

## Geomac proposal

A planning meeting was held on 27 March in Valencia to consider responding to the call for proposals for demonstrating reversible ground source heat pumps for the Mediterranean region. The participants decided to enter a proposal and various persons offered to draft sections of the work programme.

## EU CERT project

The final report of this project was sent to the Commission in early March. The work of this project covers the basic requirements for training installers of heat pump systems and the EHPA will host both a certification and accreditation board.

## Sherhpa demonstration, Chichester



Kensa, a heat pump manufacturer based in Cornwall, UK have developed a 10 kW heat pump which has been installed in a 300 sq m new-build, well-insulated house near Chichester.

The ground source is an open-loop 100 m deep geothermal borehole. With brazed plate heat exchangers, it is not a good idea to use ground water in them – so an intermediate gasketed water to water plate heat exchanger is used, which leads to a loss



of efficiency, and requires an extra water pump. So Kensa decided to install a spiral heat exchanger made by Spirec, another Sherhpa partner. The heat pump is generally running with a coefficient of performance (COP) (heat out/energy in) of about 5.0, which is much better than the more normally accepted industry figure of a COP of 4.0. The reason for this higher COP is that the Spirec heat exchanger allows the use of an open loop water source directly.

This site is effectively a 'control' as there is no hydrocarbon refrigerant in this heat pump, but Kensa have established the high reliability and availability of the Spirec heat exchanger during the preceding winter. The feedback is that the owner of the house is delighted, and has a very low energy bill. A similar system using propane rather than R407C is awaiting installation.

*Richard Freeborn (Kensa Engineering)*

## Engineering building, University of Reading

The MSc students on the renewable energy course have surveyed the existing Mechanical Engineering building at this University comprising some 3500 square metres of office, laboratory and teaching space. They have concluded that the current system which is supplied by steam from a central boiler is inefficient and that with the addition of further thermal insulation to the building, a heat pump heating system would be much more efficient with a payback time of approximately 8 years at present gas prices.

Together with the new Student Services Building under construction this suggests that heat pump systems have a bright future even in a country where there is still an abundance of natural gas which is now being imported in ever increasing amounts.

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Closing date for contributions to next issue: **1 June 07**  
Theme: **Reversible heat pump systems**

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# EUROPEAN HEAT PUMP NEWS

issued by the European Heat Pump Association

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Issue 8/2 April 2007

## EHPA NEWS

This issue discusses some of the implications that will follow the Member States' agreement in mid March to limit climate change. In this post Kyoto scenario it is clear that renewable energy sources will have to take an ever increasing share of the energy mix and that heat pump systems will have a major role to play in utilising ambient heat. The month was also notable for the new report by Eurelectric, the Association of European utilities, describing the role of electricity in a carbon constrained world and the second draft of the eco label regulation for heat pumps.

### Changes in climate

The available evidence is that earth's global climate is warming at an ever increasing rate and rather faster than expected. Evidence includes:

- increase in annual average air temperatures by 0.7 C above the pre-industrial era and in the UK the average rise in 2006 was 0.2 C alone
- 0.5 C in sea temperatures in the past 30 years
- reduction in size of the Arctic and Antarctic ice sheets

All the evidence suggests that these changes are being driven by the congregation of greenhouse gases in the upper atmosphere which acts as a blanket trapping the heat generated below. As the EU has resolved to act unilaterally to limit temperature rise to 2 C to prevent irreversible climate changes, urgent action is required NOW if this limit is not to be breached.

### Actions to limit climate change

The EU Heads of State agreed to increase the EU's reduction goal for carbon dioxide emissions from 8% until 2012 to 20% until 2020. A further reduction goal of 10% (amounting to 30% in total) was announced provided that the other industrialised countries would commit to a similar reduction goal. This is a very strong political commitment which will require the following types of action –

- changes in the way we think about and use energy
- rapid adoption of energy efficient technologies
- large scale utilisation of renewable energy sources

Such decisions cannot, it seems, be left to market forces for which initial cost rather than low operating cost or low pollution, is the key purchase decision. As energy efficient technologies almost always carry a higher initial cost and lower operating costs, such technologies may need legislative or regulatory support in order to transform the market.

The eco design directive will enable DG TREN to set minimum efficiency standards for energy using appliances. For heat pumps the option exists that once the most efficient are eco-labelled then the least efficient could be excluded by setting minimum efficiency thresholds.

