IEA Heat Pump CENTRE
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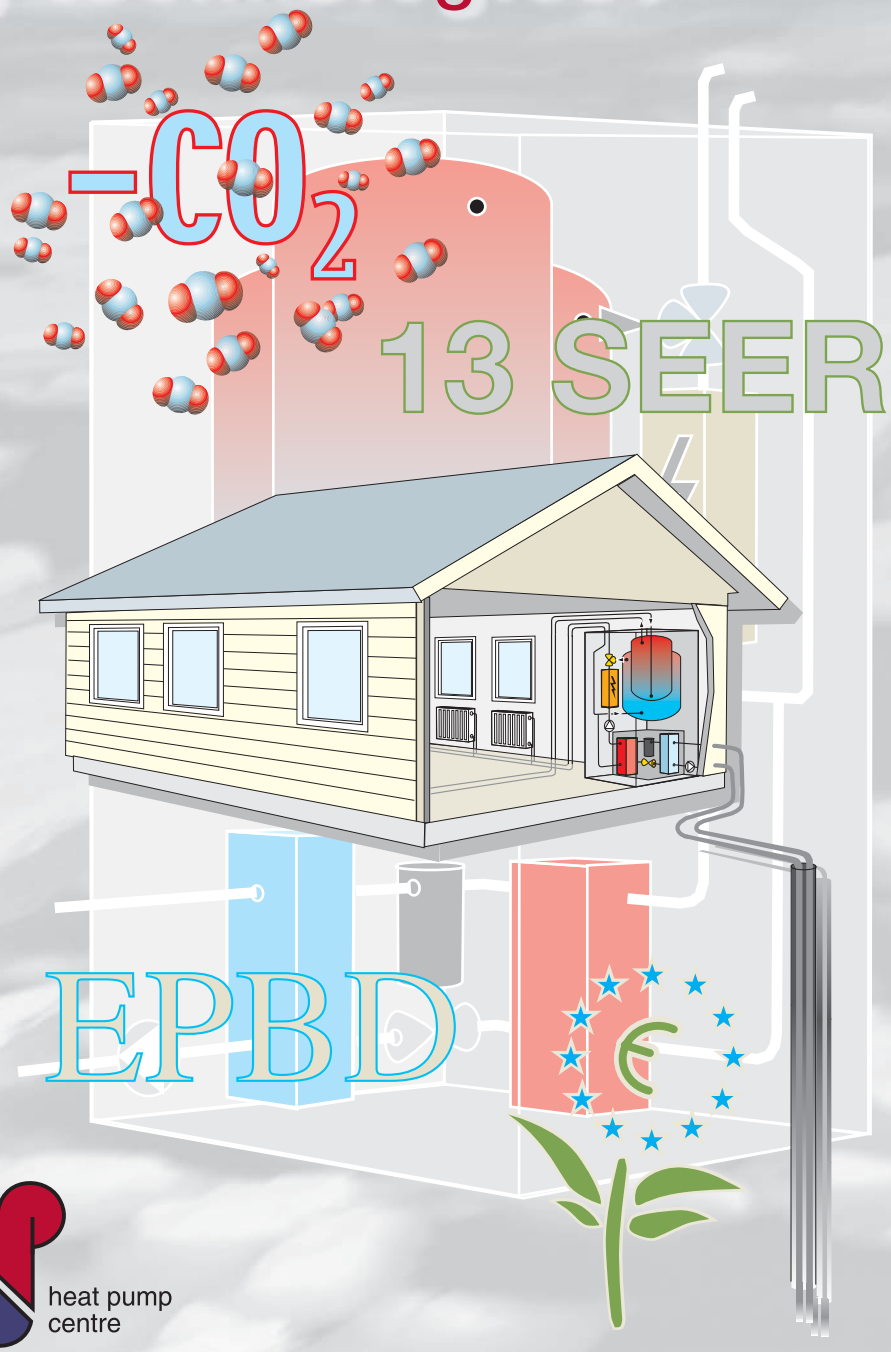
New regulations and directives – how will they affect heat pumping technologies?



The European Energy Performance of Buildings Directive

Implications of the 13 SEER for the Supply Chain – Is Heat Pump Technology Challenged

Amendments to Japanese Laws and Regulations for GHG Emission Reduction - how will they affect air conditioning and heat pump equipment

IEA OECD heat pump centre

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In this issue

New regulations and directives – how will they affect heat pumping technologies?

Regulations, standards and directives are important for policy-makers to steer the development of a technology in a certain direction. Likewise, they are important for consumers, as they set a lower limit to the quality that could be expected from manufacturers, and thus provide a competitive environment, resulting in quality products at attractive prices. Manufacturers can benefit from designing products that comply with regulations, standards and directives. Although the words 'regulations, standards and directives' may sound restrictive, grey or even boring, it is clear that everyone, customers, manufacturers, policy-makers and the environment benefits from them.

This issue presents topical articles on how regulations and directives will affect the heat pump community in different ways.
Since it's summer in the northern hemisphere, don't miss the article about Indians cycling to keep cold!

COLOPHON

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heat pump centre

Regulations and directives addressing heat pumping technologies

Sophie Hosatte
Chairman of the IEA Heat Pump Programme
Natural Resources Canada

The purposes of regulations and directives are multiple. Beyond obvious security and safety objectives, they can help ensure compatibility of components and equipment and therefore open markets to a wider number of manufacturers. In addition, they are very powerful policy instruments to overcome economic barriers (e.g. first cost), forcing the adoption of more efficient and more environmentally friendly technologies and practices, as one example. They have been identified in the portfolio of the policy measures presented in the Gleneagles Plan of Action – Climate Change, Clean Energy and Sustainable Development, following the 2005 G8 Summit, and in the recent IEA report entitled Energy Technology and Perspectives: Scenarios and Strategies to 2050.

Heat pumping technologies have a long history of evolution with regulations and directives. Synthetic refrigerants are a good example. The use of these chemical compounds in compression cycles at elevated temperature and pressure conditions has required the implementation of safety regulations. More recently, environmental concerns have led to significant changes in their utilization. In 1987, the Montreal Protocol on Substances That Deplete the Ozone Layer established the phase-out of chlorofluorocarbons (CFCs) and the progressive elimination of hydrochlorofluorocarbons (HCFCs) that deplete the ozone layer. Their substitutes, the hydrofluorocarbons (HFCs), are among the six greenhouse gases identified by the United Nations Intergovernmental Panel on Climate Change, in the Kyoto Protocol. The consequences are the acceleration of the adoption of natural refrigerants like ammonia (NH3) and carbon dioxide (CO2), turning R&D and business in new directions, looking for solutions to the new demands.

The IEA Heat Pump Programme has always been actively involved in regulations and directives, exerting leadership in these areas. Among the many topics are: International Heat Pump Status and Policy Review; Working Fluid Safety; Compression Systems with Natural Working Fluids; and Test Procedure and Seasonal Performance Calculation for Residential Heat Pumps with Combined Space and Domestic Hot Water Heating. These topics have been addressed by international collaborative projects, called Annexes, performed under the IEA Heat Pump Programme.

In this newsletter, a number of new regulations are presented as topical articles:

- In the United States, the DOE's 13 SEER creates challenges especially for the "downstream" parts of the heating, ventilation, air-conditioning, and refrigeration industry's supply chain
- In Japan, the Japanese Kyoto Protocol Target Achievement Plan, which includes comprehensive measures to reduce CO2 to achieve its Kyoto target
- The European Energy Performance of Buildings Directive introduces fundamental changes in the legislation relating to the energy efficiency of buildings

Regulations and directives are not only challenges; they also represent great opportunities in terms of innovation and economic activity. The IEA Heat Pump Programme has established a strong international network and specific collaborations that make it well positioned to play a key role in supporting the development of regulations and directives and orientating R&D activities to meet them.

Enjoy your reading!

Sophie Hosatte

Columnist

Heat sources – suitable product groups for the European Union Eco-labelling scheme

Benjamin Caspar
European Union, Environment DG
Email: Benjamin.CASPAR@cec.eu.int

The European Eco-label is voluntary tool which was established in 1992 and revised in 2000, when its scope was extended from products to services. Its Flower logo is awarded to the products which have the least environmental impact throughout their entire life-cycle. It enables manufacturers to attract attention to their environmentally friendly products or services and helps consumers identify them. The Eco-label products are checked by independent bodies to ensure that they comply with the environmental performance criteria. The European Eco-label is only awarded to products or services which are at least as efficient as conventional ones. More than 310 companies have been awarded the Flower Eco-label logo so far. The Flower logo can, therefore, be found on several hundreds of products today. Between 2003 and 2005, the sales of eco-labelled products have gone up by 200%.

Energy utilisation in the built environment is one of the most important aspects that have to be addressed in the near future. Around 40% of the primary energy use within Europe is related to the building sector. In order to reach the targets of the Kyoto-protocol, the energy utilisation in the built environment has to go through a transition. Up to now most of our space conditioning systems are major contributors to global warming. Environmentally benign heating systems have to be introduced on a large scale in order to reduce the emissions of green house gases. Developing criteria for the EU Eco-label for such environmentally benign systems is one way to encourage and guide customers in their choice of products.

One of the most promising technologies to reduce green house gas emissions is provided by heat pumps. Heat pumps offer an energy efficient way to provide space heating and preparation of sanitary hot water. Even though technical know-how of the heat pumping technology is well proven, it has not yet reached public recognition worldwide. In Europe, a sustainable market has only been established in small countries like Sweden, Switzerland and parts of Austria. Due to the escalating price of oil and electricity in conjunction with the increase of energy related taxes and growing environmental concern, the market for heat pumps have started to grow in all of Europe.

More than one branch of the heating source industry is positive about the idea of developing Eco-label criteria for Heat Pumps. The intention is to develop the Heat Pump criteria first and then use these criteria to develop criteria for other heating systems in the future.

The intention of the project is to follow the relevant directives concerning energy use and savings as well as following the principles in relation to Eco-design. Important principles guiding the process are to make energy savings and to reduce the impact on the global warming effect, directly and indirectly. Thus, the impact of the production of electricity is also being considered.

There are also chemicals with a high global warming potential to deal with, used as refrigerants. As an example, discussions are ongoing on whether to exclude the possibility to use these refrigerants or at least the most dangerous ones. Instead of banning, the effects from these refrigerants shall be included in the calculation of the annual impact of the global warming. If these refrigerants are used, they can only be used under certain circumstances and with a higher demand of efficiency.

