Introduction

In recent years there has been a resurgence in the use of wood fuel to heat UK homes, public buildings and businesses. Based on current fossil fuel prices woodfuel can often prove to be an economic solution.

Although not common yet in the UK, wood-fired central heating is well established in mainland Europe, with several hundred thousand systems in use. Modern wood heating systems have automatic ignition, thermostatic control and fuel feed. Wood fuel is almost carbon neutral as the CO_2 released by burning wood is approximately equal to the CO_2 taken in over the tree's lifetime.

South West Resource

Currently around 200,000 ODT of forestry co-products and arboricultural arisings with no marketable value are available in the south west. The region could potentially make use of energy crops to further increase the volume of fuel available. The REvision 2010 report highlighted that energy crops in the South West may be able to provide 95.9 MWe from a mix of Miscanthus and Short Rotation Coppice.

The South West already has high quality installed biomass systems, which can act as demonstrators. The region has over 65 biomass installations covering a range of scales and technology types. In 2007 the installed capacity was over 10 MW, with seven systems over 300Kw. There is strong local knowledge with many specialised woodfuel and biomass companies.

Figure 1
Wood pellet burner

Technology

Burning wood for heating is the simplest biomass conversion process, and is easily scaled to the size of the resource. Wood fuel has a lower energy density than fossil fuels so needs more storage space. It is also best to use local wood as a fuel to minimise transport costs and emissions.

Wood fuel can be supplied as logs, woodchips or as pelletised sawdust. Wood fuel can provide space heating through direct heating using a wood stove (an example of a wood pellet stove is shown in **Figure 1**) or a boiler connected to a central heating system (an example is shown in **Figure 2**) and can be retro-fitted to existing buildings.

Modern wood boilers usually transfer fuel from the store to the boiler via an auger feed (a large screw-like mechanism). Air-flow into the boiler is also regulated automatically to ensure high efficiency combustion. Pellet boilers tend to offer better control because of the uniformity and lower moisture content of the fuel.

In addition to traditional log stoves, automatic pellet stoves are also available (an example is shown in **Figure 1**). These contain a small fan to force room air over the inner jacket of the stove warming the room, some are available with a back-boiler allowing them to provide heat to radiators or a hot water system.

Figure 2
Wood burning boiler

Pellet stoves have an internal hopper that typically holds enough fuel for around 20 hours of continuous operation, refuelling is usually manual and they are ideal for smaller, well insulated properties. It is worth noting that burning wood on a simple hearth is highly inefficient, compared to wood heating systems that may have combustion efficiencies as high as 90%.

Auxilliary Equipment

Although wood heat systems are automatic, in general they work better with fairly constant heating loads. Hot water accumulator tanks can be used to store heat to partially resolve this problem and allow a smaller (and therefore cheaper) boiler to be used. System design may also include a smaller auxiliary fossil fuel system to cover the summer, shoulder and peak loads and allow the biomass system to run at the greatest efficiency. Heat meters may also be incorporated into the system to allow energy users to be billed for heat used instead of fuel supplied.

Fuel

Woodfuel for automated boilers generally comes in three common types; woodchip, pellets and logs.
Feedstocks can include energy crops such as willow trees and miscanthus, as well as forestry co-products, arboricultural arisings and clean waste streams from wood processing.

Wood can either be sold by weight or by volume. If sold by weight, it is important to know the moisture content. Unseasoned wood can contain up to 50% water whereas reclaimed building wood might be around 15%. The moisture content can be reduced to around 30% by leaving freshly felled timber uncovered or covered in a barn from March-September. If the moisture content is not reduced, combustion efficiency will be lower and greater amounts of tar can build up in the flue. However some boilers are designed to burn fuel with a moisture content of up to 50%. Commercially supplied pellets or briquettes are usually force-dried during manufacture down to a moisture content of 10% or less.

Woodchip heating system suppliers typically specify the size, maximum moisture and ash content of woodchips that can be used in their boilers and fuel delivery systems. It is important that wood fuel meets these criteria. Woodchip size specifications tend to use the classifications contained in the Austrian standard Ö-Norm M7133.

Transportation and Storage

The energy density of wood fuels is lower than fossil fuels and woodchips have a lower energy density than wood pellets. This has a significant impact on the planning of fuel storage. The low bulk density of wood fuels also means that more deliveries of fuel are likely to be needed compared to heating oil and that the financial value of each delivery is lower.

