Energy Efficiency Best Practice in Housing

Pimlico District Heating Undertaking – a case study of community heating

ENERGY EFFICIENCY
SAVE ENERGY MONEY ENVIRONMENT

Energy Saving Trust

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Introduction

Home energy use is responsible for 28 per cent of UK carbon dioxide emissions which contribute to climate change. By following Best Practice standards, new build and refurbished housing will be more energy efficient and will reduce these emissions, saving energy, money and the environment. Energy Efficiency Best Practice in Housing is a Government funded initiative, which promotes current best practice standards in housing to building professionals.

Community heating plays an important role in the reduction of carbon emissions and elimination of fuel poverty – two of the Government's key objectives.

Linking buildings by a system of pipes (known as heat mains) can reduce fuel consumption and allow fuel switching to take advantage of changing markets.

In this case study we look at the refurbishment and expansion of one of the UK's oldest community heating schemes. We also show how CityWest Homes secured capital funding through the Community Energy programme.

Our purpose is to:

- encourage local authorities to explore local heat source opportunities;
- inform organisations whose existing community heating schemes are due for refurbishment; or who are considering connecting buildings to an existing heat network in their area.

The history of Pimlico District Heating Undertaking (PDHU)

Battersea power station was planned in the mid-1920s to help meet London's rapidly rising demand for electricity. Owned by the London Power Company, Battersea was to be a power station capable of generating 400 megawatts – equivalent to the combined output of their nine existing stations.

The station was to be built in two phases. Construction began in 1928 and the first phase commenced electricity generation in 1933.

When Battersea power station was built, the idea of an associated community heating scheme was discussed.

The power station's thermal efficiency was poor, with 70 per cent of the heat raised from the coal ending up in the River Thames. However, thermal efficiency and energy conservation were not the driving force behind the development of a community heating scheme – it was the poor air quality across London caused by widespread coal burning. In 1952 this issue was to have devastating consequences when an anticyclone settled over London, causing smog. The deaths of 4,000 Londoners were directly attributable to the resulting increase in air pollutants.

The year 1950 saw the construction of PDHU as Westminster City Council commenced building Churchill Gardens on the north side of the Thames.

Churchill Gardens is still Westminster's biggest estate. PDHU was one of the first UK examples of a CHP scheme. Heat was piped across the Thames from Battersea power station via 12-inch pipes through a tunnel owned by the Metropolitan Water Board, to a pumphouse on the north side, and then to the network.

What is community heating?

A community heating scheme provides heat from a central source to more than one building or dwelling via a network of heat mains. Heat can be supplied from conventional boilers or boilers using renewable energy sources. The waste heat from power generation, known as combined heat and power (CHP) can also be used.

Community heating is appropriate for relatively dense housing. It is most cost-effective where an existing heat network can be refurbished and retained, or where electric heating is replaced?

What is CHP?

When electricity is generated using conventional generation technology, most of the energy in the fuel is lost as waste heat. CHP systems recover this waste heat which can be used for community heating in conjunction with centralised boilers. CHP thereby utilises fuel very efficiently, minimising the environmental impact and leading to very low heat production costs.

Figure 1: Photos of pipework below the Thames and the old style control room

The times of high demand for electricity and heat differ. Consequently PDHU has a thermal store (a 41m tall tower), which stores 2,500 tonnes of water just below boiling point. The accumulator enables electricity to be generated irrespective of heat demand. Excess heat is stored for use in periods when heat demand exceeds that available from electricity generation.

