Photo: ETSU for the DTI

Wood Fuel

from **Forestry** and **Arboriculture**

Good Practice Guidelines

Photo: ETSU for the DTI

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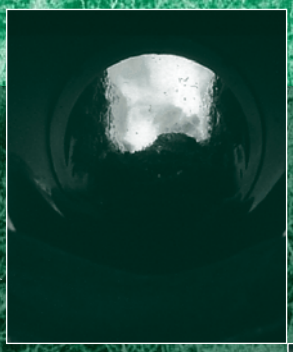

Photo: ETSU for the DTI

The development of a sustainable energy production industry

Photo: Nordic

These guidelines were produced in partnership with the following organisations:

The guidelines were produced using a consensus building process which was developed and managed by Pippa Hyam. The project was guided by a steering group made up of British BioGen, Forestry Commission, Forestry Contracting Association, Wildlife and Countryside Link and ETSU. Drafts were written and edited by Diane Warburton. The process brought together the industry, environmentalists, planners and government agencies in order to address potential stakeholder concerns and support the development of the industry in a sensitive manner. Full details of the process and participants are given in Appendix 4.

Wood Fuel

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Photo: ETSU for the DTI

The development of a sustainable energy production industry

Good Practice Guidelines

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Introduction

Photo: ETSU for the DTI

Thinning operations

Scope of these guidelines

Forestry and arboricultural operations result in a number of products, some of which can be used as a fuel for the production of heat, electricity, or both. Wood fuel is a renewable energy resource.

The use of wood fuel for energy generation is a new and growing sustainable industry, with potential for considerable expansion. It offers benefits for forest owners and managers, project developers, consumers, local communities and the environment.

Renewable energy developments are generally considered environmentally beneficial because they provide energy from resources that can be continually replaced. In particular, energy from renewable sources can reduce emissions of greenhouse gases which may contribute to global climate change.

Renewable energy using wood fuel is valuable in a range of different ways:

- It can be produced in local schemes, with economic benefits including the potential to create rural employment.
- It can contribute to meeting current and future demands for renewable energy.
- If carefully planned and executed, making use of forestry and arboricultural products can contribute to improved woodland management, with benefits for wildlife and public amenity.
- The material is flexible enough to be used in several different ways.

These benefits are likely to increase in line with the forecast increase in production from UK forests and woodlands over the next ten years.

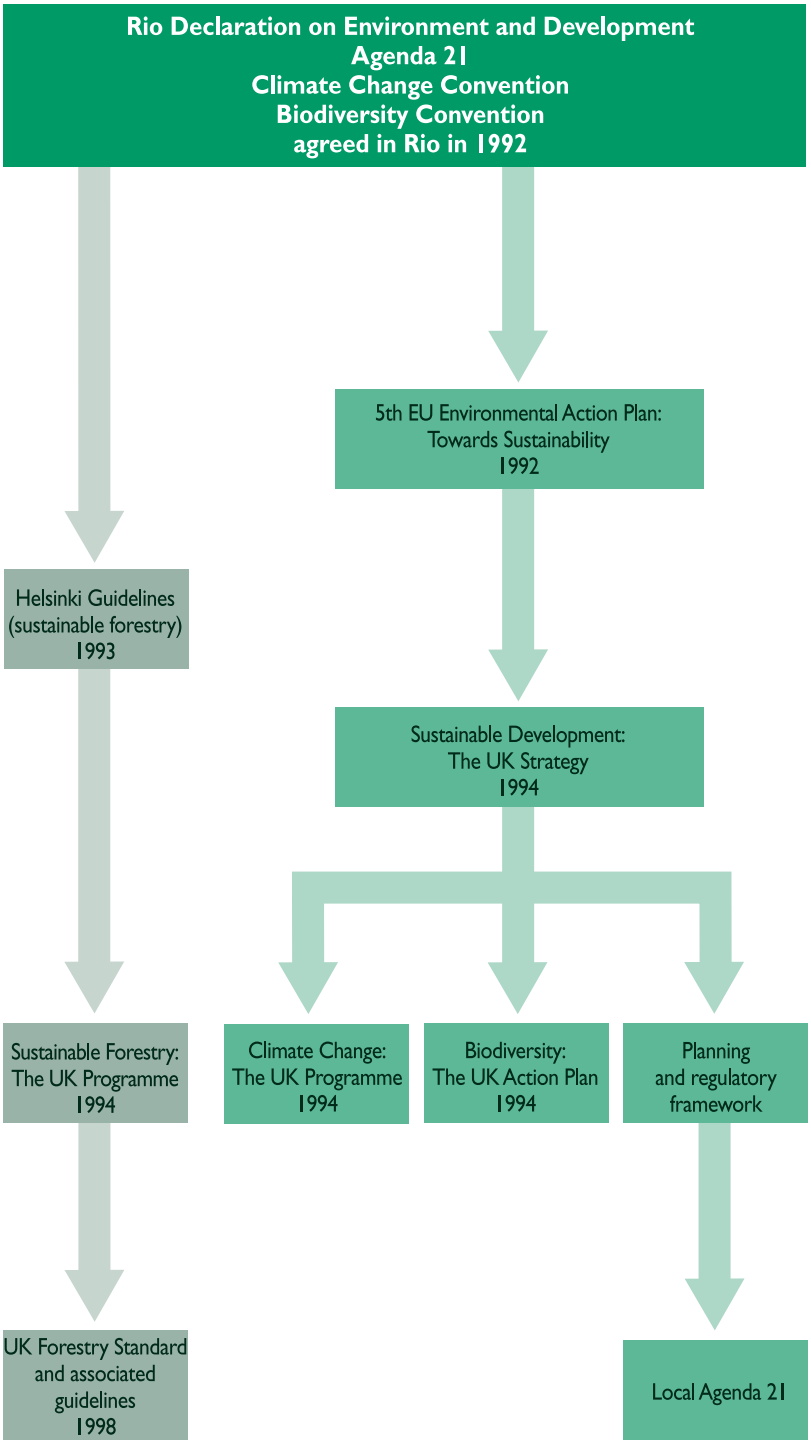
Renewable energy

Renewable energy is "the term used to cover those energy flows that occur naturally and repeatedly in the environment and can be harnessed for human benefit. The ultimate sources of most of this energy are the sun, gravity and the earth's rotation".

Taken from *New and Renewable Energy: Future Prospects in the UK*, Department of Trade and Industry, Energy Paper 62.

Fig. 1

The relationship between international policies and standards



The development of any new industry requires careful consideration of all potential impacts, negative as well as positive. In developing a wood fuel industry, it is recognised that the ecological balance of a woodland is sensitive and could be damaged by extracting material that may otherwise be left unused. The energy generation plant itself will impact on the local environment. The aim throughout these guidelines is to provide information on the use of wood fuel in sensitive and efficient energy generation technologies, while supporting sustainable forest management and therefore contributing to sustainable development.

These good practice guidelines are designed to help new projects proceed in a sensitive, appropriate and sustainable manner so that the industry as a whole can continue to expand with a responsible reputation. They are intended for use by developers, by local communities, by planning authorities which may consider applications for planning permission for a plant, and by local authorities which may be establishing renewable energy projects using wood fuel themselves or in partnership with others. The principles are similar whatever scale of project is being considered.

The guidelines have been developed by a wide range of organisations and individuals with extensive experience of wood fuel energy generation developments as developers, forest owners, users, environmental bodies and planners.

The guidelines have been drafted to:

- Complement guidance on existing forestry practice, including the *UK Forestry Standard* and associated guidelines, while recognising that forestry practice continues to evolve
- Reflect current legal planning and regulatory frameworks associated with the development and operation of an energy plant
- Incorporate principles of open consultation and community involvement.

International criteria and guidelines are often expressed in broad terms which are of limited practical value for project managers. Some of the relationships between international and national policies and standards are illustrated in Fig. 1. These guidelines are designed to make links between international principles and practice at the local level.

What are wood fuels?

The wood fuel covered in these guidelines is likely to come from three main sources:

- Plantations, natural and semi-natural woodlands, both managed and unmanaged
- Urban forestry and arboricultural operations
- Residues from wood processing.

The wood may be from conifers or broadleaf species, from urban amenity woodland or individual trees, which may be managed in a variety of ways from clear-felling to continuous cover.

In this context, wood fuel includes the tops, branches, foliage and stem pieces from forestry or arboricultural activities, fallen trees and cut logs.

A recent estimate suggests that the total wood fuel resource for England, Scotland and Wales is 1.1 million oven-dried tonnes (odt) in 1998, rising to 1.7 million odt in 2013 (*UK Industry Wood Fuel Resource Study: England, Wales and Scotland*, ETSU for the DTI 1997).

Wood fuel from forestry and arboriculture may be used alongside other renewable wood fuels such as short rotation coppice (SRC), grown specifically for fuel. More details on SRC are available in another volume in this series: *Short Rotation Coppice for Energy Production – Good Practice Guidelines*, ETSU for the DTI 1996.

Most fuels covered in this document should not be considered as waste; rather, they are co-products of the forestry industry. However, arboricultural arisings from urban areas are usually treated as waste and disposed to landfill. There are, therefore, considerable economic and environmental advantages in using these materials for wood fuel and diverting them from the waste stream. Further advice can be sought from British BioGen, other relevant trade associations, ETSU, the statutory waste authorities and the Environment Agency regarding the status of any particular type of wood fuel.

Size of wood fuel schemes

Energy generation schemes using wood fuel will range in size from log-burning stoves to heat a single room, to automatic wood-fuelled boilers heating public and commercial buildings (such as a hospital or school), up to the generation of heat and/or electricity for sale across a local neighbourhood or to the grid.

Photo: Alpine Boilers

A small modern log-burning boiler used to heat a large house

Photo: ETSU for the DTI

A wood chip district heating system

Table 1

Scale of wood fuel energy plant

size	properties served	annual fuel need	*yearly* vehicle movements	technology	physical size	cost
Wood heating schemes						
domestic 15kW$_t$	A family house	5odt	3 tractor loads	Boiler	Large suitcase	£ hundreds
350kW$_t$	A school	100odt	40 tractor loads	Boiler	Garage	£ tens of thousands
Wood-fired electricity generation plant						
size	*properties served*	*annual fuel need*	*weekly* vehicle movements	*technology*	*physical size*	*cost*
Small 250kW$_e$	About 250 houses	1,500odt	6 x 20 tonne	Gasifier or pyrolyser or engine	Small barn	£ tens of thousands
Medium 5MW$_e$	About 5,000	25,000odt	50 x 38 tonne	Gasifier or pyrolyser and engine or turbine	Medium barn	£ hundreds of thousands
Large 30MW$_e$	About 30,000	130,000odt	250 x 38 tonne	Gasifier or Pyrolyser and turbine (possibly combined cycle) or boiler and steam turbine	Factory and yard	£ millions
Fossil fuel electricity generation plant						
size	*properties served*	*annual fuel need*	*weekly* vehicle movements	*technology*	*physical size*	*cost*
Combined cycle gas turbine 500MW$_e$	About 500,000	800 million m^3 gas (1 million tonnes of coal equivalent)	Pipeline (no transport)	Gas turbine and steam turbine	Large shopping mall	£ millions
Coal power station 2,000MW$_e$	About 2,000,000	6 million tonnes of coal	Up to 3,500 x 38 tonne	Boiler and steam turbine	Massive power station	£ millions

Notes to Table 1 ● *Odt = oven dried tonnes* ● *See Appendix 1 for details of units of power (eg kW$_t$)* ● *1 train = 35 lorries*

Table provided by ETSU and Border Biofuels

Photo: Nordist

A large scale plant

The key factors determining the size of any project are likely to be:

- The availability of fuel within a feasible catchment area
- The market for the energy in the form of heat or electricity or both
- The nature of the local environment.

Although individual wood fuel energy generation schemes may be relatively small, compared with conventional fossil fuel power stations, taken together these schemes have the potential to make an important contribution to meeting the UK's overall energy needs.

Details of the range of wood-fuelled energy generation schemes, including a comparison with fossil fuel power stations, are given in Table 1.

Environmental issues

The use of wood fuel for energy production has many environmental benefits. In common with all new developments, these projects may also have some negative impacts. However, with sensitive methods, proper management and good design, any negative environmental impacts can be minimised or removed completely.

Forestry operations

Ecosystems and biodiversity

The use of wood fuel for renewable energy can result in positive and negative effects on biodiversity and ecosystems, both in the construction and operation of energy plant and within forests, as a result of harvesting wood fuel material. For example, the removal of brash from clear-felled areas in conifer plantations can benefit birds which prefer open areas with bare ground in which to forage or nest. Conversely, the removal of woody material could be harmful to some fungi and invertebrates and to the wildlife which feeds on them or needs shelter. Further guidance on the management of dead and dying wood, and on the impact of the removal of wood fuel on soil nutrients, is given in the *UK Forestry Standard* and associated guidelines.

Photo: C H Gomersall courtesy of RSPB

The woodlark is a protected species that is strongly associated with recently clear-felled and restocked forest. The removal of brash leaves bare ground which helps foraging.

Fig. 2

Carbon cycle

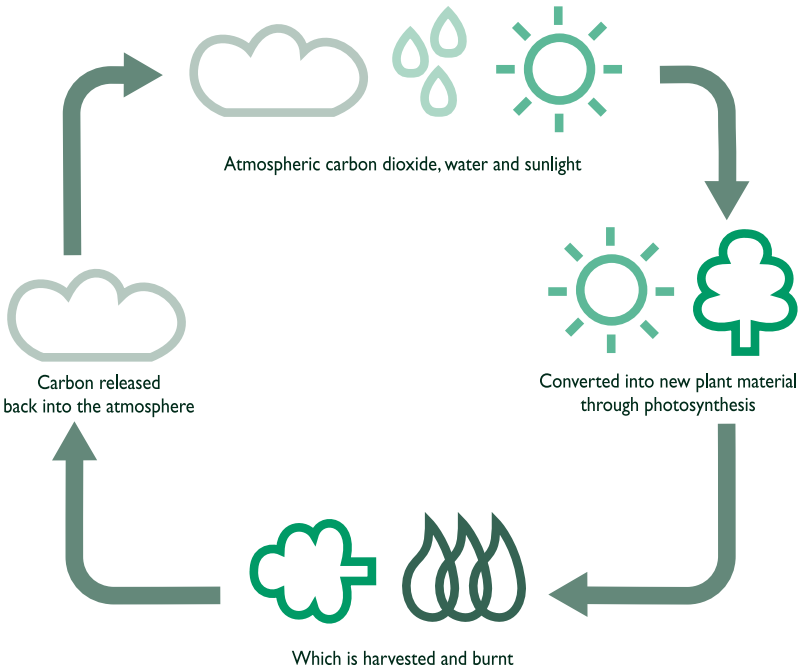
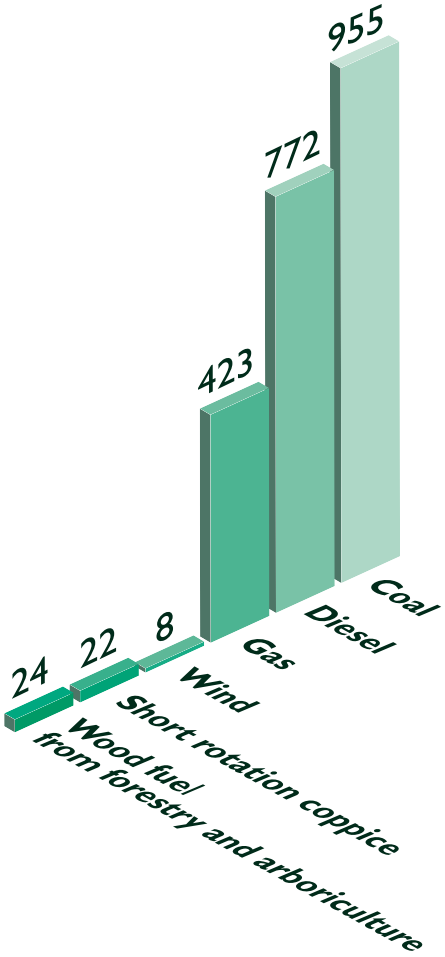


Fig. 3

Carbon dioxide lifecycle emissions (g/kWh)



Notes to Fig. 3:

- *Chart prepared by ETSU from data derived from **Renewables in Power Generation: Towards a Better Environment**, published by the International Energy Agency.*
- *g/kWh = grams of carbon dioxide per kilowatt hour*
- *Carbon dioxide emitted during the combustion of wood from forestry and arboriculture or short rotation coppice arises from carbon that the trees have taken from the atmosphere. It is therefore not included in estimates of net emissions to the atmosphere.*

Particular care will be required in extracting wood fuel or constructing energy plants on certain sites of conservation importance. When proposing to remove wood fuel for the first time, owners should consult the Forestry authorities and, in or near designated nature conservation sites, consult the statutory conservation agencies. Careful project management at all stages will be required to maximise conservation benefits and minimise possible disadvantages.

Woodland and forest management

Recent statistics suggest that up to 40% of existing lowland woodland is currently under-managed (*Lowland Forestry on Traditional Estates*, RICS 1996). Many woodland operations are not cost-effective and income is required to enable woodland owners to manage their woods. The sale of wood for fuel can offer a new source of income in these circumstances. Sensitive woodland management can also have benefits to wildlife and public amenity.

Disposal to landfill

Currently a large proportion of urban forestry and arboricultural debris goes to landfill. Making use of these materials for fuel diverts it from the waste stream and reduces pressure on landfill capacity.

Energy generation

Greenhouse gases

The scientific consensus is that carbon dioxide is an important greenhouse gas, contributing to global warming and climate change. One of the principal sources of man-made carbon dioxide emissions is energy production from the traditional fossil fuel sources of coal, gas and oil. If used to replace fossil fuels, wood fuel from sustainable sources offers significant opportunities to reduce carbon dioxide emissions and the dangers of climate change.

There is a natural carbon cycle (see Fig. 2): plants take carbon from the atmosphere as they grow. When plants are burned or decompose, the carbon is released to the atmosphere. As new plants grow, they again take carbon from the atmosphere.

