



Rural biomass community heating: a case study

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Cover: Arrival of the boiler at Llanwddyn, © Dulas Ltd

# Rural biomass community heating: a case study

## 1. Introduction

Home energy use is responsible for over a quarter of UK carbon dioxide (CO<sub>2</sub>) emissions which contribute to climate change. To help mitigate the effects of climate change, the Energy Saving Trust has a range of technical solutions to help UK housing professionals build to higher levels of energy efficiency.

Reduction of carbon emissions and elimination of fuel poverty are two of the Government's key objectives – and community heating has an important and decisive role to play.

Community heating links buildings with houses via a system of pipes (known as a heat network) with heat provided from a central source. Community heating can increase the efficiency of fuel consumption through combined heat and power (CHP) or enable fuel switching to make use of renewable sources. When the fuel used is carbon neutral, locally sourced and where Government funding is available, community heating can contribute significantly to reducing CO<sub>2</sub> emissions and regenerating rural communities for local authorities.

This case study demonstrates the potential of biomass as an energy source for community heating in a rural setting. It tracks the process from feasibility and funding through to implementation and the lessons learnt. It will be of special interest to local authorities and housing associations that cover rural areas of the UK.

## 2. Scheme background

Llanwddyn is a small community in the remote forested Vyrnwy valley in Montgomeryshire, Wales. The majority of land, forest and approximately half of the houses in the valley are currently owned by Severn Trent Water.

The remainder of the 42 houses that make up the community are in private ownership. The houses, which were built in the 1950's, are situated around a school and a community centre. The community has a high proportion of retired, low income and unemployed residents. It is not on the gas network and heating systems in the houses include open coal fires, electric storage heating and oil systems.

The community has historically depended on forestry and land management for its income.

## 3. Feasibility study and consultation

In 2000, Vyrnwy Forum, a local community group, commissioned Powys Energy Agency to investigate options for boosting the local economy, to be based on the plentiful local wood resources. In 2001, Powys Energy Agency carried out the investigation with the help of the Forestry Commission and with funding from the Energy Saving Trust.

The investigation comprised:

- Energy audit of the community centre and school.
- Energy survey of the existing houses.
- Consultation with the school, community centre and local residents, as well as stakeholder bodies including Powys County Council and Severn Trent Water Ltd.

The energy audit of the school and community centre found that the existing 50 year old oil-fired heating system was in need of replacement. This, coupled with the running costs of the existing system, indicated that the economics of switching to an efficient wood-fuelled heating system would be favourable.

Biomass is organic material which has stored sunlight in the form of chemical energy. Harvesting biomass such as crops, trees or dung and using it to generate energy (heat, electricity or motion) is called bioenergy. More information on bioenergy can be found in the Energy Saving Trust's publication 'Renewable energy sources in rural environments' (CE70).

Powys Energy Agency and the project steering group were keen to connect the houses, the school and the community centre to a wood-fuelled boiler via a heat network.

Community consultation and awareness raising are essential to the development of a successful wood-based community heating scheme, a lesson learnt from the experiences of other European countries.

Powys Energy Agency ensured that the local community were thoroughly consulted. They held a number of public meetings, produced articles for the local press and carried out two questionnaires. The objective was to gauge local interest and identify and address any of the residents' concerns. The questionnaires achieved a 50% response rate.

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Ten households expressed immediate interest. This number had risen to 19 by January 2003 and increased further to 25. Of these, 13 already had water-filled radiator systems that could be connected to the heat network. However, the remainder needed to have wet heating systems installed.

The underlying aims of the project were to:

- Create local employment supplying fuel and operating a wood-fuel heating system for the school and community.
- Reduce carbon emissions by providing a non-fossil fuel alternative heat source.
- Reduce heating costs for public and domestic buildings in the village.

Powys Energy Agency continues to source funding to support the installation of internal wet central heating systems for the remaining properties and, in the medium term, to enable energy efficiency improvements to be made in the buildings.

