

3 Storey House

Options for Wood Fuel Heating

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Introduction

This report looks at the potential for increasing the use of biomass heating at a Farmhouse in East Powys, based on an interview with the owner and site visit, analysis of current heating fuel use as well as estimated heat losses from the building fabric. Information is based on that given by the owner and on various assumptions about the efficiency of appliances and their pattern of use. Should any installation of additional wood burning or other heating equipment take place, more detailed work should be carried out to establish its suitability, its integration with the existing system and its sizing and costs as all figures given here are very much estimates. The report also gives an outline of possible costs of equipment and wood fuels, as well as the availability of grants.

The Building

The Farmhouse is a large three-storey, Grade 2 listed, detached building in East Powys. The building is of stone construction with walls or around 50cm thick. There are large single-glazed sash windows at the front of the house, and single-glazed casement windows at the sides and back. The loft has been insulated and the depth of insulation is thought to be between 100mm and 150mm (4 to 6 inches). Current building regulations specify a minimum of 250mm of mineral wool loft insulation or the equivalent insulation value if other materials are used. The suspended floor above the cellar has also been insulated with Kingspan, though other floors are solid and are not believed to be insulated. The house is said to be fairly draughty.

Fuel Use

At present the house is heated by an oil-fired rayburn which also provides heating and is used for cooking. There is also a woodburner in the sitting room which has a back-boiler, providing heat to one gravity-fed radiator and also to the hot water cylinder along with the Rayburn. Both chimneys are lined - one with a metal flue, the other with a vermiculate / cement mix.

Propane is used for a back-up cooker, and Butane for a gas heater.

Information on fuel use was provided by the building owner and can be converted to kWh (units of energy) as follows:

Fuel	Quantity per annum	Efficiency	Annual Cost £	kWh	Annual kg CO2
Central Heating Oil	2500 litres	60%	825	14,460	6,507
Wood	5 tonnes	50%	250	8,525	511
Electricity	3000kWh	100%	380	3,000	1,260
Butane	3 Cylinders	80%	60	600	118
TOTAL			1,510	26,585	8,398

In Wales, the average energy use for heating and hot water is around 22,000kWh per year, so the figure of 26,585 kWh is not unlikely for a large old house with limited insulation.

Annual CO2 emissions from heating and hot water are estimated to be around 8.4 tonnes.

Heat loss calculations

By looking at the materials of which the building is made and the size of external walls and roof, it is possible to estimate how much heat will be lost from the building and the amount of heat input needed to keep it at a constant temperature. These figures are fairly rough as it was not possible to take all necessary measurements at the house – in particular, the heights of various parts of the building. However it can be estimated that if the heating system was designed for a minimum external temperature of -1 ° C, (back-up heaters might be used during prolonged colder spells), then around 45kWh a year of energy would be needed to maintain a temperature of 19°C, assuming that

the heating appliance is around 90% efficient. This is considerably higher than the figure estimated from the fuel currently used, but may be accounted for by the fact that at present certain areas of the house have only minimal heating.

Boiler sizing

Using the method described above for heatloss calculations, a boiler size (kW output) can be estimated. This gives the maximum capacity of boiler that would be needed to maintain a temperature of 19 °C when external temperatures are -1 °C, and here would be around 20kW.

Possible heating options

Why wood fuels?

Wood fuels are seen as a good heating option for a number of reasons:

- Although wood emits carbon dioxide when burnt, this is the same carbon dioxide that is absorbed by growing trees. The carbon cycle is very short in this case, whereas fossil fuels release carbon dioxide that has been locked up for millions of years.
- Using locally produced wood fuels encourages the management of Welsh woodlands which can be good for biodiversity
- Using wood fuels invests money in the local economy and can make farming and wood processing businesses more viable.
- Using locally-sourced fuels ensures security of supply, rather than being reliant on imports from multi-national overseas companies, often in politically volatile areas,

