

# Village 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.



## **Introduction**

This detached village house dates from the 18<sup>th</sup> Century. The house comprises two floors (bedrooms and bathroom downstairs, living room, dining area and kitchen upstairs in a room which opens up to the rafters). There is also a gallery above the kitchen and hall, which opens on to the living room.

At the rear (north side) of the house, the lower half is below ground level. On the western side the house is partly below ground level, with steps leading from the main door (upstairs) down to the driveway. The house is of slate construction, with walls of around 40 – 50 cm thick. The north wall has been dry lined to the first floor.

The house is heated by a single multi-fuel stove, running off anthracite and logs. Until recently (November 2006) night storage heaters provided additional background heat to the main room and bedrooms. Due to cost concerns these have now been disconnected and the multi-fuel stove is the only source of space heating. There is no heat to the downstairs. Hot water is provided by an electric immersion heater and electric shower. The multi-fuel stove is used from October to May and is kept alight more-or-less constantly during this period.

## **Methodology**

Two methods have been used to estimate the annual heating requirements of the building.

- 1) Using information about previous fuel use, including estimated anthracite / wood use and Economy 7 electricity bills
- 2) Calculating how much energy would be required to heat the building based on heat loss through the walls, floor and roof of the building.

Without further more detailed data and analysis, neither of these methods can provide more than a broad estimation of the energy required to heat the house.

Using these figures for energy requirements, it is possible to estimate the amount of fuel that would be required to produce this amount of heat and the possible fuel costs and storage space required.

Estimates have also been given of the capital costs of installing heating equipment and a wet heating system.

## Current Energy Use

### 1) Using information about previous fuel use

Using data from estimates of anthracite and electricity (Economy 7) use, it is assumed that about 29,790 kWh is used annually for heating and 1765kWh for hot water, a total of **31,555 kWh<sup>1</sup>**

To estimate this figure, various assumptions are made:

- The heating season is from October to May inclusive
- During the heating season £55.90 is spent per fortnight on anthracite (250kg per fortnight).
- The multifuel stove is 60% efficient
- It does not include any additional heating provided by wood.
- The storage heaters provided 7,170kWh of heat over the year
- A 3kW immersion heater is on for 1 hour every two days, throughout the year
- The shower is 10kW and is used for 20 minutes every day, throughout the year.

### Using figures for the heat loss of the building

Through calculating the heat loss of the building the annual energy requirement for heating and hot water per year is estimated to be **35,173 kWh**.

- This assumes that there is 50mm insulation in the roof and that the floor is of concrete and un-insulated.
- It also assumes that heat would be provided to the whole building and that a fairly constant temperature of 19 degrees would be maintained.
- It assumes a solar water heating panel has been installed. Without this, a further 1,000kWh of heat from the main heating system would be required.

### Summary

The figures estimated from the two different methods are similar. The discrepancy may be because at present the whole house is not kept to a constant temperature. For the purposes of this report we have assumed that the average heating and hot water requirement for the house is around **35,000kWh** per year. To provide this heat at a temperature of 19°C, along with hot water, a boiler with a capacity of about 15 kW would be required.

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<sup>1</sup> 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.

## **Reducing energy demand**

The house at the moment could be classified as 'hard to heat'. Although there is some insulation in the roof, it is assumed to be fairly minimal (not more than 50mm). Increasing this to 100mm could reduce energy demand by around 1000kWh per year.

Many of the windows are double glazed but have a small air gap between the two panes. Replacing all windows with double glazed, low-e, argon-filled windows with 20mm gap (the 2002 standard) could reduce demand by up around 1500kWh per year.

Dry lining and insulating all the external walls could give the best energy savings of up to 12,000kWh per year. This could half the size of boiler / stove required, but would require the most investment and cause the most disruption.

Carrying out all three of the measures listed above could save up to 14,500 kWh of energy per year, or between £350 and £900 per year at current prices depending on the type of heating fuel. The environmental benefits would be considerable. Financial benefits would need to take into account the cost of works and time it would take to payback this investment.

