Guide to Biomass Heating

SCOTLAND'S
EAST COAST RENEWABLES

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For householders and businesses there are benefits...

associated with the installation of biomass boilers for heating and hot-water systems. The case is particularly good for properties without access to the gas grid where they offer significant running-cost savings over oil-fired boilers and for older, hard-to-heat buildings where they offer a route to a low carbon footprint. The financial case for installing biomass boilers is strengthened by the Government's recently introduced Renewable Heat Incentive (RHI) which makes payments to the operators of installations that meet the qualifying criteria.

Biomass boilers are very different from either gas or oil boilers and there are a number of considerations that anybody thinking about installing a biomass boiler needs to understand before they make the decision to purchase one. The key difference is that, unlike a gas boiler where the fuel arrives through a pipe on demand, biomass boilers require the fuel to be delivered by lorry to a fuel store which is then transferred at or near the time of use from the store into the boiler.

Whether you are considering a biomass boiler to heat your home, provide heat for your business or heat and power to an industrial process, the questions you need to consider remain the same although the complexity will be very different. This guide has been designed to provide you with a route-map through the various questions you need to consider, highlighting the issues, providing information as to where you can find out how it may affect you and giving examples of successful solutions. It has been written with the small-business owner in mind, and it is intended to inform them about the practicalities of biomass heating and how to approach assessing the practicability and the viability of installing a biomass boiler. It is equally applicable to householders relying on the advice and guidance from an experienced Microgeneration Certification Scheme approved installer as it will help them ask the right questions to ensure that they get an effective and efficient installation or, for larger non-domestic sites, by setting out the scope of a consultant-led feasibility study.

Developing a successful biomass heating installation is best approached by a sequential step-by-step approach. For instance, you need to know the heat loss of the building and energy requirement to investigate fuel supply options which in turn will help you choose the right equipment. This guide works through the various questions in a progressive manner providing, at the end of each stage, a checklist of information you need to proceed to the next. For those relying on contractors or consultants, the checklist will often provide information you will need them to provide you with to enable you to finalise your financial appraisal and successfully operate the plant.

This guide can provide no more than an overview of how to go about implementing a biomass heating scheme. If, having read this guide, you feel that biomass heating is for you and you want to spend time getting a greater understanding, then it is recommended that you visit three websites:

www.usewoodfuel.co.uk

www.biomassenergycentre.org.uk and

www.carbontrust.com/resources/guides/renewable-energy-technologies

All of these provide a wealth of information and a range of guides, tools and templates to help you. Equally importantly, they provide links into websites that will provide very detailed information and, if you are seriously considering a biomass heating installation, we would recommend you visit and become familiar with all of them.

What is biomass, why use it?

Biomass is a form of stored solar energy which is available in a number of different forms. These include wood and energy crops as well as a number of organic waste streams that include straw, sewage sludge, waste organic materials and animal litter.

Although burning biomass releases carbon dioxide to the atmosphere, this is offset by the carbon dioxide absorbed in the original growth of the biomass and that is subsequently re-captured in the growth of new biomass to replace the materials used. Over this cycle of growth, burning and re-growth, using biomass for heating results in very low net carbon emissions relative to conventional sources such as gas, heating oil or electricity.

The vast majority of biomass energy schemes use woodfuel which is the focus of this guide and, for the purposes of this guide, from this point forward any reference to biomass heating is assumed to be a woodfuel-fired scheme. Many organic waste streams are energy rich and the use of waste-to-energy technologies provide a good route to turn our waste into a significant energy resource. Waste-to-energy schemes are large, technically complex and require to be undertaken by specialist businesses, and are therefore outside the scope of this guide.

Why install biomass heating?

Biomass from wood is a naturally re-occurring or renewable energy source which, while harvesting is balanced with new growth, provides a sustainable energy source.

By contrast, our supplies of oil, gas and coal are finite. As the developing world continues to industrialise and global demand for energy continues to grow, the rate of discovery of new reserves of oil is diminishing and those new reserves we do find are becoming much harder to exploit. It is often said that the world is already beyond 'peak oil' with demand now exceeding the rate of discoveries and this can only mean an ever increasing cost of energy and price volatility.

Away from the gas grid, woodfuel supply is now a competitive market and longer-term supply arrangements are available that offer significant running cost benefits. The Government's renewable heat incentive provides the opportunity to receive payments that will help recover the higher capital cost involved in installing biomass heating schemes.

In rural communities biomass heating offers wider benefits than simply cost savings for the user. The use of biomass boilers creates employment in the harvesting, preparing and delivery of woodfuel, recycling money within the community, and contributing to the ongoing sustainability of those communities.

While biomass heating is relatively new in the UK, it is well established in countries such as Austria and Finland, and can be considered a mature technology. Reliable and proven biomass boiler equipment from established manufacturers is readily available, and the capability and resource to successfully design, install, operate and maintain boiler systems and supply woodfuel is available in Scotland today.

Who can use biomass heating?

Essentially everybody, be it householder, business or public sector organisation, is a potential user of biomass heating. In practice, considerations such as space, availability of mains gas, the Clean Air Act and the capability to carry out operational tasks should be taken into account. Those sites that are in rural areas off the gas grid but with access to local woodfuel supplies, offer the best potential.

For householders, modern pellet boilers are reliable and convenient to use but, depending on fuel storage and feed arrangements, they can require a degree of manual handling that may not be possible for everybody.

For those who are less able to manage their own heating systems, district heating schemes using a centralised biomass boiler can provide an ideal solution. A central boiler plant, with back-up arrangements, is operated and managed by an energy services company; this provides hot water into a heat main that runs around the housing complex or block of flats. In each home there are simply two pipes connected to a heat exchanger and a heat meter. This type of arrangement is increasingly being used for multiple dwelling developments that are off the gas grid.

For smaller businesses, typically hotels and guest houses, biomass heating can offer significant cost savings in these difficult times. A clean, green heating system can offer marketing benefits, with many visitors to rural Scotland keen to use accommodation with good environmental credentials.

The benefits of biomass heating are not restricted to smaller properties or space heating. A number of large hospitals including Aberdeen Royal Infirmary and Dumfries Royal Infirmary now have biomass heating installations using steam boilers. In addition, there are a number of industrial sites that use biomass boilers to provide heat for industrial processes; examples include sawmills using the heat for drying timber destined for the construction industry, or food manufacturers using steam for cooking processes.

