

**Energy Supply Company (ESCo):
Rural Terrace Retrofitted Micro District Heating Scheme Strathnairn.**

Max output	47 kwh
Make	Baxi automated log burner
Fuel Type	Log
Fuel specification	500 mm 100 mm diameter
Max Moisture content	25%
Installation date	Spring 2008
Backup	Open fires and immersion heaters
Woodfuel Store Capacity	4 tonne capacity in woodsheds
Annual Woodfuel Use	16 – 19 tonnes
Building	Insulation type/quality/age some way of indicating for both households
Heated Area	180 m ³
Heated volume	360 m ³
Building fabric	Stone built cottages
Building Use	Domestic
Owner	Private
Nearest town	Inverness
Region	Highland
Installation Costs	
Boiler House	£ 1,500
Boiler	£ 16,000
Network pipes	£ 1,400
Total	£ 18,900
Grant aid (£)	£ 4,000 SCHRI £ 1,000 Wind Farm Benefit
Source	SCHRI Local wind farm benefit fund
Cost Comparison	
Previous Fuel Type	Household 1 - Heating oil Household 2 - Electric
Previous Fuel Cost pa	£2500 (combined for 2 dwellings)
Wood Fuel Cost pa	£ 600

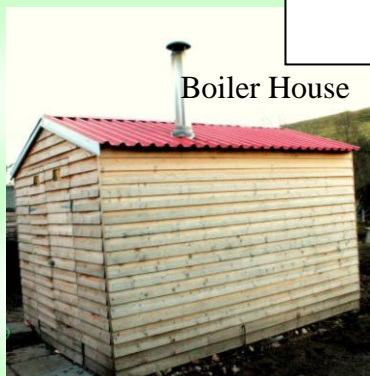
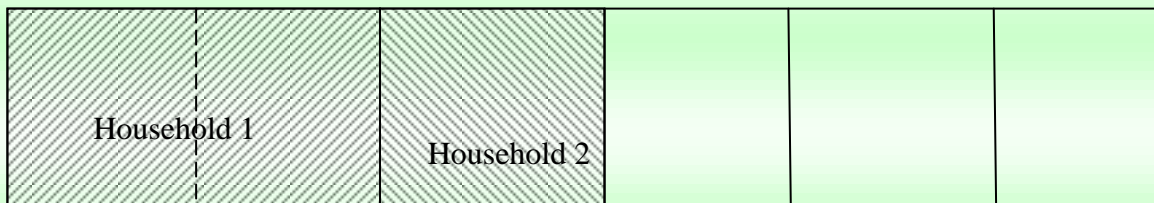


Introduction.

This is a microgrid district heating system supplying energy to two separate households by a network pipe in a six household terrace in a rural village. The external system is entirely owned by householder 1.



One household is 2 dwellings joined together, and the other is a single dwelling. The double building was previously heated by an oil Rayburn and an oil fired central heating system, while the single dwelling was heated by electricity. Both have woodfuel fireplaces. The terrace has shared access off the main road, two dwellings were being utilised as one household and the other, mid terrace, as a single household



It was decided to fit a biomass system while the two dwelling household was being renovated and made into a single dwelling. The immediate neighbours were invited to share the system. The boiler house and infrastructure being owned and operated by householder 1, with metered heat being sold to the second. Due to the access the boiler house had to be built 10metres away from the houses.

Both of the households have electric immersion heaters, one has an electric shower and both have traditional fire places to provide backup if the boiler requires repair.

The boiler house is insulated and fire lined. It was wooden clad to match the other garages and sheds in the terrace. A similar boiler system has been fitted at the back of a single garage adjacent to a house, leaving enough room to park a family car.

The log store for this boiler is about 2 metres high, 4 metres long and 1 metre wide. This holds enough wood for 6 weeks of winter heating or about 3 months of hot water in the summer. If fuel is delivered as logs it takes less than an hour to fill the wood shed.

A local saw mill has agreed to supply slab wood on a regular basis. This means that there is no need to buy and store a years supply of wood. The slab wood is dry enough to burn when it is delivered reducing the volume that is needed for storage.