## **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.

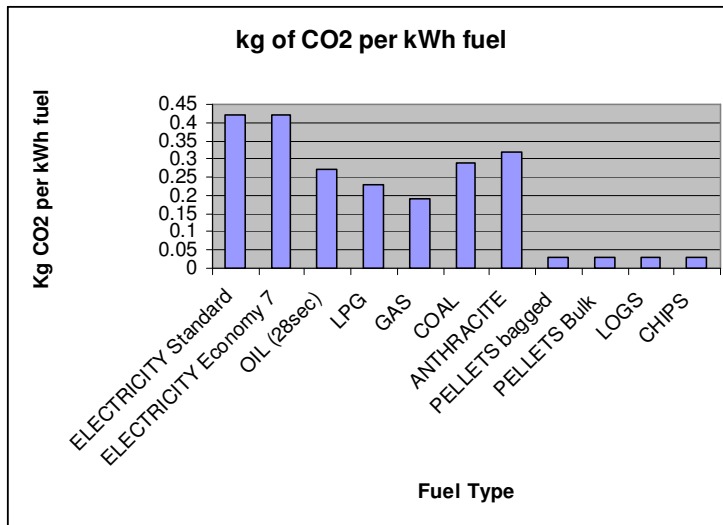


Table 1: Carbon dioxide emissions from various heating fuels. Emissions shown from wood fuels assumes that CO2 released is absorbed by growing trees (therefore not shown). CO2 emissions shown for wood fuels are those related to harvesting, extraction, transport and processing.

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 Wood Fuel in Wales leaflet, B Horne)

### Delivery of heat and hot water

For any of the wood fuel systems mentioned, it is presumed that a wet heating system (radiators) would be installed. The only alternative to this would be to re-connect the storage heaters, running off electricity, or to install multiple wood stoves.

Hot water for the hot water cylinder is currently provided by an electric immersion heater, and the shower is electric. If a wet heating system is installed, it is recommended that domestic hot water and the shower both be converted to run off the main heating system.

### Wood Stove with back boiler

The cheapest option for the house would be to install an efficient wood stove with a back boiler (around 60% efficient), connected to radiators and to the hot water cylinder (a new cylinder may be required). A pump would be needed to circulate water to the radiators downstairs and to the cylinder. Wood burns cleanest at high temperatures, and it would not be recommended to keep the stove in overnight as this releases pollutants into the atmosphere.

### **Advantages**

- Wood stoves are widely available
- Wood stoves are relatively cheap
- The system could use the existing flue
- Logs are widely available and can be a cheap option when bought in bulk

### **Disadvantages**

- System not automatic. Heat only provided when stove is alight.
- Electric pump needed to circulate water from the back boiler.
- Wood needs to be carried through the house to the wood stove
- Manual handling required to unload and stack logs
- Sufficient storage space for 43m<sup>3</sup> of seasoned logs, or frequent deliveries, would be required

### **Capital Costs**

Wood stove with back boiler - £800 - £1500

Radiators, pipe work and cylinder, including installation - £2000-£4000

It is assumed that the existing flue is suitable for re-use.

### **Running Costs**

With this option, it is estimated that about 17 tonnes of seasoned logs (hardwood) would be required every year, needing around 43m<sup>3</sup> of storage space if all was stored on site. To reduce the amount of storage required, regular deliveries of wood could be secured. However the wood must already be seasoned, as there would not be sufficient space to store wood for future years on site. If seasoned wood was sourced at £70 tonne, a year's supply would cost around £1190 a year.

### **Grants**

There are no grants available for conventional wood stoves.

### **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 downstairs.



Rika Pellet Room Heater

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. The existing flue could probably be re-used.

A pellet room heater with back boiler would require 8 tonnes of pellets per year to provide heat for the house, requiring a storage space of 12m<sup>3</sup>.

Details of Rika pellet room heaters can be found in Appendix 2.