On large sites the benefits of biomass heating do not have to be restricted to the supply of heat, and biomass-fuelled combined heat and power installations providing steam and electricity can offer a viable proposition, for example the scheme at the Tullis Russell paper mill in Glenrothes.

Domestic Pellet Boiler

Pellet boilers can provide a practical alternative to oil boilers to heat domestic dwellings. A typical stand alone boiler will have an integral hopper of 180 kgs that can be filled with 15 or 20 kg bags about once a week in the depths of winter. In almost all cases it will be installed with a thermal store which will allow the system to cope with demand that is much lower than the boiler's minimum output and for short periods much higher than its maximum output.

A typical scheme such as this by AD Heating Ltd, involving a 15 kW boiler and 500 litre thermal store, will require a boiler room about 3 m x 2 m and will cost about £16,000 to supply and install. In addition, there will be a need to store bags of pellets. A house using 2,500 litres of oil per year can expect fuel bill savings of £700 per year at current prices, and can anticipate a future income from the renewable heat incentive.

The Hill of Banchory Biomass Energy Centre and District Heating Network, Banchory, Aberdeenshire

The new Biomass Energy Centre at Hill of Banchory, fuelled by locally sourced wood chips, serves the local community via an innovative heat network. Over 100 homes have been connected since 2007, with a leisure centre and swimming pool and business park to be added, as well as 350 more homes as part of the long-term decentralised energy vision. The district heating pipework currently extends to over 6km, delivering heat efficiently to each property. Within each building, a heat-exchanger transfers heat from the network to a "wet" internal system, measured by a heat meter and is charged on a quarterly basis in pence per kWh. Heat users are supplied with low-carbon sustainable heating, without any of the inconvenience and cost of maintenance. The scheme is managed by the Hill of Banchory Energy Service Company (HOBESCO), which is responsible for its efficient operation.

Heat load and system sizing

When considering the installation of any heating system, knowing the heat load of the building is critical to getting a system that is large enough to heat the building in the coldest of weather and yet is not so oversized as to be inefficient or have a higher capital cost than necessary. This is even more important when considering the biomass option because biomass boilers are less flexible than gas or oil boilers and are inherently more costly to install. To help match biomass boilers to the needs of the building and its occupants, it is likely that in most cases there will be a thermal store (a large hot-water tank) in the system. This will allow the boiler to operate for concentrated periods of high fire to heat the water in the thermal store, with the heat subsequently being drawn down as required.

For non-domestic sites, the starting point will be to engage a suitably qualified energy consultant to carry out some design calculations for you. Their first step will be a site survey to determine the sizes of the various rooms and the construction of the floors, walls, ceilings, glazing, etc. Once this is complete, the details will be entered into a spreadsheet-based model that will allow the heat loss of the building and peak heat requirement to be calculated. Ideally the engineer will use these heat-load parameters in a proprietary biomass-heating sizing tool, such as that produced by the Carbon Trust, which will calculate the size of the boiler and thermal store, and provide expected fuel consumption rates.

This information will allow you to talk to potential fuel suppliers and boiler equipment installers. Many people recommend that you investigate the fuel supply options first because constraints such as the amount of space you have for fuel storage, issues around delivery-lorry access, local availability and likely running costs will all influence your choice of fuel. There are a range of different models of boiler readily available for the type of fuel you choose.

It is recommended that, at this early stage, you consider the impact of improving the energy efficiency of your property. In general, energy efficiency projects have a much better payback than new boilers and it does not make sense to install a larger and more expensive boiler than you need. You should ask the heating engineer to identify how you can improve the energy efficiency of the building as an integral part of the project.

One important issue which can provide operational difficulties is the provision of heat at times of minimal demand such as in summer when there is no requirement for space heating but an ongoing need for hot water. You should discuss with the engineer the most appropriate and economical way to supply hot water in these circumstances.

For householders, the best starting point is an Energy Savings Trust home visit and report; this will set out the existing energy demand and the opportunities to improve the energy efficiency of the property. This will provide a useful baseline for a conversation with a Microgeneration Certification Scheme (MCS) accredited biomass heating installer. The MCS scheme is a quality assurance scheme for microgeneration installations that applies to biomass heating schemes up to 45 kW. The scheme sets technical standards, accredits both equipment and installers, and provides website directories of both accredited equipment and installers. Importantly the scheme sets out what installers must do to provide you with a reliable and effective system, including carrying out design calculations.

Checklist

At the end of this stage you should aim to:

- know the heat load of the building;
- have an understanding of how you might reduce the heat load of the building by improving its energy efficiency;
- have a recommended boiler rating and thermal store size;
- know peak and annualised fuel consumption rates; and
- have an understanding of how you will provide domestic hot water when there is no requirement for space heating.

Resources

Carbon Trust biomass heating sizing tool:
www.carbontrust.com/resources/guides/renewable-energy-technologies/biomass-heating-tools-and-guidance

Energy Savings Trust:
www.energysavingtrust.org.uk/scotland/Generating-energy/Free-home-visits

Microgeneration Accreditation Scheme:
www.microgenerationcertification.org/

MCS Biomass Standard:
www.microgenerationcertification.org/mcs-standards/installer-standards

Perth and Kinross Council – Abernethy Primary School

Opened in 2002, Abernethy Primary School is currently being extended and refurbished to meet the needs of the 21st century and maintain its important role in this growing village.

An important part of the refurbishment is to upgrade the building fabric to the latest standards, with much higher levels of insulation and double glazing with specific attention to air tightness. Despite a 48% increase in the heated area, it is anticipated that the annual heat demand will only increase by 6% from 167,700 kWh to 177,800 kWh. The original oil-fired boiler is to be replaced by a 150 kW wood chip boiler with a 4,000 litre thermal store.

It is predicted that the previous bill for fuel oil of £9,500 will be reduced to £5,400 for wood chip. The combination of improved energy efficiency and fuel switching will reduce heating costs per square metre by over 60%. In addition, the Perth and Kinross Council anticipate an annual RHI income of over £15,000.