Carbon Dioxide emissions of various fuels

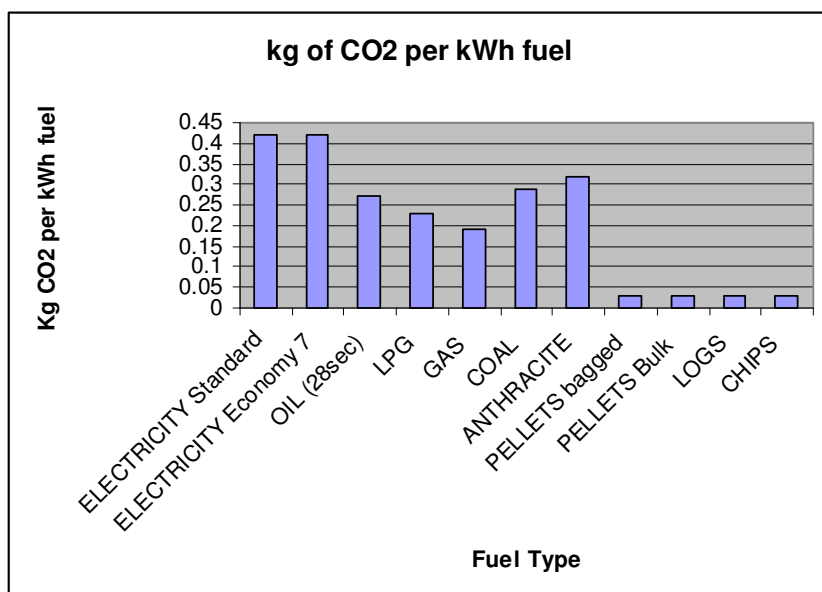


Table 1: Carbon dioxide emissions from various heating fuels. Emissions shown from wood fuels assumes that CO₂ released is absorbed by growing trees (therefore not shown). CO₂ emissions shown for wood fuels are those related to harvesting, extraction, transport and processing.

However wood fuels are only an environmentally friendly option if burnt efficiently. Burning wet wood in an open fire or inefficient wood-stove can release dioxins and other pollutants into the atmosphere. Logs should be seasoned for at least a year or more before being burnt, and stoves, boilers and flues should be regularly maintained for optimum efficiency.

Apart from log stoves, which are widely available and relatively cheap, wood-fuel heating systems tend to have high capital costs – far greater than mass-produced oil or gas boilers. Although wood-fuel systems can have lower running costs, it shouldn't be assumed that the fuels will always be considerably cheaper than fossil fuels.

Which fuel and appliance?

When choosing a wood-fuel heating system it is essential to consider where you will source your fuel, how much storage space you have available and the amount of user-input you are prepared to put in. You also need to consider whether you want a 'living-flame' to look at in your living room and whether you want a system that will come on automatically whether you are at home

or not. The figures in the following sections assume an annual heating requirement of 26,000kWh.

Logs

Of the different types of wood fuel, logs tend to be the most familiar and easily available. They can be the cheapest option, but actual costs can be hard to determine as they are often delivered by 'the load' – an unspecified quantity, with unspecified moisture content. Even where logs are seasoned, the supplier often stores them outside so they can be wet from the rain and of little use without further storage under cover. When actual costs are calculated, they can be surprisingly high, and it is also worth taking into account the labour involved in stacking and moving logs. However for many the work involved in managing a log burning appliance can be a pleasure, and if you have sufficient storage space, seasoning your own wood can guarantee cheap and good quality supplies.

Log Stoves

The cheapest option would be to install a more efficient wood stove with a back boiler, connected to radiators throughout the house. However to provide heating for the whole house this would be a fairly labour intensive process and would involve carrying split logs in to the living room on a regular basis. Wood stoves are only about 60% efficient, and those with back boilers tend to be less efficient as the continually circulating water can cool the firebox causing lower combustion temperatures. It should be possible to use the log stove in combination with the existing Rayburn, but this depends on the layout and design of the heating system.

LOG STOVE WITH BACK BOILER

Assumed efficiency of wood stove	60%
Assumed moisture content of logs	30%
Tonnes logs required per year	13
Storage space required – one year	32 m ³
Annual fuel costs @ £50 tonne	£650

Annual CO2 emissions	1.3 tonnes
Capital costs including installation (using existing radiators and flue)	Approx £1500 - £2200

Log Boiler

Log boilers can be situated in an outhouse, so it can be easier to minimise handling by putting the boiler close to the fuel store. Log boilers are 'batch' boilers, meaning they are fed with batches of logs which are burnt very hot and fast over a couple of hours. During the winter a log boiler may need to be filled and lit once a day. In the spring and autumn once every two days may be sufficient. Softwoods, hardwoods and briquettes can be used in combination to provide the heat output required. Log boilers require an accumulator or buffer tank – a very large hot water store of perhaps 1000 litres which stores the heat from the boiler until it is required.



Baxi log boiler and accumulator tank

The advantage of this is that you do not need to light the boiler when you require heat, and the boiler can work flat-out at its most efficient. A timer and / or thermostat can provide heat to the radiators when you require it. Some log boilers have automatic ignition, so you can fill the fire box and the accumulator will 'tell' it to light, when the water temperature is dropping and needs to be topped up.