Renewable energy compares very favourably with fossil fuels in terms of emissions of carbon dioxide to the atmosphere (see Fig. 3). For wood fuel, there are small net emissions of carbon dioxide through operations such as harvesting and transport, and from the construction and decommissioning of the energy plant. For fossil fuels, much larger overall emissions result because, in addition to fuel extraction, transport and plant construction, carbon contained in the fuel represents a net increase to the atmosphere.

The net carbon benefits of any particular energy system will depend on the carbon emissions associated with the energy system it replaces, the efficiency of the conversion techniques, and the carbon balance associated with growing and transporting the fuel prior to combustion (fuel which can be used close to the area of its production reduces the need for long distance haulage).

Other emissions

Energy produced from wood fuel, like any combustion process, creates certain emissions and effluents to air, ground and water. For example, there will be some wastes from the conversion process, such as dirty water and ash, which need to be disposed of carefully. Proper management should ensure that all these risks are controlled, and the Best Available Technology Not Entailing Excessive Cost (BATNEEC) should be used in all cases.

Traffic and transport

Most energy generation activities create traffic movements. Overall increases in the quantities of vehicle movements may be minimal, but the traffic is likely to be more concentrated, especially around a large energy generation plant. All renewable energy developments should aim to minimise road traffic movements to reduce potential pollution and nuisance, and alternative methods of transport, such as rail or water transport, should be investigated.

Noise

Consideration needs to be given to potential noise nuisance for neighbouring communities during processing and transporting the wood fuel, and at the energy plant.

Visual impact

Larger scale energy generation plant and power lines will have some visual impact. Design of these new developments should be in sympathy with the landscape and other local buildings, and screening with trees may be considered.

Economic issues

Economic development

- The wood fuel industry has the potential to create new opportunities for economic development and employment, directly and indirectly, at local and regional levels. This can contribute to the economic regeneration of rural communities with, for example, opportunities in:
  - Land and forest management, including harvesting
  - Operating and maintaining the energy plant
  - The development of new and existing associated service industries such as local support businesses and transport
  - The development of new enterprises: for example, greenhouses may be able to use local heat produced by these projects more cheaply than conventional energy sources.
- There is also the potential for the development of export markets for the technology and equipment used for harvesting, processing and converting the wood fuel into heat and/or electricity.

Financial incentives for harvesting wood fuel

- Harvesting wood fuel can make the management of poorly managed woodlands economic by providing a new opportunity to generate income from the sale of the wood for fuel.
- Thinnings can be sold for wood fuel; thinning also improves the quality and value of timber from the final crop of trees.
- Improved woodland management, as a result of wood fuel harvesting methods, can improve the habitat for game species, increasing the sporting value of woodlands.
- Savings can be made on the alternative costs of disposal of urban arboricultural arisings, including landfill tax as much of this material currently goes to landfill in many areas of the country.

Financial incentives for energy generation

- On-site heat and/or electricity can be produced, displacing existing bought-in energy.

Photo: Border Biofuels

A rural business centre heated by a wood chip boiler

- Markets can increasingly be identified for the local use of heat, including district heating schemes.
- Government policy promoting energy from renewable sources, and the opening up of the energy market in the UK, is likely to result in the market for renewable energy growing significantly, with increasing opportunities for developers to sell their energy.
- Electricity generated locally can reduce some of the transmission losses associated with existing energy utility infrastructures and distribution networks. Wood fuel renewable energy projects are flexible in terms of where and how the energy can be delivered as heat and/or electricity. In some cases these projects could strengthen the electricity grid by providing additional primary energy inputs close to users.
- Funding may be available to support renewable energy projects using wood fuel. This is a rapidly evolving field. Contact ETSU or British BioGen for details of potential funding and see *Financing Renewable Energy Projects – A Guide for Developers*, published by ETSU for the DTI.

Consultation

Photo: Rufus Sage, Game Conservancy Council

Visitors to recently thinned woodland

Projects to harvest, transport, process and convert wood fuel into energy will benefit from well-managed consultation with government and other statutory bodies, with local communities and near neighbours, and with other interested groups and individuals. Different interest groups will need to be consulted about the forestry aspects and about the construction and operation of the energy plant. Detailed advice on who to consult for advice and feedback at different stages of the project development is given throughout these guidelines.

This section gives general guidance on consultation within three main categories:

- **Statutory consultation, required to obtain planning permission and other formal authorisations**
- **Consultation with non-statutory bodies including local communities and environmental and other groups which may have an interest and provide useful advice**
- **Community participation, in which a deeper and longer term relationship is established with the local community and other interests.**

Why consult?

Consultation which is carefully planned and carried out can have a number of benefits to any project related to using wood fuel for energy production, including:

- Improving the quality of the project by ensuring that expert advice and local knowledge are incorporated into project design, development and management
- Ensuring that the project proceeds smoothly and that the various permissions and authorisations are negotiated at the right times
- Identifying, anticipating, avoiding or resolving conflicts at an early stage, reducing the potential for major problems and costly delays later
- Building a dialogue between those involved in doing the project and others who may be affected, allowing issues to be raised and dealt with quickly
- Creating a positive image for the project and potentially building public support.

Consultation does not solve all problems, and may seem to be a difficult option in the short term. However, a well-designed and sensitively implemented consultation strategy should always ensure a more acceptable and appropriate project in the long term.

Statutory consultation

Most forestry operations to produce wood fuel, and the construction and operation of most energy plants, will require formal consultation with a wide range of statutory bodies (see page 14 for examples). These bodies will be able to advise on specific legal requirements and provide expert guidance on, for example:

- Changing forestry and arboricultural operations
- Planning issues
- Wildlife, landscape and built heritage conservation
- Pollution control
- Health and safety
- Construction and maintenance regulations for the energy plant
- Traffic and transport issues
- Local bye-laws.

Almost all new energy generation plant are likely to need planning permission, which will involve formal public consultation as well as discussions with the planning authority. Planning permission and authorisations are covered in the section on Developing the Energy Plant, and in Appendix 2. Consultations with the Environment Agency or Scottish Environmental Protection Agency (SEPA), as the agencies responsible for waste management and control of pollution, are also likely to be needed. Advice on health and safety issues is available from the Health and Safety Executive (HSE). These statutory agencies are used to dealing with early informal consultations in confidence.

Early consultation will be needed with the Forestry authorities and the statutory conservation agencies over changes in management practices relating to obtaining the wood fuel, and the location for the energy generating plant. In most cases, it is illegal to fell trees without first obtaining approval from the Forestry authorities; these authorities will in turn have a statutory obligation to consult with local authorities, the Government Departments responsible for agriculture and other agencies.

In addition to these statutory bodies, consultations to obtain advice and approval on proposals are likely to be needed with individual landowners, and with companies and independent agencies responsible for energy, water, telecoms or transport infrastructure (see page 14 for examples).

Community consultation

Local communities and near neighbours, individually or in community organisations and residents associations, may be concerned about issues including:

- Changes to access and amenity, environmental value and enjoyment through changes to the management of woodlands
- Impacts as a result of processing the wood (such as chipping) at the point of harvest or elsewhere
- Transport and traffic, including that related to moving the wood to the energy generating plant
- The construction and operation of the plant
- The visual impact of the plant
- The impact of the plant on local air quality, health and safety
- The potential for increased local employment both in obtaining the fuel and in energy production.

As well as local people, other groups may have an interest in the development of sustainable energy generation projects using wood fuel. These groups may be local branches of, or affiliated to, national environmental bodies, they may be specifically local environmental organisations, or they may be other bodies which might have an interest in the project for its economic development, local amenity or social implications. See page 14 for examples of these groups.

Early information to local people about transport routes and energy generation, as well as quick responses to particular concerns, will help people feel confident about this new industry in their area. Local people will understand if details have not yet been finalised, and will welcome the opportunity to comment at an early stage.

Preparing for consultation

For large scale initiatives, the developer will usually have overall responsibility for managing the consultation process as they will be responsible for the development of the energy plant, as well as influencing the harvesting, storage and transportation of the fuel. However, forest managers will also want to organise activities in a manner which is sensitive to the environment and to local concerns, and may contribute substantially to the consultation process. Even if the energy generation project is a co-operative community initiative, run by local people, wide consultation and involvement is still advisable.

Consultation needs to be planned and integrated into the overall development process. The following points are among the factors the developer may wish to take into account to maximise the effectiveness of consultation and address any concerns that arise:

- An analysis could be made of all those groups or individuals that might have an interest in the development (sometimes called stakeholder analysis) and information collected on relevant local issues. This will enable developers to prepare their consultation and communications strategies.
- Energy production using wood fuel is a new industry and it may be appropriate to produce information for local people about the nature of the industry and the specific local development, covering its visual appearance and the impact and benefits it will have. A summary of the key issues is available at the end of this publication, designed to be copied and distributed to local people.
- Consultation needs to start as early as possible in the planning and design stage. It needs to be planned but also flexible enough to meet the needs of changing circumstances.
- Honesty, openness and commitment to consultation are essential. Even where it is not possible to resolve all concerns, a clear explanation should be provided.

Consultation methods

A number of consultation methods may be used, depending on local circumstances and the scale of the project. These might include:

- Leaflets outlining proposals and inviting comments
- Staffed exhibitions, to stimulate dialogue and understanding of local concerns as well as providing information on the project
- Open days, and visits to similar sites already in existence
- Open meetings
- Questionnaires, to identify interested parties and key issues
- Special meetings for key local organisations (such as parish councils)
- Workshops for mixed groups of interested parties to consider particular issues.

Any printed materials produced should always include a contact name, address and telephone number so that people can ask questions and comment on proposed developments.

Consultation is a two-way process and channels must be kept open. Liaison may continue after plant construction is completed. For example:

- Encouraging visitors to the energy generating plant or managed forests and woodlands: local groups and others may be interested in touring the plant.
- Links may be made to the environmental programmes of local schools.
- A liaison forum could be established between the developer, the local authority and local communities, building on contacts made during the development stages. This could be linked to formal and informal monitoring, which may be required in any case by conditions of the planning permission.

Who might have an interest in energy generation projects using wood fuel?

The following list is not exhaustive. It can be extended to include other organisations and local groups depending on local circumstances.

Statutory and regulatory bodies

Government Departments

- Agriculture Departments: Ministry of Agriculture, Fisheries and Food (MAFF), Welsh Office Agriculture Department, Scottish Office Agriculture and Fisheries Department, Department of Agriculture for Northern Ireland
- Government Regional Office or equivalent in Wales, Scotland and Northern Ireland
- Department of the Environment, Transport and the Regions (DETR), Department of the Environment Northern Ireland (DOE NI)
- Department of Economic Development Northern Ireland.

Local government

Different departments within the local authority may need to be consulted. Some of these may require consultation across the boundaries of county, district or borough authorities, or may be within one or more unitary authorities:

- Archaeology
- Countryside management and/or ecology
- County Fire Officer
- Engineer/technical services/Building Regulations
- Environment or environmental services
- Environmental health
- Highways
- Planning (policy, economic development)
- Waste disposal.

In some areas, the planning function is the responsibility of another body, such as National Park Boards. Advice may always be taken from the local authority planning department in the first instance.

Parish, town and community councils

Statutory conservation agencies

- Countryside Commission, English Nature, Countryside Council for Wales, Scottish Natural Heritage
- English Heritage, Historic Buildings and Monuments (Scotland) and Cadw: Welsh Historic Monuments (Wales).

Environment Agency or Scottish Environmental Protection Agency (SEPA)

Forestry authorities

- Forestry Authority, Forest Enterprises, Northern Ireland Forest Service.

Other consultees

Permission may also be required from others including:

- Landowners
- Regional Electricity Companies (RECs)
- Regional or local water companies
- Gas suppliers, telecom companies, or Railtrack, if the proposed plant is near one of their installations, land or equipment.

Community and voluntary groups

- Local community associations, tenants and residents groups
- Local civic or amenity groups (eg preservation group, town society, heritage trust)
- Groundwork trusts
- Local branches of national environmental groups
- Local access (eg footpath) campaign and action groups
- Local nature conservation groups
- County or district-wide voluntary sector umbrella organisations
- Other local voluntary groups.

Community participation

In some cases, developers or forest managers may wish to work more closely with local communities and other interested groups, and to engage their more active participation in planning and operations. The community and other groups can then become allies in the project rather than outsiders.

This approach has the advantage of gaining longer term community commitment to the project by developing a sense of ownership for both the resource (the woodland or urban trees) and the product (sustainable energy). This type of relationship is likely to achieve a greater willingness from local people to protect and conserve the resource (participation has been shown to reduce vandalism and other anti-social behaviour) and to use and promote the energy produced.

This deeper and longer term relationship helps to ensure that the public benefits of the project are fully articulated, by the community and other interest group representatives as well as by the project developers. In some instances, it may be possible for a formal partnership between the project developer, the community and others, structured as a company or trust, to be established to jointly manage the resource and the energy generation plant.

Who can help?

Local authority planning and other departments often have considerable experience of community consultation and participation. They may be able to provide initial advice on the main local interest groups and community concerns.

Community councils in Scotland and Wales, and parish and town councils in England, are also good starting points. Rural Community Councils in rural England and Councils for Voluntary Service in English towns and city boroughs are voluntary sector umbrella bodies and have contacts with many local organisations. Rural Action networks, tenants' federations and environmental networks will also provide access to a wide range of local community, environmental and other interests in the area.

For more information about how to work with local communities and other interest groups, see *Involving Communities in Forestry ... Through Community Participation*, Forestry Commission 1996, and *Guide to Effective Participation*, Partnership Books 1994.

Photo: ETSU for the DTI

A large country estate heated by an automatic wood-chip boiler

Obtaining the fuel

Photo: Forestry Contracting Association

Extraction of wood fuel

This section covers the full range of issues relating to identifying, managing and harvesting the fuel, as well as transport and storage.

The system used to harvest, store and transport the fuel depends on the scale of the operation, the specification of the end user and a host of local factors such as access and road size. This section covers all the issues which are likely to affect larger scale suppliers of wood fuel to an energy plant, although the principles will generally be applicable equally to small scale heat projects.

The principles of good practice for managing and harvesting wood fuel are well-established, and form the basis of this chapter. However, practice will continue to evolve as sustainable forest management develops and, therefore, these guidelines cannot be too prescriptive.

In general, a balance should be sought between commercial, social and environmental benefits and these guidelines recommend practices which maximise the yield of wood fuel for energy production as well as enhancing the conservation and wider environmental benefits.

Identifying sources of wood fuel

Appropriate sources of wood fuel

Wood fuel can be produced from a number of different woodland types including plantations, semi-natural and natural woodland and urban forestry.

Photo: Forestry Contracting Association

Forest residues following clear-felling of a plantation

Plantations

Plantations will in most cases already have a planned flow of timber products: logs which will be sawn to a wide variety of specifications and small roundwood which may be pulped for paper products or chipped for the manufacture of panel boards.

Over the next few years, as the wood fuel market expands, it is likely to increase the market for smaller dimension roundwood which comes from the first cycle of thinning. In addition, the wood fuel market will create an outlet for the branches and tops of trees, referred to as brash, which up until now have had no significant commercial outlet.

Forest managers will increasingly see wood fuel as an important product and will plan woodland management accordingly.

Photo Rufus Sage, Game Conservancy Council

Semi-natural woodland

Semi-natural and natural woodland

Wood fuel can be obtained from semi-natural and natural woodland through thinning and cleaning operations, or in some cases by implementing a coppice management system. Usually small-scale operations will be most appropriate.

Special care is needed to obtain wood fuel from woodland thinning operations. Thinning can encourage the development of a ground flora appropriate to the site so that native species can thrive. The development of a rich ground flora often depends on an adequate supply of light, which is a function of the degree of variation in tree age and density. However, there will be circumstances in which thinning is not advisable, such as conserving micro-habitats dependent on still, moist, dark conditions beneath a dense canopy and where it is important not to disturb rare species. It is also unwise to thin where there is a high windthrow risk and stability needs to be maintained.

Traditional coppicing systems can be of great benefit to wildlife in certain circumstances as the coppice system ensures a diversity of habitat within the woodland at any one time. Coppicing involves rotational cutting back of trees to encourage re-growth; the cuttings may then be sold for wood fuel. The *Short Rotation Coppice for Energy Production – Good Practice Guidelines*, a companion to this publication, gives advice on managing short rotation coppice for wildlife alongside effective cropping.

Economic incentives for thinning and coppicing will increase as market opportunities develop for the small-sized trees which are removed, including wood fuel for energy production.

Urban forestry and arboricultural arisings

Trees and woodlands are managed intensively in urban areas due to their proximity to roads, buildings, structures and services. These trees may be in parks, streets, field boundaries and hedgerows and along transport corridors. Options for on-site disposal of arisings from arboricultural operations are limited and much of the material is transported away from the site.

Photo: Milton Keynes Parks Trust

Urban forestry operations

Local authorities, parks management organisations, tree surgery contractors and landscape companies may have local arrangements for utilisation. However, a large quantity of the material is disposed to landfill, which incurs costs and has environmental implications. The high costs of the disposal of woody material in urban areas create particular opportunities for its use for energy production.

Sites sensitive to wood fuel extraction

Not all forests or arboricultural activities will be suitable as sources of wood fuel for energy production. Even where the source is apparently suitable, sensitivity to local circumstances and concerns will be essential. A balance must be sought between the different overall objectives of forest management including timber production, landscape enhancement, wildlife conservation, archaeological value, recreational use and soil management. Some buyers of wood fuel may require details of the source of the wood, and insist that sources are managed sustainably.