Winton House and Estate Biomass Heating Installation

Winton House is a private house near the centre of a historic country estate near Pencaitland, East Lothian. Home to the Ogilvy family, there are two separate flats and the public rooms are used for corporate and private hospitality including dinners, weddings and overnight accommodation. In 2002 its first biomass boiler, a 250 kW Veto wood chip boiler, was installed to supply heat to the main house and six cottages through a district heating network. The system did not have an accumulator tank (thermal store). By 2012 the installation was showing a number of deficiencies; it could not meet peak heat demand and routinely needed to be augmented by the back-up oil boiler; prolonged periods of low-fire operation had led to significant deterioration in the condition of the heat exchanger, and there were issues with the limited fuel hopper capacity and the frequency of filling.

A new 200 kW Herz wood chip boiler, complete with 10,000 litre accumulator tank, improved fuel storage and feed mechanism, and energy-efficient pumps and controls, was installed in a new boiler house and commissioned in December 2012 by The Wood Heating Company, with Realise Renewables acting as the Client's Engineer. The accumulator tank has allowed the new boiler, which has a 20% lower full-load output than the old boiler, to meet peak loads through the winter of 2013 without recourse to the oil boiler, which has been retained as a back-up. In its first few months of operation the new installation has met the site's heat demand, with the boiler firing for an equivalent of 40% of the time at full output. Wood chips are supplied from timber grown on the associated Winton Estate, and chipped either in the woodland or at a wood-yard nearby and delivered by tractor and large grain-trailers to the purpose-built fuel store. The woodland management, fuel supply and property aspects of the project were the responsibility of Chalmers and Co.

Fuel considerations

The choice of fuel for a woodfuel boiler, its source and delivery method are critical to the success of the project. Deciding which is the most appropriate fuel for your requirements is an important early decision influencing the type of boiler, the size and location of the fuel store, and fuel delivery arrangements. It is very worthwhile spending some time exploring the availability and cost of the different types of fuel in your area. There are a number of website-based directories that provide contact details for potential suppliers in your area, (see resources below).

Types of fuel

There are three principal types of woodfuel – logs, pellets and chips:

Logs	Provide a useful solution for those with a readily available supply, but they require you to decide how much heat you need and manually load the timber into the boiler.
Pellets	An energy-dense woodfuel that is produced in a factory. They have a uniform shape and are easy to handle.
Wood chips	Produced in or near the woodland, they have irregular shapes that are harder to handle. The moisture content of wood chips is critical to how well the boiler performs. They are generally much cheaper than pellets.

Which type you choose depends on what is readily available locally, the type of boiler, the volume you will use, the space you have to store fuel, how they will be delivered and the cost. Typically smaller sites are more likely to use pellets and larger sites chips.

Boilers are designed to work with a particular grade of fuel and the use of lower-grade material can often invalidate warranties. There are common standards for woodfuel emerging such as EN 14961. Many Austrian wood chip boiler manufacturers will specify two key parameters based on the ÖNORM M7 133 standard: the size of the chip – G30 and G50 are the common ones and the moisture content – typically W25 or W35. For more information on standards see the Biomass Energy Centre web page on standards.

For those who are keen to know that the fuel they are using is being supplied in a sustainable manner, the Forestry Stewardship Council (FSC) provides a certification scheme.

Storage and delivery arrangements

The size and shape of your fuel store will largely be dependent on the amount and type of fuel you wish to store; key factors are the minimum quantity you would normally expect to hold and the optimum delivery quantity. If you choose to buy bagged (15 or 20 kg) pellets you will probably want to buy them by the one tonne pallet-load, while for 'blown' deliveries four or five tonnes is likely to be the minimum quantity. The Carbon Trust's Practical Guide for Potential Users provides illustrated details of the range of delivery and storage options.

Typically wood chips at 30% moisture content take up to four times the volume for the same energy content as pellets and delivery of whole loads of chips by tipper lorry or trailer is much more likely to be the norm. The lorry will discharge the wood chip by gravity into either the fuel bunker or into a trough equipped with a feed screw or conveyor that will transport the chip away to a hopper or bunker.

In deciding which is the better type of woodfuel and the associated delivery and storage arrangements for you, it is important to consider the health and safety aspects. How will the delivery lorry approach the building and park, and what are the implications of the discharge arrangements? In many cases, whether above or below ground, a fuel store will be a confined space which will be subject to the Confined Spaces Regulations 1997, and if there is any need to work above the ground then you will need to consider the requirements of the Working at Height Regulations 2005.

Checklist

At the end of this stage you should aim to know:

- the type of fuel you plan to use, and have identified suppliers who offer fuel to an appropriate quality standard;
- the quantity you will need to store, typical delivery quantities and the delivery method;
- the type and size of your fuel store;
- where the lorry will park to make the delivery and any hard-standings or roadways needed; and
- the delivered price of the fuel.

Resources

Forestry Commission Scotland's 'usewoodfuel' website supplier directory:
http://www.usewoodfuel.co.uk/using-woodfuel/find-a-wood-fuel-supplier.aspx

Low carbon Cairngorms woodfuel suppliers' directory:
http://www.lowcarboncairngorms.org/woodfuel/directory.asp

Logpile:
http://www.nef.org.uk/logpile/fuelsuppliers/index.htm

Carbon Trust's UK-wide woodfuel suppliers' directory:
http://www.woodfueldirectory.org/

Biomass energy centre – woodfuel standards:
www.biomassenergycentre.org.uk/portal/page?_pageid=77,1&_dad=portal&_schema=PORTAL

