



Installation of ground source heat pumps in social housing homes Chy An Gweal, Penzance, Cornwall

Penwith Housing Association, Cornwall, UK.

Summary

This project was the first in the UK to retrofit ground source heat pumps to a group of existing social housing homes, completed in July 2004. Fourteen bungalows were each fitted with Powergen 'HeatPlant' heat pumps connected to vertical ground loops, providing affordable space heating (via radiator systems) and hot water with low carbon emissions. The project was carried out by Penwith Housing Association working in partnership with GeoScience (a UK national leader in GSHP technology which has now transferred its heat pump business to EarthEnergy Ltd), the utility company Powergen, the local authority Penwith District Council, and the Cornwall Sustainable Energy Partnership. The aim of the project was to demonstrate that ground source heat pumps could provide affordable space and water heating in existing homes in a rural area where there was no availability of mains gas. The project was funded by the Clear Skies programme, Penwith District Council and Penwith Housing Association. The success of the project has demonstrated that GSHP systems can work very well in this context. It has helped to stimulate the use of this renewable energy technology by a growing number of social housing providers in the UK.

End-user area

- New buildings
- Refurbishment of buildings
- Transport and mobility
- Financial instruments
- Industry
- Legal initiatives (regulations, directives, etc)
- Planning issues
- Sustainable communities
- User behaviour
- Education
- Other

Target Audience

- Citizens
- Households
- Property owners
- Schools and universities
- Decision makers
- Local and regional authorities
- Transport companies
- Utilities
- ESCOs
- Architects and engineers
- Financial institutions
- Other

Technical

- Energy efficiency
- Heating
- Cooling
- Appliances
- Lighting
- CHP
- District Heating
- Solar energy
- Biomass
- Wind
- Geothermal
- Hydro power
- Other

Context

The process that led to the project began in 2002. At that time GSHP technology had been shown to work in new-build homes. Penwith Housing Association completed the first social housing new build project to include them in 1998, and several other social housing providers had also proved their effectiveness in new dwellings. In Cornwall the recently formed Cornwall Sustainable Energy Partnership was drawing attention to fuel poverty, the lack of energy efficiency in many homes, and the connections between these issues and climate change. There was (and still is) a major need for affordable heating in homes in areas where mains gas is not available, preferably from a low carbon technology. Chy An Gweal was chosen as a highly appropriate site. Off the gas network, the residents struggled to cope with solid fuel heating, and whilst the homes were well insulated, the heating systems caused both high running costs and CO₂ emissions. It presented an ideal opportunity to



demonstrate the potential for a renewable energy technology to solve this problem. Denys Stephens of Penwith HA, Dr Robin Curtis of GeoScience and Tim German, manager of CSEP, discussed the idea of fitting GSHP's to existing homes. This had been a theoretical possibility for some time, but the logistics of producing a replicable and affordable method of installing it in many homes had not been addressed. It was decided to take up this challenge in Cornwall.

Objectives

The aims of the project were:

- To demonstrate that ground source heat pumps could provide a renewable energy solution for space and water heating in fuel poor homes.
- To identify and solve the technical problems associated with fitting ground source heat pumps in existing homes.
- To give residents the choice of the technology to be used in their homes and assess the acceptability of a renewable energy system to end users.

Process

In June 2003 Penwith Housing Association obtained a grant offer for the project from the Clear Skies programme. Additional funding was also received from Penwith District Council. From this point the project moved into a detailed design and contract preparation stage. This work was carried out by Denys Stephens of Penwith HA and Dr Robin Curtis of GeoScience with technical support from John Parker on behalf of Powergen. The support of Mike Newell of Powergen contributed significantly to the success of the project.

A number of key design decisions were made:

- Vertical borehole systems were chosen as the best means of installing ground loops to allow installation in small gardens.
- Positions of existing services on the site were checked and recorded very carefully to avoid any possibility of damage during drilling work.
- Heat pumps were to be installed in small purpose built enclosures outside the dwellings. This avoided loss of internal space in the small homes.
- Heat distribution inside the homes would be by high water content radiator systems. The systems were designed to include the special hot water cylinder supplied with the Powergen Heatplant kit, which delivers 100% of the hot water system requirements.

