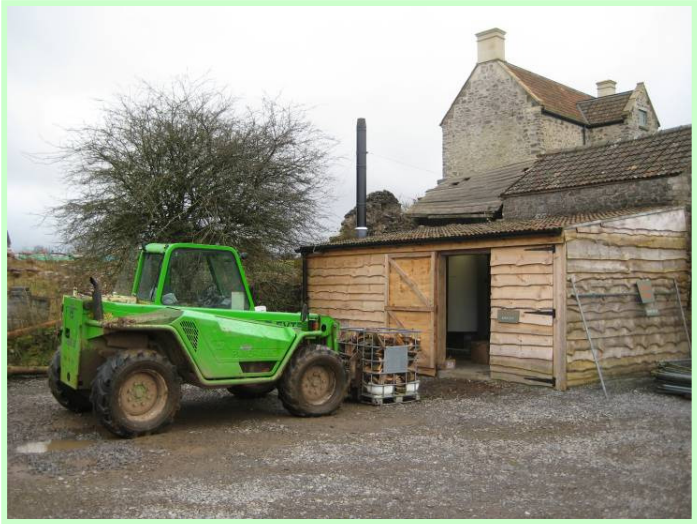
Biomass Boiler Case Study

Fernhill Farm, Mendip

Fernhill Farm is an ambitious renovation of a derelict 17th century farmhouse and farm buildings linked by a mini district heating scheme. The site comprises a family home and a camping barn which can accommodate 32 visitors. A further barn is being developed and will ultimately serve as a teaching area, workshop space, and provide a communal area for residents of the camping barns. Waste water and sewage produced by the site is treated using a willow bed filtration system.

Heating requirements

As the buildings on the farm were either derelict or new build there was no historic data available on fuel use and costs. The boiler size and heat use was estimated from the size of buildings, insulation level and the number of occupants.



The boiler house and flue. A telehandler is used to move baskets of logs.

The main house comprises 11 rooms over three floors including four bedrooms. The building is detached, has single glazed wooden windows, solid walls and a pitched roof with above average insulation. The camping barns offer single storey dormitory style accommodation for 32 occupants. As a new building this was constructed according to Part L of the building regulations and has double glazed windows and internal insulation on the roofs and walls. Unlike the other two buildings the camping barn has significant hot water requirement for showers and washing. During times of full occupancy during summer the daily hot water requirement may range from 125-160 kilowatt hours (kWh) per day. On a yearly basis this could equal about 60% of the total heating requirements of the building. The old barn /workshop area is still under construction. The peak load of the boiler was calculated at between 76-88 kilowatts (kW) and the annual heat requirement of 101,000 – 117,000 kWh (based on a wood fuel boiler working at 90% efficiency and an occupancy rate of 1,200 hours per year). This level of heating is equivalent to the use of 10,000 – 11,500 litres of oil.

Boiler location

Although, there were existing buildings available it was decided that a new boiler house would be built. This option was chosen because of the flexibility that it would provide as well as having less stringent

planning requirements. A timber clad lean-to was built adjacent to a row of small workshops. The boiler house is below the workshops and the visual impact of the installation is low. The flue is hidden on one side by an established hawthorn tree and on the other side by the workshop roof. The distance from the middle of boiler store to the house is 15m whilst the distance to the camping barn is 55m. The workshops are approximately 10m from the old barn. Therefore a total of 80m heat main and trenching was required for the district heating scheme.

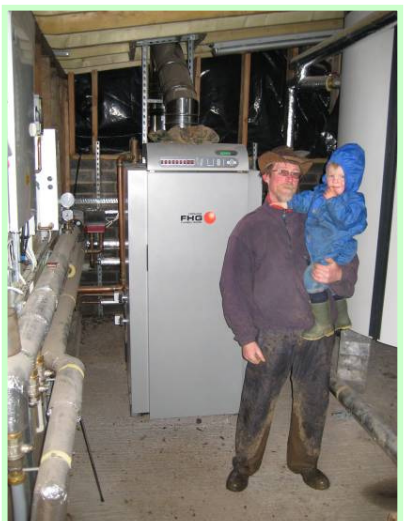
Project development

The owner of the farm, Andrew Wear, started thinking about installing a wood fuel boiler and/or other renewables in the summer of 2006. Initially advice was sought from Mendip AONB who put the owner of the property in touch with the Centre for Sustainable Energy (CSE). At this time CSE were running a regional programme called the South West Co-ordinated Woodfuel Initiative (CWI). This provided a free site visit and mini feasibility study undertaken by an independent consultant. Based on the report received the owner decided to go ahead with an installation. Unfortunately, the CWI programme has now ceased.

The report offered a variety of alternative technology options including wood chip, multifuel and log boilers. The owner looked at 8 boilers in total but ultimately decided that a log boiler would be the best option for the site given the wood fuel available. The boiler was finally commissioned on the 1st August 2008.

Boiler choice

The chosen system was a 70 kW Froling log boiler installed along with two 3,000 litre accumulator tanks. The latter enables the storage of hot water to cater for any peaks in hot water usage. A log boiler was preferred because it offered a solution at a reasonable cost and could utilise existing woodland and equipment on the estate. Despite being more "hands on" the activities relating to the boiler (fuel loading, lighting, ash removal etc.) could also be done by farm staff as they are passing the boiler. The preferred installer was Eco-Engineering who are based in Gloucestershire.