Forestry Stewardship Council:
www.fsc.org

Meldrum House

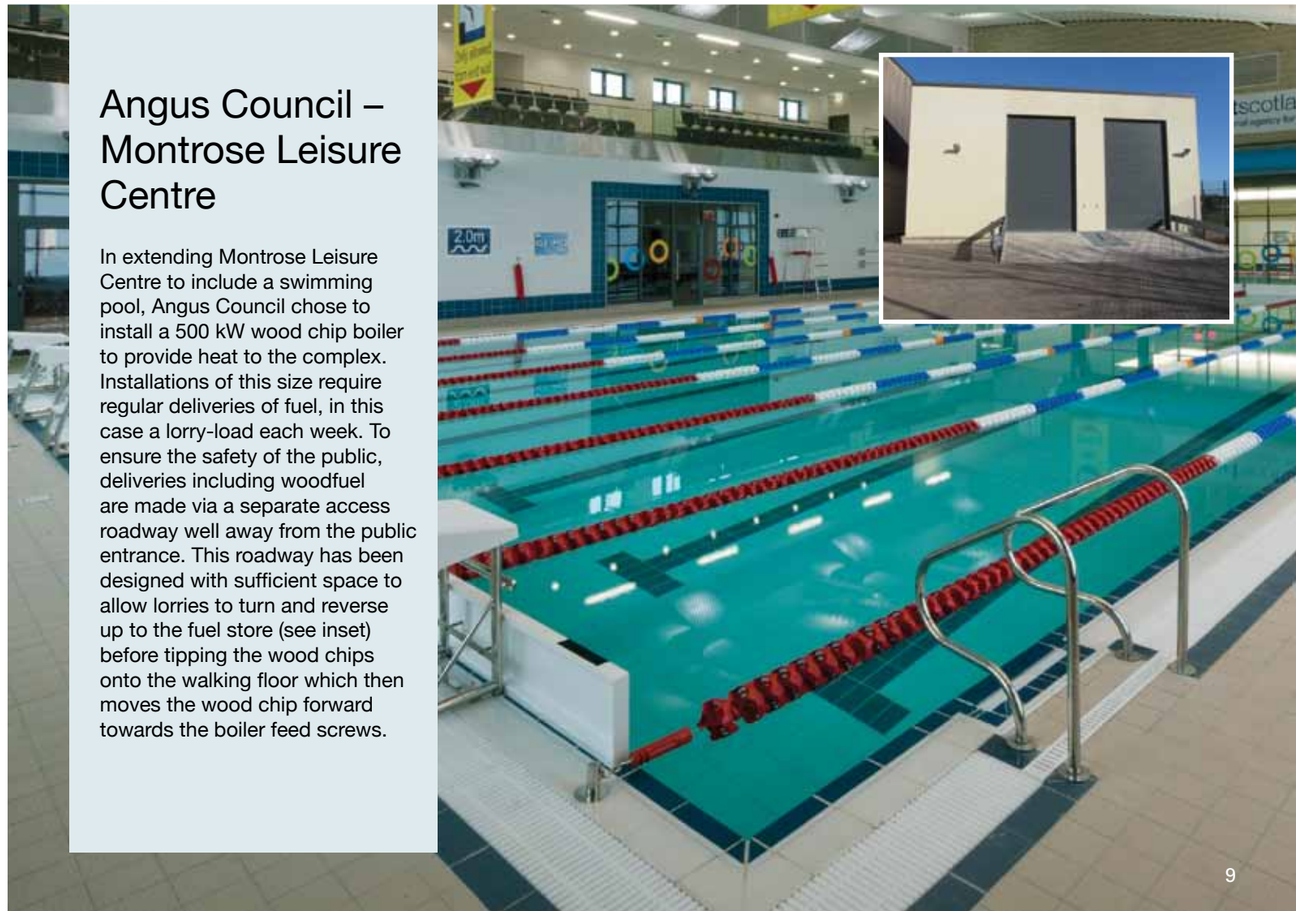
Meldrum House Country Hotel and Golf Course is a renowned luxury hotel conference centre and wedding venue that has a championship golf course. In 2009 the hotel installed two 150 kW pellet boilers either of which is capable of meeting the full heat load of the boiler and a 7,500 litre heat store.

The boiler installation is operated on a day-to-day basis by the green-keeping staff and, to minimise the occurrence of operational issues, pellets with their consistent size and quality, rather than wood chip, were chosen as the fuel source. The pellets are delivered by a blower lorry with three compartments that can make deliveries of 4, 8 or 12 tonnes as required.

Peter Walker, the hotel's manager commented that: "Meldrum House is committed to energy conservation and sustainable tourism and the hotel was recently awarded a Green Tourism Scheme Silver award.

Angus Council – Montrose Leisure Centre

In extending Montrose Leisure Centre to include a swimming pool, Angus Council chose to install a 500 kW wood chip boiler to provide heat to the complex. Installations of this size require regular deliveries of fuel, in this case a lorry-load each week. To ensure the safety of the public, deliveries including woodfuel are made via a separate access roadway well away from the public entrance. This roadway has been designed with sufficient space to allow lorries to turn and reverse up to the fuel store (see inset) before tipping the wood chips onto the walking floor which then moves the wood chip forward towards the boiler feed screws.



Operations and maintenance

It is worthwhile, at this early stage, considering the ongoing operations and maintenance arrangements you would prefer as it will influence which potential boiler suppliers and installers you should engage with.

There are a number of options as to how you choose to procure a biomass boiler system and manage its operation; at one extreme it could be an entirely self-managed solution, while at the other you could appoint an energy services company (ESCO) to build, own and operate the plant for 20–25 years. The vast majority of sites will, however, have arrangements that sit between these two extremes.

Unlike gas or oil boilers, biomass boilers require regular attention; as a minimum the ash pan will need to be emptied and the fuel bunker refilled. They also have a greater need for maintenance; poor quality fuel can cause fouling of the boiler heat exchanger which will need to be removed and it is unwise, for instance, to allow a build-up of wood dust in the bunker and fuel feed mechanism as this can result in a fire or explosion risk. You should not underestimate the health and safety aspects of keeping the installation clean and dust free; for more information see the Combustion Engineering Association's *Design and Operations Guide for Biomass Systems.*

A number of differing types of operation arrangements can be adopted but for the purposes of this guide we will consider four broad types of contract:

Service Contract	This is the equivalent of a gas boiler maintenance contract where the contractor carries out routine maintenance and attends any breakdowns.
Operation and Maintenance Contract	Under an O&M contract the contractor will, in addition to maintenance work, visit the site two to three times per week checking the boiler operation and carrying out routine cleaning. Woodfuel is generally purchased separately.
Heat-Supply Contract	An integrated package where the ESCO provides the fuel and operations and maintenance, with the customer paying for the heat delivered from the boiler plant.
Full Package	A long-term arrangement typically 20–25 years where the ESCO builds, owns and operates the plant with the customer paying for the delivered heat.

For most domestic customers the likelihood is that they will purchase a boiler from a supplier who will supply, install and commission the boiler. They will purchase pellets or logs from a local supplier and carry out routine operational tasks themselves, in many cases using the supplier to carry out an annual service visit and attend any breakdowns. This type of arrangement may also suit smaller non-domestic installations such as small hotels and guest houses where the owner is resident, has the interest and aptitude to manage the boiler, and has access to economical local fuel supplies.

In general, only the largest schemes such as that at the Tullis Russell paper mill have the capital value to justify the expense and long-term commitment of a full-build, own and operate contract, and in practice most non-domestic installations will be operated under an O&M or heat-supply contract.