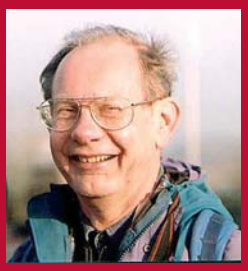
The final agreement of the criteria is planned for December 2006. For further information see the Eco-label website at: http://ec.europa.eu/environment/ecolabel/product/pg_heatpumps_en.htm

Benjamin Caspar

September 2005

How Heat Pumps can help to address today's key Energy Policy Concerns

Policy paper from the Heat Pump Programme Implementing Agreement



Roger Hitchin
Vice-Chairman
IEA Heat Pump Programme Executive Committee

Heat pumping technology[I] is a globally significant, modest cost, energyefficiency technology with a significant role to play in portfolios of measures to address key energy policy concerns. The technical and market knowledge that resides within the IEA Heat Pump Programme can help to develop applicable policies.

1. Key Concerns

IEA energy ministers and senior staff have identified a number of key strategic energy policy concerns[II]:

- Secure energy supply
- Reduce energy-related greenhouse gas emissions
- Provide access to modern energy for more than a quarter of the world's population

2. Scale of impact and costs

Heat pumping technology can have a material impact at modest cost.

There are already significant markets for heat pumps in a number of countries. Wider application could reduce worldwide carbon dioxide emissions significantly. A 30% market penetration of current technology would generate savings of about 1500 Mt pa.[III] This is around 6% of current total global emissions of about 25500 Mt pa.[IV] This is a significant proportion of the 16% savings (from a reference case) postulated in the IEA Alternative Scenario for 2030 and a substantial part of the 60% of this (that is 9.6% of the total) expected from end-use efficiency. Higher market penetration or improved equipment performance would increase these savings. Most of the savings result from the more efficient provision of heat within buildings and, to a lesser extent, from application to industrial processes. Savings in existing refrigeration and air-conditioning markets are more immediately accessible through the improved performance of established products, but are somewhat smaller. However, these end-uses are growing in developed and developing economies. The savings of fossil fuel consumption are correspondingly significant but depend on the future fuel mix of power generation.

This scale of impact is accessible at modest cost. As for other technologies, the life cycle cost varies with the application. There are situations where the difference with a conventional technology (e.g. fossil fuel furnace) is already zero or negative . More commonly it is at the lower end of estimates of the social cost of emissions (say 60 to 250 $/tC[V]). This puts heat pumps on a par with good examples of wind or biomass installations and below the cost of solar energy. As the carbon intensity of electricity generation is reduced, the carbon savings from replacing fossil fuel combustion by electric heat pumps increases. As a result of this synergy, the economics of carbon savings from heat pumps will improve.

3 Relevance

3.1 Relevance: Supply Security

Heat pumping technology can reduce exposure to supply risk by significantly reducing energy import levels and providing greater fuel flexibility through the use of electricity as a multi-fuel based energy carrier.

- Most OECD countries are net energy importers, and are exposed to supply security risk from technical or political interruptions to imports.[VI]
- Energy-efficiency improvements reduce demand and thus the scale of imports. As a result, risk management becomes more tractable.
- End-uses that use electricity, as is the case for most heat pumps,[VII] are less dependent on any particular fuel source, since electricity can be generated from a wide range of fossil and renewable sources

3.2 Relevance: Environmental impact

The wider use of heat pumping technology can significantly reduce carbon dioxide emissions at modest (often zero or negative) cost.

- The most pressing global environmental concern is climate change, though ozone depletion, air quality and visual and other amenity issues are also important .
- The use of heat pumps for space and water heating for buildings and industry is often more carbon efficient than the direct use of the fossil fuel for the same purposes.[VIII] The scale of the impact has already been described.
- As electricity generation efficiency improves and the generation mix contains a larger mix of renewables, the carbon savings from the use of heat pumps increases. Thus, there is synergy between heat pumping and lower-carbon electricity supply policies.[IX]

3.3 Relevance: Developing economies

Heat pumping technology can reduce the infrastructure costs for energy supply networks in developing economies

- Developing economies need to make large investments in energy supply and distribution infrastructure to meet the growing and essential needs of households and for industrial development. The provision of supply networks for gas and electricity to households has a particularly high cost.
- Providing space and water heating (and, where appropriate, cooling) through electric heat pumps is not only carbon and energy-efficient but can remove the need for a costly household gas distribution network. [X]

4. Priorities for action

The IEA Secretariat and Implementing Agreements could jointly identify and promote policy measures to encourage the appropriate uptake of heat pumping (and other energy efficiency) technologies within portfolios of measures to address these policy objectives.

The IEA has expertise in assessing energy policies and identifying where they are successful, and has influence in encouraging governments to implement appropriate policies according to their specific needs. It has the opportunity to draw on the knowledge within the Heat Pump Programme on heat pump markets, products and technical options, and on experience with existing policies. [XI]

We recommend that steps be taken to implement such collaborative studies

5. Some Options

At a macro-economic level, appropriate policies seem likely to include measures that pass environmental costs to end-users, such as carbon trading or carbon taxes. Such measures would allow efficient markets to recognise the value of all energy-efficient technologies including heat pumps.[XII] [XIII]

However, markets are imperfect. The 2001 IGCC report pointed out that, for mitigation technology in general, "expanded R&D is needed.....but implementation policies remain the major hurdle..." This is certainly true of heat pump applications. Lack of awareness of, and confidence in the technology need to be overcome. The supply and servicing infrastructure in most countries is immature. Relatively high capital costs also limit market growth, even when life-cycle costs are low. Policy measures to overcome these market hurdles are already employed in some countries and include:

- establishment of accreditation schemes for installers and for equipment
- support for the establishment of properly constituted trade associations
- provision of objective information on performance

There is also scope for further technical development. Unlike fossil-fuelled heat generation, the current performance of most heat pumping systems still falls short of the levels that are theoretically possible. Although the ozone-depletion potential of refrigerants has been dramatically reduced, there is still scope to develop and apply non-depleting refrigerants and procedures to contain other refrigerants more securely. Much of this work is most efficiently carried out through international collaboration. This is the mainstream role of IEA Implementing Agreements.

[I] Heat pumping is a technology that (usually) uses electricity to either upgrade waste or renewable heat to useful temperatures, or to extract heat for refrigeration or other cooling applications.

[II] Energy Ministers' meeting May 2005, Claude Mandil statement to G8 summit July 2005, Antonio Pfluger opening the IEA Heat Pump Conference May 2005. The general sentiments are echoed in the actions which the Gleneagles G8 communique placed on the IEA

[III] IEA HPC (1997) Heat Pumps can cut global emissions by more than 6% - Renewable Energy for a Cleaner Future. IEA Heat Pump Centre, Sittard, the Netherlands. (Note: More recent papers suggest that the savings could be up to 16%.)

[IV] Of this 31% is related to buildings, 40% to industry, 22% to transport and 4% to agriculture. Heat pump figures from IEA HPP studies: for industry 100 to 240 Mt CO2 pa. (Annex 21). The current most common use of heat pumping technology is for cooling and refrigeration end-uses in buildings. However, this accounts for only about 110 Mt CO2 per year (IIR 2001).

[V] UK Government Economic Service Working Paper 140

[VI] The major risk management options relate to diversification of suppliers and supply routes, and to ensuring that suppliers and consumers have common interests in an uninterrupted supply.

[VII] Some application use gas, steam or waste heat

[VIII] It is already more carbon-efficient to burn natural gas in a combined-cycle generation plant and then to use the electricity in a heat pump, than it is to use a gas boiler or furnace

[IX] The impacts noted above conservatively assume that the electricity generation fuel mix remains unchanged

[X] High fixed costs and the consequent economies of scale mean that the additional costs incurred for higher capacity electricity distribution can be less than the cost of household gas supply system.

[XI] Similar opportunities exist for other energy-efficiency technologies

[XII] And could be used to stabilise consumer prices, removing the uncertainty created by price volatility

[XIII] Current high fuel prices improve cost-effectiveness but may not be sustained.

General

Official launch of the 'wärmepumpe' klima:aktiv programme

Energiesparemesse - Wels

The right time and place to launch this initiative

Austria The current price of energy means that its efficient use and conservation are ever more important. Saving energy, not wasting it, is now a principle that is difficult to challenge. For anyone planning to build or renovate a house or an existing property, there are three crucial questions to ask:

- What can I do to save energy?
- How can I achieve a high degree of energy efficiency?
- Which technologies are readily available that will help me?

The answers to all of these questions, together with the latest information on the developments of green technologies, were available at Energiesparmesse.
Energiesparmesse, hosted by the town of Wels, is Europe's largest energy efficiency and energy savings exhibition. The exhibition site comprises a total area of about 57.000 square metres in 24 halls.
Between March 2nd & 5th 2006 some 850 exhibitors - with about 15 % of them coming from abroad – presented a wide range of products and technologies to an energy-efficiency-minded audience. Heating systems, solar thermal technologies and solar PV components were all featured in the exhibition, alongside other technologies such as new trends in the field of building materials and water treatment.

Overall, the Energiesparmesse is one of the largest trade fairs of its type, dedicated to the issue of sustainable energy use.

klima:aktiv - the initiative

klima:aktiv is the climate protection initiative of the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. The federal minister - Josef Pröll -describes the vision of klima:aktiv as follows:
"Whether it is building, living, reconstruction or driving – our lifestyle has dramatic effects on our climate. To protect it, we must reduce CO_2 emissions rapidly. klima:aktiv offers tailormade programmes for all those who want to benefit from the advantages offered by modern, climate-friendly technologies, whether in their jobs or in their private lives."

More information regarding all the klima:aktiv programmes can be found on the klima:aktiv web site – www.klimaaktiv.at

The 'wärmepumpe' klima:aktiv programme -

On the second day of the successful Energiesparmesse Trade Fair, Austria's Federal Minister - DI Josef Pröll - officially launched the 'wärmepumpe' programme. The minister toured the trade fair, showing particular interest in modern heat pump systems. He pointed out that "a major element of the 'wärmepumpe' programme is to promote an environmentally friendly and efficient heating system. On the one hand, that strengthens our domestic heat pump market and boosts the competitiveness of that part of industry; on the other hand, Austrian consumers profit from high quality products".

