



# Energy Efficiency Best Practice in Housing

## Rural biomass Community Heating case study

### Llanwddyn, Powys County Council

A guide for local authorities and housing associations covering rural areas of the UK



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## Introduction

Energy Efficiency Best Practice in Housing is a Government funded initiative which promotes current best practice standards to building professionals.

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 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, finally, the lessons learnt. It will be of special interest to local authorities and housing associations that cover rural areas of the UK.

## 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 – 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.

## Feasibility study and consultation

In 2000, Vyrnwy Forum, a local community group, commissioned Powys Energy Agency to investigate options for boosting the local economy which would 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 (EST).

The investigation comprised: (1) energy audit of the community centre and school, (2) energy survey of the existing houses and (3) 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 Renewable energy sources for dwellings for rural environments (CE70) and Community heating using new and renewable sources

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, where such schemes are more common. 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.

Ten households expressed immediate interest – this number had risen to 19 by January 2003 and is now 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:

- 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.

## Existing domestic fuel costs

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. 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 are on some form of benefit. The poor SAP ratings and low incomes indicate that there is very likely to be a high level of fuel poverty in this community.

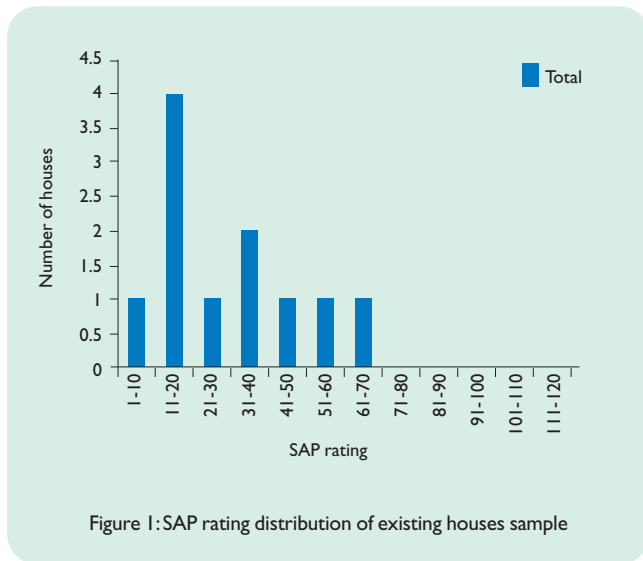


Figure 1: SAP rating distribution of existing houses sample

## 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 covered 73% 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 £50m Community Energy programme for grant funding which was available for up to 40% of the capital costs of a scheme. For more information on the current process and criteria of the Community Energy programme see the contact details at the end of this publication. The total project cost was £375,000.

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

## Energy Service Company (ESCO)

Powys County Council invited 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.

More on ESCOs can be found in the Community Energy guide Financing community energy schemes

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 gave rise to one of the underlying aims of the project – 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.

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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
- local employment
- 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, the operating noise levels for the boiler, the stack height, traffic levels (during both construction and regular fuel deliveries) and the appearance of the boiler house.

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

## 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.

### 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.

More on design of heat networks can be found in Guide to community heating and CHP – commercial, public and domestic applications (GPG234)

### 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

## 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.

## 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 5 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.

## 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 the Scheme Finance section.

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.