LOG BOILER WITH ACCUMULATOR TANK

Assumed seasonal efficiency of boiler	80%
Assumed moisture content of logs	30%
Tonnes logs required per year	10
Storage space required – one year	24 m ³
Annual fuel costs @ £50 tonne	£500
Annual CO2 emissions	1 tonne
Capital and installation costs (using existing radiators and flue)	Approx £10,000 – £15,000

Pellets

Wood pellets are made from compressed sawdust from wood processing or manufacturing businesses. They have a low moisture content (less than 10%) and, because of their small size, can be trickle fed into pellet burning equipment, making it efficient and controllable. Although energy is required to manufacture pellets, it is only a small percentage of the energy contained within the fuel, and their high energy density makes them more economic (in both financial and CO2 terms) to transport than other wood fuels.

Pellet room heater with back boiler

A pellet room heater with back boiler could provide a more controllable heat source, whilst still providing a 'living flame' in the sitting room. As with a log stove, a pumped system would be needed to provide hot water to the domestic hot water cylinder and to the radiators.

Pellet room heaters have an integral hopper in which pellets for up to three days or so can be stored. As pellets are uniform in shape and size, are very energy dense and can be trickle fed into the combustion chamber, pellet stoves can be relatively automatic and heat can be regulated by a thermostat.

Pellet room heaters use a fan to control combustion and distribute heat, and it is worth bearing in mind that this can make a low-level noise.



Rika Pellet Room Heater

PELLET ROOM HEATER WITH BACKBOILER

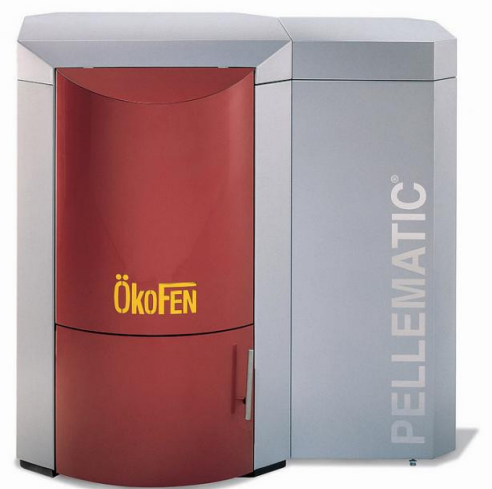
Assumed seasonal efficiency of boiler	80%
Assumed moisture content of pellets	10%
Tonnes pellets required per year	7
Storage space required – one year	10 m ³
Annual fuel costs @ £196 tonne	£1310
Annual CO2 emissions	1 tonne
Capital costs (using existing radiators and flue)	Approx £3,500 - £5,500

Pellet / log combination stoves

Rika have recently developed a room heater than can run off logs or pellets. The stove has a sensor that will detect when the combustion chamber no longer has sufficient logs in it, and will automatically switch over to pellets fed from a hopper. At present it is not commercially available, but should be in the near future.

Pellet boilers

A pellet boiler can provide a highly automated form of wood heating for space and water. A pellet boiler, like a log boiler, will sit in an outhouse or utility room rather than in the space to be heated. Unlike log boilers, a large accumulator or heat store tank is not always necessary though it can improve efficiency. Pellet boilers have an automatic feed system which means little user input is required. The most sophisticated systems may need little more than a fuel delivery once a year (if there is sufficient storage space for a year's supply of pellets), a routine monthly maintenance check and occasional emptying of ash. The pellet boiler and fuel store could be placed in one of the outhouses behind the house. At present pellets in mid-Wales are often delivered in bags, but bulk options, blown into the fuel hopper, are also available.



Okofen Pellet Boiler

PELLET BOILER

Assumed seasonal efficiency of boiler	85%
Assumed moisture content of pellets	10%
Tonnes pellets required per year	6
Storage space required – one year	10 m ³
Annual fuel costs @ £196 tonne	£1176
Annual CO2 emissions	0.9 tonne
Capital and installation costs (using existing radiators)	Approx £10,000 - £15,000

Pellet or log-fired cooking ranges

Highly efficient wood-fired cooking ranges such as Wamsler are available in the UK, and can provide cooking and hot water / space heating running off logs. The German company Lohberger manufactures range cookers that can run off solid fuels including logs, and also have a supplementary pellet hopper, which will automatically supply the firebox with pellets if the logs have burnt out.