## 4. Standard Assessment Procedure rating

The Standard Assessment Procedure (SAP) for Energy Rating of Dwellings is a measure of the predicted energy costs based on space and water heating. The scale is 1 to 120, with 1 being the poorest rating. The SAP rating of the 21 dwellings for which information was available varied from 1 to 75 (see figure 1). Of this sample, about half of the occupants were on some form of benefit. The poor SAP ratings and low incomes indicated that there was very likely to be a high level of fuel poverty in this community.

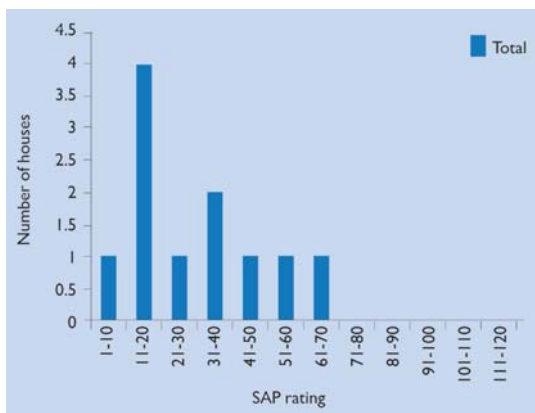


Figure 1: SAP rating distribution of existing houses sample

Table 1: Scheme finance

Grant / loan / contribution	Amount	Source
Grant	£114,200 (30.5% capital costs)	European Regional Development Fund
Grant	£163,200 (43.5% capital costs)	Local Regeneration Fund (Welsh Assembly Government via Powys County Council)
Grant	£47,459 (12.5% capital costs, 26% eligible costs)	Community Energy programme capital costs: boilers, site preparation and design.
Grant	£50,000 (13% capital costs)	Welsh Development Agency

## 5. Scheme finance

In common with all community heating schemes, the initial capital costs were relatively high. Due to the location and perceived benefits of the scheme, several avenues of grant funding were available and it was able to attract 100% grant funding.

The sources of funding were the European Regional Development Fund and the Local Regeneration Fund, which between them covered 74% of the capital costs. The Welsh Development Agency through the Rural Recovery Fund contributed 13%. Powys County Council also applied successfully to the Government's £50 million Community Energy programme for grant funding which was available for up to 40% of the capital costs of a scheme. The total project cost was £375,000.

## 6. Energy Service Company

Powys County Council invited Energy Service Companies (ESCOs) to submit bids to design, build and operate the wood-fuelled district heating system.

An ESCO is a company that contracts to provide an energy service, which may be defined in terms of agreed conditions for occupants. The traditional definition of an ESCO refers to the complete energy package i.e. 'energy supply measures concerned with its efficient use'. Under this definition, the ESCO would be concerned with maximising efficient and cost-effective supply to, and use of, energy by their customers.

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A condition of the capital grant funding was that the infrastructure, including boiler, heat and distribution network, domestic interfaces and fuel storage shed, must be owned by a public sector organisation. The infrastructure will remain the property of Powys County Council, who would then lease the infrastructure to the successful ESCO.

High levels of fuel poverty in the community initiated one of the underlying aims of the project, which was to reduce heating costs for public and domestic buildings in the village. Therefore a key assessment criterion for the tenders was the delivered heat price.

Additional key assessment criteria were:

- Technical experience
- Financial footing
- Technical solution; robustness and flexibility
- Customer service and billing plan
- Wood-fuel price
- Company origin (Wales)
- Local employment
- Community liaison
- Understanding of concept; new approaches suggested
- Cost

To ensure that the successful ESCO tackled the fuel poverty issues, Powys County Council specified that:

- User fees should be based on the quantity of heat consumed – each connection being metered.
- Delivered heat price should be lower than that currently paid, based on cost of oil.
- Heat price should be fixed for the length of the contract, with inflation allowances.
- The ESCO should develop a strategy to assist low-income houses to budget for heat.