An O&M contract provides the installation owner with the opportunity to secure the services of experienced operators and at the same time be able to shop around for the best fuel supply deals. This sort of arrangement has disadvantages, for instance poor boiler performance could be due to either poor quality fuel or clogged fuel feed screws. This creates the opportunity for disputes between the O&M contractor and fuel supplier.

By contrast, a heat-supply contract puts all the risks in the hands of one contractor. If they are to make a profit from supplying heat to the customer then it is in their interest to ensure that the boiler works at peak efficiency, and that means feed screws are kept clear and good quality fuel is used. This type of arrangement is increasingly being used by experienced estates managers in organisations such as local authorities. This philosophy is often taken one stage further by site owners who will seek out suppliers who will supply and install the boiler equipment, and subsequently, operate it under a heat-supply contract.

Checklist

At the end of this stage you should know:

– how you propose to approach operations and maintenance of your boiler system.

Resources
Combustion Engineering Association guide:
www.cea.org.uk/publications.asp

Queen Margaret University

In moving from its previous dispersed city centre locations to a purpose-built campus at Musselburgh, Queen Margaret University was determined to take the once-in-a-lifetime opportunity to build a low carbon sustainable campus. A key part of this approach was the installation of a 1.5 MW biomass boiler supplied from an underground fuel bunker, a 30,000 litre heat store and a district heating network together with two 2.4 MW back-up gas boilers to meet an estimated peak heat demand of 4.8 MW. The value and flexibility of the heat store can be appreciated from the 2010 system performance when, despite being rated at about one third of peak demand, the biomass boiler supplied 96% of the site's energy requirement.

The biomass boiler and its associated plant is owned by the University but it was supplied and installed by Buccleuth Bioenergy who now provide on going operations and maintenance including fuel supply under a long-term contract that sees them being paid on the basis of the amount of heat supplied. This type of arrangement, which is often called performance contracting, has significant benefits for the host site by transferring risk to a single supplier who is incentivised to provide an effective plant that can be run efficiently.

Tullis Russell

Tullis Russell is an employee-owned premium paper and board manufacturer in Glenrothes, Fife employing over 500 people. Papermaking is a very energy-intensive process and the ability to secure long-term, sustainable and economic energy supplies is very important to the long term viability of the business. To meet this objective Tullis Russell and RWE npower Renewables have entered into a long-term power supply contract. RWE, who have built the state of the art facility, will own and operate the biomass-fired combined heat and power (CHP) plant at the Glenrothes site. The plant, which replaces Tullis Russell's existing coal-fired power plant, is due to become operational by October 2013. The plant will supply 120 t/hr of steam and 17 MW of electricity to Tullis Russell and have the capacity to provide a further 32 MW of electricity to the national grid. In reducing CO_2 emissions by 250,000 tonnes per annum the site will make a substantial contribution to Scotland's renewable energy targets.

Equipment and location

Once you know the rating of the boiler and size of the thermal store, your preferred fuel supply and operational arrangements you are in a position to identify potential suppliers and installers. Before you approach anybody, spend a little time thinking through what you will need them to do for you, and finding ones who have the experience to deliver what you want. Things to consider include:

Design	There are a number of items such as connections to the heating system, flues and fuel-feed arrangements that need to be designed correctly if the boiler is to work well.
Accreditation	For domestic boilers to receive any future RHI payments you will need to use an MCS-accredited supplier. For non-domestic installations check that potential suppliers are familiar with the requirements of the RHI.
Operational Support	Can they provide your preferred operational arrangements?

Once you have identified a number of suitable suppliers you should meet with them to discuss the type of equipment that is best for you and where it will be located, although for most sites space is limited and the conversation is likely to be an iterative process that focuses on “what can we fit, where?”

When working through this, it is probably best to start with the bigger items:

Boiler	How big is it and how much space is needed around it? How heavy is it? Is the floor suitable? How will you get it into the space provided?
Fuel Store	What volume do you need to store? What is the ideal size and shape? Can it be located in a position to allow automatic fuel feed to the boiler? How will the fuel be delivered?
Thermal Store	These are heavy when full of water. Where will it go?

Sorting out these initial questions of location does not mean that you have the final solution; there are a number of other important issues to be considered:

Flue	Can you install a flue that ensures the boiler operates well and meets planning and air quality requirements?
Air Supply	Will there be an adequate air supply for combustion and boiler-house ventilation?
Connection	How will the boiler and heat store be connected to the existing system?
Electricity Supply	Is the electricity supply capable of supplying the boiler installation?
Access	Will there be safe access and egress to and from the boiler house?
Fuel Delivery	What facilities are required to allow the lorry to park and discharge the fuel?

Whilst these discussions are likely to start with an equipment supplier and installer, they are quickly going to involve questions about building requirements and modifications. If the likely building work is any more than minimal, it could be useful to include an architect in these discussions who will be able to advise you on the practicality of the proposals and any planning and building regulations implications.

One topic that you should explore at this stage is the question of back-up arrangements in the event of breakdown. Ideas worth considering include retention of an existing oil boiler or the fitting of electric immersion heaters in the thermal store.

One particular risk associated with biomass boiler systems is the risk of fuel burn-back from the boiler along the fuel feed mechanism. This risk has been addressed by boiler manufacturers fitting duplicate anti-burn-back devices to their boilers. When evaluating the various boiler options you should ask about the anti-burn-back features, understand how they work and be aware of any additional requirements they may place on you, e.g. a water supply.

Checklist

At the end of this stage you should know:

- the size, shape and weight of the boiler, heat store and fuel store;
- the boiler emissions;
- the back-up arrangements you plan to adopt in the event of boiler breakdown;
- the indicative cost for supply, installation and commissioning of the boiler system;
- the amount and scope of any building work necessary to accommodate the new heating system; and
- the indicative cost of any building work.

Domestic pellet store

For householders who want to avoid the manual handling of pellets, a “www.woodpelletstorage.ie” store provides a convenient solution. It can be located outside the building within 10-15 metres of the boiler, where fuel delivered by blower lorry can then be transferred from it utilising a suction system. Typically such a store will have a capacity that will allow a minimum delivery quantity before you run out, typically five to seven tonnes.

A five tonne store has a footprint of 2 m x 2 m and is 3.5 m high and will work well complete with a suction transfer system. Cost in the region of £2,500.

