The Farm House

Wood Fuel Heating Options

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Disclaimer

Please note that the figures given in this report are estimations only, and no investment in energy efficiency measures or heating equipment should be made without a further analysis of requirements, benefits and costs. Neither Jacinta MacDermot nor Wood Fuel Powys can take any responsibility for the implementation of any of the measures outlined in this report.

The Farm House is a detached house of slate construction. There is a barn that has recently been renovated and another barn that is used as a workshop about 25 – 30 metres from the main house. Another house is rented out to tenants. The buildings sit within 400 acres of farmland which includes 40 acres of broadleaf woodland.

The Farm House

The Farm House has limited insulation, with an estimated 50mm of fibreglass insulation in the roof and single-glazed windows. The floor and walls are not insulated. The conservatory, which is single-glazed, is also heated. There are plans to install secondary glazing which will improve the energy efficiency of the house considerably.

The Farm House is heated by oil along with an electric (night storage) AGA and wood stoves / open fires. Heat is distributed through radiators and the temperature is controlled by a thermostat in the hall. Hot water is supplied by the oil boiler with a rarely-used electric immersion backup.

Heat load estimated from current oil use

Oil use is estimated as around £1080 per year. Assuming the boiler is about 80% efficient and that oil is priced at 32 pence per litre plus 5% VAT, it is estimated that about 3,200 litres of oil are used per year to heat the main house, providing around 25,000kWh[1] of heat per year. For a house of this size and insulation level, this is very low. It is assumed that this is because the house is not in constant use, and because the oil boiler is supplemented by the AGA and wood stoves.

Electricity bills come to around £3600 per year. A 3.3kW solar (photovoltaic) array located on the roof of the barn extension feeds into the national grid. As well as lighting, household appliances and the electric AGA, electricity is also used occasionally for a hot-tub. A modern electric night-storage AGA with two ovens is quoted on the manufacturer's website as using around 224kWh per week. This equates to around 11,600 kWh per year.

The total energy use for heating, hot water and cooking is therefore estimated to be around 36,000kWh.

[1] A kWh is a measure of energy. 1 unit of electricity on your electricity bill is 1kWh. An electric one bar heater, left on for an hour, will use 1kWh of electricity. The average energy use for heating and hot water in domestic households was about 22,000kWh in 1999.

Heat load from estimated heat loss of building

Heat requirements can also be calculated using the dimensions of the house and looking at the building fabric and insulation values, and from this calculating how much energy would be required to keep the house at the required temperature during the heating season and to provide hot water. This also gives an estimation of the size of boiler that would be required to provide this amount of heat. Using this method, without taking the conservatory into consideration, and assuming that solar water heating is installed to provide 60% of hot water over the year, around 67,000kWh of energy would be required per year. A boiler of around 30kW would be required to provide this heat.

The discrepancy between the figures estimated through the two different methods may be due to the fact that the house is not in constant use, and also that a woodstove is used to supplement heat. For the purposes of this report, the lower figure of 36,000kWh has been used. However accurate calculations should be carried out by the installer prior to installing any new system, and consideration given to whether the boiler should match the current pattern of use or be sized according to the maximum heat requirement of the house. A larger boiler and accumulator tank will be slightly more expensive but not considerably so, and other costs such as the construction of the boiler house, flue and installation will remain more-or-less the same.

The Barn Extension

The Barn extension was renovated about 4 years ago (2003) and has high levels of insulation in the walls and roof. All windows are double-glazed.

Heating and hot water in the barn extension are provided by an oil boiler, delivered through an under-floor heating system. There is also a large open fire. The barn is used intermittently and it is thought that the annual oil bill is around £250. Assuming the oil boiler is 90% efficient and oil is 32 pence per litre plus 5% VAT, this equates to about 6,500kWh delivered heat per year.

Possible heating options

For the purposes of this report we have considered the possibility of heating the main farm house with logs or wood chip sourced from the farm. The barn extension is used only sporadically and with its high levels of insulation has a modest heat requirement. Although it would be possible to install one central boiler that would heat both the barn extension and the farm house, savings on fuel costs / CO2 emissions may not justify the capital costs of installing a distribution system and the work required to connect it to the heating system in the barn extension. However this option should be re-considered if a log boiler for the farm house were to be installed in the workshop.

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 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.
- At the Farm House, self-supply is possible.