Design Parameters

The boiler was required to supply heat to the two dwellings and require the minimum of maintenance. An automated log boiler and accumulator tank was chosen because it only requires loading and firing once per day in the winter and once every few days in the summer. The controls were required to be simple so that both households can operate them and the proven technology is relatively simple and robust. Log technology was chosen because fuel is readily available and cost effective over the lifetime of the boiler. One important design criterion was that the cost of the boiler and fuel should be no more than the cost of oil over the lifetime of the plant. Pellets and woodchip were considered but pellets would not fit the payback criterion and there was not sufficient energy demand or space to justify a woodchip system.



The system needed to be suitable for fitting two 150 year old stone cottages. This proved to be relatively simple, requiring an access hole below ground level in one of the dwellings and the extension of the existing wet heating system in the other.

Energy Supply Company conditions

The boiler is operated as an energy supply company (ESCO) with the owners supplying heat to the neighbour as well as their own house. Energy is priced to cover the costs of fuel and maintenance and to ensure that there will be sufficient capital to replace the boiler in the future.

The arrangement is more of a mutual benefit rather than a true business relationship, as the cost of fitting a boiler with sufficient capacity to heat two houses was marginally more than for one. The only additional cost to the owner was the additional length of district heating pipe. The neighbours fitted their own wet heating system to receive heat from the boiler.

Energy costs are calculated on an annual basis against a basket of fuels. (Oil and electricity were chosen because these were the main fuels used by the households before the biomass boiler was installed). The energy transmitted to each dwelling is monitored by heat metres and both houses pay for their energy costs. Fuel, maintenance and capital costs are taken out of the income.

The owners and the neighbours both have the right to withdraw from the agreement after giving due notice. The neighbours have retained the capacity to heat their house with electricity and a wood fuel stove, so the connection to the Baxi system is not a burden on their title deeds. This also means that if the owner sells the house and boiler system the buyer is not obliged to carry on the ESCO arrangement with the neighbour.

Responsibility for the heating system stops at the outside wall of the neighbour's house. The maintenance of the internal wet system is the responsibility of each householder.

Both householders have access to the boiler house solely for the purposes of loading the boiler and adjusting their own systems. The owner is responsible for the maintenance and servicing of the boiler.

Installation process



Statutory:

An existing shed was extensively modified to take the boiler building warrant was not necessary because the boiler is below 50 kW and was fitted in an existing building. Current building regulations(2008) require a building warrant for boilers over 50 kW or for building of a new dedicated boiler house, irrespective of the size of the boiler. A retrospective building warrant will be applied for as part of the renovation of the cottages.

Installers:

Installation proved to be complicated because the intended supplier was not accredited to fit the system for the SCHRI grant scheme. A local installer was the preferred option in case there were any maintenance or repair issues in the future. A national company was chosen to install the system because they had a local headquarters and were known to the builder carrying out the renovation work to the houses.

The supply of the boiler and accumulator tank was arranged through the installer. The contract was to design, supply and fit. The Micro grid required some specialised plumbing and the installers had extensive experience of fitting biomass systems where one boiler supplied several buildings.



Grant aid:

The application form for the SCHRI grant was very straight forward. It was necessary to demonstrate that the equipment is approved for installation by providing a reference number from a list of approved plant. The accredited installer was able to supply this. The local Wind Farm Benefit Fund paid £ 1000 on receipt of proof that the boiler had been installed by an accredited installer and approved by SCHRI.

Why Woodfuel?

Woodfuel was chosen because of environmental and economic factors. Although the cost of the boiler will take about 8 years to pay off when compared to the cost of oil and electricity, woodfuel was chosen because it allowed the houses to be heated without relying on the fossil fuel market, which was very volatile at the time that the boiler was fitted. The price of heating oil had reached £0.65 / litre, and looked set to continue to rise. As two of the houses were being renovated it seemed like a good time to remove the oil system and replace it with a biomass boiler.



Small roundwood is available from forestry companies, and timber wagons pass the cottages on a regular basis, so two metre long small diameter timber was available. These are easy to lift and cut, meaning that very little effort is required to prepare a supply of wood.