Other important issues covered were:

- Community consultation
- Boiler siting
- Insurance
- Reliability of supply and service level
- Planning

The main issues for a biomass heating scheme to address in order to obtain planning permission are:

- Water and air emissions
- Ash disposal
- Operating noise levels for boiler
- Stack height
- Traffic levels (during both construction and regular fuel deliveries)
- Appearance of boiler house

As this is a relatively young industry few local organisations had the technical capabilities and knowledge to carry out this work.

## 7. Implementation

Under a design and build contract the ESCO constructed a dedicated boiler house and designed and installed the heat system.

Severn Trent Water donated the site for the boiler house and fuel store which was located close to the school. The school site is owned by Powys County Council and houses the boiler.

Currently the two main types of wood-fuel for automatic feed boilers are wood-chip and wood-pellet. Due to the availability of wood from local forests and nearby space to store and chip, it was considered that wood-chip was the more appropriate fuel. Wood-pellet, whilst requiring less storage space, is more expensive and there is currently very limited pellet production.

In October 2003, a 600kW wood-chip boiler was installed, linked to a smaller backup oil-fired boiler rated at 315kW. The boilers were sized to meet the full load of the school, the community centre and all 42 dwellings in the immediate vicinity, should they all wish to join.

### 7.1 The heat network

Heat from the boilers is delivered to the school, community centre and the houses via the heat network. The heat network consists of plastic pipes buried one metre below the ground and located along the roads for ease of access. It also ensures that it is easy for houses wishing to join the scheme in the future to do so. The pipes are then connected to each building's central heating network via a heating interface unit.

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## 7.2 Fuel and storage

The contract specified that at least 60% of the wood-chip fuel for the boiler would be sourced within a 15 mile radius of Llanwddyn. For the first year of operation Forestry Commission Wales have supplied and delivered 200 tonnes of small round wood to the fuel storage facility at no cost. Beyond this period Forestry Commission Wales are happy to agree a long-term supply contract from the local estate.

For long term sustainability of a community heating project it is important that fuel prices are guaranteed by contract for fixed periods. If buying wood by weight, it is also important to agree the moisture content of the wood, as this affects its potential heat production.

The fuel will be delivered to a storage facility located 200 metres from the boiler house where it will be seasoned outside for 12 months, before being chipped for use. It is estimated that two deliveries from the storage facility to the boiler per week will be necessary. These take place in accordance with health and safety procedures and using a high tip trailer drawn by a tractor. The fuel reception is constructed in fabricated steel with a lifting lid.



Figure 2: Arrival of boiler at Llanwddyn

## 8. Scheme benefits

Although the scheme is at the time of writing still under construction, the wood-chip boiler is in place, with the school and community centre connected

via the heat network. Improvements to the school insulation levels have lowered the heat load to below projections in the early stages of project development.

The houses are not yet connected. Therefore, given that the full anticipated load is not yet operational, the wood-chip boiler has been running at below its rated capacity. Because this is not ideal, the wood-fuel boiler has been turned off until the entire network is connected. The back-up oil fired boiler is being used instead. When the houses come on-line this will extend the heating load and increase the peak load, enabling better use of the wood-chip boiler.

### 8.1 Carbon dioxide

The installation of wood-fuel heating for the school, community centre and the outlying houses is predicted to save 1,805 tonnes of CO<sub>2</sub> over the next five years.

The use of wood-fuel to offset other heating fuels will reduce pollution levels regionally. The relative emissions factors for a number of fuels are shown in figure 3. It can be seen that wood-fuel has by far the lowest CO<sub>2</sub> factor of all fuels and also has comparable or lower SO<sub>x</sub>, NO<sub>x</sub> and particulate emissions.

### 8.2 Fuel cost savings

A pricing strategy needs to provide both sufficient annual cost savings for potential customers and a sustainable income for the fuel supplier. A sustainable level of wood-chip sales and sufficient incentive for heat customers coincided at around £39 per tonne (at 40% moisture). More detailed calculations show that this would achieve an approximate reduction of 18% in total fuel costs.

Based on this projection, the agreed heat price for domestic customers was 2.65p/kWh. The heat for the community centre and school is charged at 2.45p/kWh. This charge covers all fuel, operation and maintenance costs. Capital equipment costs were covered by the capital grants as detailed in part 5 (scheme finance).