Alyth Primary School

In 2009 Alyth Primary School presented a problem to the Energy Manager at Perth and Kinross Council. The existing oil-fired boilers were approaching the end of their serviceable life and could no longer be relied upon to heat the school. As the current building is critical in providing a service to the community until a replacement is constructed, a temporary but cost-effective means of heating the building had to be found.

A pre-fabricated containerised biomass boiler installation provided the ideal solution with the existing oil boilers being retained to provide back-up. The boiler is supplied with wood chips delivered in a scissor lift trailer.

While the principal purpose of the project was to maintain the heat supply to the building, the biomass boiler also delivers reduced running costs and carbon dioxide emissions, and the Council will also benefit from RHI payments. When the school is finally replaced in the future, the boiler-house can be uncoupled, loaded onto a lorry and relocated elsewhere.

Consents

In many instances a biomass boiler system will require local authority consent. Once you have identified the equipment you prefer, how you plan to install it, the building modifications you will need to make and have some preliminary layout drawings, then you should have a discussion with the local authority planning and environmental health departments. You should tell them what you propose and ask their advice regarding the need for both planning consent and a building warrant, and any conditions that may apply to that consent. This will in the long run save you both time and money. The local authority will, in dealing with your request, consider how the development meets the local development plan, the health, safety and welfare implications of any building modifications, and the implications for local air quality.

The purpose of the planning system is to regulate the use of land and buildings, balancing competing demands to make sure that land is used and developed in the public's long-term interest and make sure that communities can enjoy a better quality of life. You need planning permission for any new development which includes any new building or change of use of buildings and land. Some developments, for example such as certain house extensions, are classed as permitted development and don't need permission from the council. This can apply in some instances to biomass boiler installations as long as building work and flues are within certain parameters. You should always check with your council's planning and environmental health departments about whether your proposal will require planning permission.

Building Standards in Scotland are governed by the Building (Scotland) Act 2003 and its supporting regulations, and are administered and enforced by the local authority. Their principal purpose is to ensure the health, safety and welfare of persons in or about buildings. In relation to an application for a building warrant to install a woodfuel boiler installation, the building control officer will be concerned with issues such as: that the modifications do not detrimentally affect the structural integrity of the building, that the proposals meet the requirements for fire safety, that they provide safe access and egress from the boiler house, that the resulting heating system meets the fuel and power conservation requirements, etc. Guidance as to how to achieve compliance with Scottish Building Standards is contained within a series of Technical Handbooks that are available on the Scottish Government website, (see below).

In terms of air quality legislation, biomass boilers are regulated in different ways depending on their size and fuel type. The local authority becomes the regulatory authority when a biomass boiler or stove falls under the Clean Air Act 1993. The two pollutants from biomass emissions which are of most concern for local authorities are nitrogen dioxide (NO_2) and fine particulate matter (called PM10).

Checklist

At the end of this stage you should know:

– whether an application is likely to be consented and any conditions that will be required.

(Note that these may require you to revisit your discussions with potential suppliers/contractors to get modified indicative costs).

In the situation where boilers or stoves are located within a Smoke Control Area (SCA) they must not emit black smoke and should be using an approved smokeless fuel or be an exempt appliance. For more information on smokeless fuels and exempt appliances consult the smoke control website or contact the local authority environmental health department.

The Clean Air Act 1993 also gives the local authority powers regarding the control of emissions from larger domestic and industrial boilers that burn solid fuel used at a rate of 45.4 kg per hour or more; or liquid or gas fuel used at a rate of 366.4 kW or more. In this situation you are required by law to obtain local authority approval for the chimney height and may be required to install equipment to control dust emissions.

When a biomass boiler is part of a much larger new development, is being installed in an existing development or is located within or adjacent to an Air Quality Management Area (AQMA), it will require planning permission. An AQMA is an area where statutory air quality objectives are unlikely to be achieved. You can find out more about any Air Quality Management Areas by either contacting the local authority environmental health department or consulting air pollution web pages. As part of the planning process an Air Quality Impact Assessment may be required. The Environmental Protection UK guidance document *Biomass and Air Quality Information for Developers* details the type of biomass equipment that will need an assessment, and outlines the type of information that should be included in such an assessment.

Large industrial plants that fall within the Environmental Permitting Regulations may be required to apply for permission under the Pollution and Prevention Control (Scotland) regulations (PPC). If you think your plant may fall within these regulations you should check with the Scottish Environmental Protection Agency (SEPA) at the earliest opportunity.

Those considering the firing of a biomass boiler with waste wood should consider Waste Incineration (Scotland) Regulations. There are a number of exceptions to the regulations including wood waste with the exception of that which may contain specific coatings and preservatives. It is recommended that you consult the local authority/SEPA at an early stage, outlining your waste woodfuel proposal and ensuring that the exemption will apply.

Resources

A guide to the planning system in Scotland:
www.scotland.gov.uk/Resource/Doc/281542/0084999.pdf