Special care, and consultation with statutory conservation bodies, will be required where the site which is the potential source of the wood fuel has special qualities such as:

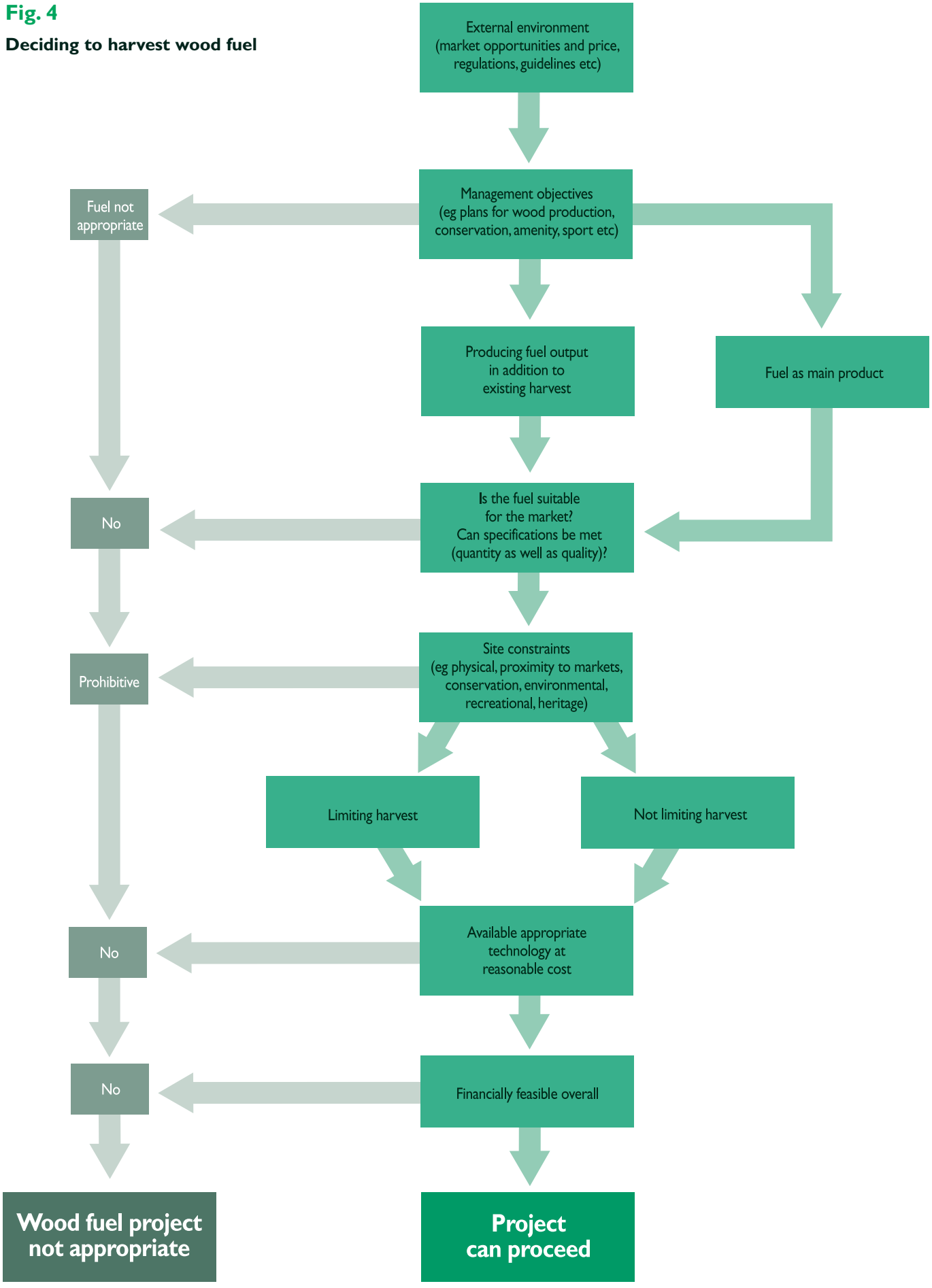
- **Nature conservation.** The nature conservation value of the site, and adjacent sites, will affect plans for harvesting wood fuel. Consultation with the statutory conservation agencies will be required as there are likely to be legal consequences of national or European-level designations which need to be taken into account. These sites may include:
  - Sites covered by statutory designation including Sites of Special Scientific Interest (SSSIs) in England, Scotland and Wales, Areas of Special Scientific Interest (ASSIs) in Northern Ireland, National Nature Reserves (NNRs), Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). Although SACs and SPAs are usually designated as SSSIs/ASSIs, their international status may confer additional responsibilities.
  - Ancient semi-natural woodlands and long-established plantations with semi-natural qualities (listed on *Ancient Woodland Inventories* held by the statutory conservation agencies in Great Britain).
  - Semi-natural secondary woodlands of natural character, particularly birch in Highland Scotland, where no management exists for regeneration (usually because the wood is grazed or browsed too heavily). Fuel wood harvesting does operate below levels at which felling licences are required but, unless grazing is controlled, may still progressively eliminate woodland cover.
  - Sites supporting species and habitats listed in the EU Habitats and Species and Wild Birds Directives and in the UK Biodiversity Action Plans.
  - Sites supporting species of flora and fauna specially protected under the Wildlife and Countryside Act 1981 and the Wildlife (Northern Ireland) Order 1985.
  - Other sites covered by non-statutory conservation designations (such as Wildlife Sites).

  Advice should always be sought on the ecological and other implications of particular designations. The *UK Forestry Standard* and associated guidelines gives details about forest management which is sensitive to conservation requirements. It is also good practice to consult the county wildlife trust, and the local community, on the special qualities of any site.

  In addition to designated sites, special consideration should be given to dead and dying wood. Some dead, dying and rotten wood must always be retained in any site: it is of little value for fuel but is valuable for wildlife as it provides one of the greatest resources for fungal and animal species.
- **Archaeology.** Sites of archaeological interest have survived in a variety of forms including earthworks, ruined structures and historic landscapes. Scheduled archaeological sites must be protected.
- **Landscape.** Certain landscapes are also designated as requiring special consideration, including National Parks, Areas of Outstanding Natural Beauty (AONBs) and various county-level designations.

Fig. 4

Deciding to harvest wood fuel



Wood fuel supply

Harvesting wood fuel for energy production must be integral to the whole process of managing the woodland. Whatever management regime is intended for a rural woodland, or urban trees, it is important that all the objectives are fully thought through and implemented in a planned way.

Tree felling and woodland planting is subject to regulation. Harvesting activity and the subsequent regeneration of the woodland is regulated under Felling Licensing regulations and through the approval process for Forest Plans and Woodland Grant Scheme applications. Further details are available in the *UK Forestry Standard* and associated guidelines, and the Countryside Commission's *Site Management Planning Guide*. Good management can improve the economic viability of the woodland or forest, as well as being of benefit to wildlife.

Normally, only material left above ground from harvested trees should be collected for wood fuel (not stumps or roots). The harvest could include:

- Small trees
- Tops and branches
- Limbs from broadleaved trees
- Arboricultural arisings
- Felled street trees.

There are a number of considerations that should be taken into account in planning and carrying out harvesting, all of which are dealt with in more detail below:

- Fuel specification
- Harvesting methods
- Site constraints on harvesting
- Health and safety
- Noise
- Environmental considerations
- Timing of harvesting.

Fuel specification

Harvesting systems need to be considered in relation to transport, processing, storage and drying of the wood fuel. The entire fuel supply chain will ultimately depend upon the requirements of the market.

Energy generators will specify that wood fuel should be supplied in certain forms. This specification will be determined chiefly by the technology used for energy production, which will carry tight guidelines on what fuel can be used within equipment guarantees. Requirements vary according to the size and nature of the project, but specifications are likely to determine the particle size, moisture content and cleanliness of the fuel.

Larger wood energy plant (heat and/or electricity) may purchase 'raw' wood fuel such as roundwood or baled brash material to be processed on site, while others will buy green (wet) wood chip, drying it on site or burning it in specialised equipment. In larger scale schemes, suppliers and purchasers may agree a customised fuel specification.

For smaller scale wood heat and combined heat and power (CHP) installations, a simple standard system to describe wood fuels is essential to avoid misunderstanding between supplier and purchaser and to ensure that suitable wood fuel is used in an appropriate conversion plant. For more details, see *Describing Wood Fuel* and *Supplying Wood Fuel*, published by British BioGen.

Harvesting methods

The choice of harvesting methods and machinery will depend on the specific site sensitivities, the requirements of the end user for a specific product, the scale of the operation and the forest layout, and will be determined as an integral part of overall harvesting. The scale of equipment varies from hand-held tools to large harvesting machinery.

The main harvesting methods are:

- **Whole-tree harvesting.** Single-phase harvesting operations involve the whole tree being removed from the stump to the forest road. The tree is then divided into conventional stem wood and energy products. This method usually uses relatively sophisticated technology and is more

Photo: Forestry Contracting Association

Whole-tree harvesting by cable crane

Photo: Forestry Contracting Association

Whole-tree chipping

Photo: Forestry Contracting Association

Second-pass residue harvesting – baling at the forest landing

Photo: ETSU for the DTI

Shortwood harvesting

appropriate for large conifer blocks. Extraction methods include the use of skidders or cable cranes for off-ground transport of the tree from stump to landing.

Where whole-tree harvesting is used, the type of equipment will depend on the site, as outlined in Fig. 5. See *Whole-Tree Harvesting – A Guide to Good Practice*, published by the Forestry Authority, for details.

- **Whole-tree chipping (terrain chipping).** The whole tree, usually of smaller size, is felled and then chipped at the stump and the chips extracted to the landing.
- **Second-pass residue harvesting.** The stem wood is removed in a first-pass conventional harvesting operation. The energy elements are removed in a second-pass operation, either by chipping at stump and extraction of the chips or by extraction of the intact material for later chipping either at the forest road or the end user plant.

  If the energy elements are extracted intact, there is an option for them to be baled at the forest landing to increase their density to reduce onward transport costs.
- **Shortwood harvesting.** The trees, or the limbs of trees, are felled and cut into short lengths using a timber processor or chainsaw. The short pieces are then extracted for chipping at a central point or, as in terrain chipping, chipped at the stump and the chips extracted. This method is applicable to broadleaf trees and for use in urban areas.

Site constraints on harvesting

The site constraints on harvesting must be considered at an early stage as they will affect the choice of harvesting technology as well as the timing and scale of harvesting. The terrain and soil type, weather conditions, water courses, the provision of roadside facilities, siting of brash stores and wildlife habitats will need particular attention.

Harvesting must always be undertaken with care when the soil is wet, because heavy harvesting equipment on wet ground can compact soil and damage its structure. In wet conditions, wide-tyred or tracked vehicles may be used in conjunction with brash mats.

Care must be taken where sites are prone to nutrient risk or ground damage (see Table 2 on page 23). In these circumstances, harvesting could result in soil erosion and water pollution. The soil could be damaged by the formation of worn trails caused by dragging the trees along the same route; these trails risk becoming water channels, resulting in erosion

and sediment movement into water courses especially in high rainfall areas. Rocky or unstable steeply sloping sites may also be vulnerable.

Health and safety

There are differences between the health and safety implications of urban amenity woodland and most commercial forestry operations, although the duty of care applies everywhere. In amenity woodlands, there may be substantial public safety implications, particularly if chipping is done on-site.

The legal framework for health and safety must be adhered to. Details of regulations and guidelines are given in the *FASTCo Safety Guides* (from the Forestry and Arboricultural Safety and Training Council) and *The Management of Health and Safety*, from the Forestry Contracting Association.

Current health and safety procedures should be followed at all times during the harvesting and handling of the wood fuel. Operators must be trained in safe working methods and must use adequate personal protective clothing and equipment for their tasks.

Public liability insurance will be needed for all work to remove or process wood fuel on site and all responsible contractors will have such insurance.

Noise

Noise from harvesting machinery for wood fuel will be similar to the noise from normal forestry equipment. It is always good practice for operators to be considerate when working near houses. Good communication channels with local people should be developed and particular sensitivities borne in mind. This will be particularly important in urban arboricultural activities.

Environmental considerations

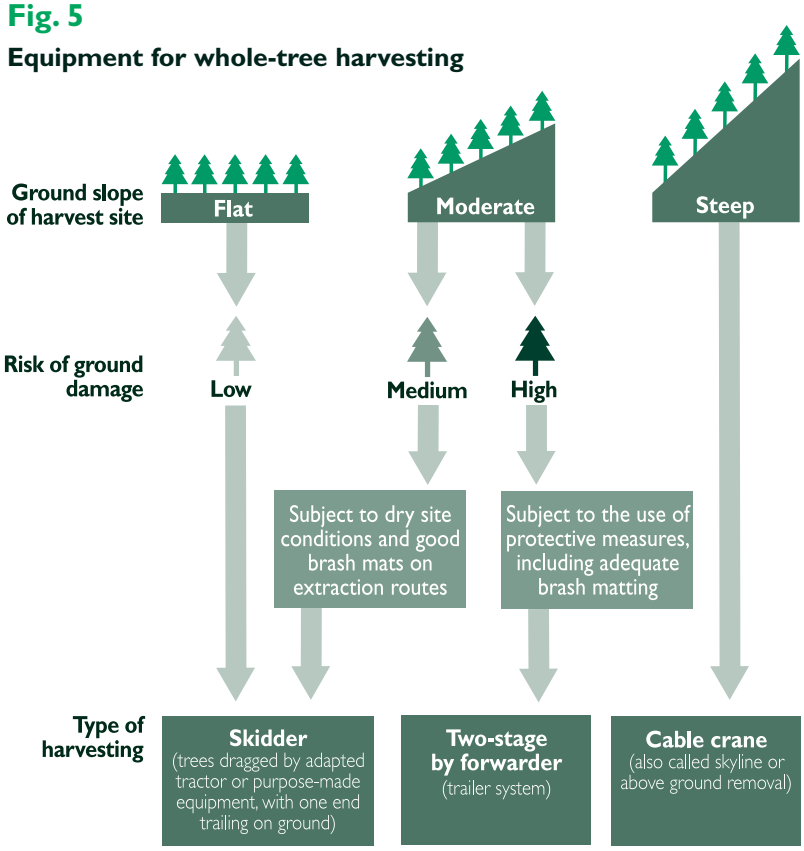
The amount of material taken from the forest will always depend on the woodland management objectives (in the forest management plan) and the specific local circumstances. In general, it is advisable not to be too 'tidy', and to always leave some material to protect habitats for fungi and insects and to maintain soil fertility. The *UK Forestry Standard* and associated guidelines offer detailed advice.

The impact of harvesting on water courses should be minimised by, for example:

- Liaising with the Environment Agency or SEPA and water companies at the early planning stages when harvesting in water supply catchments

Fig. 5

Equipment for whole-tree harvesting



Adapted from ***Whole-Tree Harvesting – A Guide to Good Practice****, Forestry Authority, 1997*

Table 2

Risk of soil damage from whole-tree harvesting

Brown earths	low / low
Podzols	low / med
Rankers	low / high
Skeletal soils	low / high
Limestone soils	low / low
Surface water gleys	med / low
Groundwater gleys	med / low
Ironpan soils	med / high
Littoral soils with shallow water-table	high / high
Sandy littoral soils	med / low
Juncus bogs	high / low
Other peat soils <45cm deep	med / high
Other peat soils >45cm deep	high / high

KEY

low	med	high	
			Risk of ground damage
			Risk of soil fertility degradation

Notes to Table 2:

- *Derived from* ***Whole-Tree Harvesting – A Guide to Good Practice****, Forestry Authority, 1997*
- *Soil types from Forestry Commission Research Information Note 68/82/SSN:* ***Soil Classification****.*

- Protecting any private or public water supplies
- Stacking timber well away from water courses and not blocking roadside drains
- Planning extraction to minimise the number of stream and drain crossings.

Timing of harvesting

Factors which affect the timing of harvesting will include:

- The need for continuity of supply of fuel wood
- Access to sensitive sites
- The species of tree and the primary use for the wood crop
- Silvicultural requirements, depending on the highest value product of the site
- Hardwood coppicing in winter
- Conservation.

In general, the timing of forestry operations should seek to minimise disturbance to wildlife. Wild birds, and their nests and eggs, are protected by law at all times, except for some wildfowl, game birds, and various other species which may cause damage. In addition, some rare birds and other specially protected species of wildlife are afforded special protection at all times under the Wildlife and Countryside Act 1981 and the EU Birds Directives; in these cases the advice of the statutory conservation agencies should be sought. *Forests and Birds*, published jointly by the Forestry Commission and RSPB, gives detailed advice.

Wood fuel preparation

Wood fuel needs some form of processing before combustion, primarily size reduction and drying. Storage will also be required. These activities may be undertaken in the forest, or at the end user plant. More details on fuel management at the plant are given in the Energy Conversion and Distribution section, under Operation of the Plant.

Size reduction

Three types of equipment are generally suitable for breaking wood fuel into smaller particles:

- Chippers are well-proven units with sharp blades which cleave the wood against a stationary anvil. Intended primarily for green wood (drier timbers result in high wear rates), there is dust production and chipping can be uneven. The machines are vulnerable to soil and stone contamination and, because they are noisy, may be subject to restricted working hours.
- Hammermills use fast-moving blocks of metal to shatter wood and break it further against a metal screen. The machines are easy to maintain and tolerate contaminated material, although they tend to produce a coarse, variably sized chip. Like chippers, hammermills are noisy and may be subject to restricted operating hours.

Photo: C.H.Gomersall courtesy of RSPB

Size reduction by chipping

- Shredders are low speed machines which shear the feedstock with rotors and offer the advantage of lower noise levels. Very variable size particles will be produced unless a screen is fitted.

Where wood chips are being used in equipment using automatic combustion, the chip size required by the manufacturer's boiler feed system must be ascertained before obtaining wood chips from a supplier, or before acquiring any chipping or shredding equipment.

Storage

Most schemes will require some form of wood fuel storage: for example, electricity generation requires a continuous fuel supply throughout the year, with obvious storage implications including buffer storage in case bad weather affects deliveries of fuel.

In most cases, some material will be stored in the forest for a period of time. However, this is less usual in urban forests with extensive public access and where the dangers of vandalism (to or with the wood) and fire hazards need to be taken into account. In these circumstances, storage may be at an intermediate location or at the energy plant. The space required for storage will depend on the yield and size of the forest and commercial risk considerations (for example, how much 'reserve' fuel is estimated to be needed).

Generally, the visual impact will be negligible: facilities for storing wood fuel tend not to look out of place in the forest situation. However, care should be taken to ensure that piles of wood are unobtrusive. If the harvested wood requires some form of weather protection, it should be simple and unobtrusive or provided by an existing building.

The location of the storage site in the forest will be determined by what is on the forest floor and what is nearby: for example, wood fuel storage should be away from water courses and drains to avoid the possibility of leachate causing water contamination.

