2019 notes this is currently the largest wind farm in the world.

APPENDIX 2C: Metrics used in calculation of jobs estimates

Job Type	Scaling metric	Notes	Source
Onshore wind construction	7 job years per MW	2030 value for direct jobs of 11 job years/MW from EWEA (2009) scaled down by 63.5% as this is the proportion of direct construction jobs that Kahouli and Martin (2018), in their study of wind energy jobs in Brittany, consider are local to the site of construction.	European Wind Energy Association, 2009 and Kahouli and Martin, 2018
Onshore wind maintenance	0.29 jobs per MW	2030 value for operation and maintenance jobs from source.	European Wind Energy Association, 2009
Offshore wind construction	10.5 job years per MW	Uplift of 1.5x compared with onshore wind based on predicted cost difference by 2030.	European Wind Energy Association, 2009
Offshore wind maintenance	0.43 jobs per MW	Uplift of 1.5x compared with onshore wind based on predicted cost difference by 2030.	European Wind Energy Association, 2009
Tidal lagoon construction	13,392 job years for two 380MW lagoons	2,232 construction and manufacturing jobs will be directly sustained by the build of Swansea Bay tidal lagoon (320MW) over 4 years. Assume 1.5 times this number for 2 offshore lagoons off Cumbria over same time.	http://www.tidallagoonpower.com/projects/swansea-bay/
Tidal lagoon maintenance		Assumes same relationship between construction and maintenance jobs as for offshore wind.	
Solar PV - domestic installation	0.038 job years per installation	50 hrs installation plus 7 hours quote, invoicing, etc. for 3.5kWp system.	Personal communication from a local installer
Solar PV – domestic maintenance	0.002 jobs per installation	Assumes inspected every 5 years, half a day per visit.	
Solar PV - commercial roof mounted installation	2.93 Job years per MW	220 hours for a 50kWp system, including admin, scaffolding, etc.	Personal communication from a local installer
Solar PV - Commercial roof mounted installation	3.19 job years per MW	Bold scenario, 20GW in 2030 (p.32) direct employment 63,800 FTE years	Cebr, 2014
Solar PV – commercial maintenance	0.07669 jobs per MW	600-700 people employed in 2016 when there was 8475.7MW	Solar Trade Association, 2016 and https://www.gov.uk/government/statistics/solar-photovoltaics-deployment
Hydro installation (low head: run of river schemes)	48.5 job years per MW installed	From data for <100KW projects	Forrest and Wallace, 2009
Hydro maintenance (low head: run of river schemes)	1.3 jobs per MW	From data for <100KW projects	Forrest and Wallace, 2009

Transport sector jobs

Job Type	Scaling Metric	Notes	Sources
Driving buses	0.313 FTE jobs per 10,000 bus km/year	600 bus drivers employed by Stagecoach Cumbria and North Lancashire and 19.15 million km travelled.	Stagecoach Cumbria and North Lancashire, 2019
Maintaining buses	881 FTE jobs per 10,000 bus miles/year	106 maintenance staff and cleaners and 63 supervisors and managers employed by Stagecoach Cumbria and North Lancashire and 19.15 million km travelled. Existing maintenance intensity assumed to apply to Trolley/EV/hydrogen buses.	Stagecoach Cumbria and North Lancashire, 2019
Railways - operation and maintenance	4.1 FTE jobs per 10,000 train miles/year	Total UK rail industry staff divided by total train-km (Includes supply chain).	Rail Delivery Group *Annual Report 2016* and Office for Rail and Road, 2016 /17 statistics
Maintaining private internal combustion engine vehicles (ICE)	0.5 FTE jobs per 1,000,000 private vehicle miles/year	Based on 233,000 FTE jobs supporting 316.7 billion vehicle miles.	ONS, Table TRA8901 and Table EMP04, *All in Employment by Occupation*, Apr-June 2016

Maintaining private electric vehicles (EVs)	0.3 FTE jobs per 1,000,000 private vehicle miles/year	Based on EVs requiring approximately 2/3 of the maintenance of ICE vehicles.	Van den Bulk, 2009
Installing EV chargepoints (public)	0.09 job years / chargepoint	Approximately 19 days per chargepoint (200 working days/year)	Personal communication from Charge My Street, 2020
Installing EV chargepoints (workplace)	0.05 job years / chargepoint	Assumes workplace chargepoints done in half the time required for public ones.	
Installing EV chargepoints (domestic)	0.01 job years /chargepoint	Assume a tenth that of a public chargepoint (cost is less than £1000, public charge points can be £10,000).	