It is estimated that the school and community centre will save £750 per year compared to previous consumption patterns. The present domestic average heating cost is around £450 per year. Annual savings for domestic consumers are predicted to range from £20 for oil fired heating, to £210 for off-peak electricity. It should be remembered that some occupants might opt for improved comfort levels over financial savings.

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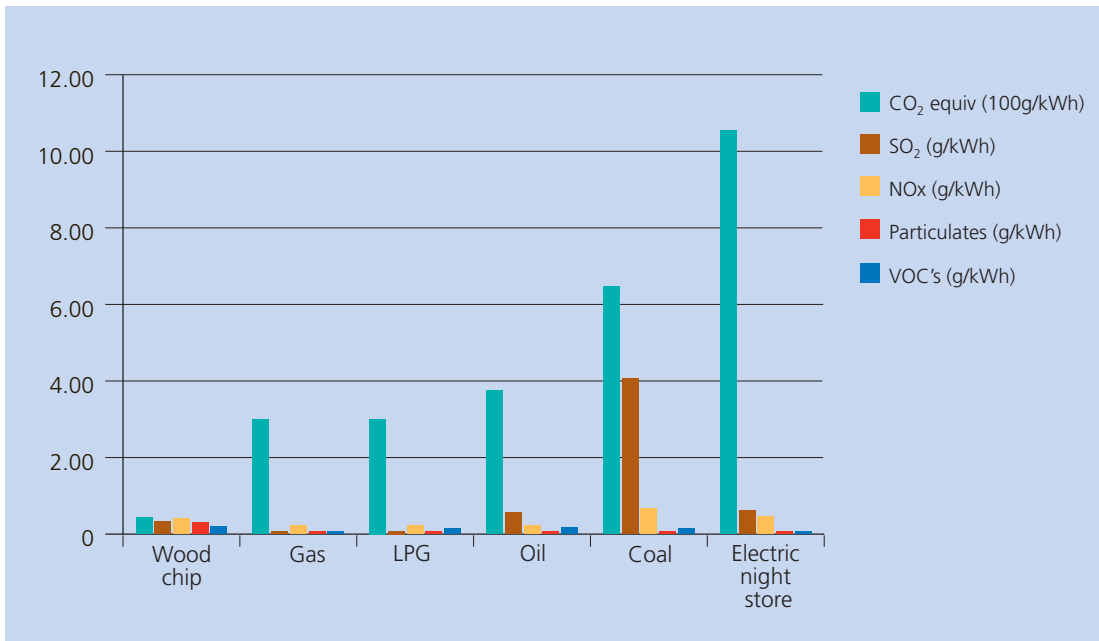


Figure 3: Emissions from heating installations

## 8.3 Community benefits

The regular fuel supply required for a local wood-chip boiler provides an outlet for low-grade timber. This can enhance the return from woodland management and yield a host of sporting, amenity and ecological benefits. Production of wood-fuel also retains money spent on energy within the local economy, creating important employment opportunities in fuel processing and transport.

## 9. Lessons learnt

The main lessons that Powys County Council have learnt are:

- The idea for the scheme came from the community – this ensured greater community support.
- Compromises have to be made between what is technically best practice and what is supported by the community.
- There is a lack of technical experience in this field – reflected in the limited number of responses to the tender.
- It is useful to have an example of wood energy heating nearby that can be visited – in this case Webbley School.
- A scheme becomes more economically viable if several different types of load, with different demand profiles, can be connected together.
- Two small boilers could be considered instead of a single large one to better match boiler output to demand over the year.
- Involve an organisation's building service expertise as soon as possible – they are familiar with heating design and contractual details.
- It is important to keep everyone informed of intentions and activities, providing plenty of opportunities for consultation, discussion and feedback.
- Timing of the scheme is very important, particularly when schools are involved. For example, school holidays dictate when work can be carried out. Connecting domestic properties is also much easier outside the heating season.