Drying

Drying timber will improve the calorific value and make storage easier. Wet timber (roundwood and chip) is prone to fungal attack and composting will occur. The dryer the material, the less prone it is to decay.

The appropriate moisture content of the fuel should be determined in discussion with the energy plant operator.

Wood will dry in the forest under the right conditions. The best option is likely to be storage as brash for about six months, followed by chipping and further drying. Compacted conifer brash is unlikely to dry out unless opened up; loose, baled or bundled residues should air dry reasonably well if managed appropriately.

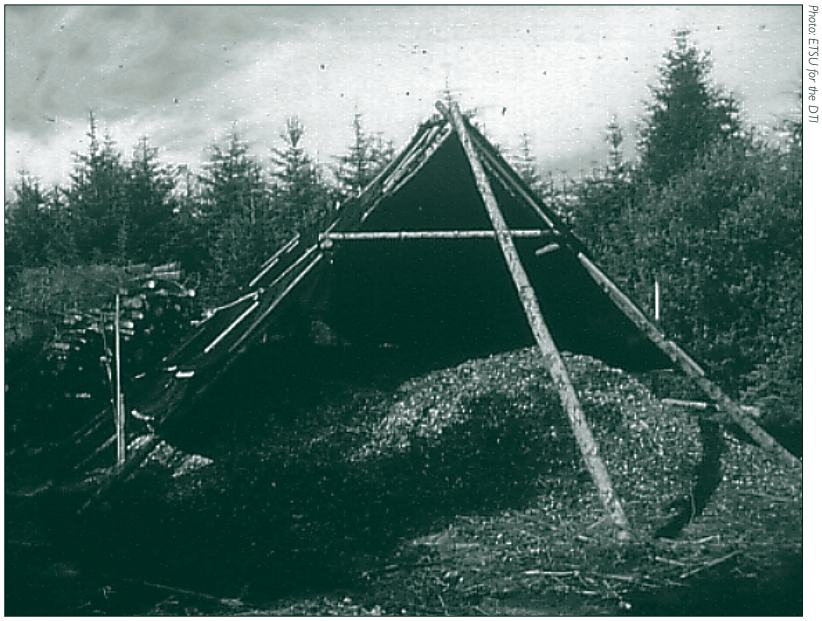


Photo: ETSU for the DTI

Wood chips stored in the forest

Brash from forestry or arboriculture may often be chipped at harvest as part of keeping the site tidy and functional. In these circumstances billeting or chunking may be preferable to smaller chips as piles of chunks and billets will have bigger air spaces and be easier to ventilate. Very large stacks of wood (over 3 metres high) must be carefully managed to avoid overheating and to minimise dust, spores and other emissions.

In the UK, timber can be air-dried down to around 20% moisture content, although this is very dependent on weather conditions. In some conditions, forced drying will be required to reduce moisture content to acceptable levels.

Blowing air through a pile of wood chips will help drying; the natural heating of the pile may be used with air blowing to speed up the drying process. Blowing warm air, from an engine exhaust or insulated boiler house, will further speed the drying rate.

Research is continuing on these issues: see *Storage and Drying of Comminuted Forest Residues* and *Storage and Drying of Short Rotation Coppice*, both published by ETSU for the DTI.

Transport

Traffic movements in and out of the forest, and within the forest, may be increased by harvesting wood fuel because the volume of the products from the forest is greater. However, the effects of increased traffic flow will be felt most around the energy generating plant as traffic will concentrate there. As well as fuel deliveries, there will also be some traffic generated by workers at the energy plant and ancillary services.

The scale of traffic movements will depend on the size of the plant (see Table 1 on page 6), but rural roads are likely to be affected by increased traffic flow. Any planning permission may restrict delivery timings, require assessments of roads including road and bridge capacity, specify types and size of vehicles and require public consultation to be undertaken.

Vehicle choice will normally be determined by maximum payload, vehicle size, fuel efficiency, access to the forest and the storage capacity of the site. For very small schemes it is possible that a tractor and trailer may be the best option. However, for schemes of any significant size, traditional tipper or curtain-sided lorries will be used for chip transport, and flatbed or timber lorries for transport of unchipped material.

The developer of the plant will advise on the optimum distance to transport the fuel for the particular project. Overall, the energy balance associated with using wood fuel to generate energy will be negatively affected if long-distance road transport is required.

Photo: ETSU for the DTI

Transport of baled forest residues

Traffic impact can be minimised in a number of ways:

- Locating the energy generation plant close to sources of fuel. Local sources of fuel supply not only may be more economic, but are also likely to be more acceptable to the local community and the planning authority.
- Locating the plant close to existing industrial facilities, or close to a motorway junction or railway siding.
- Developing and using alternatives to road transport, such as rail and water transport.
- Establishing a dedicated fleet of lorries, on larger schemes, to help ensure that only a limited number of heavy vehicles are involved.
- Considering the potential for densifying the wood fuel at source.
- Specifying restrictions and obligations in contracts with transport companies.
- Minimising emissions from vehicles by:
  - Minimising traffic volume (which will have economic as well as environmental benefits)
  - Ensuring that fuel-efficient and well-maintained vehicles are used.

For more details, see *Road Haulage of Roundwood Timber – Code of Practice*, published by the Forestry Contracting Association.

Developing the energy plant

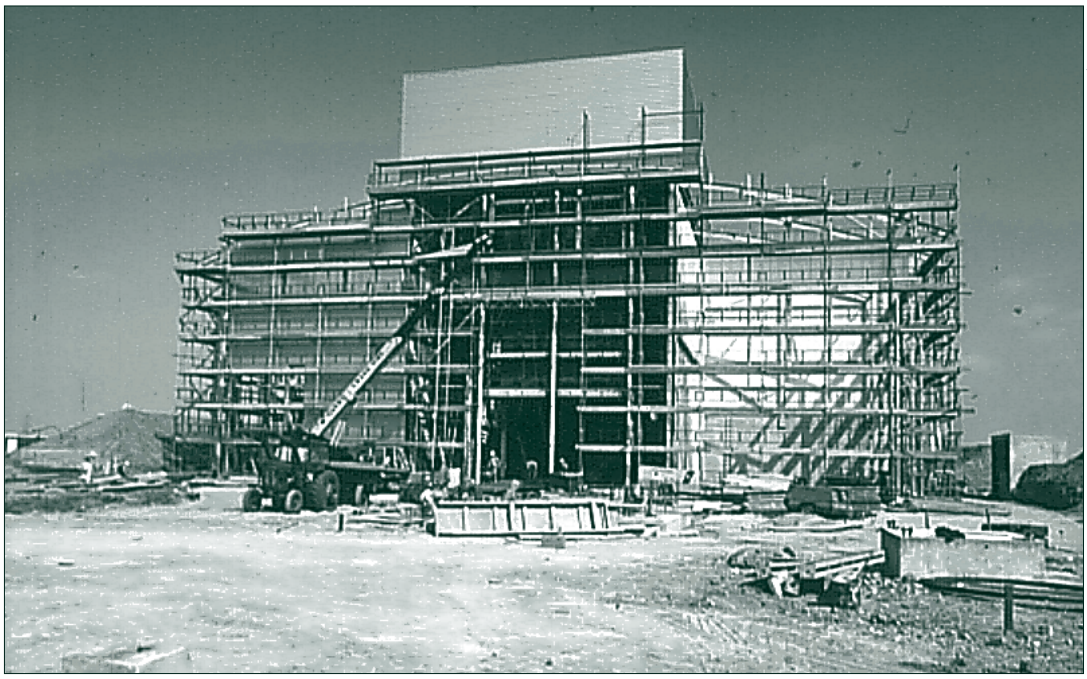


Photo: ETSU for the DTI

Large scale power plant under construction

This section outlines the key considerations in establishing a project to produce energy from wood fuel, including financial viability, fuel specification, site selection for the plant itself, planning permission and construction of the plant.

The term 'developer' is used in energy generation projects (heat and/or electricity) to describe the individual or group driving the project forward. The developer may be a forester, an entrepreneur, a community organisation, a specialist energy generation company or some form of consortium.

The developer will be concerned with the construction and/or running of the energy and/or the wood fuel processing plant. They will specify in what form the fuel is required and how it is to be delivered, and may be involved in producing the fuel. Therefore, while the level of involvement in harvesting and transporting the fuel varies, the developer will set those requirements and has overall responsibility for all the technical, commercial, environmental and consultative issues which arise at all stages. In some small scale heat-only schemes, these issues and the action required will be minimal, although the principles remain the same.

Financial viability

Financial viability is only one of the drivers for the creation of new schemes: environmental issues and economic regeneration may be equally important. Nevertheless, a financial assessment of the project will have to be undertaken before any decision is made. The financial viability of any project will depend on a number of factors:

- **Market.** There must be a market for the energy, locally and/or through sale to the grid. Niche markets, such as heat for a local hospital or small specialist wood processing business, may have the highest value. On a smaller scale, woodland owners may want to use the wood as a resource to produce heat for their own use, thereby reducing heating bills.

  Increasing the scale of the plant does not necessarily increase viability: the plant can be sized and located according to the energy markets in the vicinity. If a local market for heat can be identified, and the plant sized and located to supply that market, a small scale scheme can be financially viable.

- **Location.** Proximity to fuel source is important: current practice indicates that developers usually prefer to obtain the majority of the fuel within, for example, a radius of 50-100km for a medium-sized plant. In addition, applications for planning permission may be assessed more favourably if local sources of fuel are used.

  Proximity to markets will be essential if sales of heat are to be maximised.

- **Reliable fuel source.** Readily available and reliable sources of fuel at the right cost are important and a fuel supply contract is likely to be let over several years to ensure this. In larger projects, a contractual security of supply will be necessary to raise external finance, if required. In some cases, fuel may be sourced from a number of suppliers. Alternatively, several woodland owners could form a co-operative and sell in bulk to a developer, or a developer may encourage foresters to work together to improve security of supply. Wood fuel from forestry and arboriculture may also be used alongside wood fuel from short rotation coppice or from wood processing industries. Larger scale projects may need to guarantee alternative sources of fuel in order to obtain financial support.

- **Local critical mass.** A critical mass of activity in any area will help to develop the market and infrastructure. This could be achieved by several small projects or one large one.

- **Investor demands.** The expectations of investors will need to be taken into account in financial forecasting: some investors may be interested primarily in environmental benefits and others will be more concerned with economic returns.

- **Costs.** The costs of the plant will depend on its size: see the Introduction for an indication of the relative costs of different energy generation plant.

- **Funding.** There may be opportunities for financial and other support. Contact ETSU or British BioGen for advice on funding.

Photo: The Ceramic Stove Company

Log-burning oven in a London restaurant

Site selection for plant

The selection of the site for the energy generation plant will begin by narrowing down a number of options. Even small projects may need to consider more than one site. Where a bid for a Non-Fossil Fuel Obligation (NFFO) contract is involved, the site will need to have been identified at a very early stage in the process.

The developer will have to consider any restrictions on site use. Local authorities should be one of the first points of contact when considering a site for larger schemes. Their Structure and Local Plans (or Unitary Development Plans in unitary authority areas) increasingly include policies advising on the prospects for renewable energy development and will be the basis on which the local authority will determine the suitability of a site. These plans may also identify areas which are suitable for certain types of development.

Practical site requirements

Before finalising the choice of site, a number of technical requirements will need to be addressed by the developer. Smaller schemes are not likely to face all these issues:

- There must be a range of sources of fuel nearby, as already described.
- Good vehicle access from existing routes and hard roads will be a priority, and careful planning to ensure highway safety will be required. The Highways Agency and the local authority highways department will have an input to vehicle access arrangements.
- Connections to utilities will be needed, such as for water supply and discharges. The consent of the water company and the Environment Agency or SEPA may be required for larger energy or fuel processing plant depending on location and planned operations.
- There must be disposal routes for any solid waste from the plant.
- Electricity generating plant will find that site location will influence the ease and cost of grid connection, and may increase the value of electricity generated to the Regional Electricity Company. In some cases, siting the energy plant at an appropriate point in the local network may give cost benefits to the Regional Electricity Company, and project developers may be able to share this benefit.
- Heat generation plants need to be close to existing and future markets as distribution costs depend on distance.

Environmental requirements for site

Plant of any size will have environmental impacts, and environmental restrictions on some sites will affect the feasibility of using them for energy generation plant. Developers will want to consider the following issues in identifying and planning a site for a plant:

- Landscape or nature conservation constraints, including statutory designations on the site itself or nearby areas: the statutory conservation agencies should be consulted if the proposed site is in or near one of these areas. See Sites Sensitive to Wood Fuel Extraction in the Obtaining the Fuel section for details (page 19).
- Ecological and hydrological impacts: the statutory conservation agencies should be consulted informally before considering a larger project on a site in or next to a sensitive or designated area for conservation.
- Air quality standards (such as smoke and other emissions): the statutory emission regulation agencies should be consulted.
- The visual impact of the plant, power lines (if required) and any ancillary operations and storage: a large plant would be less visually intrusive in an existing industrial development area.
- Impacts on neighbourhood amenities: including noise, light pollution, dust, smells and traffic during construction and operation, especially potential impacts on local residents caused by prevailing wind conditions.
- Impacts on the built heritage: as well as remains and buildings protected by statute or designation (such as Scheduled Ancient Monuments, listed buildings and Conservation Areas), account needs to be taken of other archaeological remains, historic landscapes and the vernacular of the area.
- Public rights of way across the selected site: these must be maintained and taken into consideration in the planning of the development; public rights of way cannot be closed (other than temporarily), but can be re-routed if agreement is reached with local councils, local residents and rights of way users.

Planning permission

Planning permission will be required for almost all energy production plants using wood fuel: even a small scale wood combustion plant may need planning permission for its chimney. Therefore, developers of schemes of any size are advised to check with their local planning authority at the earliest stage. Details of the full planning process likely to apply to energy generation projects are given in Appendix 2.

Some plant will require a statutory Environmental Assessment (EA) and environmental statement as well as environmental regulation and monitoring by the local authority or the Environment Agency or SEPA, depending on the nature, scale and location of the scheme.

Developers should check with the local authority to see if an EA is required: some local planning authorities may require an EA at their discretion. See Appendix 2 for details on what an EA is, when an EA is required and what an environmental statement should cover.

Even if a formal EA is not required, it is good practice to produce environmental information for the public and the planning authority, covering much of the key information required in an EA, including any potentially adverse effects of the proposed development and how they will be dealt with.

Information produced and distributed at an early stage will show that the risks of any impacts have been considered and can reduce misunderstandings later in the project development process, which can save time and money in the long run. See the section on Consultation for further details.

An energy generation plant will also require formal authorisation and licensing under a number of different legislative and regulatory frameworks such as the Clean Air Act 1993 and the Environmental Protection Act 1990. Details of the likely authorisations needed for energy generation using wood fuel are outlined in Appendix 2.

Construction of the plant

The level of the impacts of construction will depend on the size of the plant. A small on-site heat generating plant is likely to have minimal impacts during construction. In larger schemes, in which electricity is supplied to the grid, a purpose-built energy generating plant will be constructed, which is likely to entail new building.

The implications of larger projects may include construction noise and dust, impact on the access road, transport noise, light pollution, risk of oil spillages, soil erosion, establishing a construction compound larger than the final site, and negotiations for wayleaves.

A developer can apply to the local authority for a prior consent over times of working, noise levels and similar issues (under the provisions of Section 61 of the Control of Pollution Act 1974). This may help provide reassurance to local residents: difficulties at this stage can damage the reputation of a plant before it even starts operation. It would also be good practice to consult with the local authority's Environmental Health Officers, as they would deal with any complaints and could defuse any local concerns more quickly if they are able to give answers directly.

The Construction (Design and Management) Regulations 1994 require the developers (or their agents), designers and contractors to co-ordinate and manage health and safety effectively throughout all stages of a construction project from conception, design and planning through to the execution of works on site and subsequent maintenance and repair. Most larger wood fuel projects will be subject to the Construction (Design and Management) (CDM) regulations, except projects which take less than 30 days for construction, or less than 500 person work days.

A method statement will be required as part of the planning permission (see page 31). This should be drafted by those carrying out the specific works, and discussed with the planning officers, the building control officers and the environmental health department of the relevant local authority, and with community representatives and local people. This will help to demonstrate that the developer has thought about possible problems and their mitigation.

A health and safety plan (to bring together all relevant information from those responsible, starting with pre-construction) and a health and safety file (an enlarged maintenance manual to inform future health and safety

decisions) may also be required. The level of detail required will depend on the scale and complexity of the project. Projects involving minimal high risk work will call for simple health and safety plans and few, if any, specialist skills. Large projects or those involving high risk work will call for correspondingly more detailed assessment and specialist skills.

Method statement

The method statement should spell out specific measures which developers plan to take to minimise disruption and mitigate any undesirable impacts during construction. It will have been negotiated as part of the planning permission and should form part of the contract for the construction of the building.

The method statement will need to provide detailed guidance for the construction contractors, but it would be good practice to produce an additional summary in plain English for local communities and the local planning authority. The method statement is likely to cover the following:

Noise

Any potential noise nuisance should be reduced as much as possible by working only during the normal working day. It would be good practice to consult the local authority's Environmental Health Officer who can advise on acceptable construction site noise levels. Developers will wish to have regard to British Standard (BS) 5228 on Noise Control on Construction and Demolition.

Timing

Construction must be timed carefully to avoid damage if the area or surroundings are environmentally sensitive (such as at certain times of year); there should also be consultation with the local planning and highway authorities regarding proposed traffic movements.

Dust

Water can be used to suppress dust. Care is needed to avoid excessive application of water so that suspended silt is not washed into a drain or water course.

Lighting

Consultation is recommended with the local authority's Environmental Health Officer for advice on guidelines on light pollution (further details on light pollution are given in the section on Operation of the Plant, page 39).

Size of construction compound

The site will need to be sufficiently large to allow space for mitigation of any construction impacts, as well as simply meeting the physical needs of construction. Attention should be given to returning the surrounding area to its original status after construction.