The **'wärmepumpe'** project is scheduled to run for four years, during which time the programme management team intends to offer a wide range of action programmes – all under the campaign theme, **'intelligent use of nature's energy'** - to different target groups

To help achieve the programme's objectives, leading partners have teamed up with the project management team - Austrian Heat Pump Association (LGWA) - and so have access to the knowledge and experience of an arsenal of research, Energie Tirol, Grazer Energieagentur (GEA) and the Österreichischen Gesellschaft für Umwelt und Technik (ÖGUT)

Combining economy and ecology

The work is intended to result in the promotion of environmental friendly and efficient heating systems, a boost to the domestic heat pump industry and expansion of potential markets.
A realistic target is that, by 2010, heat pump sales in Austria should be running at 10 000 units per year. Consumers will benefit from attractive information campaigns and, more importantly, measures will be put in place to ensure the quality of the product and continuous quality and reliability of completed installations.
klima:aktiv "wärmepumpe" is financed by the Federal Ministry of Agriculture, Forestry, Environment and Water Management, the Austrian Association of Electricity Companies (VEÖ) and thirteen heat suppliers.

A far-ranging programme

Increased use of heat pumps in the new buildings sector is the major focus of the programme. However it will also look at their use in multi family houses, commercial properties and renovation projects.

The main objectives of the programme are:

- Increased PR and market penetration
- Education and training initiatives for installers
- Information activities
- A feasibility study for heat pumps using no HFKW
- Quality assurance, for example, monitoring of heat pumps over a heating season and development of models to attract additional users of heat pumps.

A further factor that will help in making this programme successful is that both the chairmen of Austria's two heat pump organisations – Mr. Andreas Bangheri and Mr. Karl Ochsner – are committed to ensuring continuing constructive co-operation to realise this shared vision.

Comissioner for the EU's energy policy, federal minister Pröll and some of the members of the supporting companies. (Source: Glanzegg)

Increasing market share

'It is particularly fortunate that the 150th anniversary of heat pump technology and the launch of the 'wärmepumpe' klima:aktiv programme coincide', says Martina Höller, the Project Manager.
It is no coincidence that there is an increasing demand for heat pump systems, and that the heat pump market is an expanding market. In 2005, sales increased by more than 25 %, which means that 6000 heat pumps were sold last year.

Also at the Energiesparmesse

- An award for the most efficient heat pump system was presented by representatives of the Upper Austrian Government.
- The results of the "Energiegenie der Installateure" competition, open to all types of installers, were announced, with heat pump installers taking two of the top three places. More information at www.lgwa.at

Further information
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ECBCS launches new Annex on Heat Pumping and Reversible Air Conditioning

IEA The IEA implementing agreement on Energy Conservation in Buildings and Community Systems Programme (ECBCS), has started up a new project (Annex) on heat pumping and reversible air conditioning (Annex 48).

Substituting a boiler by a heat pump may save more than 50 % of primary energy - assuming that the electricity is produced by a modern gas-steam power plant - or even more if a part of that electricity is produced from a renewable source. Today, heat pumping is probably one of the quickest and safest ways of saving energy and reducing CO^2 emissions. The aim of this project is to promote the best heat pumping techniques applicable to air conditioning of commercial buildings, with particular emphasis on integration of these techniques into the entire air conditioning system. Specific objectives include:

- Making air conditioning as reversible as possible.
- Making the best use of currently available technology.
- Technological information already gathered in previous ECBCS, SHC and HPP projects will be extensively used.
- The specific characteristics of the building, of the occupancy and of the climate will be carefully taken into account.
- Guidelines about where and how to use each type of equipment will be established. Optimum control strategies will also be identified.
- A selection of (new and existing) building types will be established during the preparation phase, as determined by priorities expressed by the participants and by specific expertise available.

The operating agent for this project is Professor Jean Lebrun from Belgium.
For further information on this new project, please visit www.ecbcs.org/annexes/annex48.htm

Source: www.iea.org

Working Fluids

The 2nd International Seminar on Natural Refrigerants was held successfully in Tokyo

Japan The 2nd International Seminar on Natural Refrigerants was successfully held on February 10, 2006 in Tokyo, attended by about 250 persons, including delegates from China, Korea, and Sweden. The seminar was organised and sponsored jointly by the Heat Pump & Thermal Storage Technology Centre of Japan (HPTCJ) and by the Japan Refrigeration and Air Conditioning Industry Association (JRAIA).

In the morning session, two invited speakers from the USA and Europe, Dr. S.O. Andersen of the US EPA (Environmental Protection Agency), and Mr. F.P. Bush of the EPEE (European Partnership for Energy and the Environment), presented lectures on hot topics about the current situation of refrigerant regulation, as follows:

- 'US Refrigerant Regulation and Voluntary Programs to Protect the Climate and its Fragile Ozone Layer', Stephen O. Andersen and Kristen Taddonio
- 'European Policy and Legislation for Refrigerants', Friedrich P. Bush

After the lunch break, the seminar continued with six lectures by Japanese experts from a variety of fields: the new NEDO R&D program on HFC-free refrigeration and air conditioning equipment; natural refrigerant technology for air conditioning in general; natural refrigerant technology for mobile air conditioners; natural refrigerant technology for commercial refrigerating equipment; natural refrigerant technology for domestic hot water heating, and natural refrigerant technology for vending machines.

This seminar was chaired by Professor Eiji Hihara of Univ. of Tokyo, who has led a study group on natural refrigerants in the Heat Pump and Thermal Storage Technology Center of Japan (HPTCJ) since 2000. It is planned to repeat this kind of seminar every two years in conjunction with the HVAC & R JAPAN, an international trade fair.

A further report on this seminar can be found in JARN (March 25, 2006), page 43.

New replacement chemicals for R134a

DuPont Fluorochemicals and Honeywell have both announced that they have developed new replacement chemicals for R134a. The main reason for developing these replacements is the EU F-gas Directive, concerning deadlines for use of R134a in vehicles from 2011.

Source: RAC News, April 2006

The F-gas Regulation comes into force

EU The F-gas Regulation and the MAC Directive were published in the Official Journal of the European Union on 14 June 2006. The Regulation will come into force on 4 July 2006 and will apply with effect from 4 July 2007. The F-gas regulation is covered in a topical article in the next issue of the HPP Newsletter.

Technology & Applications

Growing interest for ground source heat pumps in the UK

United Kingdom Almost 200 delegates attended the inaugural meeting of the Ground Source Heat Pump Association, organised by the National Energy Foundation (NEF) in Milton Keynes on 20th June. The new association has been formed to promote and develop the Ground Source Heat Pump (GSHP) industry, which is growing rapidly, with installations in the UK increasing by at least 60 % each year. Dr Tim Lunel of NEF said in his keynote address that "Demand for ground source heat pumps will continue to surge as more and more houses are built to a target of using at least 10 % renewables in response to local authorities' energy strategies". Karl Drage of Geothermal Internal, who was elected as Chairman of the new Association, added "Recent gas price rises mean that homes with ground source heat pumps now cost less to run than when using any other fuel".

Source: www.nef.org.uk

Keep cool on the bike

India For those who can't boast of a regular supply of electricity, especially in far-flung rural areas, there's a cool piece of news. Here's a refrigerator that's powered not by electricity, but by a bicycle. 'Mycooler', an innovation of the Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE), is all set to storm the rural markets.

Aimed at providing refrigeration in areas that don't have an electricity supply, 'Mycooler', has been jointly developed G V Rao, Navaneeth and P G David, engineers associated with ISHRAE.

At an ambient temperature of 35 °C, when the bicycle is pedalled at a speed of 16 kmph for 20 minutes, the temperature in the refrigeration box can be reduced to 8 °C. "This temperature will stay for up to three hours, after which one has to pedal again for three to five minutes," Rao said.

Source: The HVAC&R Industry for May 11, 2006 Issue: 19 Volume: 5

From sewage pipe to home heating in Oslo

Norway Thanks to a giant heat pump, the district heating system in Oslo abstracts heat from 2400 m³/hour of sewage to heat one million square metres of the city's homes and buildings. The newly installed heat pump is probably the world's largest using untreated sewage, rainwater and melted snow. Operating with a COP of 2.8, it heats water to 90 °C. The pump's clean, efficient technology, developed over 15 years, has raised the share of renewable energy input to Oslo's district heating system from 50 % to 70 %.

Source: www.friotherm.com/downloads/skoyen heat pump type 50fy.pdf

Nature meets technology

Ziehl-Abegg developed the totally new blade geometry in its new FE 2 OWLET fan to mimic that of an owl's wing: owls are the quietest birds in flight. The new patent-pending fan blades are being used for the first time in the FE 2 OWLET fan. OWLET stands for OWL plus LET from winglet. The aerodynamic characteristics are markedly improved by the completely new blade geometry. The second generation of the company's premium fan, the FE, is now

improved in terms of low noise emission, reliability and high efficiency. In initial practical tests, the FE 2 OWLET attained clearly better efficiency and noise emission values than its predecessor models, which were already landmarks in their own right.

Source: www.ziehl-abegg.com

Ground source heat pumps replaces district heating in Stockholm

Sweden Over the last few years, the price of district heating in Stockholm has risen considerably. As a reaction to this, one association of home owners has changed its heating source from district heating to ground source heat pumps. The association consists of five buildings containing a total of 24 apartments. A total of 400 metres were drilled, each borehole 200 metres deep, and each building was equipped with a 40 kW heat pump. The annual savings on this investment account to about EUR 48 000, with an estimated energy price of EUR 90/MWh.

Source: Energi&Miljö, May, 2006 (In Swedish)

Markets

Daikin purchases McQuay's parent company

Daikin Industries announced that it will purchase McQuay's parent company, Malaysia-based OYL Industries. The purchase will reportedly make Osaka, Japan-based Daikin the world's second-largest manufacturer of HVAC equipment. OYL and McQuay will continue to operate as subsidiaries of Daikin. The acquisition, which is subject to regulatory approval, will not be completed for several months, according to Daikin.

Source: The HVAC&R Industry for May 25, 2006 Issue: 21 Volume: 5

Danfoss grows on the heat pump market

Denmark Danfoss recently acquired 100 % of the share capital of the Swiss company Steinmann Apparatebau AG. The company entered the heat pump market in the fall of 2005, when it bought the Swedish company Thermia, which is one of the leading European manufacturers in this area. Through its new acquisition, Danfoss is now one of the largest manufacturers of heat pumps in Europe.

Source: www.danfoss.com

World AC market highlights from new BSRIA study

Sales of window air conditioners in India are up 26 % from 2004 by volume. India's market for split systems grew 35 % by volume from 2004 to 2005. The market for chillers in India is expected to nearly double by 2009.
Over the past few years, competition has led to consolidation of major brands. While the market share of big players has grown, only around 40 manufacturers remain in the market (out of up to 200 several years ago). Overall AC sales in China are up around 9 % compared to 2004.
Sales of split systems in Italy, France and Greece were significantly lower than in 2004, mainly due to high stock levels. European sales as a whole were supported by Russia and Turkey, which enjoyed very high volume sales growth in 2005 at 16 % and 29 % respectively. The 'key seven' markets averaged only 2 % growth. Although recent price erosion appears to be stabilising, this can in part be attributed to increased sales of slightly more expensive R410a systems and continuation of the shift towards heat pumps and inverter-driven systems.
Sales of split systems in Japan consequently rose 10 % by volume, although the markets for other systems remain flat.
Sales of US-style ducted splits rose 17 % by volume in 2005 in the USA. This is largely attributable to anticipation of SEER 13 in January 2006, and the associated higher prices from this point on.

