Biomass Boiler Case Study

Folly Farm, Mendip

Folly Farm is an environmental learning centre based near Chew Valley Lake which is owned and managed by the Avon Wildlife Trust. The farmhouse and outbuildings date from the late 17th to early 20th century and underwent a complete redevelopment between 2006 and 2008. This major renovation was supported by the Heritage Lottery Fund, Biffaward and the South West Regional Development Agency (SWRDA). The centre now provides residential accommodation, restaurant facilities, workshops, meeting rooms and teaching facilities. The farm comprises a 250 acre nature reserve used for nature projects and teaching traditional skills; 60% of the reserve is woodland.

The Folly Farm Centre.

Heating requirements

As the buildings on the farm have been completely remodelled and now provide residential facilities the current energy consumption bears no relation to the level of consumption prior to the work. The boiler size and heat requirements were estimated from the floor space of the buildings (600m^2), insulation level and the number of occupants. The centre comprises 20 bedrooms and at peak times there are around 40 visitors and staff on site. The buildings are insulated to a high standard in the roof spaces, walls and under floors and triple glazed windows have been installed.

Project development

Initially, a feasibility study into the renewable energy options for Folly Farm was carried out in 2003. The report indicated the potential for biomass heating. Folly Farm considered various alternative technology options including wood chip, wood pellet and log boilers. The centre was keen to investigate whether they could use wood harvested from the farm woodland to fuel a wood chip boiler. However, this source was insufficient for their needs and the centre was concerned about the quality of imported wood chip. In the end it was decided that a wood pellet boiler would provide the best complement of automation and

user friendliness for staff and volunteers. It took several years of fund raising and development work before the boiler was finally commissioned in April 2008.

Boiler choice and heating plant

The chosen system was a 150 kW Greentec wood pellet boiler installed by Ashwell Engineering based in Leicestershire. A new building was built to house the boiler. The boiler house measures 8m long by 4m wide and 3m in height and is situated away from the main centre. This facility also houses a back-up boiler which uses liquid petroleum gas (LPG). Some of the centre's hot water is provided by a solar water heating system which is mounted on A-frames and set into the grass bank in front of the main building.

Folly Farm Director Philip Niemand with the 150 kW pellet boiler.

An integrated storage hopper is located within the boiler house. Pellets are moved from this area via a screw auger which feeds the combustion unit of the boiler every 30 seconds. When the boiler is at full capacity it burns 35 kg of pellets per hour.

The boiler does not have a large water storage tank (known as an accumulator tank); instead, the hot water produced is constantly circulated around the site. When the centre does not have any residents staying in the converted barns the boiler switches to a summer setting which links with the solar system to supply hot water only to bathrooms and the kitchen.

Wood fuel requirements and cost saving potential

Until Folly Farm has been running for several years it will be difficult to know the average heating requirement for the centre. This will also vary because some years will have more courses, events and visitors than others. The table below shows the annual amount of wood pellets required and savings compared to LPG and heating oil. This is based on three future scenarios. The lowest annual heating use comes from a low occupancy level similar to a primary school whilst the highest figure equates to a high occupancy level similar to a hotel.

Full load hours equivalent (FLHE)	Annual heating requirement (kWh/yr)	Annual amount of wood pellets required (tonnes/yr)	Annual cost of wood pellets	Annual cost of equivalent heating using LPG	Annual pellet savings compared to LPG	Annual cost of equivalent heating using Oil	Annual pellet savings compared to Oil
800	120,000	28.4	£5,957	£8,434	**£2,477**	£6,462	**£506**
1200	180,000	42.5	£8,925	£12,651	**£3,726**	£9,694	**£769**
1600	240,000	56.7	£11,907	£16,869	**£4,962**	£12,925	**£1,019**

Assumptions:

