GREEN POWER

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THE USE OF SOLAR HEATING SYSTEMS BY A LOCAL AUTHORITY

EXTENDED RENEWABLE ENERGY CASE STUDY

Installation of six flat-plate collectors on the roof of B Block

INTRODUCTION

Solar water heating systems collect energy from the sun and convert it to useful heat for many domestic and commercial applications. A common misconception is that the UK is too cloudy for successful solar collection. This case study demonstrates that this is not necessarily the case.

There are a number of different systems available, ranging from cheap self-installed models to complex systems that maximise solar potential, although most use similar technology. A system comprises a solar collector, usually orientated to the south on a roof, inside which a fluid is heated by the sun. This fluid is sometimes used directly from the collector for water heating (eg in a swimming pool), but is more commonly used to transfer the heat to a separate water supply that is then used in a conventional way.

There are now over 42,000 solar water heating systems operating in the UK, with the majority being used to produce domestic hot water, or for heating swimming pools. Currently, about 2000 new systems are added each year. Most systems are robust and reliable, giving on average 20 years' useful service.

LOCATION

New Walk Centre, B Block, Leicester city centre.

BACKGROUND

The New Walk Centre is the main administrative headquarters of Leicester City Council and is divided into two separate high-rise buildings. B Block is the shorter of the two: an 8-storey office block, housing just over 400 staff together with the main council restaurant. The restaurant is a major user of hot water, so in 1996 a report was commissioned to see if the water heating could be achieved in a more sustainable manner, in line with Leicester City Council's energy and environmental targets (see box on page 3). The report concluded that the boiler's energy use could be reduced through the installation of a solar water

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The project described in this publication is a current example of an operating renewable energy scheme, but may not represent best practice in all respects.

BACKGROUND ON LEICESTER

Leicester is a city of 280,000 inhabitants in the East Midlands. The City Council is the local authority for the city and surrounding areas, a total of 115,000 dwellings. It has a very strong environmental record: since Leicester became the UK's first "environment city" in 1990, it has gone on to develop the Leicester Energy Strategy in 1994 and the Blueprint for Sustainable Development in 1996.

CLIMATIC DATA (1999)

Degree Days (Basis 15.5°C): 2063

Annual Mean Temperature: 10.6°C

Annual Total Sunshine Hours: 1572

The New Walk Centre

heating system to preheat the water. This would then have the additional benefit of reducing carbon dioxide (CO_2) emissions and increasing the level of renewable energy use within Leicester.

HOW FLAT-PLATE COLLECTORS WORK

These are some of the simplest solar collectors, consisting of a plate with pipes attached. The pipes (often made of copper as this absorbs and conducts heat well) contain water which is pumped around the system to collect heat from the sun. To maximise heat gains, the surface of the collector is painted black. However, the system is not as efficient as evacuated tubes because it tends to re-emit heat. Therefore, a number of measures are taken to try to reduce losses. Firstly, many panels use a "selective surface" which still absorbs heat but does not release as much. Secondly, the system is insulated as well as possible, by embedding the collector in foam insulation, then sealing the surface with a glass or plastic cover. These systems tend to work well in summer, but due to heat losses are not very effective at lower temperatures and with low solar input.

TECHNOLOGY

Once the Council's Energy Centre had approval for the use of solar water heating, the task of designing and installing the system was passed to the Engineering Department. It concluded that the best application would be to install a relatively cheap system that would be capable of raising the temperature of large amounts of water by just a few degrees, rather than a system that would raise small amounts to very high temperatures. Therefore, the system specified was an array of six Viessman Calorsol-W classic flat solar collectors. These have a total area of 10m^2, angled towards the south on the roof of B Block above the plant room. In ideal summer conditions they are capable of raising 400 litres of water from the mains temperature of 10-15°C to 45°C every day.

To optimise the performance of the system, it has been included in the Council's computerised Building Energy Management System (BEMS). The BEMS operates by continuously monitoring the energy consumption and water temperatures of the installation over a short time period (typically between 15 minutes and an hour) from a remote location. As well as being able to produce precise figures in the form of easily manipulated graphs and tables, the system can automatically flag up any anomalies. Therefore, the system can be continuously analysed from a remote location to spot any faults before they become major or costly.