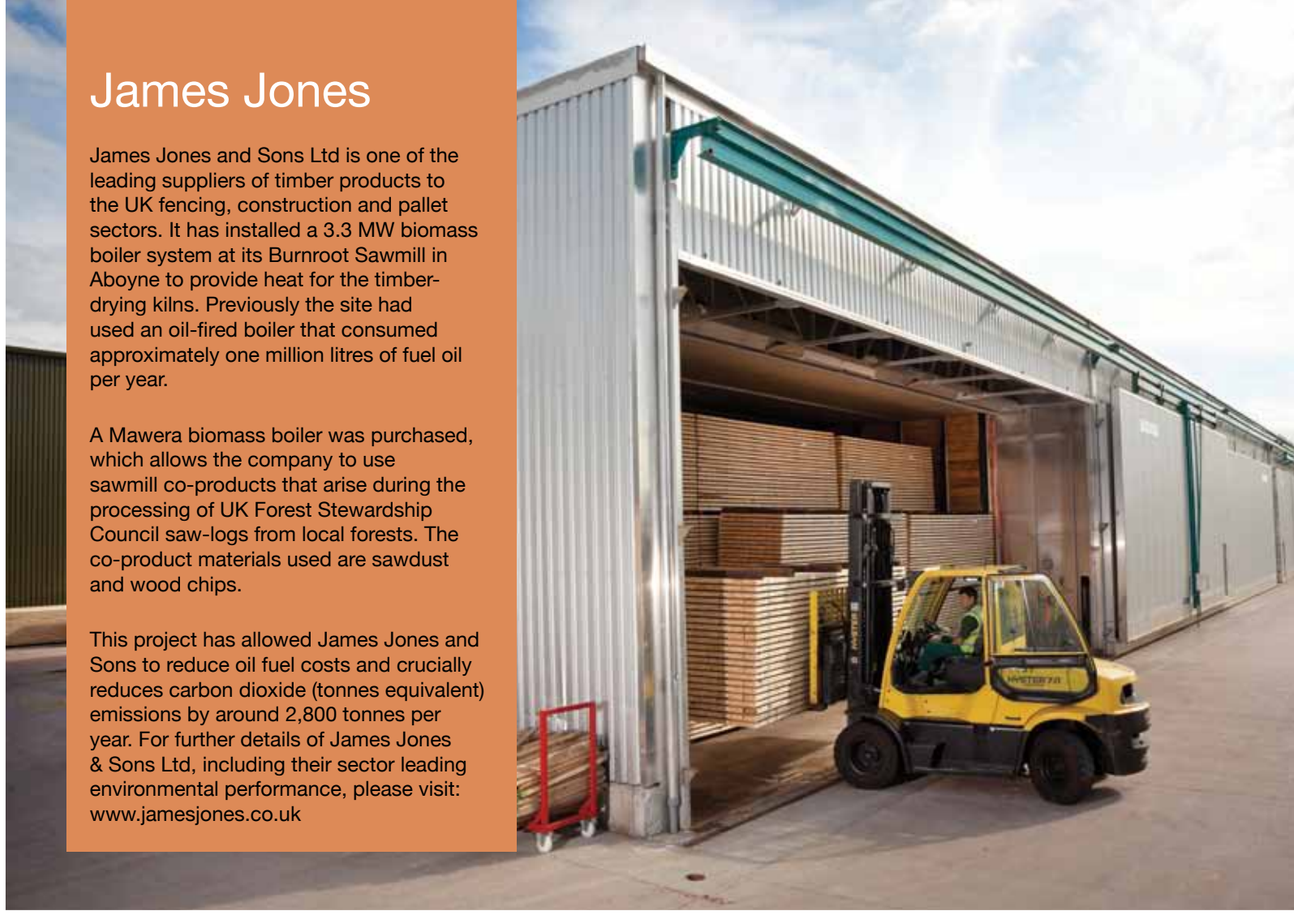
Scottish Building Standards – Technical Handbooks:
www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/publications/pubtech

Scottish Government Air Quality Policy Guidance:
www.scotland.gov.uk/Topics/Environment/waste-and-pollution/Pollution-1/16215/PG09

Smoke control website:
http://smokecontrol.defra.gov.uk/

Waste incineration:
www.scotland.gov.uk/Topics/Environment/waste-and-pollution/Pollution-1/Industrial-Pollution/WIDscript

PPC regulations:
www.sepa.org.uk/air/process_industry_regulation/pollution_prevention_control.aspx



James Jones

James Jones and Sons Ltd is one of the leading suppliers of timber products to the UK fencing, construction and pallet sectors. It has installed a 3.3 MW biomass boiler system at its Burnroot Sawmill in Aboyne to provide heat for the timber-drying kilns. Previously the site had used an oil-fired boiler that consumed approximately one million litres of fuel oil per year.

A Mawera biomass boiler was purchased, which allows the company to use sawmill co-products that arise during the processing of UK Forest Stewardship Council saw-logs from local forests. The co-product materials used are sawdust and wood chips.

This project has allowed James Jones and Sons to reduce oil fuel costs and crucially reduces carbon dioxide (tonnes equivalent) emissions by around 2,800 tonnes per year. For further details of James Jones & Sons Ltd, including their sector leading environmental performance, please visit: www.jamesjones.co.uk

Seaview Primary School

A 300 kW wood chip biomass boiler has been installed at the new Seaview Primary School in Monifieth which opened in 2010. The school is in close proximity to local housing and there were local concerns about the possible health impact of particulate emissions from the boiler. Whilst there was no background air quality issues within the locality and the new biomass boiler would not have breached statutory limits, the Council decided to address the local concerns by installing a ceramic filter (pictured) within the boiler flue. Installed at a cost of £14,000 this has been very effective in reducing PM10 particulate emissions to the extent that the emissions from the boiler have less particulate matter than the background air surrounding the school.

Financial support

The UK Government has a target that 15% of all energy supplies in the UK should come from renewable sources by 2020. This is backed up by a range of policy instruments to encourage investment in low carbon energy sources including the use of heat derived from renewable sources through the Renewable Heat Incentive or RHI.

Under the RHI, the operators of new renewable heat installations are able to recover the cost of the capital expenditure, over the life of the equipment, through payments based on the amount of heat they actually produce. Technologies that qualify for RHI payments include biomass boilers, heat pumps, solar thermal collectors and energy from waste. The RHI commenced in April 2012 for non-domestic installations and is planned to start in April 2014 for domestic installations. In both cases only equipment installed after July 2009 will qualify for payments.

To qualify for the RHI, non-domestic biomass boilers must meet the following criteria:

- be installed after 15 July 2009;
- new equipment within the technology capacity bands;
- Microgeneration Certification Scheme (MCS) or equivalent certification (if available);
- used to heat a space, water or for carrying out a process;
- cannot be used to heat a single domestic dwelling; and
- cannot be purchased or installed with a public grant.

The payments tariff for installations becoming accredited at the current (March 2013) time is set out in the table below. It should be noted that for small and medium boilers there are two rates, one for the first 1,314 hours of operation each year and a lower one for all subsequent operating hours. Payments are made on a three-monthly basis for 20 years and the tariffs will be adjusted in line with inflation. The RHI is intended to stimulate the market for renewable heat equipment and drive down capital costs, as this occurs the tariffs for new participants may be adjusted to take account of uptake and cost reductions.

The UK Government is reviewing how the RHI scheme is currently working and in future there will be an emissions cap on biomass boilers and a requirement to source fuel from certified sustainable sources.