Wamsler range cookers start from £1795 including VAT but excluding installation and delivery.

Solar Water Heating

As the building is listed, solar water heating is unlikely to be acceptable for this property.

Grants

Grants for pellet room heaters and log and pellet boilers are available from the Low Carbon Building Programme - www.lowcarbonbuildings.co.uk. Before applying basic energy efficiency measures must have been carried out, and wood fuel equipment must of an approved type from an approved installer. For automated wood pellet room heaters the grant rate is an overall maximum of £600 **or** 20% of the relevant eligible costs, whichever is the lower. For wood fuelled boiler systems the grant rate is an overall maximum of £1,500 **or** 30% of the relevant eligible costs, whichever is the lower.

Grants are not available for traditional wood stoves or wood fired cooking ranges.

Suppliers and installers

There are several local suppliers and installers of wood fuel heating systems – this list is not exhaustive and in the case of wood stoves, many more suppliers and installers can be found.

4WOOD LLP

Beacon Stoves

Newcastle Emlyn,

Parc Gwair,

Capel Iwan,

Carmarthenshire

SA38 9LT

Tel: 01559 371058

info@beaconstoves.co.uk

www.beaconstoves.co.uk

Supplies and installs small and medium scale wood stoves and boilers, pellet room heaters and boilers and wood chip stoves from 4kW to 100kW.

DERWAS OF WELSHPOOL

Henfaes Lane,

Welshpool

Powys

SY21 7BE

Tel: 01938 552246

www.dragon-stoves.co.uk

Supplies Woodpecker pellet boilers from Gerkros, Ireland. Pellet boiler installed at premises.

DULAS Ltd

Unit 1, Dyfi Eco Parc,

Machynlleth,

Powys

SY20 8AX.

Tel: 01654 705 000

dulas@dulas.org.uk

www.dulas.org.uk

Supplies and installs wood fuel heating systems including log and pellet boilers.

Kernow Fires Ltd

Unit 2

Trenant Industrial Estate

Wadebridge

PL27 6HB

CORNWALL

Tel: 01208 812527

Distributor for Lohberger Log / Pellet cooking ranges.

ORGANIC ENERGY COMPANY

Severn Road,

Welshpool,

Powys

SY21 7AZ.

Tel: 0845 458 4076

ajb@organicenergy.co.uk

www.organicenergy.co.uk

UK distributor for fully automatic Okofen wood pellet central heating boilers, wood pellet room heaters (5kW upwards), high efficiency wood fuelled range cookers and wood pellet fuel. Also operates a training centre for the installation of Okofen boilers.

REDFYRE COOKERS

Osprey Road

Sowton Industrial Estate,

Exeter

Devon

EX2 7JG

Tel: 01392 261999

wamsler@redgyrecookers.co.uk

www.wamslercookers.co.uk

Supply Wamsler wood fired range cookers and central heating cookers.

VERY EFFICIENT HEATING COMPANY

Old Station,

Machynlleth,

Powys

SY20 8BL.

Tel: 01654 700324

enquiries@veryefficientheating.co.uk

www.veryefficientheating.co.uk

Designs, installs and maintains solar heating (SWH) systems - both flat plate and evacuated tubes – and high efficiency conventional heating and wood burners. 15kW Baxi pellet boiler heats premises. 8kW Pellet room heater also installed.

Pellet suppliers

FAST FORWARD ENERGY

Waterloo Industrial Estate,

Llandrindod Wells,

Powys

LD1 6BH.

Tel: 01597 823835

Manufactures and supplies pellets in Mid-Wales

WELSH BIOFUELS LTD

32 Chilcott Avenue,
Bridgend,
Brynmenyn Industrial Estate,
Brynmenyn,
CF32 9RQ.

Tel: 01656 729714

ken@welsh-biofuels.co.uk

www.welsh-biofuels.co.uk

Manufactures and supplies wood pellets. Accredited installer of wood-fired boilers & pellet stoves (Froling, Passat and Rika).

PEMBROKESHIRE BIOENERGY

Tel: 01834 891224

Paul Ratcliffe- Imports pellets from Ireland.

Conclusions and recommendations

Wood fuel heating options do offer the potential to considerably reduce CO₂ emissions associated with heating the farm house, and potentially to also reduce annual fuel costs. Both log and pellet systems are viable – the choice will depend on the amount of user input that is considered acceptable, weighed up against availability of fuels and fuel costs. Improving the energy efficiency of the house is to be recommended.