COSTS AND SAVINGS

The total cost to purchase and install the system was £15,000. The reduction in boiler usage saves over 50,000kWh of energy per annum and approximately 8000kg of CO_2. This equates to a financial saving of approximately £450 per annum. The simple payback for this system is therefore approximately 30 years.

However, for a true comparison; to achieve the same energy and carbon savings by using gas boiler technology would have required new low-NO_X gas condensing boilers to be installed at a cost of £23,500. By installing the solar system into this existing gas boiler installation the overall efficiency of the plant has been improved by 8% (including standing losses) and carbon emissions reduced by

PLANNING ISSUES

As with many construction projects, planning consent may be needed to alter the external appearance of the building. Generally, water heating systems fall within the permitted development category, but formal planning applications are needed in some cases, especially if the system is to be installed on an historic or listed building. However, the only building that directly overlooks the roof of B Block is the 13-storey A Block, so formal planning application is avoided.

The Roots of Leicester's Sustainable Commitment

Leicester City Council is the first unitary local authority in the UK to have achieved full Environmental Management Audit Scheme (EMAS) certification. This has been made possible due to a comprehensive and holistic approach to environmental policy. Energy awareness has been central to Leicester's environmental policy since the municipality of Leicester was granted the status of first "environment city" in 1990. This commitment to energy has been reflected since then by the continuing publication of reports and targets, together with the Council's status as one of the first Energy Efficiency Advice Centres (EEACs) to be launched in the UK (in 1993). This record is set to continue and expand as the Council bids for European Objective II funding to incorporate new and renewable energy into homes, schools and businesses in the area.

One of the key commitments Leicester gave when bidding to become firsr "environment city" was the reduction of energy use within the city to 50% of 1990 levels by 2025. This target is enhanced by the vision of meeting 20% of the city's energy needs from renewable sources by 2020. To help to meet these challenging targets, the City Council is actively promoting energy efficiency and renewable energy through the EEAC, housing associations and Article 10 regeneration projects, and, most importantly, is taking the lead itself, through the implementation of energy efficiency measures and the integration of renewable energy into council buildings.

The Council's commitment to sustainable energy use starts at the very top level, with the Chief Executive making a Corporate Commitment in 1992 to embed consideration of energy consumption into all decision-making. This means that all equipment now purchased must conform to a certain standard of energy efficiency; all new-build projects must actively seek to incorporate new and renewable energy and energy-efficient technologies. All the monitoring and purchasing of energy is now handled centrally at the Energy Centre, so that best value can be obtained and any anomalies can be spotted and rectified easily. It is this commitment at all levels that has allowed Leicester to set such ambitious energy targets.

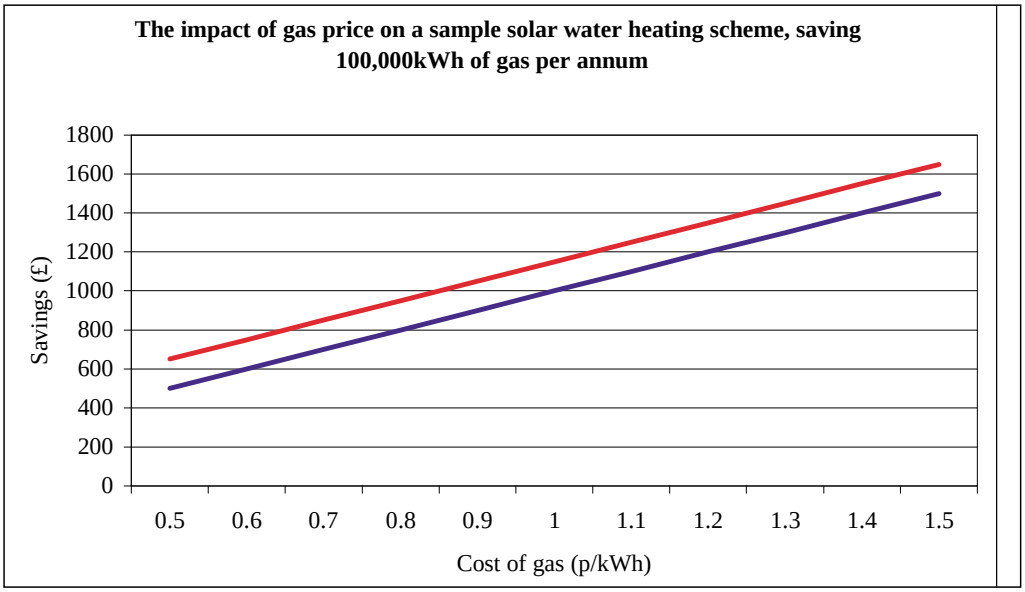
some 7 tonnes annually. This demonstrates how solar thermal systems can be used to upgrade plant efficiency and reduce carbon emissions at half the cost of boiler plant replacement. In light of the Climate Change Levy, this type of upgrade would seem most appropriate for boiler plant which are over halfway through their projected lives.