Alongside the design a process contracts were arranged for drilling/groundwork and heat distribution systems. Following the appointment of contractors the work on site was carried out between January and July 2004. During the course of the work it became clear that whilst installing plumbing systems to suit ground source heat pumps was not unduly different to conventional heating systems, the challenges for a social housing landlord in employing a drilling contractor were considerable. So whilst the work was completed to a good standard and functioned well, there was a question mark against the likelihood of other social housing providers being willing to replicate the procurement method used for this project. In response to this an enhancement of the Powergen HeatPlant scheme was developed, which was extended to include complete installation of the ground source heat pump, including all of the groundwork, for a fixed price. This effectively removed the most significant element of risk from future projects, and was perhaps a turning point in establishing the viability of GSHP technology in the UK social housing sector.



Drilling a borehole



Installing ground loop

Financial resources and partners

Project Partners

Penwith Housing Association – registered social housing landlord

Role in project: Initiated the project. Project management and building related design.

EarthEnergy Limited (part of the GeoScience consultancy at the time of the project) - Geothermal Energy company, specialising in Ground Source Heat Pump systems to provide Renewable Heating and Cooling for buildings across the UK.

Role in project: Consultant for GSHP system design and management of the installation process.

Powergen: Powergen is part of E.ON, the world's largest investor owned energy company.

Role in project: Supply of HeatPlant GSHP kits. Technical support and design advice.

Penwith District Council: Local Authority for the Penwith area

Role in project: part funding of the project

Cornwall Sustainable Energy Partnership: Cornwall Sustainable Energy Partnership (CSEP) was established in 2001. CSEP's aim is to create a sustainable energy future for Cornwall and the isles of Scilly by actively integrating sustainable energy into public, private and community sector strategies.

Role in project: Public relations and publicity.

Project Costs

Total cost: € 233,000.00

Funding: Clear Skies Programme: € 102,000.00

Penwith District Council: € 37,000.00

Penwith Housing Association: € 94,000.00

Note: The costs for this project should not be regarded as typical for current GSHP installations. A number of factors arising from the fact that it was a pilot project incurred higher costs than would be usual for a similar project carried out in the UK at the time of writing this study (August 2007).



Results

At Chy An Gweal itself the residents were happy with their new central heating systems. The project has served as living proof that ground source heat pumps can deliver space and hot water heating at an affordable cost, coupled with low CO₂ emissions. Shortly after completion the project won a South West Green Energy Award (Best Community Project 2004) and the 2004 National Home Improvement Council Award for 'Innovative Approaches to Central Heating and Domestic Hot Water Installations.' In 2006 the project was awarded the Building & Engineer Awards 'Energy Efficient Project of the Year.' These awards have done much to raise awareness of the technology. One of the most important outcomes of the project is that it has encouraged other social housing landlords to install ground source heat pumps. In the EST Innovation Programme funded project 'Closing the Loop' the project partners are working to promote the use of ground source heat pumps in UK social housing. Further information can be found online at www.completingtheloop.org.uk. Under the Powergen HeatPlant programme (which includes both newbuild and retrofit projects) to date 25 housing associations and local authorities have GSHP installations either completed or in progress, and the total number of systems running or being installed is in the region of 700. In Cornwall these include two further Penwith HA projects, four projects for Cornwall Rural Housing Association, one for Coastline Housing, and a very substantial programme being carried out by Carrick Housing. The Carrick Housing project won the 2006 South West Green Energy Award for 'Best Housing Installation.'

Interest in ground source heat pump technology has increased dramatically following the recent high profile of climate change and associated new legislation. It is a field in which Cornwall can justifiably claim to lead the UK in terms of the expertise of businesses based in the county, the ground breaking projects that have taken place and the number of installed systems.