Waste Sector jobs

Job Type	Scaling Metric	Notes	Sources
Recycling of household waste	2.9 jobs per 1,000 tonnes of waste recycled	Reduced from 4.9 jobs per 1,000 tonnes in source to just be collection and sorting jobs.	Friends of the Earth, 2010
Waste disposal	0.29 jobs per 1,000 tonnes of waste	Source states that waste disposal (landfill & incineration) employs roughly a 10th of reuse and recycling.	Waste Watch, 1999, p.6
Recycling of other waste	1.2 jobs per 1,000		

Appendix 3

REPORT OF CONSULTATION EVENTS

Preliminary research results were presented during three online consultation events in November and December 2020 to a total of 43 participants. Thirty one different Cumbrian organisations were represented, as follows:

- Action with Communities in Cumbria
- Allerdale and Copeland Green Party
- Allerdale Borough Council
- Ambleside Action for a Future
- Carlisle City Council
- Carlisle College
- Copeland Borough Council
- Cumbria Chamber of Commerce
- Cumbria County Council
- Cumbria CVS
- Cumbria Local Economic Partnership
- Cumbria Youth Alliance
- Eden District Council
- Eden Housing Association
- Environment Agency – Cumbria and Lancashire
- Federation of Small Businesses – Lancs and Cumbria
- Friends of the Earth
- Kendal Futures
- Lake District National Park Authority
- Millom Without Parish Councils
- NASUWT (Cumbria County Council branch)
- Northern TUC
- PCS (DEFRA branch)
- Penrith Action for Community Transition
- Penrith Business Improvement District
- South Lakeland District Council
- South Lakes Action on Climate Change
- Sustainable Brampton
- Sustainable Keswick
- Unison
- University of Cumbria

During breakout discussion sessions, participants shared information about initiatives that are currently underway to reduce carbon emissions or create green jobs and discussed barriers to the development and uptake of green jobs.

Existing initiatives highlighted included several projects led by community sustainability groups, such as:

- **Ambleside Action for a Future's work** to establish a community solar PV project
- **Community gardening** to grow food in the Eden area.
- **Sustainable Brampton**'s community renewable energy (biodigester) project which aims to provide a district heating scheme and renewable energy for water purification.
- **Community owned renewable energy initiatives** (Burneside Community Energy).

In addition, the Woodland Trust is working on tree planting, the Cumbria Cycle Mayor campaigns for car free days and streets, Kendal Futures has set out a vision for energy efficient homes and active travel, and there are various local authority plans and strategies for reducing organisational and area carbon emissions.

Furthermore, greening the workplace is now coming to top of the agenda for trade unions. They are seeking to embed 'Just Transition' considerations into their collective agreements with employers, covering jobs, pay and conditions, equal opportunities, health and safety and skills.

The barriers to action to reduce carbon emissions and support the transition to low carbon jobs were also discussed. These are collated and summarised below with suggested actions split into things that can be done at a local level (some of which may already be being done to a certain extent) and required national policy changes.

3.1 TRANSPORT

In the absence of significant improvements in public transport, electric vehicle uptake will be particularly important in rural areas but the cost of electric cars may be prohibitive for the wider population initially. Whilst longer term savings on tax, power and servicing might induce investment in EV purchase now, as EVs become more popular the current road tax exemption is likely to end which could reduce the longer term costs savings and put off potential purchasers.

The relatively short range of EVs compared to the internal combustion engine (ICE) is an issue in large, rural, hilly county with limited charge points.

Experience elsewhere suggests it is challenging to achieve modal shifts in transport especially journeys for work and shopping despite the fact that the majority of people support making fewer car journeys[1]. A key barrier to people ditching car use in favour of active travel is often the lack of safe, car free routes.

Electric bicycles are attractive in Cumbria's hilly terrain. People on low incomes may find the high cost of bicycle battery replacement prohibitive.