Spillages and pollution of water courses

Measures to reduce or contain spillages, such as bunding, will probably be a condition of planning permission. It may be necessary under some circumstances to provide cut-off ditches and settling ponds to deal with suspended solids in surface water leaving the site.

Duration of construction

An estimated construction timetable should be included in the method statement; construction of a wood fuel energy plant would normally take from three to twelve months.

Transport and traffic

The construction process might require consideration of:

- Off-site highway changes, such as setting back hedges or hedge-trimming
- The loading and height of bridges
- Road developments, such as road widening.

Such works should be the subject of early discussions with the planning authority and highway authority as they will need to be identified in the planning application. Road widening and other highway alteration works are likely to be covered by legal agreements under the Town and Country Planning Act 1990 and the Highways Act 1980.

Photo: Nordjet

Control panel for monitoring

Monitoring

The planning and authorisation process will identify any statutory and voluntary monitoring procedures that may be required. For example, monitoring may be required under the Environmental Protection Act (EPA) authorisations. The scale of monitoring depends to some extent on the scale of operations. However, good monitoring procedures can be one of the most effective tools in boosting local confidence in the plant, as the impacts are seen to be constantly under scrutiny.

Ideally, monitoring needs to start before operations begin, to ensure that an appropriate benchmark can be established against which future findings can be measured. All the impacts of the plant may need to be monitored and a range of different types of monitoring may be required, including:

- Some emissions to air may need to be monitored comprehensively on the site of the plant itself, and in some cases at varying distances from it; sampling (such as of foliage and soil) may also need to be carried out. Some aspects of this monitoring are likely to be a condition of the EPA authorisation.
- Noise is unlikely to be monitored routinely on an official basis; for local authorities it is essentially a complaint-driven process.
- Traffic and transport routes should be monitored to ensure that transport contractors are keeping to contract obligations, and that impacts are acceptable.

Good monitoring practice not only meets regulatory requirements but can improve efficiency and provide economic benefits if monitored data is used to regularly review and improve performance.

Energy conversion and distribution

Photo: Nordist

This section covers the technological options and implications for energy conversion using wood fuel, energy distribution, and the operation of the plant. It outlines the key issues and ways in which the environmental benefits may be enhanced and any negative impacts minimised.

Energy production using wood fuel is still an emerging industry and there remain many alternative approaches. Schemes vary in size from small heat plant to large plant supplying electricity to the National Grid and/or heat to industrial users and district heating networks.

All the principles covered in this section will apply to schemes regardless of scale. However, the extent to which they are applicable may vary considerably depending on the size of the proposed development.

Technology

The design of the plant and choice of technology will depend on whether the priority is to supply heat, electricity or combined heat and power (CHP). Specialist advice will be required: see Appendix 6 for details of useful contacts.

The main features of the most usual technologies for producing heat and/or electricity using wood fuel are outlined below.

Combined heat and power

Environmentally, combined heat and power (CHP) is the preferred technology for generating energy from wood fuel because it is the most fuel-efficient. CHP collects the 'waste' heat given off by the electricity generation system and uses it to provide heating for nearby houses or businesses.

CHP will not be suitable for all developments as CHP systems require an adjacent outlet for heat produced, which is not always available. However, carefully planned projects should be able to find uses for some or all of the heat product.

Uses for this heat might range from drying the wood fuel, to heating nearby buildings such as a local business, hospital, educational institution or other large scale heat user, or developing a new heat user such as a fish farm.

Rural industries that have a demand for heat and electricity such as kilns or greenhouses are ideal for smaller scale on-site wood-fuelled CHP plant.

Combined cycle generation

Combined cycle generation is a technology which can be used to increase the efficiency of electricity generation by collecting the 'waste' heat from the generating plant and using it to generate more electricity. This can only work if the heat is given off at a high temperature, so a turbine, which could be fuelled by either a gasifier or a pyrolyser (see page 35), is used to drive the main generator. The 'spare' heat is then used to raise steam to drive a steam turbine and a second generator.

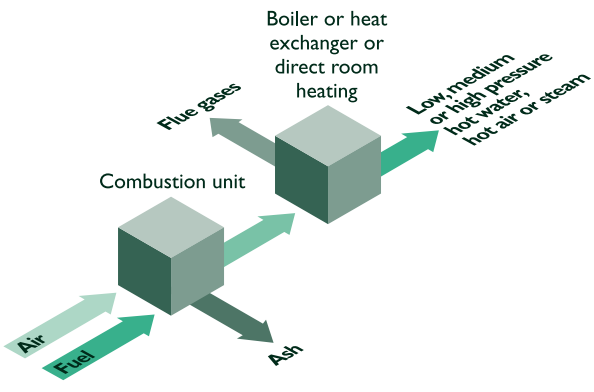
Combined cycle plant will use some but not all of the 'spare' heat to generate extra electricity; the remainder could be used for fuel drying or local heating.

Heat-only systems

Wood fuel can be used in a wide range of stoves, boilers and burners. Log-fuelled boilers require manual loading; automatic wood-chip-fuelled systems tend to be more expensive. In some instances, a gasifier (see page 35) may be used to produce a fuel gas from the wood chips. This gas can then be burnt in a similar way to any other fuel gas, to produce hot water, steam or hot air.

Larger automatic wood-chip boilers are thermostatically controlled and can be integrated with a building energy management system. They can automatically retrieve wood chips from stock and feed them to the boiler. Ash removal can also be automatic.

Heat-only systems



Electricity generation

There is a wide range of possible technologies for generating electricity from wood fuel. The three current leading technologies are combustion plant, gasifiers and pyrolysis plant:

- **Combustion plants.** Here the wood-chip is burnt and the hot combustion gases are used to raise steam, in much the same way as in a heating system. The steam is then used to drive a steam turbine which drives a generator to produce electricity.

  Virtually all the existing wood-fired electricity generating plant in the world are steam turbine systems, as are most fossil fuel-fired plant. The conversion efficiency from primary fuel to electricity is fairly low, especially for small systems, but the capital cost is also relatively low and the technology is tried and tested. Using the 'waste' heat in a CHP scheme results in much better efficiencies and economics.

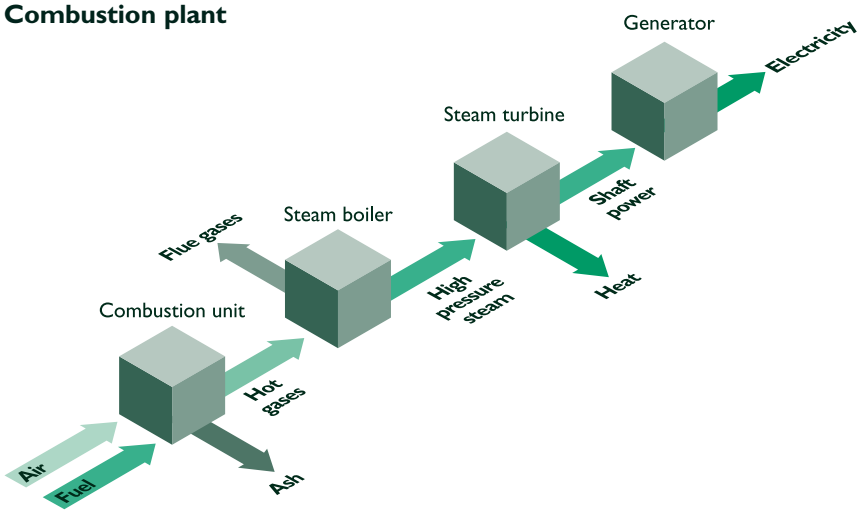
- **Gasification.** If the wood is heated with a restricted supply of air, combustible gases will be given off. These gases can be cleaned and used to drive an engine: this might be a reciprocating internal combustion engine (like a car engine) or a gas turbine (like a jet engine). The engine is used to turn a generator to produce electricity. Gasification can give higher efficiencies than combustion plant.

  Gasifier systems can be used for systems of virtually any size. Although gasifier technology has been established for some time (for example to make town gas from coal), at the time of writing it has not been fully demonstrated commercially using wood fuel.

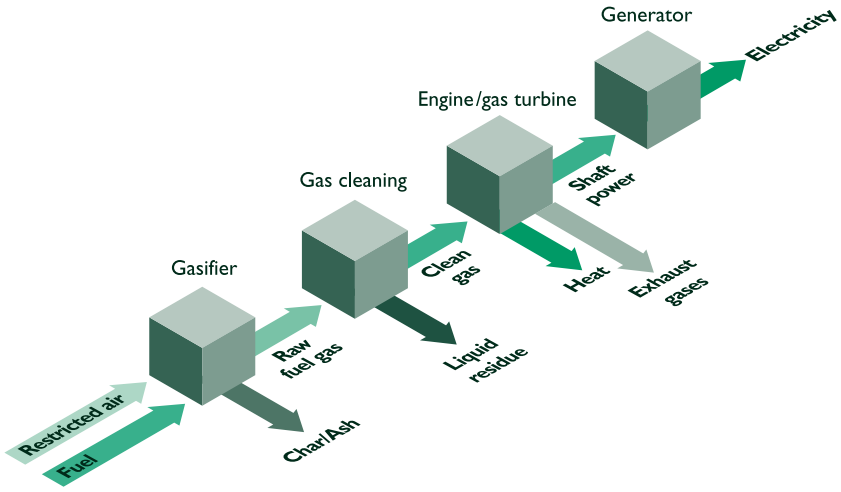
- **Pyrolysis.** In pyrolysis, the wood is heated in the complete absence of oxygen. The heated wood degrades to produce gases, liquids and charcoal. Usually, the majority of the output is a liquid fuel which can be used to drive a reciprocating engine or turbine to turn a generator. The gas can be burnt to heat the pyrolyser, and the charcoal may also be burnt, or sold for other purposes.

  Pyrolysis is a fairly new technology and is not yet commercially demonstrated for wood fuel. However, it is attracting considerable attention from developers because, as the fuel is liquid, it has great flexibility and additional potential markets as it can be easily stored and transported.

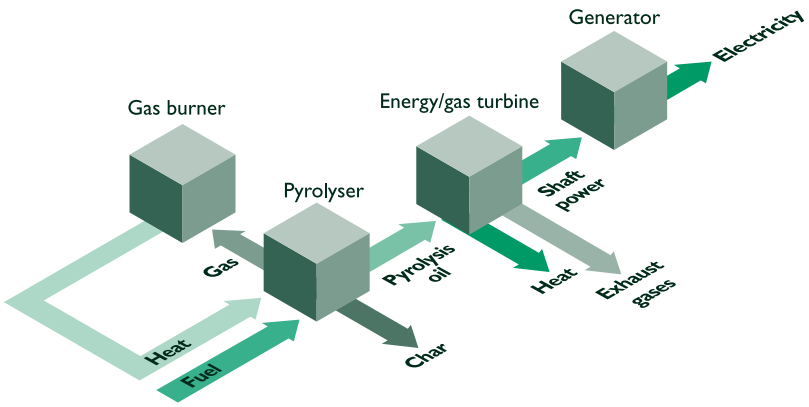
Combustion plant



Gasification



Pyrolysis



Energy distribution

Electricity connection

An electricity connection and appropriate import/export metering will be required if the electricity generated will not be consumed within the boundaries of the plant and associated businesses. If the plant is constructed on a new site, it will also usually require an electricity connection to the local electricity distribution network to provide energy to operate ancillary equipment and other site loads during maintenance and shutdown periods, unless stand-by generation equipment is also installed.

The operator can decide on a number of trading options depending upon the size and location of the generator and to whom the electricity is supplied, and will need to address various technical, regulatory, commercial and contractual issues. A summary of the options and benefits, and the associated agreements, contracts and licence requirements, is given in Appendix 3.

The Regional Electricity Company (REC) has statutory obligations under the Electricity Act 1989 in respect of the safety and quality of electricity supply to its customers. The REC will determine the method by and the point at which connection can be made to the distribution network, depending upon the export capacity of the plant and the characteristics of the local distribution network.

The cost of connection could vary considerably depending on where the plant is located within the REC's distribution network and the proportion of the connection work done by the developer or done by the REC. The cost of connection will in part reflect the distances involved and the specification required.

If the developer has some flexibility as to where the plant can be located within a particular area, they should discuss with the REC the respective connection costs for different sizes of generator and, if practicable, size and locate the installation accordingly.

Planning permission is required for the grid connection. The developer will have established a dialogue with the REC to determine the route and will have assessed any visual implications of the preferred route and method of grid connection. It is good practice to consult the local planning authority, the landowners and local residents about the possible line of any grid connection. Planning permission is not required for underground cables. See Appendix 2 for more details on planning consent for grid connection.

Heat use and distribution

All energy plant using wood fuel will generate heat, and the environmental performance of a scheme will be greatly enhanced if the heat is used to substitute heat which would otherwise be generated directly or indirectly from fossil fuels.

Energy may be used or distributed as heat at three different levels:

- Single room equipment: such as log stoves providing direct heat for one room
- Central heating system with boiler: for a house or larger institutions such as schools, hospitals, greenhouses, sawmills
- District heating: best understood as a central heating system for a group of properties, a whole village or a town.

District heating is the most complex form of heat distribution and has a number of specific implications which are outlined below.

District heating

District heating schemes use pressurised hot water carried in insulated underground pipes with branches to customers, similar to mains cold water or gas supply. The hot water either directly heats the property, by flowing around the central heating system, or transfers heat via a heat exchanger to a closed central heating system.

At present, district heating is relatively uncommon in the UK, compared to other forms of heat, because of the costs of the distribution system. The existing district heating systems in the UK are based on discrete urban communities with a local, and usually large, heat source such as a refuse incinerator or, in one case, geothermal energy. However, district heating is likely to be more viable in future as political and economic pressures on the need for efficiency in energy generation and distribution increase, and there are already extensive developments throughout mainland Europe.

Heat can only be economically transported over relatively short distances, unlike electricity, so the critical aspects of the feasibility of supplying heat as a product are the size and proximity of the heat demand or potential market. The key issues are outlined below:

- **Location.** Distance, geographical features, land ownership and classification and planning controls will have to be assessed for their impact on laying heat supply pipes. Crossing rivers, roads or difficult ground conditions can be expensive, and

Photo: ETSU for the DTI

A Devon farmhouse and cottages heated by an automatic wood-chip boiler

surveys of other services would have to be conducted and permission and/or wayleaves sought from landowners for the use of their land.

The regulations concerning the laying of underground pipes will depend on the site and the route of the pipes:

- In the first instance, advice should be sought from the local planning authority, either the district/borough council or unitary authority.
- If the pipes are to be laid across and along public highways, then the County Council or unitary authority must be involved. For certain major roads, the Highways Agency is the responsible authority.
- The Environment Agency or SEPA should be informed if any water course is involved in the route of the pipeline.
- BG Transco (British Gas), the local water and electricity companies and the Independent Television Commission should also be consulted in order to identify the presence of any underground services which might conflict with the route of the pipeline.

- **Demand pattern.** Space heating demand in the UK is seasonal and usually covers seven or eight months. Demand may also only occur during working hours (in commercial premises), may depend on working patterns and seasonal activities (especially in agricultural applications) and may vary throughout the day.

- **Customer requirements.** District heating can be incorporated into customers' existing central heating systems or, using heat exchangers, can supply hot air. Where it replaces an electric heating system such as storage heaters, new radiators and pipework will need to be installed.

  Stand-by boilers will be required so that suppliers can meet contractual requirements to provide energy. It may be that the wood-fuelled boiler would be the main boiler and meet core demand, and a boiler using alternative fuels would help meet peak demand.

  It is unlikely that all of the heat produced by a wood energy plant can be sold all of the time, in the current market conditions, because heat demand is variable and because it represents a new and unfamiliar concept. In some cases, heat storage, or operation as CHP, may help smooth out heat demand variations.

- **Metering, tariffs and contracts.** Metering can be very simple. An energy meter connected between the supply and return pipes measures the flow in each, and the temperature difference, and therefore the total amount of heat energy supplied (in kWh).

  If the energy plant is supplying more than a few customers, a tariff structure will be devised, based on a unit charge and some kind of standing charge (as with other utilities). Charges should be competitive with all other forms of heating energy such as electricity, oil or gas. Where there are only one or two customers, for example an industrial or agricultural unit or hospital, the tariff may be negotiated individually.

Operation of the plant

The energy generating plant is the centre of the production of renewable energy using wood fuels. It is here that the balance between the global environmental benefits of renewable energy generation and the local impact of its production is most apparent. Good practice requires careful planning to ensure that the benefits of clean energy are matched by sensitively and effectively managed systems for energy conversion.

As with any industrial development, the operations of the energy generating plant may have some negative impacts in terms of emissions and an increase in traffic around the plant. Most of these impacts will be regulated by planning permission and regulatory authorisations (see Appendix 2). Many of these impacts, and therefore any mitigating activities, will be negligible in smaller schemes.

However, even the largest wood-fuelled energy generating plant currently envisaged will have far fewer negative impacts on the local area than many other developments, and can be compared more easily with other rural developments than with conventional energy plant. Nevertheless, and especially in larger schemes, attention needs to be given to the following, all of which are covered in more detail below:

- Fuel management at the plant
- Noise
- Light
- Dust and smell
- Ash
- Emissions to ground and water courses
- Emissions to atmosphere
- Transport and traffic (see previous sections)
- Health and safety.

Fuel management at the plant

The importance of a reliable fuel source has already been described. Some plant will need significant on-site storage (see the Obtaining the Fuel section).

Plant managers will have mechanisms for checking the quality of the wood fuel supplied. Contracts will specify these criteria and monitoring will ensure standards are maintained. Projects using wood fuel need to consider the entire fuel supply chain and process the wood at the most appropriate stages.

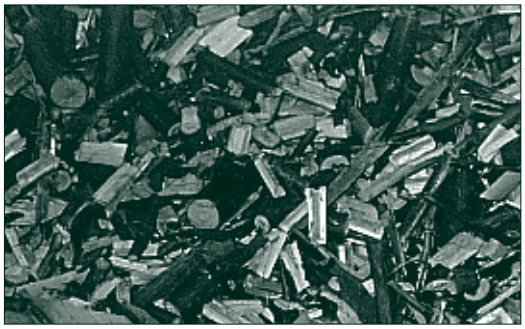


Photo: ETSU for the DTI

Chipped wood fuel

The key quality issues for wood handling and processing are moisture content and chip size. Moisture content varies from 15% (a dry timber) to over 60%; the wetter fuel requiring significantly larger and more elaborate combustion chambers, and therefore more expensive plant.