GSHP heated radiator

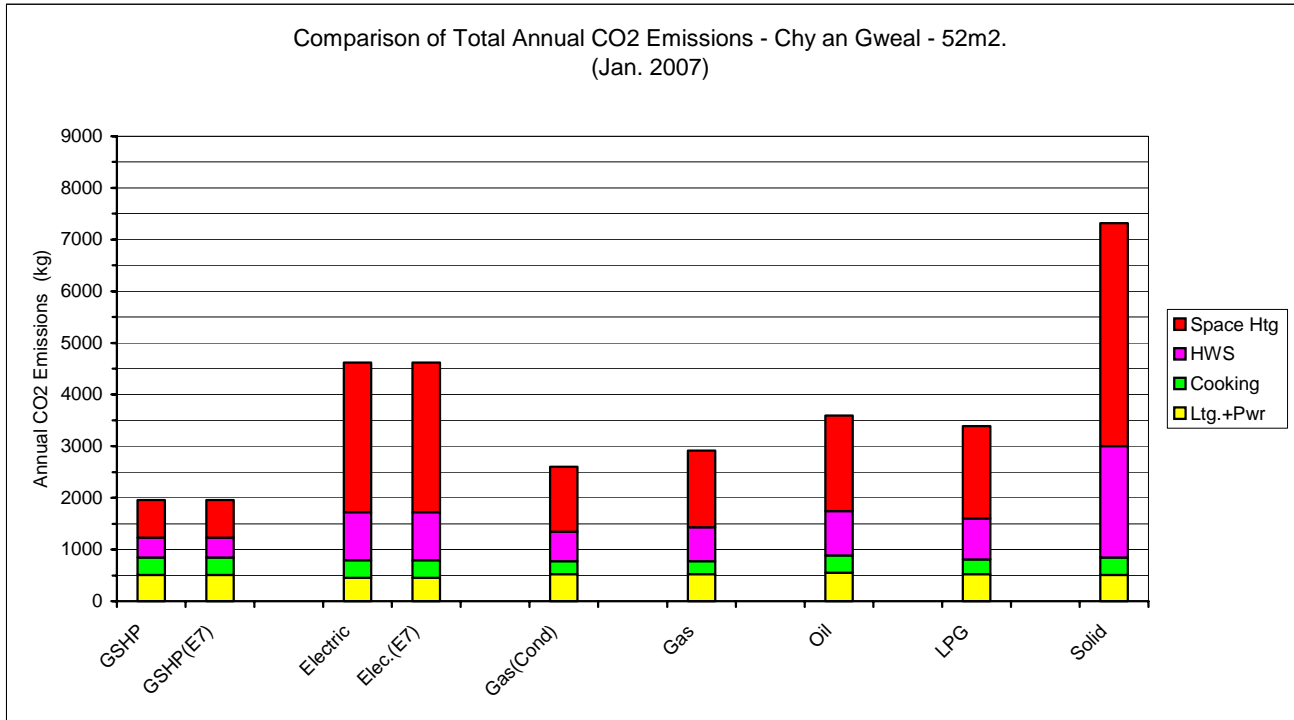


Engineer working on heat pump in external enclosure

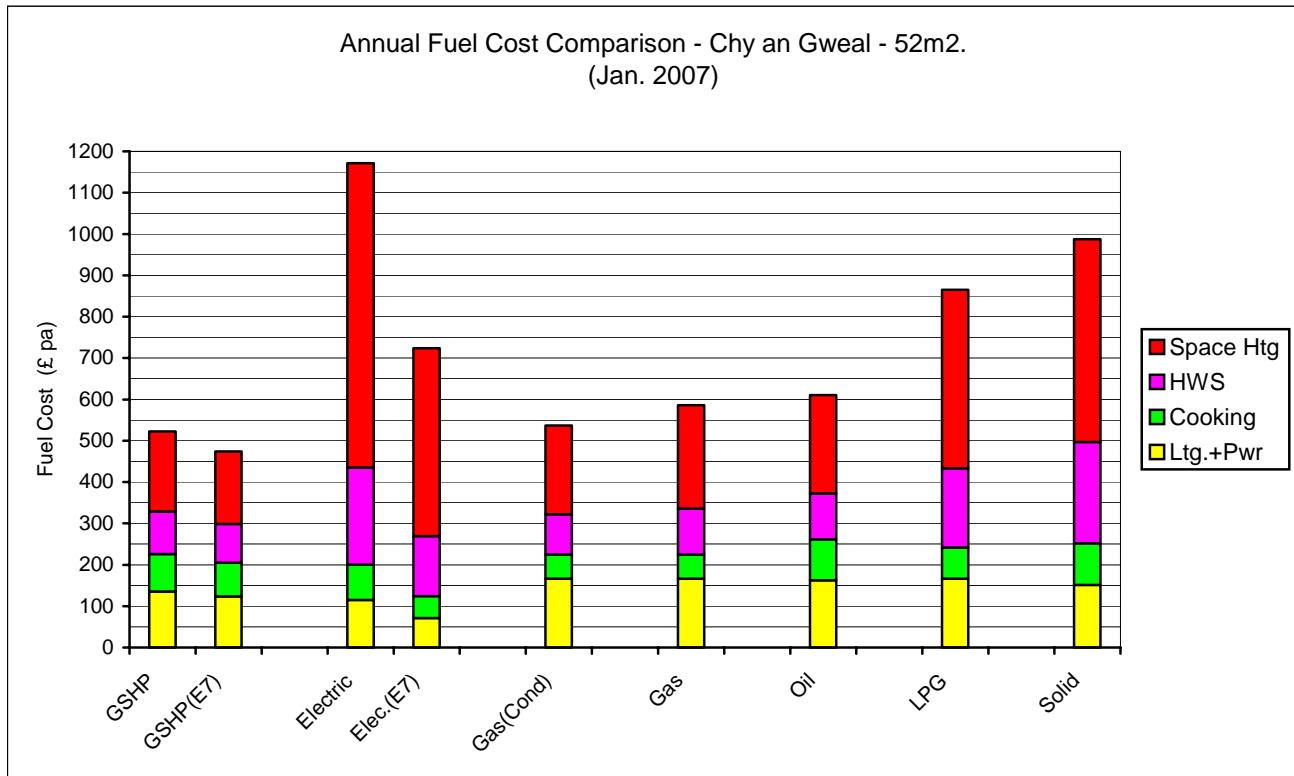
The graphs below, calculated by Powergen, are based on a typical property included in the project and compare the fuel costs and CO₂ emission levels obtained using the ground source heat pump systems with the results that would be obtained using fossil fuel systems to deliver the same amount of energy. The calculations assume that the heat pumps are run on UK mains electricity for the purposes of running costs and CO₂ levels. The CO₂ emissions could be eliminated by running the heat pumps 'green' electricity. The costs of fuels for running cost comparisons are also based on current UK prices.