Source: www.bsria.co.uk

Austria – remarkable increase in heat pump sales in 2005

Austria Today, heat pumps are among the most environmentally friendly and efficient heating technologies available. Therefore, in 2005, an increasing number of consumers decided on a modern heating system with low heating costs and reduced CO_2-emissions. This boosted the demand for heat pumps used for heating and caused a market growth of 28 %, with an export ratio of 53 %.

Austrian residential heat pump market

A total of 9883 heat pumps were sold for heating and hot water production, with a split as follows:

- 61,7 % for heating
- 32,2 % for hot water production
- 5,1 % for heat recovery, and
- 0,9 % for dehumidification of swimming-pools

In 2005, 6100 heat pumps were sold for space heatingIn terms of heat sources, the most popular are ground-coupled heat pumps, with a market share of 74 %. Of these, 52 % are of brine/water type, and 22 % of direct vaporisation type. Water/water heat pumps made up 11,8 % of the market, followed by the air/water heat pumps with 14,2 % market share.

The thermal capacity of all installed heat pumps is 80 MWth, saving an oil equivalent of 237 459 tonnes. CO_2 reduction amounts to 641 139 tonnes if green electricity is used, or 493 149 tonnes if a traditional electricity generation mix is used. (Source: The Austrian heat pump market 2005. G.Fanninger, PHD. University of Klagenfurt)

Market potential

The heat pump market in Austria is at present concentrated on new buildings, as they offer ideal conditions for using heat pumps. Due to high building standards and the installation of low-temperature heat distribution systems, ground-coupled heat pump systems achieve high SPFs. However, there is a large market potential in the retrofit sector, which does not at present make much use of heat pumps. This may be due to the existing high-temperature hydronic systems, which reduce the SPF due to the higher heat pump outlet temperatures required.

Collecting data

Both heat pump associations – LGWA und BWP – were responsible for collecting the data. 22 companies submitted their sales figures, which represent nearly 100 % of the Austrian market. Professor G. Fanninger (PHD), under contract to the National Ministry for Transportation, Innovation and Technology, finalised the market statistics.

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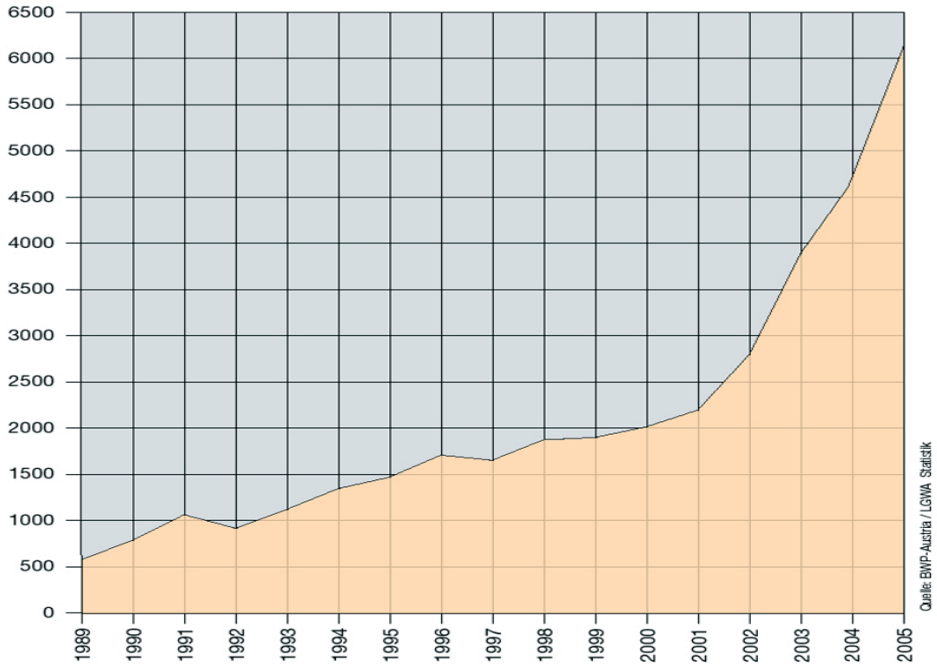


Austrian Heat Pump Market (for space heating) 1989 - 2005

IEA Heat Pump Programme

GENERAL

Norway assembles National Team

After some time without a national team in Norway, a new team has now been formed. Chairman of the team is Bard Baardsen from NOVAP, with participants ranging from researchers to market organisations and companies. The work is planned to include disseminating information on heat pumping technologies in Norway, acting as a source of information for policy makers, and assisting consulting engineers and designers to develop systems of higher quality.

Source: Kulde Scandinavia issue 2, 2006 (In Norwegian)

New on the web page

HPP's annual report was added to the web site in May 2006. It describes highlights from 2005, includes a report from the 8th IEA heat pump conference that was held in Las Vegas, USA in June 2005, and describes progress of the ongoing IEA HPP Annexes.

In addition to the annual report, two policy papers prepared by the HPP have been added to the web site. The first policy paper, which was published in the last newsletter, is on "The Potential Impact of Heat Pumps on Energy Policy Concerns". The second policy paper is on "How Heat Pumps Can Help to Address Today's Key Energy Policy Concerns ". This policy paper is published in this issue of the newsletter.

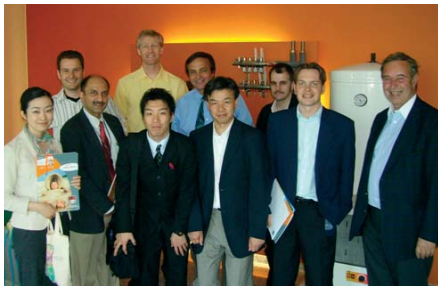
The HPP workshops section describes a workshop held in Tokyo, Japan.

A large number of links to National Standardization Organisations can now be found on the website.

ANNEX29

International heat pump experts' visit to Upper Austria - a review

During May, national experts attended the IEA HPP Annex 29 workshop held in Linz, Upper Austria.



Within the scope of this Annex, the workshop focused on the question **"How to overcome market and technical barriers in the field of ground source heat pumps"**. Progressing from that general question to more specific results, the workshop covered many different and interesting areas. Continuing an established tradition, Mr. Hermann Halozan chaired the

session and organised the workshop and the study trip.

The picture shows delegates on the study trip to Austria's well-known producer of heat pumps– Neura Electronics.
The managing director, Mr. Peter Huemer, showed the production line, the company's latest innovation, and gave an overview presentation of the Upper Austrian heat pump market. (Source: Neura: www.neura.at)

The presentations were as follows:

Progress and impact at the European level
Mr. Karl Ochsner, Chair of EHPA Strategy Committee, presented the next measures taken by the EHPA for boosting heat pump technology at the European level, and said that "The aim is to become a voice of the heat pump sector in EU and to be a back-up base for national actions".

Progress and impact driven by the national government
As an example of a national programme on climate protection, Mr.

klima:aktiv wärmepumpe

Andreas Bangheri presented the initiative of Austria's Federal Ministry of Agriculture, Forestry, Environment and Water Management – klima: aktiv. Klima: aktiv offers tailor-made programmes for all those who want to benefit from the advantages offered by modern, climate-friendly technologies. A major target of the "wärmepumpe" klima: aktiv programme is to promote an environmentally-friendly and effective heating system. This has benefits in two ways – it strengthens the domestic heat pump market and boosts the competitiveness of the Austrian heat pump industry, as well as ensuring that Austrian consumers benefit from high-quality products. For more Information: www.waermepumpe.klimaaktiv.at

Ground source heat pumps in different countries

Experts from Norway, Canada and the USA (Jorn Stene, Vasile Minea and Moonis Ally respectively) presented the current market situation in respect of ground source heat pumps. They focused their presentations on grants/subsidies, systems used, sales figures and typical national aspects in the field of heat pump technology. (See the Japanese information campaign)

(Source: Presentation: Katsunori Nagano, Sayaka Takeda, Takao Katsura)

Technical aspects
As far as the technical aspects of ground source heat pumps are concerned, a new design tool was presented by representatives of the Hokkaido University. Mr. Present-

schnik, from the research testing centre, described the current status of development, testing and monitoring of heat pumps. Mr. Widerin, project manager, showed how the building fountains can be used as heat sinks. The picture shows the Norddeutsche Landesbank, Hannover.
Technical data:
Type of Absorber: 122 drilled piles
Heating Capacity: 150 kW
Cooling Capacity: 350 kW
(Source ENERCRET, Nägele)

Mr Bangeri gave the closing remarks for the event:
"For me, it was a pleasure to take part in the workshop. On the one hand, I learned a lot about the utilisation of ground source heat pumps in other countries, and on the other hand about real and potential problems and burdens. The main task is to work together in a strong network to encourage our visions for the heat pump market".

ANNEX30

Annex Meeting in Aachen

At the third Annex meeting on 04.04.2006 in Aachen/Germany, it was reported that Task 1 "State of the Art, Market Analysis" has been finalised, while Task 2 "Matrix of heat pumps", (and in particular, the type and number of case studies) and "RD&D projects" was discussed. Finally, Task 3 "Overcoming economic, environmental and legal barriers" was introduced and a list of problems and barriers for the use of heat pumps in retrofitted buildings was discussed. The operating agent, IZW e.V, has already started preparation of the final report of Task 1.
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ANNEX 32

Multifunctional heat pump systems for low energy dwellings

At present, most heat pumps are installed in newly built dwellings. In the low-energy building sector in particular, multifunctional heat pump systems which cover different building needs such as space

heating, domestic hot water heating and ventilation have advantages. Annex 32 entitled "Economical heating and cooling systems for low-energy houses" was therefore started in January 2006. Its objectives are to extend the functionality range, e.g. to space conditioning incl. cooling and de-/humidification, and to improve both system components and integration with regard to design and control, subject to the limitations of investment costs. The work will include field testing to gather more experience of these systems. The kick-off meeting took place in Muttenz, Switzerland, at the end of April 2006. Participa¬ting countries are Canada, Switzerland (Operating Agent), Germany, Japan, the Netherlands, Sweden and the USA.