Size and moisture control, and fuel handling, are outlined below and covered in more detail under Fuel Preparation in the Obtaining the Fuel section. See also *Handling and Preparation of Wood Fuel at Utilisation Plant*, ETSU for the DTI 1996.

- **Size control.** Combustion and handling systems differ in their sensitivity to variations in chip size. Long, stringy material may block some processes, while coarse or fine particles cause problems for others. Where wood fuel characteristics do not match the needs of the plant, some form of fuel preparation equipment will be needed at the plant to screen and reduce the size of the fuel.
- **Moisture control.** Wood fuel may require drying for several reasons:
  - Small combustion plant are unlikely to tolerate fuel with over 45% moisture content.
  - Some gasification and pyrolysis plant will need fuel of less than 15% moisture content.
  - Process efficiency may be improved by eliminating furnace heat loss incurred by driving off moisture.

  Low-grade heat sources which would otherwise be vented, such as waste heat recovery from electricity generating plant, may be used for drying without affecting the plant energy output. Alternatively, some of the wood fuel may be burned to dry the rest, especially where feedstock size control produces a quantity of reject material.

  Details about drying fuel prior to combustion are given under Fuel Preparation in the Obtaining the Fuel section.
- **Fuel handling.** Steady movement of fuel is vital for smooth running of the plant. It can be difficult to make wood chips flow: they tend to move as a mass and may jam at converging sections if chip geometry is not uniform and consistent, so careful choice of equipment is important.

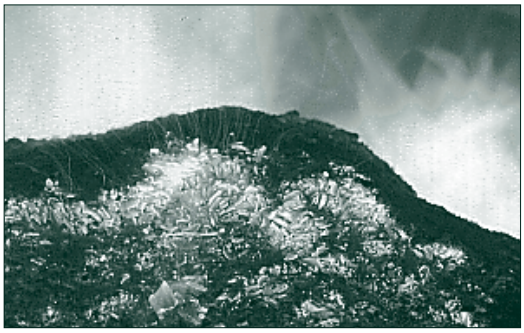


Photo: ETSU for the DTI

Wood fuel in a furnace

Noise

Noise must be considered in projects of all sizes. The conditions of the planning permission are likely to specify noise limits, especially for large projects. Expert advice is required in each case to identify and negotiate acoustic measures (if these are required) and noise conditions. Although not always essential, the developer and/or the local authority may wish to carry out a background noise survey to establish the ambient level of noise in the environment prior to the development.

Sources of potential noise need to be identified, such as engines and chippers and other equipment to prepare the fuel. Plans can then be made to mitigate these through use of appropriate technology and through careful design of the site to include features such as acoustic fencing or earth mounding, or by creating a hedge or tree barrier around the plant.

Light

There are no statutory criteria for light pollution although measures should be taken to reduce unnecessary obtrusive light: light pollution can cause serious physiological and ecological problems, and wastes energy and money. The Institution of Lighting Engineers' *Guidance Notes for the Reduction of Light Pollution* suggests a number of measures, including:

- Lights should be directed at and not above their target; if aimed at observers, the main beam angle should be no more than 70°.
- In certain environmental zones, such as National Parks, Areas of Outstanding Natural Beauty (AONBs) or other 'dark landscapes', only light from public roads should be deemed acceptable for all-night lighting. Similar guidelines apply to other special areas.
- Curfews should be introduced, for example between 11pm and dawn, when lights not required for security are shut off.
- Further advice can be obtained from the local authority Environmental Health Officer, or the Institution of Lighting Engineers.

Dust and smell

The combustion of wood fuel is unlikely to create dust and smell problems beyond the boundaries of the site. On site, developers should address potential problems through the design of the site. Expert advice is required in each individual case to consider what is likely to be discharged, what are the potential risks and how can they be avoided or at least minimised.

Long term chip storage is undesirable, and is unlikely because it is uneconomic. Health and safety problems may arise from spores which can develop when wood is chipped when wet and then stored for several months. This is specifically an on-site problem related to health and safety at work and should not affect the wider neighbourhood.

Ash

There are two sources of ash from wood fuel combustion: ash collected in the combustion unit (the residue left in the primary chamber); and ash collected from the flue gases in larger plant.

The amount of ash produced depends on the material used; wood fuel has a very low ash content, normally between 0.5% and 5% of the original weight. Handling procedures for ash are regulated under the Environmental Protection Act.

Ash can be a valuable by-product: it may have potential value as a low nitrate fertiliser or as a raw material in the brick and cement industries. It is good practice for a full assessment of the contents of the ash to be undertaken before any use is determined.

Emissions to ground and water courses

Emissions from the plant to water courses can arise from surface water run-off, plant process waste water and sewage. Emissions which affect surface water (rivers, lakes etc) or ground water (aquifers) will be regulated by the Environment Agency or SEPA. Any discharges into the sewerage system will be regulated by the sewerage system operator which is usually the local water company.

- **Surface water run-off.** As rain falls and runs off the ground it can pick up contaminants including suspended particles or dissolved chemicals from stored wood, dust from chipping operations or oil spills. Ideally, contamination of run-off water should be avoided by, for example, covering wood stores.

  Where there is a risk of run-off polluting water courses, it should be collected and cleaned to a

level suitable for discharge into water courses or sewers. Settlement ponds and oil traps can effectively deal with such problems, or reed beds could be investigated as an alternative.

- **Plant process waste water.** All types of energy plants can produce waste water either from cooling systems or from the process of converting wood into liquid or gaseous form before using as a fuel. These waste waters are likely to require treatment before discharging to water courses or sewers. It is good practice to design plants to eliminate or minimise any waste water production. Where waste water is produced, it should be analysed to determine the level of contamination and then treated to meet the requirements of the appropriate regulatory body.
- **Sewage.** This waste water, from plant worker amenities, will be discharged to the sewer or to a septic tank.

Emissions to atmosphere

There will be some emissions to the atmosphere from the combustion of wood fuel, as with the combustion of any fuel. Atmospheric emissions will be controlled and monitored under the Environmental Protection Act or the Clean Air Act, in accordance with the formal guidance. All records relating to the authorisations are in the public domain and available for public viewing at the local authority offices.

Good practice requires making every effort to reduce the impact of operations on air quality and to prevent emissions through the efficient use of conversion technologies and, where appropriate, best abatement technology.

The principal emissions that could arise from the plant, and mitigating actions, are outlined below:

- **Particulates.** Pollution abatement equipment and good combustion control will minimise any tiny particles in the flue gas.
- **Carbon dioxide.** One of the principal environmental benefits of wood as a fuel is that it is carbon neutral: any carbon dioxide emitted will be compensated by the carbon dioxide taken up by growing trees. See the Carbon Cycle diagram and details on the contribution of wood fuel to reducing greenhouse gas emissions in the Introduction.
- **Carbon monoxide.** Carbon monoxide emissions will be minimised by burning fuel with an appropriate amount of oxygen, with good distribution of air and fuel.
- **Organics.** Like all combustion processes, burning wood fuel may produce very small quantities of toxic organic substances. Controlled combustion techniques and use of appropriate pollution abatement equipment will keep these well within regulatory levels.
- **Nitrogen oxides.** Wood has a small inherent nitrogen content (0.1-0.2% by weight). Any nitrogen oxide emissions can be minimised by careful control of combustion processes.
- **Water vapour.** Water in the form of vapour will also be emitted. The water vapour may give the visual effect of a plume but has minimal pollution implications.

Exhaust stacks will be necessary for all plant. The height will be determined in negotiation with the local authority for planning consent, bearing in mind wind conditions and the proximity of nearby buildings. Reciprocating engine exhausts can have low visual impact because their small-diameter flues can be arranged to follow a building profile.

There may be a visual plume, but this is only water vapour. It is important that local people fully recognise the balance between mitigating the impact of the contents of the plume (ie water) and the permanent construction of a higher chimney, which may be less acceptable. This is an issue for detailed community consultation and expert advice from the Environment Agency or SEPA.

Specialist plume modelling exercises can help establish the appropriate height of the chimney, as the height of the nearby buildings and the general topography affect the visibility of the plume. These exercises can also help allay any concerns from local residents by confirming the correct height and design of the chimney.

Health and safety

The main health and safety risks at the plant are related to fire and to occupational health and safety. These risks can be minimised in the following ways:

- Installing high temperature insulation to minimise radiant heat.
- Ensuring heat exchange protection through thermostatic control.
- Ensuring safety pressure relief valves are in place.
- Ensuring a thermostatic dousing system is in place to avoid burn-back.
- Installing negative pressure fans to ensure personal safety even if the combustor access doors are open.
- Regular checking of high pressure steam equipment.
- Taking advice from manufacturers on how their equipment should be used.

Photo: Nordist

Regular checking of equipment is important for safety

- Ensuring the adoption of all necessary health and safety regulations on taking care around steam turbines, rotating machinery and electrical equipment.
- Special care needs to be taken by plant operators in handling pyrolysis oils, which are hazardous; expert advice should be sought.

Decommissioning

As a matter of good practice, any developer will want to prepare and plan for change. They may therefore wish to consider possible alternative uses for the facility at the end of its life as an energy generating plant, in which case it would be good practice to consider decommissioning at the planning stage of the project. This may lead on to building another energy generation plant or a completely different use for the site.

A well-designed, good quality building in the right location may be able to be adapted (and sold) for alternative industrial uses if no longer required as an energy plant. Alternatively, the land may have a development value. Like any industrial site, it will need to be checked for ground contamination (such as diesel fuel spillage) and assessment and remediation carried out. However, the risks are likely to be less in the case of an energy generating plant using wood fuel than in many other industrial developments.

The developer and local authority may wish to consider the possibility of limited life planning permission, 20 years for example, at which time restitution of the land can be discussed in detail.

Appendix I

Glossary

The following terms are used in these guidelines, and the definitions given below refer to their meaning in the context of this document: other sources may use the terms differently.

Ancient Woodland: A classification for woodland which has been in continuous existence from before AD1600 in England, Wales and Northern Ireland, and from before AD1750 in Scotland.

Arboriculture: Care of trees and shrubs primarily for amenity purposes.

BATNEEC: Best Available Technique Not Entailing Excessive Cost. Not *entailing excessive cost* applies if the benefits of employing the techniques outweigh the costs – in general, the greater the environmental damage, the greater the costs of BAT that can be required before costs are considered excessive.

Billet: Wood cut as short sticks 3-30cm in length.

Biodiversity: The variety of ecosystems and living organisms (species).

Biofuel: Any solid, liquid or gaseous fuel derived from biomass.

Biomass: Fuel derived from agricultural or forestry material.

Brash: Trimmings from trees.

Brash matting: Quantities of brash left on the forest floor.

Bunding: A barrier constructed around the site to prevent discharge entering water courses in the event of an accident.

Cable cranes: Equipment for off-ground transport of logs and whole trees from point of harvest.

Carbon balance: The difference between carbon absorbed by plant growth and carbon emitted through combustion and respiration.

Carbon cycle: A natural process in which plants take carbon from the atmosphere as they grow and release it again to the atmosphere when they decompose or are burned. As new plants grow, they again take carbon from the atmosphere. See Introduction for details.

Carbon dioxide: Naturally occurring greenhouse gas given off during combustion and absorbed by plants for growth.

Char: The solid residue from pyrolysis containing a high percentage of unburned carbon.

Chips: Small pieces of wood for energy conversion (eg 2.5cm x 2.5cm).

Clear-felling: Cutting down an area of woodland. Sometimes a scatter or clumps of trees may be left standing within the felled area.

Combined heat and power (CHP): In normal modes of generation, most of the heat is discharged to atmosphere. CHP recovers this heat via heat exchangers, increasing the efficiency of utilising fuel.

Consultation: Have deliberations with; seek information or advice from; take into consideration.

Coppice: Typically hardwoods cut for re-growth at regular intervals to provide a sustainable source of wood.

COSHH: Control of Substances Hazardous to Health, Regulations 1994.

Curtilage: Boundary of site.

Decommissioning: Planned closing down of an energy generating plant.

District heating: System of distributing heat around a geographical area using insulated underground pipes to carry pressurised hot water from a central source. The hot water may either directly heat the properties, by flowing around the central heating system, or transfer heat via a heat exchanger to a closed central heating system.

Ecological balance: See Ecosystem.

Ecology: Branch of biology dealing with organisms' relations to one another and to their surroundings.

Ecosystem: A community of plants and animals (including humans) interacting with each other and the forces of nature. Balanced ecosystems are stable when considered over the long term.

Effluents: Liquid material which flows out as a result of a process.

Emissions: Material which is given off from a process as liquid, gas, noise, light, odour etc.

Energy balance: The ratio of energy into a process (inputs), to energy from a process (outputs).

Energy crops: Crops dedicated to energy production.

Environment Agency: Statutory body regulating emissions to water, air and land.

Environmental Assessment: See Appendix 2 for details.

Environmental Impact Assessment: See Appendix 2 for details.

EPA: Environmental Protection Act 1990.

Environmental Statement: See Appendix 2 for details.

EU: European Union.

Exhaust stack: Chimney.

Feedstock: The raw material used as fuel to generate heat and/or electricity.

Flue: Chimney.

Forestry authorities: Forestry Authority, Forest Enterprise, Northern Ireland Forest Service.

Fossil fuel: Any energy source derived from finite fossil sources, eg coal and oil.

Fossil Fuel Levy: Levy on electricity generated from fossil fuel sources used to fund the NFFO.

Fuel specification: Technical description of fuel characteristics and properties.

Gas turbine: Rotary engine burning gaseous fuels.

Gasification: Conversion of solid or liquid fuel into combustible gas.

Gasifier: Piece of equipment used to convert solid or liquid fuel into combustible gas.

Greenhouse gas: A gas which traps heat from the sun causing the Earth's atmosphere to warm up (eg carbon dioxide or methane).

Grid: The system of transmission cables which is used to transport electricity around the country.

Heavy metals: Potentially toxic metals such as nickel, cadmium etc present through natural or other causes.

Hectare: Limit of area 10,000 square metres (2.471 acres).

HSE (Health and Safety Executive): Statutory body for health and safety regulation and enforcement.

Hydrological: Related to water.

Landfill: Practice of disposing of waste into natural or man-made holes in the ground.

Micro-habitats: Small self-contained habitats.

NFFO (Non-Fossil Fuel Obligation): Obligation requiring Regional Electricity Companies to purchase a certain amount of electricity from non-fossil fuel sources.

NFPA (Non-Fossil Fuel Purchasing Authority): Responsible for purchase of electricity under the NFFO.

Odt (oven dried tonnes): Dry weight.

Organics: Substances which may be given off in very small quantities during any combustion process. Some are toxic and are minimised through pollution abatement equipment.

Participation: Have share, take part.

Particulates: Small dust particles which can be emitted from combustion processes.

Planning authorities: The authorities responsible for giving planning permission for new developments; usually part of the local authority.

Planning conditions: Conditions relating to the construction and operation of a development imposed as part of the granting of planning permission.

Planning permission: Formal local authority permission to carry out development.

Plantation: Woodland where the current trees have been planted. Often includes naturally regenerating trees as well. Includes former semi-natural woodlands restocked by planting.

Plume: Visible emission to air from chimney (water vapour).

Pool (Electricity): Mechanism for centrally controlled trade of electricity.

Pyrolyser: Equipment in which the feedstock is heated in the absence of oxygen to produce pyrolysis oil.

Pyrolysis: Process in which wood is heated in the absence of oxygen. The heated wood degrades to produce gases, liquids and charcoal.

REC (Regional Electricity Company): Monopoly franchise to operate and maintain the local electricity distribution network.

Renewable energy: "The term used to cover those energy flows that occur naturally and repeatedly in the environment and can be harnessed for human benefit" – see Introduction for details.

Root mat: Network of roots created by crop immediately below the soil surface.

Rotation: Length of time between harvests or 'cutting cycle'.

Second tier supplier: Licensed supplier (other than the local REC) contracting to supply electricity to customers connected via the electricity distribution networks.

Semi-natural woodland: Woodland composed of mainly locally native trees and shrubs which derive from natural seedfall or coppice rather than planting.

SEPA (Scottish Environmental Protection Agency): Statutory body regulating emissions to water, air and land in Scotland; equivalent to the Environment Agency.

Short Rotation Coppice (SRC): Willow or poplar grown as an agricultural crop on a short (2-5 year) rotation cutting cycle and at a planting density of 10-20,000 cuttings per hectare.

Silviculture: The techniques of tending and regenerating woodlands, and harvesting their physical products.

Skidders: Machine used to drag whole tree stems out of the forest stand.

Statutory bodies: Organisations with formal responsibilities for designating and/or enforcing certain duties, eg protection of sites of special conservation interest.

Statutory conservation agencies: Countryside Commission, English Nature, Countryside Council for Wales, Scottish Natural Heritage, English Heritage, Historic Buildings and Monuments (Scotland) and Cadw: Welsh Historic Monuments (Wales).

Statutory rights of way: Pathways or access routes which are legally recognised and must allow public right of way.

Sustainable: Practices which meet the principles of sustainable development.

Sustainable development: Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.

Thinning: A temporary reduction in standing volume made after canopy closure to promote growth and greater value in the remaining trees.

Transmission losses: The energy consumed by the network infrastructure in moving the energy from the point of generation to the point of use.

Triad: The three half-hour periods of maximum demand used to determine the use of system charges in electricity supply contracts.

Turbine: Rotating machine which can be driven by expanding hot gases from the combustion of fuel and can be used to drive an electric generator.

UK Forestry Standard: The UK Forestry Standard sets out criteria and standards for the sustainable management of all forests and woodlands in the UK. It incorporates a range of guidelines and other supporting documentation and is the centrepiece of a system to guide and monitor forestry. The Standard is linked to the developing international protocols for sustainable forestry including the 1993 Helsinki Guidelines, and the subsequent Pan European Criteria for sustainable forest management. It can be used in the UK as a basis for the development of forest management schemes, and for assessing compliance with management certification standards such as ISO 14000 and EMAS.