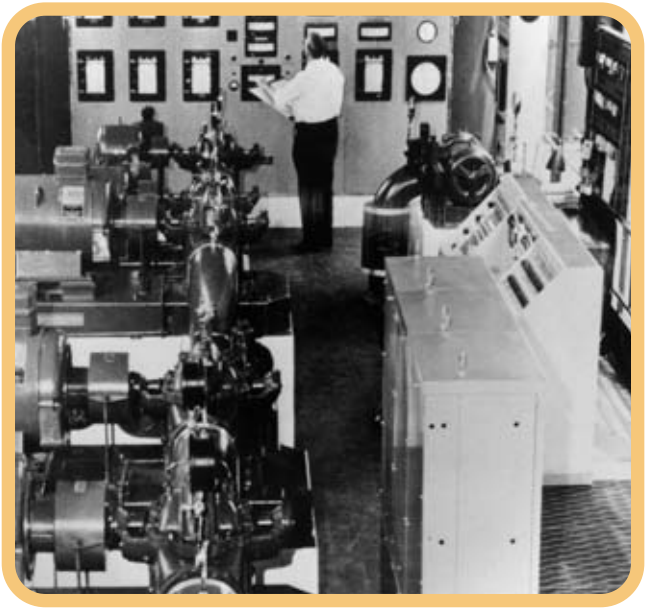

Figure 2: The old boiler house

CityWest Homes - arms length management organisation

CityWest Homes was established in April 2002 as an arms length management organisation (ALMO), wholly owned by Westminster City Council and originally formed from the section of the council's housing department responsible for the delivery of landlord services. CityWest Homes manages Westminster's housing stock of 22,000 homes. These are predominantly flats and maisonettes with 14,000 tenanted and 8,000 leasehold.

Figure 3: Existing housing stock

A stock survey in 2002 found that 9,500 of the 14,000 tenanted dwellings did not meet the Government's Decent Homes standard. CityWest Homes' key objective is to ensure that all tenanted properties achieve this standard by 2006.

Following a £12 million investment to improve energy efficiency, Westminster City Council housing stock performs relatively well with a mean SAP rating of 60. Now the aim is to improve the energy efficiency of every home in Westminster by 30 per cent in the next 15 years. With 50 communal heating schemes (either block or community schemes), community heating will continue to play an important part in CityWest Homes' strategy.

PDHU today

In 1980 Battersea Power Station closed down. A boiler house with heat-only boilers with an output of 30MWh was built on the site to ensure continuous heat supply. Initially coal fired, they were converted to gas in 1989. The boilers were heat only, resulting in the loss of efficiency of CHP. This heat supply is guaranteed until 2010.

Some 3,100 dwellings, 48 commercial premises and one school are currently connected to the heat network.

Controlled use across the system – monitoring

As the scheme covers such a wide area, diagnosis of system failure used to be very time consuming, with six people employed on site.

Now CityWest Homes has a computerised control station at the Energy Centre. It monitors and controls temperatures at buildings throughout the network. It also ensures that the optimum amount of energy is used to achieve the required heat levels. The building management system enables a high level of reliability, which is of fundamental importance to users and to the future support of the scheme.

An advanced leakage monitoring system enables moisture penetration into the lagging to be detected and dealt with before any leaks can occur due to corrosion. This prevents loss of service to the heat users.

Figure 4: Monitoring system

Reintroduction of CHP and extension of the network

The Battersea power station site will be redeveloped in the near future. Whilst the current heat supply is guaranteed until 2010, CityWest Homes have identified the need for a new boiler house, ideally on the north side of the Thames. They are keen that PDHU should regain its former status as one of the UK's most celebrated CHP schemes.

CityWest Homes also wish to extend the heat network to provide low cost heating to additional buildings.

The first stage of this scheme extension is the addition of Abbot's Manor 'B', which includes Glastonbury, Dryburgh and Furness Houses as well as the National Statistics Office, Pimlico School, Churchill Gardens School and St Gabriel's School.

The scheme extension will help to spread the fixed overheads and contribute to lower heating costs for the residents.

Community heating specialists have carried out a detailed feasibility study, funded by the Community Energy programme. The study compared options using a discounted cash-flow analysis in accordance with the Treasury 'Green Book' guidelines (See reference 1 – page 7).

For the existing heat loads the following five options were feasible for the future of the PDHU.

1. Maintaining the heat supply from existing heat supplier – renegotiating a long term contract.
2. Installing new boilers at the pump house and terminating the supply from the existing heat supplier.
3. Installing new boilers and CHP at the pump house and terminating the contract with existing heat supplier.
4. Installing a new CHP plant at the pump house but retaining heat supply for the balance of the heat from existing heat supplier.
5. Removing the district heating system and installing individual boilers.

Both option 4 and option 5 were dismissed prior to the detailed feasibility study. Option 4 was considered to be a complex option as it would require two separate heating plants. This would have been inefficient in terms of both staffing and maintenance. There would also have been difficulties setting up a contract with the existing heat supplier to ensure optimum operation. Option 5 was not considered further as it would have been very costly to implement with no environmental benefit.

Table 1: Net Present Cost for 25 years of heat supply

PDHU options	Existing loads	Existing and all new loads
	£m	£m
Option 1	15.5	22.4
Option 2	14.2	21.3
Option 3	11.3	17.9

As a result of the feasibility study CityWest Homes have decided to install:

- high efficiency boilers for winter peak demand and backup (3 x 8MWe); and
- two 1.55MWe CHP engines, which will generate enough heat to support the summer baseload.