Although this is a very poor payback (and is unlikely ever to be repaid within the useful life of the equipment) there are a number of factors which contributed to this:

1. The solar panels were installed as a retrofit project which always makes a project more expensive than new-build.
2. As the New Walk Centre is such a high user of gas it has been able to negotiate gas prices as low as 0.704p/kWh. Therefore, the financial savings do not reflect the true energy savings and would be greatly improved for a site with more expensive gas. This is demonstrated graphically in the chart overleaf, with the impact of the Climate Change Levy shown in red.
3. As the project was not linked to any other similar projects, no economies of scale were achievable through the bulk purchasing of equipment, which can significantly reduce prices. This is an area which has been addressed in other areas where the economies of scale achieved can reduce the cost of equipment by well over 50%.
4. Water demand has not always been as high as expected, leading to times when heat gain is wasted.

However, Leicester City Council is satisfied with this project as one of its main aims was to be a demonstration project for the Housing Department. It was intended to show that a solar system could help provide hot water for a community housing development, with 24- hour demand, 365 days per year. This installation has successfully heated a large volume of water - even in the winter. The project would be far more economically feasible for a new community housing development for the following reasons:

1. The solar panels would be installed in new housing projects, so would be cheaper to install.
2. The housing projects would not be able to negotiate such cheap gas due to their lower consumptions, which would make the gas savings more financially valuable.
3. A large number of solar panels would be purchased in bulk, leading to lower purchasing prices.
4. Water demand would be more stable all year round, ensuring that less of the hot water generated would be wasted.
5. VAT is now only charged on professionally installed panels on residential properties at 5% - an effective reduction in cost of 12.5%.



SOURCES OF HELP FOR SPECIFYING SOLAR SCHEMES

Leicester City Council experienced great difficulty initially in finding any company willing to assist with either designing or installing a solar system. Since then, much has changed, with many more solar companies entering the market. This information has recently been collated into a useful manual by the Energy Conservation and Solar Centre. This can be obtained directly by phoning 020 7922 1662. More information is available from the Solar Trade Association on 01208 873518.

BENEFITS

- **Enhanced "green" image of Leicester City Council.**
- **50,000kWh of gas, £450, and 8000kg of CO_2 saved per annum.**
- **Successful experimental application, to show that solar thermal technology can be fitted to new housing projects.**

FURTHER INFORMATION

For information on this project, and others in Leicester, please contact:

Leicester Energy Agency
2-4 Market Place South
Leicester
LE1 5HB
Tel: 0116 2995133
Fax: 0116 2995137
e-mail: Donlack@energy-advice.co.uk
Web: www.energy-advice.co.uk

For information on the DTI's New & Renewable Energy Programme please contact:

New & Renewable Energy Enquiries Bureau
ETSU
Harwell
Didcot
Oxfordshire
OX11 0QJ
Tel: 01235 432450
Fax: 01235 433066
e-mail: NRE-enquiries@aeat.co.uk
Web: www.dti.gov.uk/renewable/index.html

NEW REVIEW

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