Potential local level actions

a. Identify the likely trajectory of the second hand EV market and the point at which EVs with sufficient range could become affordable.
b. Signpost information on the performance of EVs in hilly terrain to the public.
c. Promote the government funds available for installation of chargepoints to householders and businesses: the Electric Vehicle Homecharge scheme and Workplace Charging Scheme2.
d. Local Authorities to apply to the government's On-street Residential Chargepoint Scheme3
e. Work with the Community Benefit Society, Charge My Street, which provides community-owned charge points, targeting residential areas where most properties do not have off-street parking.
f. Public sector organisations to lead the way in adopting EVs and encouraging staff to do the same.
g. Promote the government's Plug in Car Grant which offers 35% of the purchase price of certain new electric vehicles, up to a maximum of £3,000.
h. The continued support for and promotion of active travel options through eg local bike training, cycle maps and public transport
i. Planning policies need to ensure that new developments are not car-dependant, eg new housing within easy walking distance of, or with car free routes to, essential services and provided with good bus services.
j. Provide and promote chargers for electric bicycles
k. Electric bike hire schemes could help with costs – LDNPA are looking at carbon benefits of these kinds of initiatives.
l. Prioritise the delivery of cycleways and pathways in those places well suited to cycling and walking due to being relatively flat, such as Carlisle.
m. Covid19 has resulted in an increase in delivery drivers - work with trades unions to encourage shift to low carbon delivery vehicles including bikes/mopeds.

UK policy changes needed

a. Improvements to rail services
b. More local control over bus services (eg powers to franchise services, as in London).
c. Extension of fiscal measures to encourage uptake of EVs
d. More resources for local authorities to improve dedicated cycle/walking routes

1 https://www.cyclinguk.org/news/clear-and-unambiguous-government-survey-reveals-significant-support-using-car-less
2 https://www.gov.uk/government/collections/government-grants-for-low-emission-vehicles#workplace-charging-scheme
3 https://energysavingtrust.org.uk/grants-and-loans/street-residential-chargepoint-scheme/

3.2 RENEWABLE ENERGY

Onshore wind energy has been hampered by onerous planning barriers, along with antipathy towards wind turbines in some communities in Cumbria.

The leaseholding of buildings is a barrier to uptake of PV on commercial buildings as installation is not in the interest of the building owner.

Pasture-based solar PV may conflict with other potential land uses (eg woodland creation, flood defence) though is compatible with continued use for sheep grazing and the creastion of biodiverse grasslands;

Potential local level actions

a. Install solar PV systems on all appropriate public buildings, using Cumbria-based installers in partnership with local community energy organisations.

b. Work with Electricity North West on increasing grid capacity to enable connection of renewable supply, heat pumps and EV chargers

c. Work with bidders and the Crown Estate in the current licensing Round 4 for offshore wind to ensure use of the ports of Workington and Barrow and local supply chain benefits.

d. Ensure renewable energy generation is the right technology in the right place.

UK policy changes needed

a. Changes to planning guidance on onshore wind to reduce barriers.

b. Support for onshore wind and solar.

c. Support for small scale renewable energy which communities can be involved in developing and owning, so that the public has a stake in the low carbon transition

d. A long term roll out of offshore wind in the Irish Sea of Cumbria so there is a steady stream of construction work over the next 15 years.

3.3 ENERGY IN BUILDINGS

It can be costly to retrofit existing homes and commercial buildings. At the moment it is most economical to ensure high energy efficiency for new builds. The VAT rate for heat pumps in new builds is only 5% in comparison to 20% VAT on retrofitting heat pumps (unless the cost of materials is less than the cost of installation).

Specialist skills are needed for air source heat pumps installation. The Trustmark scheme for GHG appears to be onerous. Small local companies may not have the capacity or competence to gain accreditation and are not motivated to invest in it. As of November 2020 there was only one firm in Cumbria accredited and registered to install air source heat pumps under the Green Homes Grant (GHG) scheme. The resulting lack of local suppliers means that incentive schemes inevitably draw installers in from outside Cumbria.