Further countries interested in the Annex 32 are Norway and Austria. The main subject of the kick-off meeting was the project plan¬ning to coordinate the national contributions. Canada's contribution is concerned with NOVOCLIMAT low-energy dwellings for cold climates, complying with the Canadian R-2000 building standard. Both optimisation of the design and control and field testing are planned.

Germany has two comprehensive field testing projects, one for ground-coupled and outside- air heat pumps in low energy buildings, and one for heat pumps replacing boilers in existing buildings. Field test results aim to discover weak points and to enhance the performance of the heat pumps under investigations. A further point is to evaluate if refrigerant loss occurs, and how this affects operation of the system.

Japan has a wide range of different climatic conditions, so customised heat pump solutions have to be developed. Even though many heat pumps are in use in Japan, most of the systems are small split units operating in reverse application for space cooling. Japan's project contribution is therefore entitled "The future heat pump for Japan", referring to the development of more flexible and multifunctional solutions to cover the different requirements.

Sweden has an extensive heat pump market, both in ground-coupled and exhaust air heat pumps. Due to the Swedish building regulations, an exhaust air heat pump is installed in nearly every new dwelling. However, the systems are not primarily intended for low-energy buildings, and so redesigns are needed at both component and system level, which is the focus of the Swedish contribution.

In the USA, 57 % of residential energy consumption is used for space heating, domestic hot water (DHW) heating and space cooling. The US Department of Energy (DOE) has therefore launched a research program to reduce consumption to half of this value. A particular focus in the USA is dehumidification, needed for comfort in the climatic conditions in the southern states. Multifunctional integrated heat pump systems have been identified as the best suited system in previous feasibility studies. Design options are being tested at present, and a prototype field test is scheduled for the end of 2007.

Switzerland's contribution is dedicated to the investigation of the cooling function. In low-energy dwellings with large glass façades in particular, there is a risk of overheating in the summer. Even though cooling in energy-efficient single-family dwellings is not very common yet, manufacturers are redesigning their heat pumps to include a comfort cooling option. In fact, a cooling option can increase comfort in the summer, and if the systems are well designed, the additional energy consumption may be marginal. Thus the objective of the contribution is to develop standard layouts and controls for integrated heat pump systems, including space cooling.

Having similar objectives but different scopes, a close information exchange has been established between IEA HPP Annex 2 and Annex 48 in the Energy Conservation in Buildings and Community Systems (ECBCS) program entitled "Heat pumping and reversible air conditioning". The main focus of the ECBCS Annex 48 is (as far as possible) reversible operation of chillers in commercial buildings.

Carsten Wemhoener, Thomas Afjei, Switzerland

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Figure 1: Participants at the kick-off meeting of Annex 32 in Switzerland

The IEA Heat Pump Programme present at the Montreal COP-11 Meeting

The Eleventh Session of the Conference of the Parties (COP-11) to the United Nation Framework Convention on Climate Change took place in last November-December in Montreal, Canada. This was the first meeting of the Parties to the Kyoto Protocol since it entered into force on February 16, 2005.

Professor Herman Halozan from the Graz University of Technology in Austria, the Austrian delegate at the Heat Pump Programme Executive Committee, was invited as a keynote speaker at a side event of the conference on ground-source heat pumps on December 1st. This event was organized by Energy Strategies a non-governmental organization (NGO) based in Montreal, with the support of the Canadian GeoExchange Coalition and Hydro-Québec, the Québec province electric utility. The purpose of this event was to transmit to the attendees that ground-source heat pumps are not just a long term solution, but are already a solution for the present, which can provide quantifiable results in reducing the greenhouse gas emissions of each country during the 2008-2012 period.

During his presentation Professor Halozan talked about the Heat Pump Programme and detailed the work content of the Heat Pump Programme Annex 29 (collaborative project between participating countries) "Ground Source Heat Pumps-Overcoming Market and Technical Barriers"currently on-going. Following Professor Halozan's opening keynote, representatives of the geothermal industry in China, Austria, the United States and Canada have presented the experiences of their own countries regarding market penetration of geothermal energy and overcoming their barriers.

Ongoing Annexes

Bold text indicates Operating Agent.

Annex 29 Ground-Source Heat Pumps - Overcoming Market and Technical Barriers	29	AT, CA, JP, NO, SE, US
Annex 30 Retrofit heat pumps for buildings	30	DE, FR, NL
Annex 31 Advanced modelling and tools for analysis of energy use in supermarkets.	31	CA, DE, SE
Annex 32 Economical heating and cooling systems for low-energy houses.	32	CA, CH, DE, NL, SE, US

IEA Heat Pump Programme participating countries: Austria (AT), Canada (CA), France (FR), Germany (DE), Japan (JP), The Netherlands (NL), Norway (NO), Sweden (SE), Switzerland (CH), United Kingdom (UK), United States (US). All countries are members of the IEA Heat Pump Centre (HPC). Sweden is Operating Agent of the HPC.

The European Energy Performance of Buildings Directive

Roger Hitchin , United Kingdom

The European Energy Performance of Buildings Directive introduces fundamental changes in the legislation relating to the energy efficiency of buildings. Nearly all air-conditioning systems and boilers are required to be inspected regularly to assess their energy efficiency. Energy performance ratings – similar in principle to energy labels – are required whenever buildings are constructed, sold or let. These will be based on calculations that take account of the efficiency of HVAC and lighting systems as well as the building envelope. This means that reliable product and system performance data is essential.
Although implementation is lagging behind the very ambitious planned timetable, at the start of 2006 many countries were in the process of introducing some parts of the Directive.

The General Aims of the Directive and the position as of March 2006

The European Union Energy Performance of Buildings Directive (Directive 2002/91/EC, more commonly known as the EPBD) was published in January 2003. Its overall objective is to 'promote the improvement of energy performance of buildings within the Community taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.' It has far-reaching implications for the owners, operators and developers of all buildings in Europe (both domestic and non-domestic) and supports the broader objectives of the recently-agreed directive on energy end-use efficiency and energy services. The latter should become EU legislation by mid 2006 and will require member states to achieve 9 % savings in energy consumption over the nine years beginning in 2008.
Each EU member state was required to transpose the EPBD into national law by the beginning of 2006, although there was provision for some parts to be delayed by up to three years in certain circumstances. Reflecting the different legal and building control systems and existing infrastructure and practices in different Member States, they have discretion in how they implement the Directive as long as they satisfy its fundamental requirements. Given the scope of the Directive, which in some areas overlaps with existing national regulations, and in others requires completely new mechanisms to be put in place, this was a very demanding timetable.

At the end of February 2006, 3 countries had notified full transposition and 7 countries partial transposition. All 10 countries requested an extension for certification and inspection, most up to the maximum 3 years. However this is by no means the complete story – quite what constitutes "transposition" is not entirely clear. It could be interpreted as anything between passing enabling legislation to having the full delivery mechanisms in place. In addition, several countries that did not formally notify implementation are known to have measures coming into force that satisfy some of the Directive's provisions.

Key Provisions

There are, in effect, three basic requirements: minimum energy performance for whole buildings; performance certification for buildings and inspection of heating and air-conditioning systems.

Minimum Energy Performance Requirements

All member states are required to introduce legislation that sets mandatory minimum performance standards for new buildings and for large buildings undergoing major renovation. Many countries already have such requirements, but few express them in the way that the Directive demands. The EPBD demands that the standards be based on an integrated energy calculation that takes account of, amongst other things, the performance of the HVAC and lighting systems as well as the building fabric. For many countries this introduces considerations of system efficiency for the first time. Thus the question of how to calculate seasonal system efficiency and seasonal component efficiency (including, for example, chillers and heat pumps) is now of equal importance to that of calculating heat gains and losses. In one or two countries, regulations for dwellings are already based on an energy calculation - though usually ignoring lighting. Other types of building are often much more complex and varied in design and

use. While energy calculation tools for such buildings exist, they are focused on design applications rather than regulation, especially in terms of the detail and amount of information that is required. There is an inherent conflict between the requirements of reproducibility, accuracy, time to carry out the calculation and ease of independent checking. Different countries are adopting somewhat different approaches reflecting differing trade-offs between these conflicts.

Energy Performance Certificates

Whenever a building is constructed, sold or let, an Energy Performance Certificate has to be available. In addition, "public buildings" are required to prominently display the energy performance certificate. The certificate has to be accompanied by recommendations for cost-effective improvements to the building's performance. Certificates have similar functions to the energy labels that are in widespread use for appliances but the Directive does not specify what form they should take.

There are two schools of thought on the most useful basis for the certificates: an "asset" rating or an "operational" rating. Each has its own strengths and weaknesses and serves a different purpose.

An "asset" rating is calculated using standard values for weather and building use. It is useful for potential renters and purchasers of existing buildings because it produces a like-for-like rating that is independent of the current user and weather. It can be applied to both new and existing buildings. Although there is no formal requirement to use the same calculation procedure as is applied to new buildings, it is logical to do so.

An "operational" rating is based on measured energy use, so it reflects how the building is used and managed. This is less useful for a prospective buyer, but more useful for energy managers because it includes the effects of operational factors that they can influence.

A basic operational rating using fuel consumption records is probably the simplest possible form of rating to determine, but such a simple measure is quite limited in value. It is difficult, for example, to identify which measures will be cost-effective without the collecting additional information about the building. On the other hand, energy calculations are usually carried out for new rather than existing buildings, using detailed information from design drawings. For existing buildings, detailed data rarely exist and would be expensive to collect. Ways of reducing the potentially high cost of such procedures are needed. Several countries are developing user interfaces for calculation tools that require less information and include inference procedures to provide default values for missing data. Typically, these defaults are somewhat pessimistic to encourage building owners to provide evidence that the building is actually better than the default. For example, there might be a default assumption of single glazing which can be overridden if there is evidence that double glazing has been installed.

It is far from clear which option most countries will adopt, but broad preferences seem to be developing for asset ratings for "construction, sale or let" certificates and operational ratings for "public display" ratings. There appears to be no reason why a certificate could not contain both types of information. Indeed, there may be a case for using records of fuel consumption to identify buildings for which detailed asset ratings are required.

Because of the difficulty of developing meaningful benchmarks for the primary energy consumption or carbon emissions (either is permitted) for the heterogeneous range of (especially) non-domestic buildings, several countries are proposing the use of "notional" or "reference" buildings. These are typically of the same size and shape as the actual building, but assumed to have standard levels of insulation and system efficiencies. The calculated consumption of the actual building is then compared with that of the notional building to produce a rating that is, in effect, calibrated to the specific building design.