#### **Advantages**

- Controllable heat
- Semi-automatic
- Cheaper than pellet boiler systems
- Pellets clean and easy to store

#### **Disadvantages**

- Limited fuel suppliers
- Low-level noise from fan
- Hopper requires filling every few days
- Electricity required to power fan and pump water

#### **Capital Costs**

Pellet room heater with back boiler £3800 - £5000 including VAT

Radiators and pipe work, including installation - £2000-£4000

It is assumed that the existing flue is suitable for re-use

#### **Running costs**

The price of pellets varies according to the quantity bought and delivery distance. A tonne of pellets from Fast Forward Energy, delivered in bulk, will cost in the region of £196 a tonne, delivered (including VAT). The total annual cost for heating from pellets would therefore be around £1,568. The minimum delivery is 4 tonnes.

#### **Grants**

Pellet room heaters are eligible for support under the Low Carbon Building Programme of a maximum of £600 regardless of size subject to an overall 20% limit (exclusive of VAT),

## 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.

## 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. 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. 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.

A log boiler could be housed in the existing garage. It would be connected to radiators and the hot water cylinder in the house via a short length of underground heat main (super-insulated pipe) and a heat exchanger.

Because log boilers can be more efficient than log stoves, less fuel would be needed to provide heat for the house - approximately 13 tonnes of seasoned logs (30%moisture content) per year, requiring 32m<sup>3</sup> of storage space.

Contact details of suppliers can be found below.

### 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
- Fuel widely available
- 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



Baxi log boiler and accumulator tank

### **Capital costs**

Log boiler (installed) and flue £8,000 - £14,000

Accumulator tank (1000 litres) £800 - £1500

Heat main + civil works £500

Radiators and pipe work, including installation - £2000-£4000

### **Running costs**

As a log boiler will be more efficient than a wood stove, in theory less logs will be needed to provide heating for the house. However some people who have replaced woodstoves with log or pellet boilers have found that their fuel bills have risen because they tend to heat the whole house to higher temperatures. 13 tonnes of logs at 30% moisture content could cost around £1197. 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).

### **Pellet boiler**

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.

To heat the house with pellets, about 8 tonnes will be required per year, needing a storage space of 12m<sup>3</sup>. Details of further suppliers can be found below.

### **Advantages**

Can be highly automated

Little user input required

Controllable heat

Less space required for fuel storage (than logs)

### **Disadvantages**

Pellets not widely available

High capital costs

Relatively high running costs

### Capital costs

Pellet boiler, flue and storage hopper including installation

£6000 - £14,000

Heat main £500

Radiators and pipe work, including installation - £2000-£4000

### Running costs

8 tonnes of pellets might cost around £1,568 per year, depending on quantities delivered. As with log boilers, switching from a woodstove to a central heating system can see a rise in fuel bills because of increased heating demand and comfort levels.



Okofen Pellet Boiler

### Grants

As with log boilers, domestic pellet 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 are not suitable for most domestic properties. They can be highly automated and can use locally sourced wood chip (depending on quality) which is generally lower in price than other wood fuel options. Wood chip is not considered to be an option for this house.

### Oil or LPG

LPG and oil boilers have a lower capital cost than wood fuel boilers, and can also be advantageous in terms of lesser space requirements for the actual boiler. The boiler could be located in the house – in the utility room, for example. Storage space for an oil or gas tank would still be required. A high efficiency condensing oil or lpg boiler could save 8 tonnes of CO<sub>2</sub> per year (compared to anthracite) and could be used in conjunction with solar water heating. The disadvantages of LPG and Oil are their CO<sub>2</sub> emissions and contribution to climate change, and also price instability – it is widely thought that prices will continue to increase and that, looking ahead, supplies may become less secure.

### Capital Costs

LPG or Oil condensing boiler - £1000

Fuel tank £1000

Radiators and pipe work, including installation - £2000-£4000

### Running costs

LPG would cost around £2,168 per year, while oil would cost around £1240. The boiler would require an annual service.