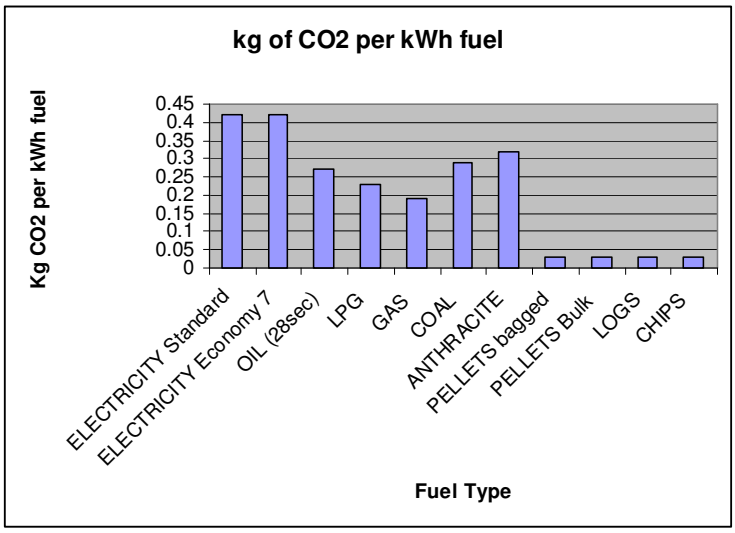

Table 1: Carbon dioxide emissions from various heating fuels. Emissions shown from wood fuels assumes that CO2 released is absorbed by growing trees (therefore not shown). CO2 emissions shown for wood fuels are those related to harvesting, extraction, transport and processing.

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?

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.

Some of the characteristics of various heating systems are listed below:

	Log stove	Log boiler	Ceramic Stove	Pellet Stove	Pellet boiler	Chip boiler
Single room	●		●	●		
Whole house	●	●			●	
Larger house		●			●	●
Group of properties					●	●
Wish to use own fuel	●	●	●			●
Domestic hot water	●	●		●	●	●
Attractive feature	●		●	●		
Boiler space required		●			●	●
Level of automation	0	1-3	0	2-4	3-5	3-5
	0 = no automation 5 = complete automation					

(From Glasu's Wood Fuel in Wales leaflet)

Pellet room heater / Boiler

Although pellets can offer a highly efficient and automated form of heating, this option has not been considered for the Farm House because of the quantity of wood available on site.

Log Boiler

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. Wood can be cut to length to fit the firebox. 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. (As an estimate, around 60litres of water storage for each kW output of the boiler). 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. The size of boiler and accumulator tank should be chosen to complement each other in view of the heat requirements of the house.

Baxi log boiler and accumulator tank

To provide 36,000kWh of heat per year to the house, approximately 12 tonnes of seasoned logs (30%moisture content) would be required, requiring 29m³ of storage space. As the wood will need to be seasoned for at least one or preferably 2 years before use, a storage space of 87m³ would be desirable.

Although the wood is 'free', consideration should be given to the amount of labour required to process and season the wood, and load the boiler.

Log Boiler Advantages

Can be highly efficient
You do not need to light the boiler when you want heat
Only requires filling once a day or so
Logs need not be carried through the house
Self-supply possible
Can use longer lengths of wood than with a woodstove

Disadvantages

Large space needed for boiler and accumulator
Large storage space needed for logs
Fuel needs processing / stacking / loading
Can be hard to source seasoned logs
High capital costs

Capital costs

Costs of log boilers vary according to the sophistication of the equipment. Higher costs can mean less user input and higher efficiency. Comparative prices for 3 makes of log boiler are shown below. It should be noted that prices quoted are for the boiler alone – there will be additional costs for the flue, accumulator tank (perhaps £1000), controls and installation, as well as the construction of a suitable boiler house. There may also be differences in what is included in the price of the boiler.

Manufacturer	Model	Output	Price excl VAT
Baxi	Sola Innova	20kW	£2395
Froling	FHG Turbo 3000	20kW	£8988
Farm2000	HT20	20kW	£3911

Contact details of suppliers can be found below.

Running costs

Although wood can be supplied from the farm, the cost of labour to cut, split and stack the wood, as well as fill the boiler, should be considered. As with conventional boilers, the log boiler will need to be serviced annually.

Grants

Domestic log boilers are eligible for support under the Low Carbon Building Programme of a maximum of £1500 regardless of size subject to an overall 30% limit (exclusive of VAT).

Wood Chip

Wood Chip Boilers are only available with a rated output sufficient for a very large house, commercial building or groups of buildings. Wood chip boilers are at their most efficient when running flat out, and unlike pellet boilers are less comfortable being turned down to operate at a fraction of their rated output. They can be highly automated, with a hopper which feeds chip into the boiler as it is required, removing the need for daily loading and lighting. However wood chip is less energy dense than logs and a larger storage area is required – to provide 35,000kWh of heat around 12 tonnes of wood chip (at 30% moisture content) would be required, with a storage space of around 59m^3 for one year's supply. It is unlikely that the heat load for the building is sufficient for a wood chip boiler, but should other buildings be incorporated into the system and wood chip be considered a local contractor could be employed to come over once or twice a year to chip a quantity of wood for the boiler. (See contact details below).

Solar Water Heating

In the summer, domestic hot water could be provided by solar water heating panels, situated on a south facing roof. An array of around 3 m^2 could provide most of the hot water for the house during the summer. Detailed system design needs to be carried out to establish the best way of incorporating solar water heating into the heating system, taking into account the pattern of usage by occupants. The domestic hot water cylinders are currently on the north side of the building, and the layout of the top floor means that installation of solar water heating panels on the south facing roof is likely to require pipework running across the house internally. The best solution, for minimum disruption, should be discussed with a solar water heating installer. Solar water heating should be able to provide up to 50 to 60 % of hot water over the year, and the majority of hot water during the summer. Grants of an overall maximum of £400 or 30% of the relevant eligible costs, whichever is the lower, are available from the Low Carbon Building Programme.