System Inspections

The Directive requires that most boilers and heating systems over 20kW should be inspected regularly, with similar provision for air-conditioning systems of over 12kW capacity. The inspections are intended to assess the efficiency and sizing of the systems, and to provide advice for improving efficiency. For boilers (but not for air-conditioning) alternative policy measures are permitted provided that they can be shown to have equivalent energy-saving impact.

Some countries already have systems in place for mandatory boiler inspection, mainly for safety reasons. For others this is an entirely new and potentially costly measure.

Work is still in progress in most countries to decide how to implement the inspection requirements. The frequency and detail of inspections will determine the number of inspectors required, the skill levels and possible training needed and, importantly the cost and benefits of the procedure.

The role of European standards

A number of European Standards are being developed in parallel with the implementation of the Directive. Draft standards are due to be issued for formal voting during 2006. If accepted, they will become full standards in 2007. Unless national legislation demands it, they are not mandatory in member states. However, when agreed, they should represent good practice. Most countries are taking note of them in the development of implementation tools and practices. As experience in implementing the Directive is gained the initial standards are likely to be further developed. It is probable that, over time, the range of national implementation mechanisms will tend to become narrower and more strongly aligned with the standards.

Conclusions

The European Energy Performance of Buildings Directive introduces fundamental changes in the legislation relating to the energy efficiency of buildings. These include extending labelling and minimum performance standards to buildings as products. While this has been recognised as desirable for a long time, the implementation problems have been seen as substantial. By imposing a regulatory requirement, the issues has moved from being the scientific one "how can we do this rigorously?" to the more pragmatic "how can we come up with something that is practicable and adequate?". The result has been very substantial progress, albeit uneven across member states and less rapid than the very ambitious timetable of the Directive.

Inspection and certification of existing buildings is lagging behind measures that apply to new ones. This is hardly surprising since, in most countries, there is less exiting infrastructure and practice to build on – and the potential costs are substantially higher. Nevertheless, the measures that are already being put in place provide a strong incentive for reliable product and system performance data - and energy efficient systems and products.

An overview of what one country is doing

From April 2006, there will be a fundamental change to the way of dealing with energy requirements in Building Regulations in England and Wales (Scotland and Northern Ireland will follow). Instead of having to satisfy particular values for insulation levels, lighting efficiencies etc, it will be necessary to show that the carbon emissions of the building as a whole are below a particular level. This will mean doing an energy calculation.

For housing the calculation will be a new version of the existing Standard Assessment Procedure SAP, so the procedure will not be too different from the present situation.

For non-domestic buildings (and a few large dwellings), new procedures will be used. The simplest of these is the Simplified Building Energy Model SBEM. This is intended to be able to deal with most buildings and can be downloaded from www.ncm.bre.co.uk , together with the user interface iSBEM and a User Guide. Some commercial software companies will also include SBEM as part of their product package. Other software – for example, energy simulation programs – may also be used, provided that it has been accredited as suitable by the relevant government department, ODPM.

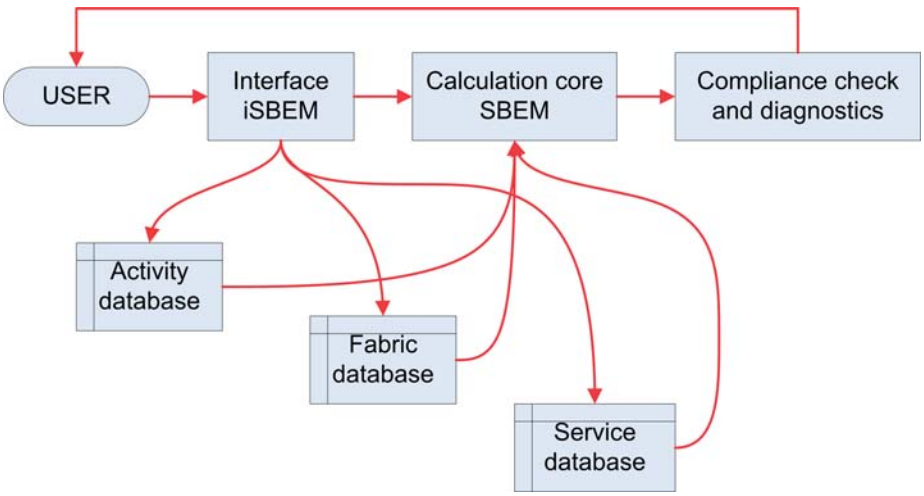
The calculations take account of the efficiency of heating, lighting and cooling systems as well as the provision of day-lighting and the insulation and air-tightness of the building. The target emissions value for a building is determined by calculating the emissions of a "notional building" of the same size, shape, use and weather as the proposed building but with standard values for insulation, heating efficiencies etc. This is then reducing by a factor defined in the Regulations to set the target. (All the notional building calculations are carried out automatically by the software.)

There will still be minimum allowable values for insulation, boiler efficiency etc but, in themselves, these will not produce a compliant building.

These changes have been introduced as part of compliance with the European Energy Performance of Buildings Directive. Other measures will be introduced to comply with further requirements of the Directive.

Strictly speaking, SBEM is the calculation core issued by ODPM (and iSBEM its associated user interface) of a methodology summarised in the diagram below. Some software vendors are embedding SBEM within their own interfaces, and others will use accredited calculation tools – for example detailed simulation software – in place of SBEM.

The activity database (and weather data) have to be used for compliance, whatever calculation core or interface are used. The fabric and service databases are convenient but not mandatory (though the assumptions used for the notional building may not be changed).



In accordance with the requirements of the EPBD, SBEM takes account of

- indoor conditions such as occupancy, temperature, lighting level, ventilation (set to standard values for Building Regulations purposes)
- building fabric performance: insulation and airtightness
- energy performance of heating cooling and hot water services
- lighting and daylighting
- position and orientation
- passive design features
- renewable and CHP options

Since non-domestic buildings vary enormously in size, usage and design, the procedure has to be applicable to a wide range of situations. However, to make it suitable for every conceivable building would be difficult to achieve without also complicating its use, so a degree of compromise is necessary. The current version of SBEM is capable of development to address a number of building and system features that are not presently dealt with, so upgrades can be expected from time to time.

Wherever possible, the calculation procedures are taken from the emerging CEN standards that support the EPBD. In particular, the thermal calculation uses a monthly heat balance procedure from European standard EN 13790 (rather than complex hourly simulations or simple degree-day calculations). This takes account of the impact of the thermal capacity of the structure and can deal with the majority of situations. In some areas the standards are incomplete, and here new methods built on the principles of the standards have been developed. The resulting software has been independently assessed for ODPM before being released.

In order to check compliance, the user has to describe the shape, orientation and construction of the building, allocate a use to each space and describe the building services systems that are specified. To keep these tasks as straightforward as possible, drop-down lists of options are offered for many decisions – with the user having the freedom to define their own variations if necessary.

Although the immediate application of SBEM is to compliance with Building Regulations, it has been developed with an eye to future application to existing buildings as part of the EPBD requirement for Energy Performance Ratings. To simplify this potentially time-consuming task, it contains a number of inference procedures that can speed the data entry process, provided that some uncertainty is acceptable.

Some estimates of costs and benefits of inspections (from the Auditac Intelligent Energy Europe project)

The AUDITAC project (www.energyagency.at/projekte/auditac.htm) supported by the European Commission under the Intelligent Energy Europe programme, has made some preliminary estimates of the costs and benefits of air-conditioning inspections:

It first asked "How many inspections per year will be needed if 'regular' means every three years?" As table 1 show, in Italy, for example, by 2012 there would be around 1 million inspections each year. In the table, inspections are divided into those of room air conditioners (RAC) and centralised air-conditioning systems (CAC).

	2007		2012		2017	
	RAC	CAC	RAC	CAC	RAC	CAC
IT	628000	181900	828000	237000	962500	279600
SP	405000	124400	490500	151100	545400	167500
FR	311300	64300	405100	84200	477900	98600
GE	239200	42400	322900	57300	384100	68000
UK	161700	54600	191300	64200	105700	69800

It then asked "How many inspectors will that need?". This depends on the time required per inspection and therefore on the scope of the inspection. Table 2 shows figures for two alternative scenarios, one assuming one-day inspections by "inspectors" and the other for a more detailed two-day inspection by "experts". Italy would require the equivalent of between 5000 and 10, 000 full-time inspectors.

	2007		2012		2017	
	Inspector	Expert	Inspector	Expert	Inspector	Expert
IT	4050	8100	5325	10650	6210	12420
SP	2650	5300	3210	6420	3565	7130
FR	1880	3760	2450	4900	2885	5770
GE	1410	2820	1900	3800	2260	4520
UK	1080	2160	1280	2560	1380	2760

If we assume that an inspection might reduce consumption by between 5% and 10% (assuming that an "inspection" is mainly going to identify quick-fix issues), we can estimate the value of these savings:

We can also estimate the cost of inspectors' time and get an idea of the payback:

Clearly, the payback period is longer than the assumed interval between inspections – and is sometime comparable to the plant life. In most countries this is too long to be attractive to most users, so the market demand in the absence of regulation would probably be small. But there are ways of reducing the costs. An obvious way is to reduce the frequency of inspections, perhaps by requiring more frequent inspection of systems that are likely to show larger potential savings, for example systems with a previous history of faults (or with poor records), or older systems, or larger systems.

Another possibility would be to integrate the inspection with the regular operation and maintenance procedures - a good O and M system will already cover the issues and incur no extra cost, except perhaps to cover the cost of a quality assurance scheme. It is not at present clear whether this would satisfy the Directive's requirement for independent inspection.

A benefit not included in the figures above is the identification of systems that appear to justify a more thorough energy audit that would be likely to identify bigger savings. Procedures to encourage and help users to do this are the main purpose of the AUDITAC project

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	Cooled area 10^6 m2	**Specific Consumption** kWh/m2	**Total Consumption** TWh/yr	**Savings** 10^6 €/yr
IT	370.4	50.1	18.6	37.2 – 74.4
SP	407.7	81.5	33.2	66.4 – 132.8
FR	268.1	32.6	8.7	17.4 – 34.8
GE	185.3	22.8	4.2	8.4 – 16.8
UK	166.2	19.7	3.3	6.6 – 13.2

	Costs 10^6 €/yr	**Savings** 10^ €/yr	**Simple Payback** (no investment cost) years
IT	810	37.2 – 74.4	11 –22
SP	530	66.4 – 132.8	4 – 8
FR	376	17.4 – 34.8	11 – 22
GE	282	8.4 – 16.8	17 - 34
UK	216	6.6 – 13.2	16 - 33

An overview of how Sweden is implementing the EPBD

Svein Ruud , Sweden

Sweden has conducted several investigations of how to implement the EPBD. Finally, in the spring of 2006, a "Proposal for a Law on Energy Declaration of Buildings" was submitted to the Swedish Parliament. The law was passed by the Parliament before the summer recess, and will come into effect on October 1st 2006.