Potential local level actions

a. Support the development of the supply chain (architects, plumbers, electricians and other trades) for carbon neutral new build, heat pump install and retrofitting.

b. Use local planning and other policies to the full extent possible to ensure new development is zero-carbon. This will in turn help build skills and capacity in the local workforce and supply chain that will help in retrofit of properties.

c. Test/inspect during and after build to ensure that new buildings perform as predicted with regard to energy efficiency, and share results with architects, developers, planners and householders.

d. Provide advice and support to help building owners undertake major retrofit projects and so help create and illustrate demand for installers to encourage local traders to invest in training and accreditation.

e. Fast track training in PAS 2030/2035 in local colleges.

f. Target least-efficient properties (E-G) first for retrofits to get early carbon savings (could start with ones off the gas grid)

g. Promote whole house retrofits, rather than single measures, to include low carbon heat.

h. Investigate opportunities for district heating systems.

i. Bring all public buildings with Display Energy Certificates (DECs) of band D or below to at least band B (287 buildings).

j. Offer targeted support to owners of other non-domestic buildings with EPCs of Bands D and below.

k. Engage local businesses in improving their environmental performance, e.g. SLDC initiative for SMEs https://www.southlakeland.gov.uk/news/subsidised-green-certification-on-offer-to-small-businesses/, and the University of Cumbria eco-innovations programme https://www.cumbria.ac.uk/business/eco-innovation-cumbria/

UK policy changed needed

a. Consistent, long term funding mechanisms for energy efficiency retrofits which give suppliers the confidence to invest in training and accreditation.

b. All new build to be required to be 'zero carbon'.

c. Tighten building regulations eg require energy efficiency improvements to whole property when extensions are being built.

3.4 FINANCIAL

Early adopters of new technologies are disadvantaged by higher costs which, coupled with the expectation that costs will decline over time, discourages early uptake.

The removal of national support (eg feed in tariffs) causes local employers to withdraw from the market.

Cumbria may be a more expensive location and work delivery landscape than other areas putting the county at a competitive disadvantage.

Potential local level actions

a. Identification of potential sources of investment, such as green and community bonds, community shares, localised pension funds, growth deals.

National policy needed

a. Further changes to the HMT Green Book guidance on policies, programmes and projects to influence procurement.

3.5 DEMOGRAPHIC CHALLENGES

Cumbria has an ageing population and reducing workforce numbers. There is a lack of relevant skills, and the policies, resources and training required to enable people to develop new skills.

Cumbria lacks the infrastructure to deliver the skills needed. Capital expenditure is needed on schools/colleges.

New apprenticeships are needed to replace the existing focus on high carbon skills eg the demand for ICE vehicle maintenance will reduce and EV increase.

Technical education framework is quite complicated to work around.

Potential local level actions

a. Consider the experience of 'Scarborough construction skills village' which was established to assist in the employment of young people into the housing sector. Funded by the LEP, Scarborough Council, housing companies and suppliers it helps to plug the skills gap being experienced by the housebuilders. http://skills-village.co.uk/

b. Consider whether local community centres, which may be in poor condition, could be revamped into local training hubs.

c. Connect the unemployed with opportunities for green jobs training and pay.

d. The TUC's report Voice and place: how to plan fair and successful paths to net zero emissions suggests the following:
   - use procurement and advocacy and soft powers to ensure that the recovery strategy has a core aim of driving up employer engagement in training, with a view to increasing: – the number of employers providing workplace training – engagement with unions on the learning and skills agenda, including the use of workplace learning agreements negotiated with relevant trade unions – the number of employees provided with time off to train
   - ensure local skills strategies are aligned with infrastructure and investment decisions, around investment in a future net zero economy
   - secure employment and training opportunities for local communities through intelligent procurement and framework agreements such as those used for the London Olympics and HS2, including making sure that apprenticeships and other training opportunities are established across supply chains
   - sign the TUC Apprenticeship Charter, like has been done with Liverpool City Region, and work with LEPs to engage employers to ensure every apprenticeship has purpose, is paid fairly, with high-quality learning and training elements and access to trade unions.

National policy needed

a. Industrial policy which has net zero carbon emissions and a just transition as its defining principles.

b. Recognition of a national shortage of green job skills and funding support.

c. A devolved adult education budget to meet Cumbria's needs and fit with regional economic strategy.

3.6 WASTE

At the present time the UK doesn't have the capacity to produce enough recycled plastics to meet the 30% recycled target. Could Cumbria be in a position to propose a new plastics reprocessing plant backed by government funding?

Cumbria is under resourced to process food waste, especially in the Lake District .

Potential local level actions

a. District and County Councils work together to improve quality and quantity of materials collected for recycling.
b. Investigate opportunities to expand current salvage, repair and reuse activities to create local reuse/repair clusters, the production of 'green steel' from steel scrap using renewable electricity, and the production of office-grade recycled paper.
c. Identify the opportunities for building a new plastics reprocessing plant and viable food waste reprocessing facilities in Cumbria.
d. Share case studies with business networks which illustrate the savings that can be made from improved resource efficiency and reducing waste and re-invested back into employment.