- FLHE is the equivalent number of hours in the year that the boiler is working at its full capacity. This is different from the number of hours in the year that the boiler is 'on'. For instance, a boiler running for eight hours in a day may not represent a continuous load at full capacity because of start-up time etc. However, FLHE takes into account the number of hours that the boiler is at part load and converts it into a single inclusive figure.
- Wood pellet boiler with an efficiency of 90% replaces a 70% efficient fossil fuel boiler.
- Calorific values: Wood pellets = 4,700 kWh/tonne; LPG = 7.4kWh/litre; Heating oil = 10.6 kWh/litre
- Current prices (as of March 2009): Pellets = £210/tonne; LPG = 36.4pence/litre; Heating oil = 40p/litre

The table above suggests that pellets are likely to be cheaper than oil and LPG. Many businesses and community buildings in Mendip AONB are heated with these fossil fuels so pellets may enable a reduction in their heating bills. The price of oil has risen dramatically in recent years reaching up to 70 pence per litre in the summer of 2008. Prices of oil fluctuate considerably but the long term forecast is for prices to remain high.

The boiler house. The right hand flue comes from the pellet boiler (the left hand flue comes from the LPG back up).

You can size a biomass boiler and calculate fuel use for your building by following the link in the more information section below.

Fuel Supply and Storage

The integrated storage hopper accommodates a maximum of 12 tonnes of wood pellets and is filled pneumatically from a blower tanker. This boiler requires 6mm pellets and the centre are currently paying £210/tonne for bulk 10 tonne deliveries. During the winter of 2008-09 the centre has been fully occupied for 20 nights and 40 days and has on average used one tonne of pellets per week.

Wood pellets made from compressed sawdust.

Operation and Maintenance

Folly Farm has signed up for an annual maintenance contract with the installer. Automatic ash removal was an optional extra with this boiler but was not installed. Instead, the weekly activity of manual de-ashing is carried out by one of the farm's large volunteer network. Each week about half a wheelbarrow of ash is removed from the trays at the bottom of the boiler. Other routine tasks include vacuuming out the boiler house and cleaning the boiler tubes using pipe cleaners that were supplied with the boiler.

Capital and Operational Cost

The overall capital costs of the installation were £75,000 including following:

- Boiler delivery, installation and commissioning
- All the pipe work, sensors and flue
- Plumbing into the existing system
- 200 m of insulated heat main
- The limestone rendered boiler house

Philip Niemand clears ash from the combustion chamber.

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. Additional funding was received from the Heritage Lottery Fund, Biffaward and SWRDA.

Carbon savings

If Folly Farm had decided to install a new LPG boiler rather than a wood pellet boiler then the centre would have produced between 33-66 tonnes of CO_2 per year depending on the three heating scenarios outlined in the table above. By contrast the biomass system is likely to result in just 3.3-6.6 tonnes of additional CO_2 emissions from moving and processing woodfuel. Therefore, approximately 30-60 tonnes of CO_2 are saved annually.

Key Lessons Learnt

One of the biggest issues that Folly Farm has had to deal with is getting a reliable and reasonably priced supply of good quality pellets. One of the suppliers they used at first supplied them with a mixture of 6mm and 8mm pellets which caused problems with the fuel feed mechanism. On other occasions they have found that some batches of pellets have been quite powdery and have broken up easily.

When visitor numbers have been low it makes sense to use the LPG back up as this is more responsive to frequent stops and starts than the pellet boiler. Most modern biomass systems allow modulation to around 30% of maximum output but they are not suited to continuous low level output. Many boilers overcome this problem with an accumulator tank which reduces the periods during which the boiler operates less efficiently at part load. In hindsight, it would have been beneficial to install an accumulator tank at Folly Farm to maximise the use of the boiler and therefore carbon savings and fuel costs.

Summary information

Boiler type	Ashwell Engineering Greentec
Installer	Ashwell Engineering
Capital cost	£75,000
Amount of wood fuel used	28-56 tonnes / year
Grant	£10,000

Contacts and more information

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