The law is an interpretation of the EPBD adapted to Swedish circumstances. Instead of "Energy performance certificate", the Swedish proposal defines an "Energy declaration". The law establishes who is responsible for preparing energy declarations. Declarations must include details of the energy performance, a reference value and (if relevant) cost-effective measures to improve the energy performance while maintaining a good indoor climate. In addition, the declaration must include information on radon measurements that have been made, and on compulsory ventilation checks (OVK). As far as possible, inspection of air-conditioning systems shall be coordinated with the inspection made in connection with the energy declaration. Energy declarations must be prepared by approved independent experts. If an energy declaration is not provided when required, the buyer of a building may have a declaration prepared at the seller's expense. When required, energy declarations must be available to the public. All energy declarations must be sent to The National Board of Housing, Building and Planning (Boverket), who has also been appointed as responsible for establishing a register of all declarations. Local government must ensure that energy declarations are properly available, and that inspections of air-conditioning systems not covered by the energy declaration inspections are performed. The Swedish government, or a public authority appointed by the government, will define permissible exceptions from the law, how thorough the inspections shall be, requirements on the independent experts, access to the register, how energy performance shall be established, which reference values that shall be used and if additional information shall be given in the energy declaration. It is most likely that The National Board of Housing, Building and Planning will be appointed to produce these instructions in the form of regulations. All multi-family houses and all public buildings larger than 1000 m2 shall have an energy declaration by December 31st 2008. With effect from January 1st 2009, these building and all other buildings must provide an energy declaration when required by the EPBD.

In parallel with the work on the new law, the National Board of Housing, Building and Planning has also carried out a larger overhaul of the Swedish Building Regulations (BBR). The chapter on Energy Efficiency has been modified to bring it into line with the requirements of the EPBD. This represents a fundamental change to the way of dealing with energy requirements in the Swedish Building Regulations. Instead of having to provide a particular value of insulation level, it will be necessary to show that the energy use of the building as a whole is less than a particular level. This will involve energy calculations and also, through measurements in the real building, showing that the requirements on energy use are met in practice. A first version of the new building regulations will come into force on July 1st 2006.

The last proposal for the new building regulations contained formulations that were very unfavourable to heat pumps. It was proposed that heat pumps should be considered as being outside the system boundary of the building, even if they in fact were placed inside the building. However, after tremendous lobbying, these parts of the proposal were deleted before the new building regulations were approved by the Board. The new building regulations, as of July 1st 2006, will therefore have little influence on the Swedish heat pump market, i.e. business as usual.

However, when the "Law on Energy Declaration of Buildings" is passed, the chapter on energy efficiency will probably be further revised. One likely revision is that all electrically heated dwellings will be required to have the same level of demand, regardless the type of distribution system. There may also be stricter energy demands on all multi-family houses. The new requirements are planned to come into force on January 1st 2007.

As buildings with heat pumps driven by electricity will also be regarded as being electrically heated, the stricter

requirements will probably affect the Swedish heat pump market. Exhaust air heat pumps, which today are installed in about 90% of all new Swedish single-family houses, will be disadvantaged, but ground source heat pumps will benefit. This means that, even if the number of heat pumps sold remains the same, there will probably be a shift from less expensive to more expensive heat pumps in newly built Swedish single-family houses.

Stricter requirements for multi-family houses will probably create a new market for larger exhaust air heat pumps. Heat recovery from exhaust air is one of the obvious ways of meeting the new requirements, and exhaust air heat pumps are the simplest way of achieving this without a radical change in how multi-family houses are built.

There is still a lot work to do before the Swedish implementation of the EPBD is fully established. Final requirements and educational programs for the independent experts are still not in place. In addition, there is no tested and approved calculation program for Swedish conditions that fulfils all the requirements of the EPBD. Reference values have yet not been established. Finally, it is still not clear how the energy performance of different types of building should be defined in practice. For instance, the government investigation has suggested that household electricity should be included in the energy performance of single-family houses, but not of multi-family houses, whereas the new building regulations say that it must be excluded for both building types.

1) Including domestic hot water, but excluding household electricity
2) Sweden is divided into two separate climatic zones, with the boundary approximately slightly north of Stockholm
3) These values may be reduced, and non-directly but still mainly electrically heated dwellings will probably be included in this column by January 1st 2007
4) These values may be reduced for multi family-houses by January 1st 2007
5) Additional specific energy use is allowed in buildings with higher specific air flow rates than the nominal air flow rate of 0,35 litre/m2
6) Area heated above +10 °C. Garage area is excluded even if heated above +10 °C.
7) Alternative requirements may be specified for smaller buildings (< 100 m2). These are more like the old regulations, where a specific insulation levels are required. However, the required insulation level is higher than in the old regulations, and even higher requirements are specified for buildings with direct electric heating.
8) The building's specific energy use may be reduced by the specific energy delivered from thermal solar collectors or PV-panels installed on the building .

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Location[2]	Dwellings[8] with direct[3] electric heating	Dwellings[8] without direct electric heating[4]	Other premises [5] (offices, schools, etc)
North of Sweden	95	130	120
South of Sweden	75	110	100

Table 1. Highest allowable specific energy use for heating and cooling of buildings according to the new Swedish Building Regulations, as from July 1st 2006 (kWh/m2 a)1, 6, 7.

Implications of the 13 SEER for the Supply Chain – Is Heat Pump Technology Challenged

James Walters, USA

Implementing the U.S. Department of Energy's (DOE) new energy efficiency standards for air-conditioners and heat pumps creates challenges especially for the "downstream" (of the manufacturer) parts of the heating, ventilation, air-conditioning, and refrigeration (HVACR) industry's supply chain. This paper based on a symposium[1] , "13 SEER[2] Is Here! Are You Ready?" held at the 2006 AHR Exposition held in conjunction with the ASHRAE Winter Meeting in Chicago, Ilinois. suggests that the challenges typically identified with the 13 SEER standard are those dealing with ensuring the proper education of wholesalers, distributors and consumers about the changes.

Introduction

New, Federal energy efficiency standards for residential and small commercial air-conditioners and heat pumps went into effect January 23, 2006 in the United States. Industry-sponsored educational and informational material, seminars and symposia about the change typically do not include discussions of the impact of the change on heat pump technology. A review of some of the informational material on the transition, reviewed in this paper, does not immediately offer reasons why this is the case.

Body

Implementing the U.S. Department of Energy's (DOE) new energy efficiency standards for air-conditioners and heat pumps will create challenges especially for the "downstream" (of the manufacturer) parts of the industry's supply chain, wholesalers and contractors. Additionally, the new standards themselves have a number of exceptions which can confuse not only the consumer but professionals in the supply chain. An issue is whether the challenges of complying with the new regulations, and their exceptions, can or should be addressed by technological changes in heat pumps – the jury is out.

By The Numbers – The New Standards

All central air-conditioners and heat pumps manufactured in the US on January 23, 2006 and after has to meet the 13 SEER (seasonal energy efficiency ratio, Btu/Wh) standard. Specifically, the standard for air-conditioners is 13 SEER and 13 SEER/7.7 HSPF[3] for heat pumps. The standards also apply to split and packaged units imported into the U.S. on or after January 23, 2006 and to single-phase units < 65,000 Btu/h (< 19,000 W).

Through-the-wall (TTW) products are exempted from the 13 SEER and have the following ratings. Split systems must meet 10.9 SEER and 7.1 HSPF. Packaged systems must meet 10.6 SEER and 7.0 HSPF. TTW products are specified as those ≤ 30,000 Btu/h (8,800 W) and not weatherized. They must be marked for installation through an exterior wall and the out door air heat exchange area must be < 800 in^2 (0.5m^2) for split units and < 1,210 in^2 (0.7804 m^2) for packaged systems.

Space constrained products are also exempted from the 13 SEER standard.

The energy efficiency standard for these products is 12 SEER/7.4 HSPF and these are applicable to splits and packaged systems with the following characteristics: having a cooling capacity ≤ 30,000 Btu/h (8,800 W); being substantially smaller than other units and being a product type available for purchase in the U.S. as of December 1, 2000. However, it should be noted that as of this writing, no products have been classified by DOE as space constrained.

Additionally, DOE has provided a waiver for small duct high velocity (SDHV) systems manufactured by Unico, SpacePak and Energy Saving Products. These products are designed for, and produce, at least 1.2 in. (300 Pa) external static pressure at 220-350 cfm/ton (0.104m^3/s – 0.165m^3/s) and use high velocity room outlets of >1000 fpm (5 m/s) and <6 in^2 (0.0039 m^2)of free area.

The main points to recall from these new rules and the exceptions and waivers are:

- New Federal standards apply to single-phase products < 65,000 Btu/h (19,000 W).
- DOE has not yet acted on 3-phase products < 65,000 Btu/h (19,000 W).
- Products below 13 SEER/7.7 HSPF and manufactured prior to 1/23/06 can be sold and installed after 1/23/06.
- Products imported into the U.S. as of 1/23/06 must meet standards even if manufactured prior to 1/23/06.
- Ductless mini-splits[4] must meet 13 SEER/7.7HSPF standards.

Wholesaler/Distributor Challenges and Solutions

Beyond the factory fence, the wholesaler is in a unique position to provide solutions to contractors and end-use buyers. The wholesaler/distributor faces a number of challenges beginning with educating the dealer and contractor base about how to implement the 13 SEER standard. This education covers several areas including:

- Identifying data which will ensure proper component matching;
- Promoting the correct matching of indoor and outdoor components and line sets on replacement jobs.
- Using the correct components e.g. manifold gauges, hoses, reclaimers, lubricants and thermal expansion valves (TXVs) versus fixed orifice expansion devices.

Underlying these engineering points is the need for effective communication with consumers about the new standard and its exemptions and allowances, e.g., being able to use <13 SEER equipment if it were manufactured before January 23, 2006. Contractors also need to provide information and analysis to builders and developers on the costs and benefits of using higher efficiency equipment. Contractors should recognize the importance of factory training for their technical personnel.