A local saw mill has agreed to supply slab wood on a regular basis. This means that there is no need to buy and store a years supply of wood. The saw mill can supply cut logs which removes the need to chain saw them, and the price is still less than half of the cost of heating oil.

How easy was it to find information on woodfuel heating?

There is a lot of information on the internet about woodfuel, but getting a firm understanding about the technology and costs was difficult. The difference between fitting a new oil boiler and a woodfuel boiler means that it is necessary to do a lot of research or to find someone who knows about woodfuel systems. A case study from Highland Birchwoods and the opportunity to look at a similar system made the decision to fit a woodfuel boiler much easier.

The grant system can be a bit confusing and it is helpful to be able to discuss it with someone who has been through it.

There was very little information on the design of micro grid systems or running a very small ESCO.

What would have made the process easier?

The process would have been a lot easier if there was an independent body which was able to look at the site and make recommendations.

The manufacturers of the boiler are not particularly easy to talk to, as biomass seems to be a recent departure from fossil fuel boilers. There is an expectation that the potential buyer knows a lot about biomass. It would be easier to talk to a local installer rather than the manufacturer.

Are you happy with the system?

One of the best features of the system is the accumulator tank. It stores the equivalent of about 130 kWh of heat, so the boiler does not need to be burning all of the time.

Although the controls are very basic, it is capable of relighting its self from glowing embers once the temperature of the tank had dropped. If it is filled with wood once per day it does not normally need to be relit for up to a week at a time. Compared with a domestic open fire or stove, the boiler requires very little effort.

The system is remarkably clean and has produced less than a carrier bag full of ash in more than six months of operation. One unexpected bonus was that the boiler house can be used as a drying room. This allows washing to be dried all year round without the need for a tumble dryer.

What would you do differently ?

The Baxi system is very simple and robust, but local installers have come on to the market with other makes of boilers since it was fitted. It would have been simpler to be able to discuss the system with the installer who was familiar with the product rather than asking a general plumbing firm to fit an unfamiliar boiler.

Fitting heat exchangers at the point of entry to the houses would protect the properties from potential water damage by limiting the amount of water in the heating system.



Would you recommend the system to others?

An automated log boiler requires a little more effort than an oil fired system, and needs space to stack and store wood which would not be possible for everyone. As this system does not have a back up boiler, it is necessary to ensure that there is always a supply of dried wood available.

The ESCO idea requires good relationships with the neighbours and we would recommend a legal binding contract.

At this level it supplies an economy of scale through the sharing of capital costs within the heating tariff rather than a true business opportunity, and anyone wishing to set up such an arrangement, should take legal advice.

What lessons would you pass on to others ?

Plan ahead, get guarantees from your installers, and make sure that you include the decommissioning of your old system after your new one has been installed and tested.

Look at other installations. The decision to fit this boiler was made after seeing a similar system.

Installing one boiler to heat more than one house reduces the capital cost of the boiler per building but does incur additional costs for network piping and heat meters. As a rule of thumb, plan an additional sum of about 10% of the boiler cost per additional household.

Buying small roundwood and cutting it yourself is a very cheap way of running an automated log boiler but it is necessary to be competent with using a chain saw. Four hours is sufficient to cut 6 weeks worth of wood. If the boiler is run as an ESCO it is necessary to factor this time as well as consumables into the cost of supplying heat.

Having logs delivered is more expensive, but saves time. Local sawmills will sometimes deliver either backs (slabs cut off of round wood) or logs cut to size. Small roundwood at £25 / tonne has an energy cost of about 0.7 pence per kWh but requires cutting and splitting. Sawmill backs at £ 60/ tonne supplied in 50 cm lengths have an energy cost of about 1.7 p / kWh and do not need to be sawn or split. For comparison Heating oil at £0.46 / litre equates to 4.51 p / kWh.

The system was planned when heating oil prices were about £0.65 per litre. This has now fallen to about £0.46 / litre. This has increased the payback time. As an owner of a boiler in a small ESCO it is important to be sure that the cash flow does not depend on a temporarily high energy price.