Andrew Wear and his son Seth with their Froling 70 kW log boiler

Heating plant

The boiler house measures 8m x 4m x 3m in height and accommodates the boiler, three 2000 litre accumulator tanks and a small space for log storage. There is also a separate 150 litre immersion tank in camping barns. Currently the system is backed up by electric heating but the owner is intending to install a solar water heating system in the spring pf 2010 which will provide hot water for showers in the summer months.

Wood fuel requirements and cost saving potential

The log boiler has not been in place for a full year yet so there is no exact information on the annual wood fuel usage. However, it is possible to predict the amount needed. Based on the boiler size of 70 kW, an efficiency of 90% and the boiler being in operation for 1200 hours per year it would be expected to use 23 tonnes of air dry logs (at 20% moisture content) per year. Depending on the occupancy of the camping barns and the amount of hot water required this may rise.

The Fernhill boiler has three 2000 litre accumulator tanks.

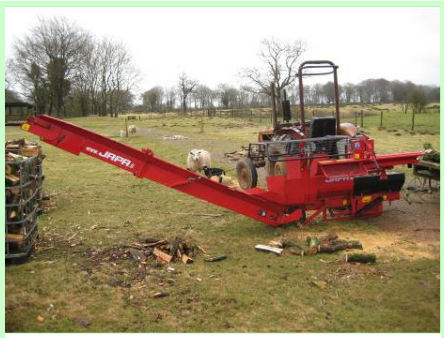
23 tonnes of logs is equivalent to around 9,000 litres of oil.

Wood fuel type	Woodfuel required (tonnes)	Volume (m^3)	Cost/ tonne*	Yearly Cost	Annual savings compared to fossil fuel		
					Oil @ 35p/litre	Oil @ 45p litre	Oil @ 55p litre
Logs (air dry ~20% MC)	23	57.5	£75	£1,725	£1,425	£2,325	£3,225
			£45	£1,035	£2,115	£3,015	£3,915

* The owner is using a free source of logs but there is a cost associated with splitting the wood and moving it around the farm. The cost of £45 allows for any future cost associated with this wood. A price of £75 is a more typical price for bulk deliveries.
Log deliveries to domestic customers tend to be priced according to a load which is the amount of logs that can fit in the back of a pick up truck. A load may cost £60-80 but is generally less than a tonne in weight.

Depending on the price of oil and woodfuel, savings during the 25 year lifetime of the boiler might be anything from £35,625 - £97,875.

The boiler uses slab wood as well as traditional logs



Automatic log splitting machine. This cost around £5000 and requires a 35 horse power tractor to run.

Fuel Supply and Storage

The owner is using wood from a number of sources. Several years ago he planted 8 acres of mixed woodland made up of 80% deciduous trees such as ash and sycamore. This plantation requires periodic thinning. Logs are also sourced from other areas of the farm and this is topped up with slab wood from a local sawmill. The farm has recently installed a willow filtration system and it is hoped that this will provide some woodfuel in the years to come.

The ideal log dimensions for the boiler are 50cm in length and 10cm in diameter. Suitable material is produced using an automatic log splitter which places the logs in metal baskets which are transported to the boiler with a telehandler.

Operation and Maintenance

Lighting the boiler is done manually and is similar to starting a log stove. This takes 5-10 minutes. The combustion chamber of the boiler is loaded with logs twice daily although this may rise depending on the number of users on site and the type of wood used. For instance during peak use, slab wood needs to be added every 2 hours whilst hard wood logs such as ash would need to be added every 4 hours. As a rule of thumb, if the boiler burns wood for one hour this will heat up 1,000 litres of water. Allowing for efficiencies, a nine hour burn would therefore heat the accumulator tanks fully. When there are few people on site this will keep the farm heated for up to 2 days before the boiler needs to be re-lit.

About 10kg of ash is produced per week which requires about 10 minutes to remove and clean. A box of ash is removed every month and used as a fertiliser.

Capital and Operational Cost

The overall capital costs of the installation were £50,000 including VAT at 17.5%. This included the following:

- Boiler delivery, installation and commissioning
- All the pipe work, sensors, accumulator tanks and flue
- Plumbing into existing system
- 80 m of insulated heat main at £42/m
- The timber clad boiler house

Unfortunately this boiler was installed prior to the Renewable Heat Incentive so does not receive payments for the heat generated. A grant of £10,000 was obtained from Mendip AONB through the Co-ordinated Woodfuel Initiative. This funding stream is no longer available.

Carbon savings

Although the biomass system has not replaced a fossil fuel boiler, had the owner not installed his system an oil boiler would have been the most obvious choice. This would have resulted in annual CO_2 emissions of 25 tonnes. By contrast the biomass system results in around 2.4 tonnes of additional CO_2 emissions from moving and processing woodfuel. Therefore, over 22 tonnes of CO_2 are saved annually.

Key Lessons Learnt

The main thing to remember when installing a log boiler is that it will take a bit more investment of time to run than a typical fossil fuel heating system. This will not suit everyone choice but if you want to save money and are happy with a few extra chores then this system could be for you. As the farmer at Fernhill says "You've got to set aside time to light your boiler but then you have to put time aside to manage your cows!"

Summary information

Boiler type	70 kW Froling log boiler
Installer	Eco Engineering
Capital cost	£50,000
Amount of wood fuel used	23 tonnes/year
Grant	£10,000

Contacts and more information

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