	Heating Oil	Wood Pellets	Wood chips
	Typical volume of fuel required per year for various examples (m3)		
4 bedroom house	2	6	20
Medium-sized public building	5	15	50
Large Secondary School	20	60	200

Table 1
Shows typical fuel volumes for various buildings.

Operation and Site Maintenance

The maintenance requirements will depend on the size and technology chosen, but the ash store will need to be emptied around once a month and the ash gate rotated once a week. Bearings may need to be occasionally greased and the system swept out twice a year. This work can be built into an ongoing maintenance contract.

Site Suitability

The economics of wood fuel are likely to be most attractive on new-build or for a building heated by bottled gas, oil or coal. The other key issues to consider are whether there is sufficient space for a fuel store and easy access for fuel deliveries.

Design

As with any renewable energy project, the first stage is to estimate the demand for energy, and then to try to minimise demand through conservation and energy efficiency measures.
It should be noted that biomass boilers will work at their most efficient when close to full load. They may be undersized, combined with accumulator tanks and run in a multiboiler set-up to allow the best coverage of the sites energy demand. Once the likely woodfuel demand for the project is estimated the next consideration is to find a local wood fuel supplier. Sawmills, farms and other landowners may have a large enough resource on site whilst others may buy direct from landowners. In addition, the boiler company may also have arrangements with local fuel suppliers. Having obtained quotes for supplying the wood fuel and the heating system, the cost of the system and fuel should be estimated over the lifetime of the boiler and compared to the cost of using a comparable fossil fuel system.

Issues

Planning

Planning requirements for biomass heating systems are similar to those for installation of a fossil fuel system with no requirement for domestic scale systems. Larger systems may need to seek planning permission for the flue and larger structures such as the boiler house and fuel store. Additional traffic on the road from fuel deliveries will also be considered.

Noise

Noise will be similar to a fossil fuel system, though as wood is a solid fuel there can be noise from the fuel delivery system. Very large commercial systems can generate considerable additional lorry movements in the local area for fuel deliveries. If producing wood chip, noise from the chipping machine and associated plant may need to be considered.

Environmental Credentials

Wood fuel is almost carbon neutral as the CO_2 released by burning wood is approximately equal to the CO_2 taken in over the tree's lifetime. However there are some carbon emissions from the production and transportation of the wood. This is around 0.025 $kgCO_2$/kWh, or one tenth the value for oil. Unlike coal, the ash can be used as a fertiliser in the garden or on farmland, or returned to the land where the wood was grown. Due to its low carbon emissions, wood heating can help projects to meet the energy performance criteria for Building Regulations.

Finance

Costs

The main operational cost of the system will be fuel cost. Wood chips are usually cheaper than fossil fuels and pellets roughly comparable to oil at current prices. However, wood-heating systems tend to be more expensive due to higher cost boilers and fuel storage.

Large systems have a whole life cost similar to fossil fuels: the initial capital cost and maintenance costs are higher, but the fuel cheaper. Expect to pay £150 to £300 per kW of boiler heat output for larger, non-domestic boilers, and £200 to £400 per kW for domestic units.

Grants

The Bioenergy Capital Grant Scheme can support the installation of biomass heating and combined heat and power projects in the industrial, commercial and community sectors, including local authorities and schools.

Documents can be found at http://www.aea-energy-and-environment.com/index2.htm.

The Low Carbon Buildings Programme from the DTI can offer a maximum £600 grant for stoves with an overall 20% limit (ex VAT) for stoves and a maximum of £1,500 subject to an overall 30% limit (ex VAT) for boilers; for home owners. For larger buildings a maximum of 40-50% of total costs (excluding VAT) is available for boilers. See funding factsheet for more details.

Sizing Tools

A very simple but approximate sizing tool for schools is available for free download from The Centre for Energy and the Environment (www.ex.ac.uk/cee/re). For homes and other buildings, a more accurate but complicated free sizing tool can be downloaded from RETSCREEN (www.retscreen.net/ang/t_software.php).

More Information

- **Regen SW maintains a list of installers and woodfuel suppliers on its web site: www.regensw.co.uk/directory**
- **The Biomass Energy Centre, www.biomassenergycentre.org.uk**
- **The Carbon Trust, www.carbontrust.co.uk/technology/technologyaccelerator/biomass.htm**
- **The Centre for Sustainable Energy, Woodfuel Advice Line, 08450 74 06 74, www.cse.org.uk**