Siting the wood fuel boiler

There is limited space around the farm house to house a wood boiler and no existing outbuildings immediately adjacent to the boiler.

One possible solution would be to house a new boiler in the workshop, connected to the house via an underground heat main (super insulated pipe). This requires a fairly long length of trench and pipe work, through the car parking area, which would add to installation costs. However the advantage of locating the boiler there is that access for loading logs could be fairly easy.

An alternative solution would be to dig out the bank to the north of the house and build a boiler house there. The advantage of this is that it is close to the house and would require a minimum of pipe work underground. However access for fuel deliveries would be difficult and should be considered.

The existing oil boiler could be retained and incorporated into the new heating system to provide back up. It could be relocated next to the wood-fired boiler, feeding into the accumulator tank.

A flue for the boiler will be required and must comply with part J2 of the Building Regulations which state the distance and height the flue must be in relation to the boiler house and adjacent buildings.

Grants

Grants mentioned above are from the Low Carbon Building Programme. However it should be noted that this grant scheme is very over-subscribed, and many applicants have found it difficult to secure funding. The installation must be carried out by an accredited installer.
It is possible that grants for domestic wood fuel installations may be available in the future from the Forestry Commission. However this is by no means certain.

LOW CARBON BUILDINGS PROGRAMME GRANT

0800 915 7722

www.lowcarbonbuildings.org.uk

Grant scheme for domestic and community renewable energy systems. For domestic wood systems, pellet room heaters and stoves are eligible for a maximum grant of £600 regardless of size, subject to an overall 20% limit (exclusive of VAT). For domestic wood fuelled boiler systems, a maximum grant of £1,500 is available, regardless of size but subject to an overall 30% limit (exclusive of VAT). Grants are also available to businesses, community groups etc. No grants for conventional wood stoves.

Some suppliers also offer a discount at purchase through the Bioenergy Capital Grants Scheme.

Suppliers and installers

There are several local suppliers and installers of wood fuel and solar water heating systems.

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.

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 Froling log boilers and KWB pellet boilers.

GWNFOR EVANS

Evans Tree Services
2 Glanllifon
Corris Uchaf
Machynlleth
SY20
Tel: 01654 761534

Supplies wood chip. Also will chip for others.

LLANISOLAR LTD

Old School Yard,
Smithfield Street,
Llanidloes,
SY18 6EJ
Tel: 01686 412552 mobile: 0781 7931191
Independent installers of solar water heating systems.

TEISEN PRODUCTS

Droitwich Road,

Bradley Green,

Redditch,

Worcestershire
B96 6RP.

Tel: 01527 821621

heat@farm2000.co.uk www.farm2000.co.uk

Manufactures wood, wood-chip, straw and most other biofuel waste fired boilers, including Farm 2000.

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 / boilers. 15kW Baxi pellet boiler heats premises. 8kW Pellet room heater also installed.

Wind Power

Opportunities for wind power on the farm are outside the scope of this report. However if the site is suitable and a connection to the grid can be achieved, a large wind turbine could be a good investment for the farm. Information on wind power, including details of how to estimate wind speeds for given locations, is available from the British Wind Energy Association www.bwea.com. Locally, expert advice is available from:

TIM BREWER
Melinbrehedyn,
Machynlleth
01654 703374 (Evenings)
Experienced wind turbine engineer. Offers consultancy / advice / project management for wind turbine installations. Installed community turbines in Machynlleth.

ROB GWILLIM
Roman House,
Taliesen
Machynlleth
SY20 8JH
Tel: 0845 456 1285
Renewable energy consultant covering all renewables and building services.

Conclusions

There are good opportunities for a wood fuelled heating system at the Farm House, particularly as there is an abundant supply of wood on site. However the labour required for processing this wood should be considered, as should the requirement for sufficient storage area to season the wood in advance. Retaining the oil boiler as a back up would allow a flexible system to suit the pattern of use of the house. Solar water heating would be a good option though may be less straightforward to install than in a house with a loft space for pipework.

Recommendations

- Improve energy efficiency in the house as far as possible
- Install thermostatic radiator valves (TRVs) on radiators, if not installed already (The radiator in the room with the room thermostat should not normally have a TRV)
- Top up insulation in the roof to 270mm where possible
- Insulate hot water pipes
- Consider only using the conservatory in the summer, rather than providing heat to it. Ensure that it is possible to shut off the conservatory from the rest of the house.
- In the long term, consider alternatives to the electric AGA
- Consider solar water heating – consult local solar water heating installers
- Consider a log fired boiler – consult local installers. It may be possible to arrange a visit to a Froling and / or Baxi installation if required.
- Investigate possibilities for wind power – consult local wind power experts.