Water courses: Streams and rivers.

Water table: The level in the soil below which soil pore space is saturated with water.

Wayleaves: Rights of way for the provision of services.

Windthrow: Uprooting of trees by the wind.

UNITS OF POWER

Kilowatt (kW) = 1000 watts

Megawatt (MW) = 1000 kW

Gigawatt (GW) = 1 million kW

Terawatt (TW) = 1 thousand million kW

When 'e' added (eg kW_e) = electrical power, so kW_e = kilowatt of electrical power

When 't' added (eg kW_t) = thermal power (heat), so kW_t = kilowatt of thermal power

Appendix 2

Planning permission and authorisations

Environmental Assessments and Statements

What are Environmental Assessments and Environmental Statements?

Environmental Assessment (EA): "A technique and a process by which information about the environmental effects of a project is collected, both by the developer and from other sources, and taken into account by the planning authority in forming their judgement on whether the development should go ahead ... the whole process whereby information about the environmental effects of a project is collected, assessed and taken into account in reaching a decision on whether the project should go ahead or not. The term 'environmental impact assessment' (EIA) is also in common use and for practical purposes is synonymous with EA".

Environmental Statement: "A document setting out the developer's own assessment of his project's likely environmental effects, which he prepares and submits in conjunction with his application for consent".

(Quotes taken from *Environmental Assessment – A Guide to the Procedures*, published by the Department of the Environment/Welsh Office 1989.)

When is an Environmental Assessment required?

Statutory EA is only mandatory for a thermal energy plant with a heat output of 300MW or more (referred to as a Schedule 1 development under the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988), and energy generation projects using wood fuel are unlikely to reach anything like the size where an EA is mandatory.

However, smaller plants will require an EA if they are likely to have significant effects on the environment because of their nature, size or location (referred to as Schedule 2 developments under the 1988 regulations).

'Significant effects' have no general definition, but Government guidance lists three main criteria of significance (taken from *Environmental Assessment – A Guide to the Procedures*, DOE/Welsh Office 1989):

- Whether the project is of more than local importance, principally in terms of physical scale
- Whether the project is intended for a particularly sensitive location, for example, a National Park or Site of Special Scientific Interest (SSSI), and for that reason may have significant effects on the area's environment even though the project is not on a major scale
- Whether the project is thought likely to give rise to particularly complex or adverse effects, for example, in terms of the discharge of pollutants.

The regulations governing this procedure are the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 (as amended) implementing EU Directive 85/337.

What should an Environmental Statement cover?

It is not possible to offer a definitive list of topics for an environmental statement, and developers will need to look at both wider and more local issues which cannot be identified in general guidelines. Also, circumstances and technologies change over time. Developers are advised to discuss it with the local authority and the Environment Agency to clarify specific local issues. However, the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 (as amended), implementing EU Directive 85/337, (Schedule 3, paras 2, 3 and 4), state that an Environmental Statement should provide certain specified information including:

a A description of the development proposed, comprising information about the site and the design and size or scale of the development

b The data necessary to identify and assess the main effects which that development is likely to have on the environment

c A description of the likely significant effects, direct and indirect, on the environment of the development, explained by reference to its possible impact on:

- Human beings
- Flora
- Fauna
- Soil
- Water
- Air
- Climate
- Landscape
- Interaction between any of the above
- Material assets
- Cultural heritage.

d Where significant adverse effects are identified with respect to any of the foregoing, a description of the measures envisaged in order to avoid, reduce or remedy these effects

e A summary in non-technical language of the information specified above.

An Environmental Statement may include, by way of explanation or amplification of any specified information, further information on any of the following matters:

a The physical characteristics of the proposed development, and the land-use requirements during the construction and operational phases

b The main characteristics of the production processes proposed, including the nature and quality of the materials to be used

c The estimated type and quantity of expected wood fuel and emissions (including pollutants of water, air or soil, noise, vibration, light, heat and radiation) resulting from the proposed development when in operation

d An outline of the main alternatives (if any) studied by the applicant, appellant or authority and an indication of the main reasons for choosing the development proposed, taking into account the environmental effects

e The likely significant direct and indirect effects on the environment of the development proposed which may result from:

(i) The use of natural resources

(ii) The emission of pollutants, the creation of nuisances, and the elimination of waste.

This includes secondary, cumulative, short, medium and long term, permanent, temporary, positive and negative effects

f The forecasting methods used to assess any effects on the environment about which information is given under subparagraph (e)

g Any difficulties, such as technical deficiencies or lack of know-how, encountered in compiling specified information.

Where further information is included in an Environmental Statement in this way, a non-technical summary of that information shall also be provided.

(Taken from *Town and Country Planning (Assessment of Environmental Effects) Regulations 1988.*)

Planning process

The way the planning procedure will operate in normal circumstances is detailed below. This is not a step-by-step guide, since the actual procedure will vary according to the size and type of plant and the requirements of different planning authorities, and other permissions will be required before and after planning permission is applied for and granted. However, the main points are covered below:

1 The developer should make contact with the planning authority at an early stage. The planning authority with jurisdiction for the development will be either the district, borough or county council, or unitary authority, or the Department of the Environment in Northern Ireland, depending on the local government structure in the area and the nature of the project. Early discussions with the local authority's Building Control and Environmental Health Officers are also important.

The initial contact should be with the Chief Planning Officer, or one of his senior officers, who will decide who should deal with the matter (it may be delegated). There may also be contact with the Economic Development Officer about larger schemes. At this stage, the project may not reach the public domain, although early provision of information to local communities is always recommended.

2 Between initial contact and a formal application for planning permission, most of the preparatory work for the development will be carried out. This will include regular contact with the planning authorities, especially on scoping work on the EA (or alternative provision of environmental information).

The scope of the EA can be developed informally in discussion, or more formally in correspondence. The latter approach would mean that the project will become more widely known because the planning authority will consult statutory consultees. The need for a statutory EA will depend in part on how far, in negotiations, the developer agrees with the planning authority to address environmental issues which will be covered in detail as part of the application procedure.

While planning applications and EAs require a high degree of technical input, it is important to recognise that these are public documents, and developers should ensure that results are presented in as accessible a form as possible, with the minimum of technical or scientific jargon. In addition, the developer will be required to produce a non-technical summary planning statement for public information; a formal summary will be required if there is an EA.

There will also be detailed consultation with the local community and with statutory and non-statutory consultees. See the section on Consultation for details of possible consultees. Only when all this is completed, and all issues of concern have been addressed, should a formal application for permission be made.

3 If a major project is planned, a more intensive dialogue between the developer and the planning authority, prior to the submission of the planning application, is recommended.

It is good practice to submit the Environmental Statement (or informal environmental information) at the same time as the planning application. It is also good practice to state 'no significant impacts anticipated' where this is the case, although if this statement is used, and subsequently found to be inaccurate, there is likely to be serious questioning of the entire project.

4 The formal process begins with the submission of the planning application, which will lead to some form of statutory consultation. The planning authority is obliged to publicise the planning application as soon as it is formally received, at which point anyone can make comments on the proposals. The planning authority will take into account any representations received when making a decision on the application. The decision could be made by either a planning committee or the Chief Planning Officer using delegated powers.

If the development does require a formal EA, the local authority has 16 weeks to determine the application. If no formal EA is required, the local authority has up to 8 weeks. The developer has the right to appeal against the failure of the local authority to decide the application at the end of 8 or 16 weeks. Such an appeal must be made no later than 6 months from the statutory determination date. Lodging such an appeal debars the planning authority from determining the application.

5 Where an adopted or approved Development Plan contains relevant policies, Section 54 (a) of the Town and Country Planning Act 1990 requires that a planning application or an appeal shall be determined in accordance with the plan unless material considerations indicate otherwise. Regard should also be had to DETR Planning Policy Guidance Notes (PPGs), particularly PPG22 on Renewable Energy, and relevant planning policy guidance for Wales, Scotland and Northern Ireland.

6 The Secretary of State for the Environment has the ability to call in planning applications, at which point they are taken out of the hands of the local authority. This may happen if there is considered to be a breach of the Development Plan policy or if the Government Regional Office, Welsh Office,

Scottish Office or Department of the Environment in Northern Ireland considers that the proposed development raises issues of more than local concern. If the developer is working effectively with the local authority and local community, many of these issues and potential problems should have been identified at an early stage.

7 If planning permission is granted, developers will need to comply with any agreed voluntary planning obligations and planning conditions which could be imposed, which will normally have been negotiated prior to granting any permission. Discussions will have been held with planning authorities to agree methods of complying with these conditions, which may involve some form of monitoring. Some elements could be dealt with through a liaison forum set up from the links the developer has already established with the local community. There may also need to be agreement to off-site highway improvements, which would involve discussions with the highway authority and local landowners.

8 If planning permission is refused, or conditions are made with which there is disagreement, developers have a right to appeal within six months.

Overall, if a site is suitable, and a well-considered planning application is made, which seeks to take into account the concerns or likely concerns of local communities and statutory consultees, it is much more likely to receive a positive response.

Planning consent for grid connections

Planning consent is required for the grid connection. The developer will have established a dialogue with the Regional Electricity Company (REC) to determine the route and will have assessed any visual implications of the preferred route and method of grid connection.

The application for planning consent for the grid connection may be done by the developer as part of the overall planning application for the plant, or may be done by the REC if the REC is doing the connection work.

New connections will have an impact both on and off-site (ie lines or cables to make the connection to the grid), and the scope of the application for consent will include the whole of any new overhead line between the site substation and the point of connection with the existing electricity grid. Good practice suggests that the local planning authority and landowners should be consulted early on the route of the line, as they can request amendments, and developers may feel it would also be appropriate to consult local residents over the potential route of the line at this stage. Wayleaves for new lines will need to be negotiated with the landowners affected.

Planning permission is not required for underground cables. Underground connection reduces the visual impact and may in certain cases be economic in comparison with overhead lines. In this case, the visual intrusion is only short term whilst the work is carried out. Alternatively, the visual effect of overhead lines may be mitigated to an acceptable level by careful route selection. Developers will plan for the likely route of a grid connection at the same time as they are planning the energy generating plant. Where a grid connection already exists, there will still be an impact on-site (ie simple fixing to existing grid system).

Authorisations

As well as planning permission, plant will need to comply with a range of licensing and other regulations governing their operations. These depend on the scale of the plant, but will generally be as outlined below:

Environmental emissions

The UK legislation applicable to wood fuel plant will depend on scale and whether or not the wood is deemed to be derived from a waste. Discussion with the appropriate regulatory body will establish relevant guidance notes outlining practically achievable releases which will form the basis of any authorisation. There are two main pieces of relevant legislation: the Environmental Protection Act 1990 and the Clean Air Act 1993.

- The Environmental Protection Act classifies projects in two ways: Part A processes which are regulated by the Environment Agency or SEPA, and Part B processes which are regulated by local authorities. Other processes come under the Clean Air Act which covers smoke, grit, dust and fumes.

  The Environmental Protection (Prescribed Processes and Substances) Regulations 1991 includes as Part A processes burning any fuel in a boiler, furnace, gas turbine or compression ignition engine with a net rated thermal input of 50MW or more and, as a Part B process, burning any fuel in a boiler, furnace, gas turbine or compression ignition engine with a net rated thermal input of not less than 20MW but less than 50MW.

  (Adapted from SI 472 (1991), which defines how wood plants will be regulated, where the fuel is not considered to be a waste.)

- Where the fuel is considered by the regulatory authority to be a waste, Part A processes (regulated by the Environment Agency) are plant of 3MW thermal input and over, while Part B processes (regulated by the local authority) are plants of 0.4-3MW thermal input. The classification of some wood fuels as waste is an area of considerable debate but, for the wood fuel industry to develop and expand to its full potential, this issue needs to be resolved.

  If the fuel is considered a waste, the plant may need to obtain a waste management licence from the Environment Agency or SEPA.

- The regulation of gasification and pyrolysis plant needs to be clarified with the regulators. SI 472 (1991) includes producing gas from 'carbonaceous material' and pyrolysis of 'carbonaceous material' as Part A processes, but it is not clear whether the definition of 'carbonaceous material' includes wood. It is possible that, where gasification or pyrolysis is an intermediate step in an overall process which ultimately produces energy from wood fuel on a single site by the combustion of a wood-derived fuel, the process will be regulated as if it were a combustion process.

Water consents

Where abstractions or discharges from water courses are required, consent from the Environment Agency or SEPA will be necessary. Discharges to sewers will require the consent of the operator and will incur a charge.

Dust and smells

Dust and smells from the operations of the plant are likely to be regulated by the Health and Safety Executive and the local authority under the Environmental Protection Act. Handling procedures for ash would also be dealt with by the Environmental Protection Act authorisation.

Appendix 3

Electricity connection

The majority of schemes will require an electricity connection to the local electricity distribution network to provide energy to operate ancillary equipment and other site loads during maintenance and shut-down periods, unless stand-by generation equipment is also installed.

If the wood fuel is to be used in an energy generating plant, then the operator will have a number of trading options depending on the size and location of the generator and who consumes or buys the electricity. These include:

- Consumption by the operator for own on-site business
- Sale as an on-site generator, that is, sale to a single customer or a qualifying group of customers related through common ownership on the same site
- Sale to the local Regional Electricity Company (REC)
- Sale via the Non-Fossil Fuel Obligation (NFFO)
- Sale through the electricity supply pool
- Sale to a second tier supplier through the Non-Pooled Generation Scheme
- Sale direct to own customer(s)
- New outlets which may emerge following deregulation of the energy market.

Each of these options will raise technical, planning, regulatory, commercial and contractual issues; some of the options involve mandatory licensing arrangements with cost implications and some will involve commercial risks. The risks and benefits need to be appraised and understood by the prospective developer to improve the negotiating position and to maximise the value of the energy generated. The following section provides an introduction to the issues; more detailed information is available in *Electricity Production Connected to the Local Network – A Guide*, published by the Association of Electricity Producers.

The final option(s) chosen will determine the nature of the agreements, contracts and licences entered into by the developer and the equipment that will form part of the installation. These may include:

- A connection agreement with the local REC determining the connection cost, import and export capacity, and any operational restrictions which may be applicable
- An agreement with the local REC or other second tier supplier (post-1998) to supply electricity for stand-by and top-up purposes, either for on-site use or by contracted customers
- A meter connection agreement with a licensed meter operator to measure and record the half-hourly import and export of electricity by the generator and/or contracted customers
- Purchase contract(s) with the local REC, second tier suppliers, NFPA (for NFFO contracts) or contracted customers for electricity supplied and/or for spill export when surplus to agreed declared generation capacity
- Interlocks on stand-by generators and contractual agreements to restrict the use of fossil fuels if the electricity is sold via a NFFO purchase contract
- Arrangements with the local REC or other second tier supplier for the benefits accruing from reduction in triad peak capacity charges and other embedded generation benefits
- A generator's licence if exporting more than 50MW to anyone other than a single on-site customer (or exporting more than 10MW from a plant with an overall capacity greater than 100MW)
- An agreement with the local REC to pay the tariff charges for use of their distribution system where the generator is also operating as a second tier supplier and selling the electricity generated to contracted customers (called a DUoS agreement which refers to charges to be paid to the local REC for use of their distribution system to export electricity to other users or suppliers)
- A second tier suppliers' licence if exporting more than 500kW to anyone other than the pool or a licensed supplier
- Electricity pool membership to cover fees applicable to generator registration, data collection and settlement reconciliation for electricity generated and consumed by contracted parties.

Even if a generator is not required to have a licence, they may still apply for pool membership on a voluntary basis, although this would not normally be beneficial to a generator with output capacity lower than 30MW.

An electricity connection to the local electricity distribution network will be required for any electricity exported, even if this is only during periods of spill when the output of the generator is greater than demand on-site or by its own contracted customers.

It is therefore advisable to establish a dialogue with the local REC at the earliest opportunity to appraise the various options, and to determine the relative terms and conditions for connection.

The REC will determine the method and the point at which connection can be made to the distribution network, dependent on the export capacity of the energy plant, the relative parameters of the immediate distribution network and the pre-existing requirements of other electricity users in the vicinity. The scope for connection to the local network in rural areas with few industrial and commercial electricity users may be limited and it may be necessary for connection to be made at a higher voltage level on the primary distribution networks.

The REC has statutory obligations under the Electricity Act 1989 in respect of the safety and quality of electricity supply to its customers and they need to ensure that generators connected to the distribution network do not

impose risks that will affect their ability to fulfil this duty. However, connection of generators to the distribution network can in some cases be beneficial to the REC. In some cases it may:

- Reduce the level of transmission and distribution losses (nationally it is calculated that 7% of electricity generated is lost annually due to heating in cables and transformer iron losses)
- Reduce the cost of purchase of electricity from the pool (particularly at times of peak demand when prices can be high)
- Reduce triad peak capacity charges
- Defray the need to reinforce the local network
- Avoid Fossil Fuel Levy surcharges if generated from renewable energy resources outside the NFFO
- Be a valued source of reactive power to assist in voltage control.

The cost of connection could vary considerably depending on where the energy plant is located within the REC's distribution network. The cost of connection will in part reflect the distances involved, but the connection cost will tend to increase in steps (rather than smoothly) as the thresholds for requiring particular assets and voltage levels are crossed.

If the developer has some flexibility as to where it can locate within a particular area, they should discuss with the REC the respective connection costs for different sizes of generator and the potential benefits that may accrue to the REC in order to optimise the costs to the developer and maximise the value of the energy generated.

The REC is required by its licence obligation to offer terms for connection to the distribution network within three months of receipt of all the technical information in relation to the size, location and operation of the generating plant, but this will generally be qualified subject to planning permission approvals and wayleave consents. To provide the terms for connection, the REC will need to appraise the impact on several voltage levels of their distribution networks and ensure that safety and statutory obligations to all connected customers (including the generator to be connected) are not compromised.

The REC will generally provide an initial estimate based upon the perceived least constrained supply route (usually by underground cable connection along the path of public highways) to give a ceiling price for the guidance of the developer, with an undertaking to provide a detailed quotation on examination of alternative routes involving securing landowner wayleave consent and planning permissions if overhead line construction and/or transformer substation construction would be required.