Technology	Capacity	Payment
Small Biomass	Less than 200 kWth	Tier 1 – 8.3p/kWh Tier 2 – 2.1p/kWh
Medium Biomass	Between 200 kWth and 1,000 kWth	Tier 1 – 5.1p/kWh Tier 2 – 2.1p/kWh
Large Biomass	More than 1,000 kWth	1p/kWh

In March 2013 the Department for Energy and Climate Change (DECC) announced that it would be publishing its proposals for a domestic RHI in the summer of 2013 and that the scheme would run from April 2014. The consultation process for the domestic RHI has been protracted and it would be unwise to pre-judge the likely outcome of that process and the eventual scheme. It is recommended that anyone interested in domestic renewable heat installations monitor the DECC website for emerging details of the scheme.

In the meantime, householders may be eligible for:

- Renewable Heat Premium Payment (applies in England, Wales and Scotland) which could provide a grant of up to £950 towards the cost of a domestic biomass boiler scheme (where mains gas has not been previously used).
- Homes Renewables Loans scheme (applies in Scotland) that can make up to £10,000 available for biomass boiler installation.

See Energy Savings Trust website for details.

For businesses, funding could be available through Scottish Enterprise or Highlands and Islands Enterprise, but remember that you cannot have a grant for the purchase of the equipment and also receive renewable heat incentive payments.

Checklist

At the end of this stage you should:

- understand the eligibility of your scheme for renewable heat incentive payments and the tariff that will apply; and
- understand whether you could benefit from a Renewable Heat Premium Payment or a Homes Renewables Loans Scheme.

Resources

Department of Energy and Climate Change guidance:
www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/renewable-heat-incentive-rhi

Renewable Heat Premium Payments:
www.energysavingtrust.org.uk/scotland/Generating-energy/Getting-money-back/Renewable-Heat-Premium-Payment-Phase-2

Home Renewables Loans Scheme:
www.energysavingtrust.org.uk/scotland/Take-action/Find-a-grant/Home-renewables-loan-scheme

Tayside Hotel

A log gasification boiler complete with a 3,000 litre thermal store was installed in November 2010 at the Tayside Hotel in Stanley. This has allowed the heating system to be extended to all bedrooms and the function room, displacing electric heaters and improving comfort. The boiler also provides a plentiful supply of hot water which is greatly appreciated by the hotel's fishermen guests. A log boiler was chosen to allow the owner William Twaddle to exploit low-cost sources of timber such as rejected log material from a nearby sawmill. William is happy to both prepare the fuel and stoke the boiler which can vary from once every two days in summer to up to three times per day in winter.

This has given significant reductions in energy bills with expenditure in 2012 being about £11,000 compared to £21,000 in 2011, a payback of about two years. In addition the site has now been accepted for renewable heat incentive payments.

Outline business case

Once you have systematically worked your way through the various questions, you will have a lot of information about the practicality of installing a biomass heating system on your site, which will include indicative capital costs for supply and installation of the equipment and running costs (fuel supply plus operations and maintenance). You now need to put all that together to understand in financial terms what that means for you or your business and whether there is a financial case for installing a biomass boiler.

There are four numbers that you need to make this assessment:

1) Total capital cost of the new system
2) Anticipated running costs of the new system
3) Running costs of the existing system
4) Projected RHI income

If you are using your own capital to fund the project the annual benefit is:

Existing minus **future running costs** plus **RHI income**

The simple payback period is:

Capital cost divided by **annual benefit**

It is very important at this stage that the numbers you use are accurate, that they include everything and make realistic rather than optimistic assumptions. There are three areas that require particular attention for an accurate appraisal: capital costs, moisture content of fuel and RHI payment tiering.

When considering capital costs make sure that you consider everything. The following list gives you an idea of some of the items that should be included in your cost estimate:

1) Boiler	8) Heat meter
2) Fuel feed arrangements	9) Interconnecting pipework
3) Fuel storage	10) Controls and wiring
4) Delivery-lorry access	11) Electricity supply
5) Boiler house	12) Professional fees
6) Heat store	13) Transport/delivery
7) Flue system	

The moisture content of wood chips has a big impact on their energy content and many boiler manufacturers specify the required moisture content for satisfactory operation of the boiler. It is important that you understand the relationship between weight, moisture content, energy content and price of wood chips. A high moisture content chip is heavier than a drier one and will deliver less useful energy; it can also cause fouling of your boiler. This can mean that an apparently low-cost source of chips sold by weight could be more expensive than the alternative when you consider the moisture content and how much useful energy you are buying.

The tiered nature of RHI payments needs to be properly considered when estimating the likely income. Payments for small biomass schemes reduce from 8.3p/kWh to 2.1p/kWh after 1,314 hours of operation. Most boilers will operate for significantly more than 1,314 hours each year and at some stage you will go from the high to the low rate. For RHI purposes, each year starts in April and this means that for many sites the long hours of winter operation will be largely at the low rate. You need to model this accurately if you are to have a robust business case appraisal. One tool you could use to help you with this is the Biomass Energy Centre's RHI calculator.

When you know capital cost, annual benefit and payback period and are satisfied your figures are both fully inclusive and realistic, you can consider the source of the money to make the investment and the cost of any borrowing. The alternatives are:

- Use of own capital
- Grant funding
- Energy efficiency/renewable energy loan schemes
- Commercial lenders
- ECSO provides funding under build own and operate contract

While we have included grant funding within the above list, it must be said that for most sites this is unlikely to be an option. The RHI is the Government's preferred support measure in this area and a publicly funded grant towards the capital cost of an installation would exclude RHI payments.

In the ESCO build, own and operate option you may not need to find any upfront capital, but you are likely to face a significant monthly standing charge which will include the cost of repaying the capital plus any interest payments over the life of the contract. You need to know what these payments are so you can compare them to the cost of any finance you may be able to arrange yourself.

Whichever of the many funding permutations you choose will influence the final cost of a new installation over its life. It is important that any project appraisal and business case should include the cost of the capital, and any decision to proceed to full project planning should be made on this basis. If you are, for instance, planning to use a loan to fund all or part of the project then you must factor the loan repayments (capital plus interest) into your appraisal.

Checklist

At the end of this stage you should have a clear idea about the financial implications of installing a woodfuel heating scheme:

- the capital cost;
- what will be the annual revenue benefit (running cost savings plus RHI income) and the simple payback; and
- how you will fund the installation and the size of any repayments.

Resources

Biomass Energy Centre RHI calculator:
www.biomassenergycentre.org.

Aberdeenshire Council

Angus Council

Fife Council

Perth & Kinross Council

East Lothian Council

www.eastcoastrenewables.org

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