## Social 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.

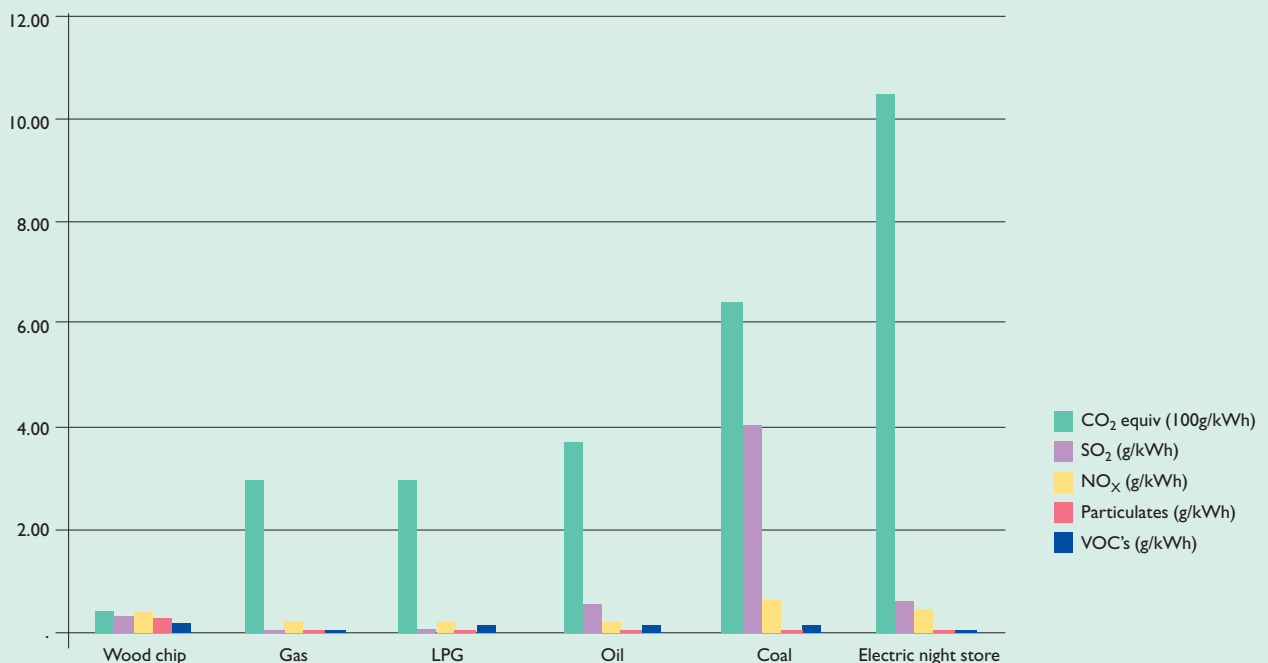


Figure 3: Emissions from heating installations

## Lessons learnt

The main lessons that Powys County Council have learnt are:

- champions are important
- the idea for the scheme came from the community – which ensured greater community support
- technically best and community support do not always go hand in hand – compromises have to be made
- 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

## 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: Installation of the heat network

## Further reading

### Energy Efficiency Best Practice in Housing

These publications can be obtained free of charge by telephoning the Helpline on **0845 120 7799** or by visiting the website at [www.est.org.uk/bestpractice](http://www.est.org.uk/bestpractice)

### Guides

Benefits of Best Practice: Community Heating (CE13)  
Community Heating – a guide (CE55)  
Renewable energy sources for dwellings for rural environments (CE70)

### Case studies

BedZED, Beddington zero energy development, Sutton (GIR089)  
Community Heating – Aberdeen City Council case study (CE65)  
Community Heating serves luxury private apartments (GPCS 400)  
Opportunities for electricity sales to tenants from residential CHP schemes (NPPI 12)  
Renewable energy in housing – case studies (CE28)  
Selling CHP electricity to tenants – opportunities for social housing landlords (NPR I 13)

### The Carbon Trust

The Carbon Trust also produce the following publications, which are available from [www.thecarbontrust.co.uk/energy](http://www.thecarbontrust.co.uk/energy) or the helpline number on 0800 58 57 94.

CHP opportunities for local authorities (GPG322)  
Energy services PPP/PFI projects for community heating (NPPI23)  
Guide to community heating and CHP – commercial, public and domestic applications (GPG234)  
Small-scale combined heat and power for buildings (GPG 176)  
The manager's guide to packaged combined heat and power systems (GIR082)  
The use of combined heat and power in community heating schemes – four case studies (GPCS370)  
Using the PFI for the upgrade and extension of community heating (NPR 123)

## 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  
Web: [www.chpa.co.uk](http://www.chpa.co.uk)  
Email: [info@chpa.co.uk](mailto:info@chpa.co.uk)

### The Community Energy programme

The Community Energy programme, managed jointly by the Energy Saving Trust and the Carbon Trust, has provided guidance and funding for the refurbishment of existing, and installation of new, community heating schemes in the public sector across the UK April 2002–March 2005. For further information, contact the helpline number on 0870 850 608 or visit [www.est.org.uk/communityenergy](http://www.est.org.uk/communityenergy).

The following publications are available to download from [www.est.org.uk/communityenergy](http://www.est.org.uk/communityenergy)

Financing community energy schemes  
Community heating using new and renewable sources

Support for renewables can also be obtained from [www.clear-skies.org](http://www.clear-skies.org)

### European Regional Development Fund

Structural Funds are the European Union's main instruments for supporting social and economic restructuring across the Union. They account for over a third of the European Union budget. The European Regional Development Fund aims to improve economic prosperity and social inclusion by investing in projects to promote development and encourage the diversification of industry into other sectors in areas lagging behind. Further information is available from [www.dti.gov.uk/europe/structural.html](http://www.dti.gov.uk/europe/structural.html)

### Welsh Development Agency

The Welsh Development Agency is a sponsored body of the Welsh Assembly Government. Further information is available from [www.wda.co.uk](http://www.wda.co.uk)

### British Biogen

British Biogen is the UK trade organisation, and has a list of members on its website: [www.britishbiogen.co.uk/](http://www.britishbiogen.co.uk/)

### International Energy Agency (IEA)

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

### Acknowledgements

Energy Efficiency Best Practice in Housing would like to thank the following individuals and organisations for their assistance in preparing this case study.

### Powys County Council and Powys Energy Agency

Web: [www.powysenergy.org.uk](http://www.powysenergy.org.uk)

### Dulas WoodEnergy Ltd

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

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