The REC may charge a fee to appraise the connection implications but this would generally be set against the final connection charge if the project proceeds.

The connection point would usually be at the curtilage of the generation plant and, if the connection charges quoted are accepted by the developer, then the REC would take on the responsibility to complete the statutory procedures required for excavation on public highways and to secure any wayleave consents and planning permissions required. All the plant and equipment, cables etc would remain in the ownership of the REC and they would accept all future liability for maintenance and replacement if subsequently damaged. The benefit to the REC would be that the additional network installed could be utilised for future connection of other customers and/or generators.

All the installation work required would generally be carried out by staff or contractors employed by the REC, although the developer can opt to use an approved contractor to carry out some of this work which is 'contestable' if they feel they can secure a more competitive quotation (the elements that are 'contestable' generally relate to the supply and installation of the new equipment, providing it meets the technical specifications set by the REC); the final connections, energisation and moving of existing connected assets, however, for safety reasons are 'non-contestable' and have to be carried out by the REC.

In some cases, where the developer is able to secure his own wayleave consents, he can opt to nominate the point of connection to the distribution network at the point where it is coupled into the existing network. The developer may derive some benefit from cost reductions in equipment specification (particularly if capacity of the connection determined with standardised plan specifications by the REC cannot be fully utilised by increasing generator capacity), but the developer will then be fully responsible for the ongoing maintenance and replacement costs and will need to include the works involved in the application for planning permission for the energy plant.

Good practice would suggest that the local planning authority should be consulted on the route of the line, as they have an opportunity to make representations or requests for amendments, or indicate that they have no objection. Developers may also feel it would be appropriate to consult local residents over the potential route of the line at this stage. County councils and district councils (or unitary authorities) are consultees on the application for consent, and objection by either council means that there is likely to be a public inquiry.

Appendix 4

Development of these guidelines

The process

These guidelines were produced using consensus building techniques. Independent facilitator Pippa Hyam designed and managed the process, which brought together the industry, environmentalists, planners and government agencies in order to address potential stakeholder concerns and support the development of the industry in a sensitive manner. The process was guided by a steering group led by Pippa Hyam and made up of British BioGen, the Forestry Commission, Forestry Contracting Association, Wildlife and Countryside Link and ETSU (on behalf of the DTI, the project funders).

This approach involved a series of workshops and small sub-group meetings, during 1997/98. Participants used their experience to develop and agree detailed guidelines on what constitutes good practice in developing an economic, efficient, environmentally sound and publicly acceptable industry to generate energy from wood fuel. Draft material was written up by the editor, circulated and amended by agreement at a final workshop. The final draft was discussed by the Steering Group, re-drafted and re-circulated again for final agreement. A full list of all those involved is given below.

The following attended one or both of the main workshops:
Ewan Bent, Shropshire County Council
Peter Billins, British BioGen
Jim Birse, British BioGen
Adrian Bowles, Border Biofuels – South
Ian Bright, Milton Keynes Parks Trust
Paul M. Brighton, Barton Willmore Planning Partnership
Andy Bull, Powys County Council
Mark Clayton, Aardvark E.M. Ltd
Alan Corson, Forest Enterprise
Mark Diamond, Environment Agency
Ben Gunnerberg, Timber Growers' Association
Rob Gwillim, Centre for Alternative Technology
Oliver Harwood, Country Landowners Association
Rodney Helliwell, Continuous Cover Forestry Group
Ian Higham, ETSU
Jo Hirst, National Farmers Union
Brian Horne, EcoGen
Barrie Hudson, Forestry Contracting Association
Graham Hurd, Shropshire Energy Team
Richard Johnstone, RSPB
Andrew Lamb, ETSU
Linda Lockhart, ATB Landbase
Andy Moffat, Forest Research
David Owen, Tilhill Economic Forestry Ltd
Jeff Simpkin, Forestry & Wildlife Advisory Group
James Simpson, Forestry Authority
Richard Smith, BSW Harvesting
Edward Stenhouse, ESL
Ruth Stevenson, Dulas Ltd
Bob Talbott, Talbotts Heating Ltd
Roger Turner, Wildlife and Countryside Link and RSPB
Barbara von Kruedener, Forest Stewardship Council
David C. Wood, A W Jenkinson Sawmill Residues.

The following individuals also participated in drafting group meetings:

Drafting Group A:
Adrian Bowles, Border Biofuels – South
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Ian Bright, Milton Keynes Parks Trust
Andy Bull, Powys County Council
Mark Clayton, Aardvark E.M. Ltd
Elaine Fisher, Environment Agency
Barrie Hudson, Forestry Contracting Association
Richard Johnstone, RSPB
Keith Kirby, English Nature
Andrew Lamb, ETSU
Simon Levy, Bioregional Development Group
Andy Moffat, Forest Research
Rufus Sage, Game Conservancy Council
James Simpson, Forestry Authority
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Drafting Group B:
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Graham Hurd, Shropshire Energy Team
Tony Redman, Nordistribution
Ben Talbott, Talbotts Heating Ltd
David Wood, UKFPA

Others who have commented on drafts:
George Macpherson, Home Grown Energy
Hilary Miller, Countryside Council for Wales
Anna Stanford, Friends of the Earth

Steering Group:
Peter Billins, British BioGen
Ian Higham, ETSU
Barrie Hudson, Forestry Contracting Association
Andy Moffat, Forest Research
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Project team:

Project manager:	Pippa Hyam
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Co-ordination by:	Projects in Partnership (Kate Rawlings and Sasha Williams)

Appendix 5

Further information

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On-line sources

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Information abot bioenergy is available on www.britishbiogen.co.uk

Regulations

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Conservation of Wild Birds. EU Directive 79/409/EEC; and *Conservation of Natural Habitats and Wild Flora and Fauna*. EU Directive 92/43/EEC. The priority species and habitats which are afforded special protection or require special conservation measures are listed in the annexes to each EU Directive

Construction (Design and Management) Regulations 1994

Control of Pollution Act 1974

Electricity Act 1989

Environmental Protection Act 1990

Health and Safety (Emissions to the Atmosphere) Regulations 1983 (SI 1983/943)

Highways Act 1980

Forestry Act 1967

Town and Country Planning Act 1990

Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 (*Amended* 1990, 1992)

Wildlife and Countryside Act 1981; *Wildlife (Northern Ireland) Order* 1985. Schedule 1 of the Wildlife and Countryside Act 1981, or Schedule 1 of the Wildlife (Northern Ireland) Order 1985, lists the rare bird species which are afforded special protection at all times. In forests where Schedule 1 birds or other specially protected species of wildlife occur, the advice of the statutory conservation agencies should be sought. The joint Forestry Commission and RSPB publication *Forests and Birds* gives detailed advice.

Appendix 6

Contacts

Association for the Protection of Rural Scotland
Gladstone's Land
3rd Floor, 483 Lawnmarket
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Association of Electricity Producers
1st Floor, 41 Whitehall
London SW1A 2BX
Tel: 0171-930 9390

Association of Local Authorities of Northern Ireland
123 York Street
Belfast BT15 1AB
Tel: 01232 249 286

Bioregional Development Group
The Ecology Centre
Honeywood Walk
Carshalton
Surrey SM5 3NX
Tel: 0181-773 2327

British BioGen
Seventh Floor
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London EC1N 8LE
Tel: 0171-831 7222

Centre for Alternative Technology
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Machynlleth
Powys SY20 9AZ
Tel: 01654 702 400

Combined Heat and Power Association
Grosvenor Gardens House
35-37 Grosvenor Gardens
London SW1W 0BS
Tel: 0171-828 4077

Continuous Cover Forestry Group
Gwinllan
Brechfa
Carmarthen
Dyfed
Tel: 01267 202 233

Council for National Parks
246 Lavender Hill
London SW11 1LJ
Tel: 0171-924 4077

Council for the Protection of Rural England (CPRE)
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London SW1W 0PP
Tel: 0171-976 6433

Council for the Protection of Rural Wales
Ty Gwyn
31 High Street
Welshpool
Powys SY21 7YD
Tel: 01938 552 525

Country Landowners Association
16 Belgrave Square
London SW1X 8PQ
Tel: 0171-235 0511

Countryside and Wildlife – Department of the Environment for Northern Ireland (DoE NI)
Commonwealth House
35 Castle Street
Belfast BT1 1GU
Tel: 01232 251477

Countryside Commission
John Dower House
Crescent Place
Cheltenham GL50 3RA
Tel: 01242 521 381

Countryside Council for Wales
Plas Penrhos
Fford Penrhos
Bangor
Gwynedd
LL57 2LQ
Tel: 01248 370 444

Countryside Recreation Network
Department of City & Regional Planning
University of Wales
PO Box 906
Cardiff CF1 3YN
Tel: 01222 874 970

Department of Agriculture for Northern Ireland (DANI)
NI Horticulture & Plant Breeding Station
Loughgall
Co Armagh BT61 8BJ
Tel: 01762 892300

Department of Economic Development – NI
Netherleigh, Massey Avenue
Belfast BT4 2JP
Tel: 01232 529900

English Heritage
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23 Savile Row
London W1X 1AB
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English Nature
Northminster House
Northminster Road
Peterborough
PE1 1UA
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Environment & Heritage Service
Commonwealth House
35 Castle Street
Belfast BT1 1GU
Tel: 01232 251 471

Environment Agency
Rivers House
St Mellons Business Park
St Mellons
Cardiff CF3 0LT
Tel: 01222 770 088

ETSU
Harwell
Didcot
Oxon OX11 0RA
Tel: 01235 433 302

Farmers' Union of Wales
Llys Amaeth
Queens Square
Aberystwyth
Dyfed SY23 2EA
Tel: 01970 612 755

Farming & Wildlife Advisory Group
National Agricultural Centre
Stoneleigh
Kenilworth
Warwickshire CV8 2RX
Tel: 01202 696699

Forest Enterprise – Forest Operations Division
231 Corstorphine Road
Edinburgh EH12 7AT
Tel: 0131-334 0303

Forest Service NI
Dundonald House
Upper Newtownards Road
Belfast BT4 3SB
Tel: 01232 524570

Forest Stewardship Council
Unit D, Station Building
Llanidloes
Powys SY18 6EB
Tel: 01686 412 176

Forestry and Arboricultural Safety and Training Council (FASTCo)
231 Corstorphine Road
Edinburgh EH12 7AT
Tel: 0131-334 0303

Forestry Authority – Forest Practice Division
Forestry Authority
231 Corstorphine Road
Edinburgh EH12 7AT
Tel: 0131-334 0303

Forestry Commission
231 Corstorphine Road
Edinburgh EH12 7AT
Tel: 0131-334 0303

Forestry Commission Research Agency
Alice Holt Lodge
Wrecclesham
Farnham
Surrey GU10 4LH
Tel: 01420 222 555

Forestry Contracting Association
Dafling
Blairduff
Inverurie
Aberdeen AB51 5LA
Tel: 01467 651 368

Forestry Industry Council of Great Britain
Stirling Business Centre
Well Green Place
Stirling FK8 2OZ
Tel: 01786 473717

Friends of the Earth
26-28 Underwood Street
London N1 7JQ
Tel: 0171-490 1555

Game Conservancy Trust
Burgate Manor
Fordingbridge
Hampshire
SP6 1EF
Tel: 01425 652 381

Institute of Chartered Foresters
7a St Colme Street
Edinburgh EH3 6AA
Tel: 0131-825 2705

Institute of Environmental Health Officers
Chadwick Court
15 Hatfields
London SE1 8DJ
Tel: 0171-928 6006

Institute of Hydrology
Maclean Building
Crowmarch Gifford
Wallingford
Oxon OX10 8BB
Tel: 01491 692 324

Institution of Lighting Engineers
Lennox House
9 Lawford Road
Rugby
Warks CV21 2DZ

Local Government Association
26 Chapter Street
London SW1P 4ND
Tel: 0171-834 2222

National Association of Local Councils
109 Great Russell Street
London WC1B 3LD
Tel: 0171-637 1865

National Farmers Union
Agriculture House
164 Shaftesbury Avenue
London WC2H 8HL
Tel: 0171-331 7200

National Forest
Enterprise Glade
Bath Lane
Moira
Swadlincote DE12 7PS
Tel: 01283 551 211

National Urban Forestry Unit
The Science Park
Stafford Road
Wolverhampton WV10 9RT
Tel: 01902 828 600

Northern Ireland Agricultural Producers' Association
15 Molesworth Street
Cookstown
Co Tyrone
Northern Ireland
Tel: 016487 65700

Northern Ireland Environment Link
77 Botanic Avenue
Belfast BT7 1JL
Tel: 01232 314 944

Ramblers Association
1-5 Wandsworth Road
London SW8 2XX
Tel: 0171-582 6878

Royal Forestry Society
102 High Street
Tring
Hertfordshire HP23 4AF
Tel: 01442 822028

Royal Scottish Forestry Society
The Stables
Dalkeith
Midlothian EH22 2NA
Tel: 0131-660 9480

Royal Society for the Protection of Birds (RSPB)
17 Regent Terrace
Edinburgh EH7 5BN
Tel: 0131-557 3136

Rural Development Commission
Dacre House
Dacre Street
London
SW1H 0DH
Tel: 0171-340 2900

Scottish Landowners Federation
25 Maritime Street
Edinburgh EH6 5PW
Tel: 0131-555 1031

Scottish Natural Heritage
12 Hope Terrace
Edinburgh EH9 2AS
Tel: 0131-447 4784

Scottish Wildlife and Countryside Link
PO Box 64
Perth PH2 0TF
Tel: 01738 630807

Timber Growers' Association
5 Dublin Street
Lane South
Edinburgh EH1 3PX
Tel: 0131-538 7111

Tree Council
51 Catherine Place
London
SW1E 6DY
Tel: 0171-828 9928

Ulster Farmers Union
Dunedin, 475 Antrim Road
Belfast BT15 3DA
Tel: 01232 370222

Ulster Timber Growers Organisation
15 Loves Road
Maghekafelt
Co Londonderry BT45 6NP
Tel: 01247 758 264

United Kingdom Forest Products Association
John Player Building
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Stirling FK7 7RS
Tel: 01786 449029

Wales Wildlife & Countryside Link
Bryn Aderyn
The Bank
Newtown
Powys SY16 2AB
Tel: 01686 629 194

Wildlife and Countryside Link
246 Lavender Hill
London SW11 1LJ
Tel: 0171-924 2355

The Wildlife Trusts
Witham Park
Waterside South
Lincoln LN5 7JR
Tel: 01522 544 400

Western Regional Energy Agency and Network (WREAN)
1 Nugents Entry, off Town Hall Street
Enniskillen
Co Fermanagh BT74 7DF
Tel: 01365 328269

WWF UK (WorldWide Fund for Nature)
Panda House
Weyside Park
Godalming
Surrey GU7 1XR
Tel: 01483 426444

Summary

Wood Fuel from Forestry and Arboriculture

The development of a sustainable energy production industry

What are wood fuels?

Wood fuels from forestry and arboriculture come from three main sources:

- Plantations, natural and semi-natural woodlands, both managed and unmanaged
- Urban forestry and arboricultural operations
- Residues from wood processing.

The fuel taken from these sources can be used for very small heating systems, such as wood-burning stoves, for more substantial combined heat and power plant generating electricity and providing heat for local uses such as heating a school or commercial greenhouses, or for electricity generating power stations. A range of different technologies are now available to generate heat and/or electricity from wood fuel in very small to large scale operations.

Wood fuel is a renewable source of energy: energy that can be replenished continuously. Wood fuel energy projects can contribute to national targets to increase the use of renewable energy.

If used to replace fossil fuels, wood fuel projects can also contribute to national and global targets to reduce carbon emissions and global warming.

Plants and trees absorb carbon dioxide (a major greenhouse gas) from the atmosphere through photosynthesis. The carbon dioxide is then released when the plant material is burnt or decomposes. This natural cycle is utilised in wood fuel projects. The emissions of carbon dioxide from the energy production process are balanced by the trees absorbing carbon dioxide as they grow.

Woodland management benefits

A significant amount of woodland is currently under-managed. The sale of wood fuel can offer a new source of income, increasing the incentive to manage woodlands. This can have a positive impact on woodland ecology and public amenity.

Reduction in waste sent to landfill

Currently a large proportion of urban forestry and arboricultural debris goes to landfill. Making use of these materials for fuel diverts them from the waste stream and reduces pressure on landfill capacity.

Economic development and employment

Wood fuel projects offer considerable potential to create jobs in the rural economy. These include jobs in land and forestry management, running and maintaining the energy plant and in service and subsidiary industries.

The responsible development of the industry

Sustainable forest management

The extraction of wood fuels from all woodlands and forest systems must be undertaken with care. Dead and rotting wood can provide an important ecosystem for many species and it is important to leave some of these materials for ecological reasons. Equally, a poorly managed wood can have detrimental effects on ecosystems and biodiversity, and the extraction of wood fuels can provide the economic incentive to improve management and thus benefit wildlife. It is important that anyone considering extracting wood fuels follows the *UK Forestry Standard* and associated guidelines.

Transport and storage of wood fuel

Most wood fuel projects will require some form of transport from the forest to the energy generation site and some storage of fuel either as logs or chips. Care must be taken to minimise the impact of these activities on the local environment and local communities.

Development and use of energy generating technology

All energy generating plant, except the smallest boilers and wood-burning stoves, will require planning consent. For the larger power stations this will include Environmental Assessments and formal public consultation.

Careful extraction of the fuel and sensitive design of the energy generation plant will maximise the environmental and economic benefits of wood fuel projects and minimise any negative impacts.

Good practice guidelines have been produced in partnership with a wide range of organisations who have an interest in wood fuel, including foresters, planners, electricity generators, and environmental and conservation groups. These guidelines are designed to help new projects proceed in a sensitive, appropriate and sustainable manner. They explain in detail all the issues that should be considered in wood fuel projects.

Copies of the good practice guidelines, *Wood Fuel from Forestry and Arboriculture – The Development of a Sustainable Energy Production Industry*, are available from:

British BioGen
7th Floor
63-66 Hatton Garden
London EC1N 8LE

The UK Forestry Standard and associated guidelines are available from the Forestry Authority.

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