*The question for the industry as well as DG TREN is whether such a strategy should not be adopted for ALL heating and cooling systems over a period of the next few years. If a consensus can be reached on heat pumps systems then there is no a priori reason why a similar approach should be successful for other heating/cooling systems and DG TREN has initiated a series of studies.*

### Economics of climate change

Sir Nicholas Stern has produced a 700 page review of the economics of climate change and his conclusions are striking (Stern Review: The economics of Climate Change, October 2006).

*'There is still time to avoid the worst impacts of climate change, if we take strong action now.'*

*'The scientific evidence is now overwhelming: climate change is a serious global threat, and it demands an urgent global response.'*

*'The investment that takes place in the next 10-20 years will have a profound effect on the climate in the second half of this century and in the next. Our actions now and over the coming decades could create risks of major disruptions to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes.'*

In its communication on Energy Policy for Europe (Communication 10 January 2007), the European Commission concluded that –

*'Energy is essential for Europe to function. But the days of cheap energy for Europe seem to be over. The challenges of climate change, increasing import dependency and higher prices are faced by all EU members.'*

## Electricity in a carbon constrained world

At a workshop in Brussels on 22 March, Eurelectric, who represent all the major electricity utilities in Europe, presented its final report on the role of electricity in a carbon constrained world. This report, which was prepared by consultants over a period of 18 months, has now been endorsed by the Board of Eurelectric. The EHPA inputs were delivered by Stephen Peterhans and Rayner Mayer at an earlier workshop on 21 November 2006.

## Carbon constraints

The analysis correctly identifies two carbon constraints –

- the accumulation of greenhouse gas emissions in the upper atmosphere
- the peak in the world gas and oil supply which will limit their availability resulting in the ever increasing price of both hydrocarbon resources

The price differential between gas and coal could therefore be as high as five by 2050.

These constraints impose limits on the supply side and so for a **low** carbon future, a balanced mix of gas, coal, renewables and nuclear is foreseen with carbon capture and storage being used to sequester carbon dioxide emissions particularly from coal fired plant.

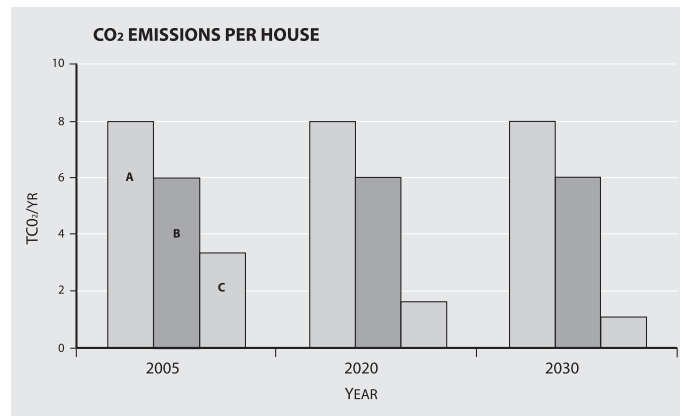
## Substitution of fossil fuels

Eurelectric conclude that electricity will have to substitute for fossil fuels in two key energy intensive activities –

- in transport where hybrid vehicles will plug into the mains supply to recharge the vehicle's batteries
- in heating and cooling applications where heat pumps will become a major source of space heating and cooling as well as hot water

In the report Eurelectric compares CO<sup>2</sup> emissions from oil, gas and heat pump heating systems and concludes that heat pumps have the **lowest** carbon footprint both at present and in the future taking into account the increasing availability of carbon free electricity (Figure 1).

**Figure 1: Comparison of domestic CO<sup>2</sup> emissions from different heating systems – oil, gas and heat pump**



- A Oil heating
- B Gas heating – Gas and oil heating assumed to be 100% efficient (to allow for maximum future advance in efficiency)
- C Heat pump (COP=4) CO<sub>2</sub>/kWh electricity reduces in line with Role of Electricity scenario

Source: The role of electricity – a new path to secure, competitive energy in a carbon constrained world (see [www.eurelectric.com](http://www.eurelectric.com))

## Increasing market share of heat pumps

Particularly for ground source heat pumps, the initial investment is much higher than a fossil fuel boiler; thus energy savings will deliver the major part of the cost savings. Eurelectric observe that some form of support will be needed to enable the market to take off and eventually deliver price reductions through mass market production.