National policy needed

a. Government support for reprocessing facilities

3.7 ATTITUDES/BEHAVIOUR CHANGE

Fear of change inhibits uptake of low carbon options eg moving from ICE to electric vehicles, undertaking complex/expensive home retrofitting, new jobs which may require new skills.

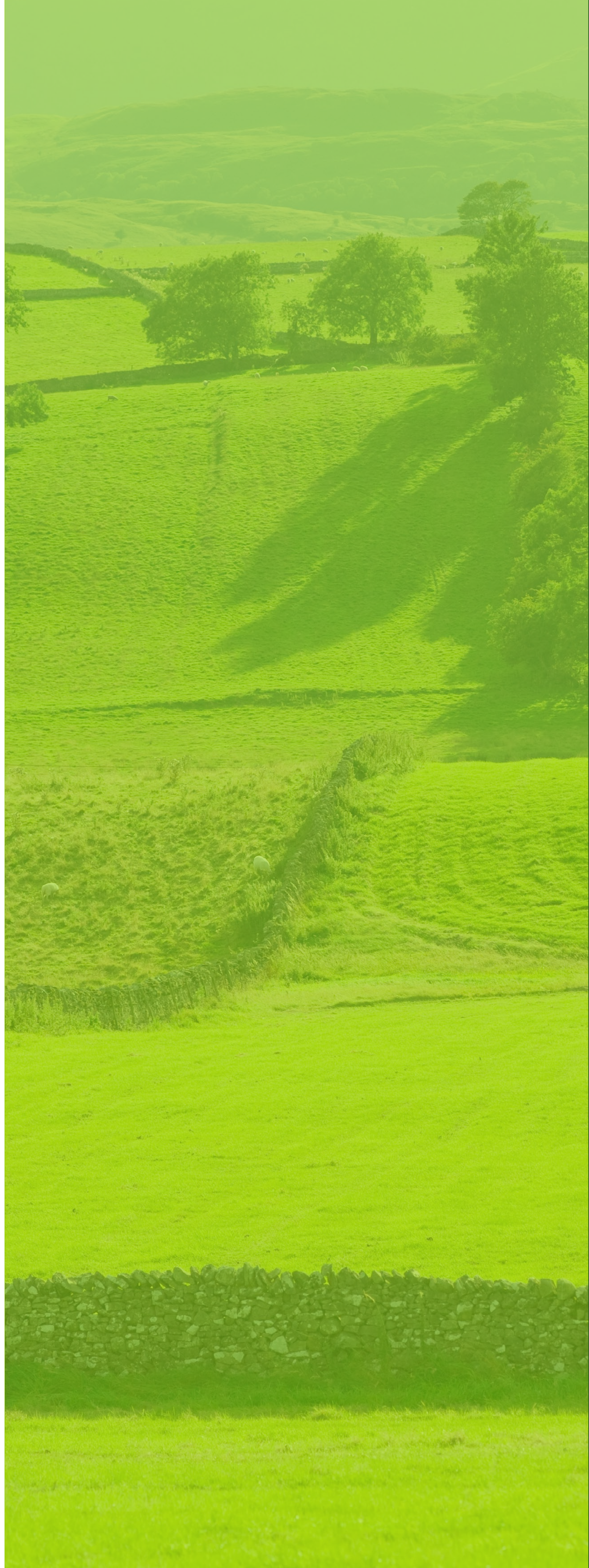
Attitudes in some areas may be informed by cultural heritage, for example the strong mining heritage of west Cumbria may influence attitudes to new, green jobs.

Reluctance to change behaviour, for example from car use to bicycle/walking.

There is a lack of consumer knowledge or misconceptions about low or no carbon alternatives to products and services.

Potential local level actions

a. Articulate the positive case for the economy, people and the environment of a just transition to low carbon jobs.
b. Take a person-centred approach to communications.
c. Provide advisory support for eg whole house retrofit.
d. Learn from national experts in climate change communications, such as Climate Outreach, https://climateoutreach.org/britain-talks-climate/
e. Work with the unionised workforce which has significant reach to individuals, organisations and communities in Cumbria.
f. Offer carbon literacy training to employees and communities to improve understanding of climate change, its causes and inspire action.



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