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## 10. The future

The scheme is not fully operational, as the houses are not yet connected to the heat distribution network. Therefore a full evaluation cannot be made. Powys County Council currently have no plans to replicate this scheme. However they are looking at the feasibility of installing a wood-fired boiler in a leisure centre located close to a school.



Figure 4: Pipes for heat network

## 11. Further information

### Combined Heat and Power Association

Grosvenor Gardens House  
35–37 Grosvenor Gardens London SW1W 0BS  
Tel: 0207 828 4077  
Fax: 0207 828 0310  
Email: [info@chpa.co.uk](mailto:info@chpa.co.uk)  
Web: [www.chpa.co.uk](http://www.chpa.co.uk)

### The European Regional Development Fund (ERDF)

ERDF is a funding programme which helps stimulate economic development and regeneration in the least prosperous regions of the European Union (EU). ERDF has already helped a wide variety of projects; all are designed to benefit the regional or local economy.  
Web: [www.communities.gov.uk/citiesandregions/european](http://www.communities.gov.uk/citiesandregions/european)

### The Community Energy programme

The Community Energy programme, managed jointly by the Energy Saving Trust and the Carbon Trust, provided guidance and funding for the refurbishment of existing, and installation of new, community heating schemes in the public sector across the UK. The programme closed as planned on 31st March 2007. Please contact the Department for Environment, Food and Rural Affairs (Defra) with any queries on 08459 335577.

### Welsh Development Agency

The functions of the Welsh Development Agency, a former Assembly Sponsored Public Body, are now part of the Welsh Assembly Government's Department of Enterprise, Innovation and Networks.  
Web: [www.wda.co.uk](http://www.wda.co.uk)

### British Biogen

British Biogen is the trade association to the UK Bioenergy industry and has a list of members on its website.  
Web: [www.britishbiogen.co.uk](http://www.britishbiogen.co.uk)

### International Energy Agency (IEA)

The IEA has its own Biomass website  
Web: [www.ieabioenergy.com](http://www.ieabioenergy.com)

### Acknowledgements

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### Powys County Council and Powys Energy Agency

### Dulas WoodEnergy Ltd



Figure 5: The boiler house



### Further reading

The Energy Saving Trust provides free technical guidance and solutions to help UK housing professionals design, build and refurbish to high levels of energy efficiency. These cover all aspects of energy efficiency in domestic new build and renovation. They are made available through the provision of training seminars, downloadable guides, online tools and a dedicated helpline.

A complete list of guidance categorised by subject area can be found in our publications index 'Energy efficiency is best practice' (CE279). To download this, and to browse all available Energy Saving Trust publications, please visit [www.energysavingtrust.org.uk/housing](http://www.energysavingtrust.org.uk/housing)

### Guides

- Benefits of best practice: Community heating (CE13)
- Community heating – a guide (CE55)
- Renewable energy sources in rural environments (CE70)

### Case studies

- BedZED, Beddington zero energy development, Sutton (GIR89)

- Community heating: Aberdeen City Council case study (CE65)
- Community heating serves luxury private apartments: a case study (CE103/GPCS400)
- Renewable energy in housing – case studies (CE28)

To obtain these publications or for more information, call 0845 120 7799, email [bestpractice@est.org.uk](mailto:bestpractice@est.org.uk) or visit [www.energysavingtrust.org.uk/housing](http://www.energysavingtrust.org.uk/housing)

### The Carbon Trust

The Carbon Trust also produces the following publications, which are available from [www.thecarbontrust.co.uk/energy](http://www.thecarbontrust.co.uk/energy) or the helpline number on 0800 085 2005.

- CHP opportunities for local authorities (GPG322)
- Guide to community heating and CHP – commercial, public and domestic applications (GPG234)
- Community heating for planners and developers (GPG389)

### The Community Energy Programme

The following Community Energy Programme publications are available to download from [www.energysavingtrust.org.uk/housing](http://www.energysavingtrust.org.uk/housing)

- Small scale community heating
- Community heating and combined heat and power
- Community heating for planners and developers
- Connecting CHP in community heating to the electrical network



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