### Summary

To Provide 35,000kWh of heat and hot water:

Fuel type	Heating system	Approximate capital costs (not including wet heating system)	Grants	CO2 emissions pa Tonnes (processing)	Fuel required pa Tonnes	Storage space required pa	Fuel cost (@ £70 tonne, seasoned) pa
Logs	Woodstove with back boiler	£2000	none	1.75	17 @ 30% moisture content	43 m <sup>3</sup>	£1197
Pellet	Roomheater with back boiler	£3800 - £4600	£600	1.1	8	12 m <sup>3</sup>	£1568
Log	Boiler	£8,000 - £14,000	£1500	1.3	13	32m <sup>3</sup>	£900
Pellet	Boiler	£6,000 - £14,000	£1500	1.1	8	12m <sup>3</sup>	£1568
LPG	Condensing boiler	£2,000	none	10	-	-	£2168
Oil	Condensing boiler	£2,000	none	10	-	-	£1240
Anthracite	Multifuel stove	n/a	none	18	5		£1219

## **Solar Water Heating**

In the summer, domestic hot water could be provided by solar water heating panels, situated on a south facing roof. For this house, a possible position would be the south roof of the garage, if this is not too overshadowed by trees. However the distance from the house makes this a less attractive option. An array of around 3 m<sup>2</sup> 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. 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.

## **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](http://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.

## **Suppliers and installers**

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

### **4WOOD LLP**

Beacon Stoves  
Newcastle Emlyn,  
Parc Gwair,  
Capel Iwan,  
Carmarthenshire

SA38 9LT

Tel: 01559 371058

[info@beaconstoves.co.uk](mailto:info@beaconstoves.co.uk)

[www.beaconstoves.co.uk](http://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](http://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](mailto:dulas@dulas.org.uk)

[www.dulas.org.uk](http://www.dulas.org.uk)

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

### **ORGANIC ENERGY COMPANY**

Severn Road,

Welshpool,

Powys

SY21 7AZ.

Tel: 0845 458 4076

[ajb@organicenergy.co.uk](mailto:ajb@organicenergy.co.uk)

[www.organicenergy.co.uk](http://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.

#### **VERY EFFICIENT HEATING COMPANY**

Old Station,  
Machynlleth,  
Powys  
SY20 8BL.

Tel: 01654 700324

[enquiries@veryefficientheating.co.uk](mailto:enquiries@veryefficientheating.co.uk)

[www.veryefficientheating.co.uk](http://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**

At present there are only two manufacturers of wood pellets in mid-Wales. However at least two further manufacturers are expected to start production within the next year or so.

#### **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](mailto:ken@welsh-biofuels.co.uk)

[www.welsh-biofuels.co.uk](http://www.welsh-biofuels.co.uk)

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

## Conclusions

Some solution to heating at the house will be required before next winter, as otherwise damp could be a problem downstairs.

There are a number of possible options for providing heating, though capital costs have to be balanced with the running costs of the system.

A log stove with back boiler is likely to provide the lowest installation and running costs, though will require a high degree of user input and will only provide heat when the stove is alight.

An efficient log boiler with accumulator tank is likely to produce the lowest running costs, and although manual handling of logs will be required there is good access to the garage where a boiler could be located. A good supply of seasoned logs would be essential to enable this option to work successfully.

The running costs of a pellet system are higher, and the price of pellets may well rise as fossil fuel prices rise. However pellets offer a highly automated system which may be attractive if less user input is required.

Of the fossil fuels, oil is likely to be the cheapest option (at the moment) and an efficient oil boiler with radiator system would give considerable carbon savings on anthracite.

It is possible that domestic grants for wood fuel installations may be available from 2008 from the successor to the Forestry Commission's Wood Energy Business Scheme. These would supplement the Low Carbon Building Programme Grant, which can be difficult to secure.

## Recommendations

The wood store should be made water-tight

It is recommended that the occupants consider how much user-input into a heating system they feel is acceptable, and whether the high capital costs of a wood fuel heating system can be accepted in order to allow them to achieve comfortable levels of heating and environmental aims.

Local suppliers of log and pellet boilers and room heaters could be approached for further information. Should the occupants wish to see a working log or pellet boiler, this could be arranged.

When the options have been considered more fully, installers could be approached for quotations to give a more accurate idea of costs.