CO₂ emissions comparisons provided by Powergen



Fuel costs comparisons provided by Powergen





Lessons learned and repeatability

Lessons Learned

Before this project was carried out, in the UK ground source heat pumps were regarded as a renewable energy option for heating new dwellings but very few had been installed in existing homes. It was an important aim of the project to devise a means of retrofitting GSHP's in existing homes that would be readily replicable, as one of the greatest challenges in CO₂ reduction in the housing field is to reduce the emissions from the vast number of existing homes that do not have the possibility of benefiting from high efficiency gas boilers. The main problems that needed to be overcome to achieve this were not technical but cultural. There was no practical experience in the social housing sector of drilling boreholes in close proximity to occupied homes, and the viability of the technology to deliver reliable heating had not been proved. It was not known if this new application of the technology would be acceptable to the occupiers of the homes it was installed in. The project demonstrated that all of these challenges could be met successfully. Since the completion of the project a number of UK social housing providers have carried out similar projects, proving the potential for gshp's to be fitted to a very large number of existing homes both in the UK and Europe. Specific lessons learned from the project include:

- Vertical boreholes work well for gshp ground collectors for homes with small gardens / external areas. With careful management the disruption traditionally associated with drilling boreholes can be reduced to a very acceptable level even for occupied homes.
- The costs of drilling boreholes can be reduced considerably if the installation is facilitated by an energy company or contractor who can procure drilling work in a significant volume. In the UK the Powergen 'HeatPlant' scheme has pioneered this approach.
- For small homes there are significant advantages in installing the heat pumps in external weatherproof enclosures.
- Despite the common association of ground source heat pumps with underfloor heating, they can work very well using a radiator system for internal heat distribution. This is much easier to install in an existing home. Where radiator systems are used it is essential to use high water content radiators unless a buffer vessel is used in the system.
- The heat pumps used in this project are designed to deliver domestic hot water in addition to space heating and to meet the full heating load of the home. Heat pumps which do not deliver domestic hot water or require supplementary flow boilers to augment the heating capacity can incur higher running costs and CO₂ emissions.
- Insulation levels in homes to be fitted with a GSHP should be increased to the highest practical level by means such as cavity fill of external cavity wall, top up roof insulation, replacement double or triple glazing and draughtproofing. The overall design heat losses of the home should not exceed the heating capacity of the heat pump!
- There is a need for plumbing and heating engineers to familiarise themselves with the operating characteristics of GSHP systems, but once this has been done the plumbing and heating installation process for radiator systems involves no greater challenges than are normal for fossil fuel systems.
- There is a need for an expert installer, particularly for assessing the suitability of ground conditions at proposed sites and to design the ground loop correctly.



Residents Mr and Mrs Birtles washing up with GSHP heated water



EU commissioner Andris Piebalgs meeting resident Mr R Fisher

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