Although options 2 and 3 offer lower lifecycle costs than option 1, there are differences in the capital investment required. Option 3 requires greater capital investment. A financial model was constructed to establish whether this could be funded. In addition to funding feasibility studies the Community Energy programme also provides capital grant funding, to address capital cost differences such as these.

Scheme of works

On 1 September 2004, Dryburgh House and Furness House were connected to the scheme adding a total of 64 flats.

Churchill Gardens School will be connected in early 2005 and Glastonbury House, which is a 22-floor tower block containing 160 flats, will be connected from April 2005.

Discussions are currently being held with Barrat Homes to connect a new development of 63 flats, 11 town houses and a health centre to the scheme. Discussions are also in progress with Pimlico School.

The National Statistics Office, which was due to connect, is currently on hold due to staff relocation and their unknown future requirements.

In respect of the new boiler house detailed design is to be finalised by the end of this year and the boilers and CHP engines have been ordered. Some site work has now commenced, including the installation of the gas main with the project programmed for completion by November 2005.

Scheme finance

CityWest Homes applied for Community Energy programme capital funding in January 2003.

Scheme funding	Percentage of total cost	Cost £
Community Energy programme	27%	1,203,880
EEC Funding – Powergen	8% (50% cost of CHP engines)	360,000
Westminster City Council	65%	2,894,935
Total	**100%**	**4,458,815**

CityWest Homes considered a number of funding options, including Energy Efficiency Commitment (EEC) funding and additional finance opportunities through the formation of an Energy Service Company (ESCO).

33 per cent of scheme funding was originally to be obtained from the Transco Affordable Warmth programme. However, with increasing bank interest rates and static local authority interest rates, Westminster City Council decided that a loan was a better option.

EEC funding was obtained for the CHP engines in addition to the Community Energy programme funding. The predicted scheme carbon savings from the CHP engines will be split equally between both schemes, The ESCO formation route was also rejected as CityWest Homes wished to maximise the long-term savings and pass them directly to residents in the form of reduced energy costs.

The M & E (mechanical and electrical) upgrade will cost approximately £1,000 per dwelling. Whilst dwellings will not be individually metered, sophisticated controls at block level ensure that the temperature for each block is controlled via a weather compensator. CityWest Homes decided that they would continue to collect a proportional heating bill based on dwelling size. The dwellings also have thermostatic radiator valves (TRVs) and room thermostats.

Whilst there is no formal safeguard built-in for inflationary fuel price rises, system costs are minimised by upgrading control systems, extensive pipe and valve lagging and low maintenance isolating valves. Maintenance costs have been considerably reduced. CityWest Homes are committed to reducing domestic bills by 10 per cent through improved efficiency.

Cost of consumer connections	
Item	**Cost**
Consumer connections for dwellings	17,800
Heat meters for dwellings	-
Consumer connections for public buildings	87,150
Heat meters for public buildings	-
Subtotal	104,950
Cost of main heating network system	
Heat distribution pipework	576,866
Primary circuit	-
Secondary circuits	25,000
Others eg pumps, controls, header systems and valves	-
Subtotal	601,866
Cost of energy centre	
CHP unit	935,000
Boilers	209,000
Site preparation and costs	1,270,000
Upgrade and installation of local gas supply infrastructure network	70,000
CHP electrical connections	103,000
Heat storage	-
Private wire network	-
Absorption chiller	-
Other	310,000
Subtotal	2,897,000
Project costs	
Design	233,000
Installation	117,000
Project development management	75,000
Other	430,000
Subtotal	855,000
Total	**£4,458,816**

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Ultimately all the community heating schemes in Westminster will be financially self-sustaining. CityWest Homes will consider selling electricity via private wire in the future, although they believe that it is too complex to incorporate at this stage. The complexities relate to the potential difficulties encouraging all residents to sign up and debt collection issues.

Average existing heat costs (including all maintenance costs)

£420 per dwelling

2.8 pence per kWh

Work is due to be completed in November 2005. Once completed the project will:

- save 1,900 tonnes of carbon per year;
- reduce bills to 3,100 homes by £104,000 per year, with commitment to reduce domestic bills by 10 per cent;
- reduce risk of fuel poverty in 1,000 households on housing benefit.