Eurelectric conclude that policy measures required to facilitate the breakthrough of the technology include –

- full recognition of the renewable nature of the energy extracted from the environment and integrating this into RES policies, with the proviso of a sufficiently high COP value
- minimum COP standards for import of heat pumps and air conditioners
- awareness campaigns and investment support
- proper training for installation personnel

## Heat pump ecolabel

The draft regulation, as circulated by DG Environment on December 2, was discussed by the Eco-labelling Board on 13 December and various comments made by those present. These comments were reviewed by a group from industry at a meeting on January 31; they concluded that the basic text was sound and made the following recommendations –

- the scope to be increased to include gas as well as electrically driven heat pumps

- the classification of heat pumps using air either as source or distribution medium should be changed to be closer to industry norm
- use of national limits as the basis for setting efficiency thresholds where these were not specified either by DACH or room air conditioner directive

The other Directorates have been formally consulted about the regulation and consequently DG Environment circulated the second draft on 22 March. If this meets Member States approval then it will be adopted at the next meeting of Eco-labelling Regulatory Committee on April 26.

The assessment and verification conditions have been altered giving due recognition to the Eurovent and DACH certification programmes – *‘Testing shall be performed in accordance to EN 14 511. An independent test laboratory accredited for the stated testing shall verify the given values. Heat pumps which are certified in the Eurovent certification programme or DACH certification programme or another programme approved by the competent body do not require additional accreditation by an independent laboratory for the given values’.*

The requirements for the completing the information fiche for installer and consumer have not been altered and are retained in the new draft.

## Sherhpa project

This project, which GRETH coordinates with the EHPA, is investigating the use of natural rather than man made refrigerants. This has required close cooperation between component suppliers of heat exchangers, research and technology providers and heat pump manufacturers because of the different thermodynamic properties of natural refrigerants. To obtain the full benefits it is necessary to alter the flow rates inside the heat exchangers and to vary the control strategy in order to optimise the heat transfer.

The sixth meeting of the Sherhpa partners was held on 28/29 March in Padua hosted by Davide del Col of the Instituto di Fisica Tecnica, University of Padua. The meeting was attended by 26 of the 31 partners and the highlight was the delivery of the 100 kW reversible heat pump by Italian heat pump manufacturer Hiref which uses propane as the refrigerant. A further innovation is the use of a mini channel heat exchanger manufactured by Onda, another Italian enterprise. This system will now be installed on the roof of the Institute and undergo prolonged testing to verify the system performance.

A second system under test involving *propane* has been developed by Neura and is a direct expansion heat

pump system which has been installed in a dwelling in Ireland whilst a third design is a reversible ground source heat pump system developed by Spanish heat pump manufacturer Ciatesa, which has been installed at the University Politecnica Valencia.

A 235 kW ammonia based heat pump is being installed by Sodru at a cheese factory in Ukraine for producing process water with which to pasteurize the cheese. Using a desuperheater, it has been possible to boost the output temperature to 70 C.

All demonstration systems to date use reciprocating compressors as Sherhpa has been unable to convince compressor manufacturers of the need to develop rotary (Scroll type) compressors for use with carbon dioxide or propane refrigerants. A time extension of 3 months has been granted to enable the other demonstration systems to be installed and characterised by 31 December 2007.

## Sherhpa related activities

January 25/26	Designing heat pump systems using carbon dioxide, Lyon – 52 participants from 12 countries – very successful – further information – contact <a href="mailto:bernard.thonon@greth.fr">bernard.thonon@greth.fr</a>
April 11/12	Handling of flammable refrigerants, Vienna – contact <a href="mailto:stephan.stumpff@arsenal.ac.at">stephan.stumpff@arsenal.ac.at</a>
May 11/16	Heat exchangers for natural refrigerant heat pumps, Crimea – contact <a href="mailto:Petro.Kapustenko@kap@kpl.kharkov.ua">Petro Kapustenko at kap@kpl.kharkov.ua</a>
May 21/22	Natural refrigerants for heat pumps, Stockholm – contact <a href="mailto:bjorn.palm@energy.kth.se">bjorn.palm@energy.kth.se</a>
May 29/30	Natural refrigerant heat pumps, Padua – contact <a href="mailto:davide.delcol@unipd.it">davide.delcol@unipd.it</a>
June 28	Heat pumps and process integration, Naples – contact <a href="mailto:jiri.klemes.j.klemes@manchester.ac.uk">jiri.klemes.j.klemes@manchester.ac.uk</a>
November tba	Carbon dioxide heat pumps, Lyon (in French) – contact <a href="mailto:ahmed.bensafi@cetiat.fr">ahmed.bensafi@cetiat.fr</a>
November 13	Final workshop Sherhpa project, Brussels – contact <a href="mailto:bernard.thonon@greth.fr">bernard.thonon@greth.fr</a>