LIFETIME COSTS

Fitting an automated log boiler to two households displacing oil and electricity heating.

The lifetime costs of the boiler have been calculated using the following assumptions.

Assumptions:

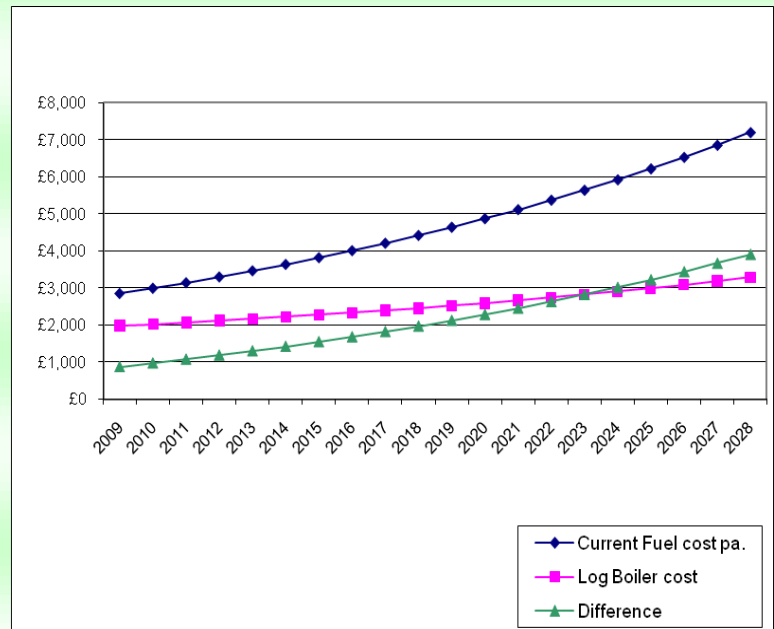
1. Oil costs rise at 5% pa.
2. Oil price based on 4th quarter 2009 at £0.0451 per kWh (46 p / litre)
3. Electricity price based on £0.13 / kWh.
4. Previous energy use = 2500 litres oil and 15000 kWh electricity compounded for both houses.
5. Wood costs rise at 3% pa.
6. The capital cost of the boiler is paid over 20 years at 5% interest rate
7. No capital costs for replacing the oil boiler have been included

It is very difficult to estimate fossil fuel or biomass inflation, and recent years have shown that the annual variation can be very large.

Using the assumptions above, the graph below shows the annual difference in cost for a woodfuel boiler compared to the combined oil and electricity costs for the previous heating systems.

Costs are based on previous energy use. Woodfuel prices have been based on the delivery price of £60 / tonne for 50 cm long sawmill backs, and no cost has been attributed to the labour costs of cutting, chopping or stacking the wood.

The capital cost of the boiler has been included with a 6% compound interest rate added to the annual residual outstanding cost. The cost of the boiler has been calculated over 20 years. Grants have been deducted from the capital cost.



The inflation rate for oil (5%) will multiply the cost by about 2.5 over 20 years.

Based on the above assumptions, the cost of running the automated log boiler for the two houses will be less in 2029 than the cost of running an oil boiler in 2008. The overall

saving in 20 years will be £ 43,000 at today's prices(2010). The system will have broken even in eight years if fuel prices and inflation follow the assumptions above.

Carbon dioxide savings.

Based on the estimated previous use of oil and electricity, the energy demand of the buildings is about 40 MWh per annum. This would produce about 14.25 tonnes of carbon dioxide (CO₂)

Assuming that all of this energy is supplied by logs, the woodfuel CO₂ emissions will be about 0.74 tonnes, or 5.19 % of the oil emissions. These figures have been calculated from "The Carbon Balance of Woodfuel" (Highland Birchwoods 2007)

<http://www.highlandbirchwoods.co.uk/UserFiles/File/publications/Woodfuel/carbon%20balance%20report.pdf> assuming 2500 litres of heating oil and 15000 kWh of electricity are displaced by about 11.6 tonnes of woodfuel to supply the gross demand of about 40MWh.