Community involvement

Local community involvement is a fundamental principle in the implementation of any community heating scheme. CityWest Homes have achieved this by holding tenant consultation meetings and open days. Churchill Gardens Estates and Lillington & Longmoore Estates residents' associations also appointed a representative to attend project team meetings.

The tenants will continue to be involved in the management of the scheme through the residents' representative.

"As residents we have enjoyed the benefits of community heating for over 52 years. Not only is it highly affordable, it is also reliable – we have had no trouble with it. In all the years we have been on the scheme, we have been very satisfied with the level of heating and hot water we receive."

Mr and Mrs Makin, Pimlico

Extending the network

CityWest Homes are exploring opportunities for extending the heat network.

A new private housing development is planned in the area. CityWest Homes have actively promoted the benefits of connecting this scheme to the heat network and the developers are currently considering this proposal.

Other schools and businesses in the vicinity are also being targeted.

"From the establishment of this ground-breaking scheme, some 50 years ago, it set new standards in the provision of clean, safe, reliable community heating. Since then, advances in technology have added greater control and efficiency to the scheme, allowing expansion to a wider area and enabling even more premises to benefit in the future. CityWest Homes is convinced of the benefit of community heating and is committed to the future of the Pimlico District Heating Undertaking."

Nigel Brooke, Chief Executive, CityWest Homes

Lessons learnt

- Good quality building management systems are essential to monitor the community heating scheme for fault diagnosis, maintaining system reliability and energy management.
- Provision of an effective planned preventative maintenance scheme is necessary.
- Energy management is vital to ensure that simple things such as pipe and valve lagging are done; that control systems work effectively and temperatures are monitored to ensure heat is only provided at the required time and temperature.
- System reliability is essential to meet residents and commercial users' expectations.
- Community involvement is vital.
- Whole life costing is the best way to establish the real project cost and best value.
- External specialist assistance is essential.

Replicating the scheme

CityWest Homes are considering the possibility of replicating this scheme at Westbourne Green redevelopment. There is the opportunity to repeat the success of this community heating scheme as there are currently six residential tower blocks electrically heated, with neighbouring additional heating loads. The blocks' heat load would be in the order of 10GWh per annum.

Funding has also been secured from the Community Energy programme for a feasibility study into incorporating CHP and improving energy efficiency in the CityWest Homes 13 largest community heating schemes.

References

(1) Green Book, appraisal and evaluation in central government (HM Treasury, 2003)

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.

Benefits of Best Practice: community heating (CE13)
Community heating – Aberdeen City Council case study (CE65)
Community heating – a guide (CE55)
Community heating serves luxury private apartments (GPCS 400 – CE103)
Domestic heating and hot water – choice of fuel and system type (GPG301 – CE?)
Rural biomass community heating case study (CE91)

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 from April 2002 to March 2005. It also offers a range of guidances:

A guide to small scale community heating
A guide to new and renewable energy in community heating
Community heating for planners and developers
Connecting CHP in community heating to the electrical network
Financing community heating
Getting best value for electricity generated in community heating

For further information contact the helpline number on 0870 850 608 or visit www.est.org.uk/communityenergy.

The Carbon Trust

The Carbon Trust offers professional, independent and objective advice on the potential for the use of CHP. Contact the Carbon Trust helpline on 0800 585 794 or visit the website www.thecarbontrust.co.uk.

Publications include:

CHP opportunities for local authorities (GPG322)
Energy Services PPP/PFI projects for community heating (NPP123)
Guide to community heating and CHP – commercial, public and domestic applications (GPG234)
The manager's guide to packaged combined heat and power systems (GIR082)
The use of combined heat and power in community heating schemes – four cases studies (GPCS370)
Using the PFI for the upgrade and extension of community heating (NPR123)

Useful organisations

Combined Heat & Power Association (CHPA)
Grosvenor Gardens House
35-37 Grosvenor Gardens
London SW1W 0BS
Tel: 020 7828 4077
Fax: 020 7828 0310
Web: www.chpa.co.uk
Email: info@chpa.co.uk

Acknowledgements

Energy Efficiency Best Practice in Housing thanks CityWest Homes for their assistance with the preparation of this case study.

Further information and contact details can be found in the plans and project section of the CityWest Homes website - www.cwh.org.uk.

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Energy Efficiency Best Practice in Housing is managed by the Energy Saving Trust on behalf of the Government.

All technical information was produced by the Building Research Establishment (BRE) on behalf of the EST.

Printed on Revive Silk which contains 75% de-inked post consumer waste and a maximum of 25% mill broke.