There are a number of "solutions" or resources available to the wholesaler/distributor to meet these challenges. Foremost in the information chain is literature and explanatory material from the manufacturers Instructional videos are available from industry associations, such as the Air-Conditioner Contractors Association (ACCA, www.acca.org) and The Heating, Air-conditioning & Refrigeration Distributors International (HARDI, www.hardinet.org). Information on the proper matching of indoor and outdoor units is available from the Air-Conditioning and Refrigeration Institute (ARI) at www.ari.org, including brochures and the presentations at the January 2006 AHR symposium on 13 SEER. Using the ARI Certification Directory (www.aridirectory.org) wholesalers/distributors are able to educate contractors and their own personnel about the need to properly match indoor and outdoor equipment to achieve 13 SEER. The directory allows the customer to see if the about-to-be installed equipment is part of the ARI Certification Program and to see its verified SEER rating. HARDI offers training for wholesaler personnel at HARDI branches. An important component of the available resources is emphasizing the value of NATE[5] (http://www.natex.org/) certification for installers. All these steps aside, the wholesaler/distributor also needs to keep adequate inventories of 13 SEER products and related components for matching systems in any location.

Contractor Challenges and Solutions

Contractors face at least three categories of issues with respect to 13 SEER. It is at the contractor/customer interface where some of the most interesting challenges occur. It is also the level at which the success of failure of successfully implementing the 13 SEER standard where mandated. The four categories are:

- Training of Staff
- Educating Customers
- Commercial Challenges

Staff training begins with the fundamental understanding that the indoor unit (coil) and outdoor unit (condenser) must be properly matched. New or retrofit work must be attuned to also eliminating the existing or potential source of chronic leaks in the system. Properly sizing the equipment to the building, residential or commercial can be addressed by referring to various ACCA Manuals[6].

Educating customers is always challenging. Contractors need to exercise outreach to existing customers through informative newsletters and special mailings of materials from their trade associations. Customers need to be encouraged to think of a "whole house" system, zoning and automated thermostats to manage diurnal comfort preferences.

Condominium owners need to be aware of size and space – the size of replacement units and existing available space for them. Whether the furnace or evaporator coil will be located in a closet, crawl space or suspended needs to be determined. Through-the-wall units may no longer fit existing wall sleeves. Refrigerant lines may in fact pass through others' property so permissions for work needs to be obtained.

Commercial equipment brings its own challenges. The minimum efficiencies for commercial equipment will change as EPACT (The Energy Policy Act) levels will rise in five years. Concurrently, the customization and specialization of equipment is increasing, thus offering engineering challenges. Further, the proscription of R-22 refrigerant in 2010 and the introduction of 410A has to be accommodated.

Conclusion

The advent of 13 SEER and future changes in commercial air-conditioning energy efficiency and refrigerants suggest that there may need to be adjustments in heat pump technology. What those adjustments are, is, in general, undefined and unclear, at least as part of general 13 SEER transition conversations.

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Footnotes

1 Sponsored by the Air-Conditioning and Refrigeration Institute (ARI), The Air-Conditioning Contractors Association (ACCA) and The Heating, Air-conditioning & Refrigeration Distributors International (HARDI)

2 Seasonal Energy Efficiency Rating is the total amount of heat removed in a cooling season divided by total watts using during that cooling period.

3 HSPF is the total heating output of a heat pump, including supplementary electric heat necessary to achieve building heating requirements during its normal annual usage period for heating, divided by the total electric power during that period and expressed in btu (W-h)

4 Ductless mini-splits is a generalized term referring to split air-conditioning systems which are made up of four components: The condensing unit, located outside the building; the indoor unit, or units, which can be wall or ceiling mounted; refrigerant lines, which connect the outdoor unit to the indoor unit; and a hand-held wireless remote or wall monitor which controls the entire system. Typically, the system does not require the installation of ductwork.

5 NATE, North American Technician Excellence Inc., is an independent, third-party certification body for HVAC/R technicians. NATE tests technicians; others train. Testing validates the technician's knowledge and a training program's instruction. NATE-approved testing organizations throughout the U.S. and Canada offer NATE tests. Candidates can earn installation and/or service certification in five specialty areas: air-conditioning, air distribution, heat pumps, gas heating & oil heating.
The entire HVAC/R industry supports NATE: manufacturers, utilities, wholesalers, educators, technicians, contractors and trade associations.

6 Manuals J, Residential Load Calculations; D, Residential Duct Systems; and S, Residential Equipment Selection.

Amendments to Japanese Laws and Regulations for GHG Emission Reduction: how will they affect air conditioning and heat pump equipment?

Shotaro Ito, Japan

Background

With the coming into force of the Kyoto Protocol in February 2005, developed countries have been required to reduce their emissions of greenhouse gases (GHG). In Japan, various measures are being taken to achieve the country's target of 6 % reduction in GHG emissions during the first commitment period, from 2008 to 2012. However, according to the published data on GHG emissions for 2004, Japan's total GHG emissions reached 1,329 million tons-$CO_{2\ eq.}$, which is a substantial 7.4% increase (an increase of 92 million tons-$CO_{2\ eq.}$) compared to the reference year. Among others, CO_2 emissions from energy used for the commercial & residential sector and the transport sector rose drastically, with the total increase in emissions from both sectors reaching 135 million tons of CO_2, which exceeded the overall growth in the sectors.

In an effort to reduce GHG emissions, which seem to be increasing, and to achieve its Kyoto target, the Japanese Government in April 2005 announced the "Kyoto Protocol Target Achievement Plan" which includes comprehensive measures to be taken. Table 1 shows the amount of emissions and target values by category.

This plan is centered on the following three items:
1) Reduction of GHG emissions
2) Forest sinks measure
3) The Kyoto mechanisms

Table 1. Japan's GHG emissions and new targets by sectors

Million ton-$CO_{2\ eq.}$	Base year	2004	2010 estimated	New target
Industrial	476	472	450	435
Commercial & domestic	273	363	333	302
Transport	217	262	259	250
Energy conversion	82	85.3	73	69
CH_4, N_20, Non-energy CO_2	139	124.6	130	123
HFC, PFC, SF_6	49.2	23.4	67	51
Total	1237	1329	1312	1230

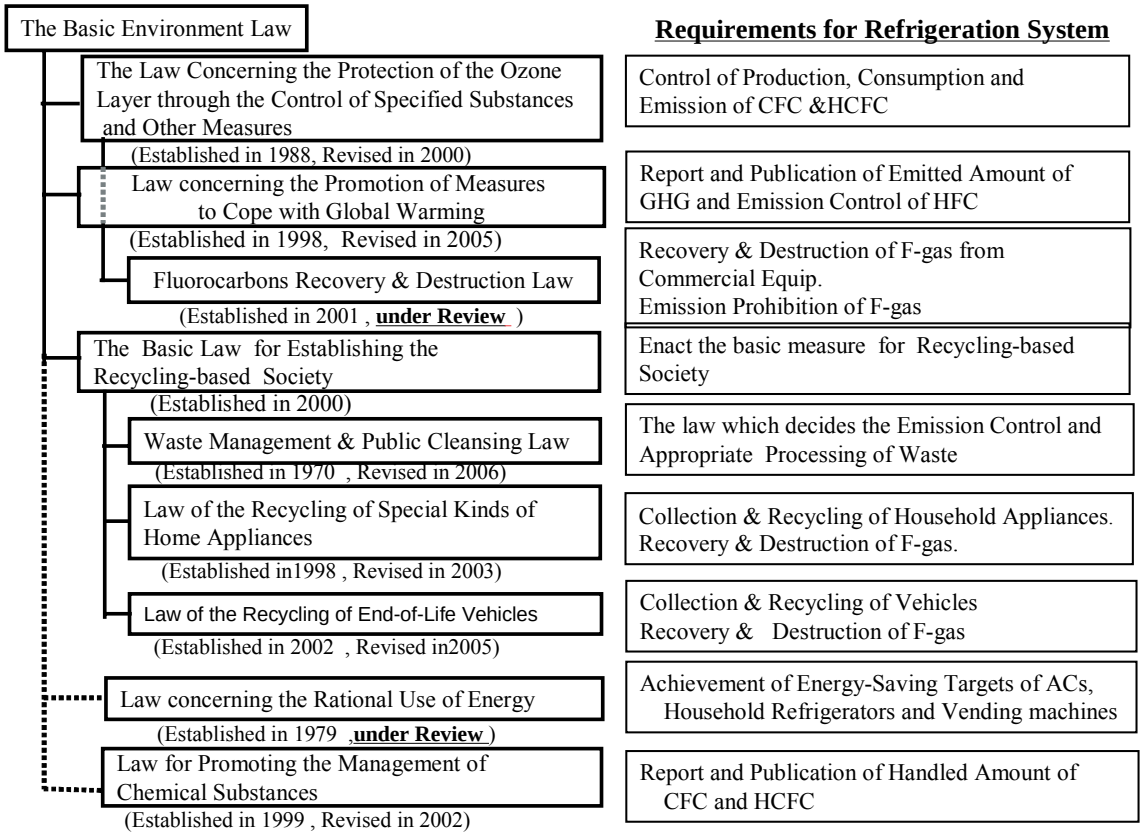
For the reduction of GHG emissions, the emphasis is placed on reducing emissions of CO2 from energy sources through innovating energy-related appliances and improving business establishments and social systems.

Meanwhile, to ensure that these governmental schemes are put into practice, the Government is, in addition to legislative measures, also encouraging industry to establish a voluntary action plan. The governmental schemes include many which may affect refrigeration equipment, including heat pumps. Key measures for the refrigeration equipment are mentioned below, together with a brief explanation of the related laws and regulations and of how the industry has struggled in this respect.

Measures for refrigeration equipment in the GHG emission reduction Target Achievement Plan

Items relating to the refrigeration equipment in the Target Achievement Plan are mainly "energy savings" and "refrigerants recovery." The former consist of 1) voluntary action plans by manufacturers of each field for restricted emissions of GHG and for energy savings, 2) control of energy use in factories and offices, 3) improvement of energy efficiency in buildings, such as offices, 4) improvement of energy efficiency of equipment, and 5) the spread of equipment with higher energy efficiency. The latter includes a thorough recovery of refrigerants during servicing or final disposal of the refrigeration and air conditioning equipment.

Figure1. Environmental & Energy-saving Laws for Refrigeration System



In order that these plans are actually carried out, "energy savings" are included in the "Energy Conservation and Recycling Law", and "refrigerants recovery" is covered by such legislation as "Law of the Recycling of Special Kinds of Home Appliances," "Fluorocarbons Recovery & Destruction Law," and "Law of the Recycling of End-of-Life Vehicles" for household appliances (including air conditioners and refrigerators), commercial refrigeration and air-conditioning equipment, and automobiles (including MAC) respectively. As shown in Figure 1, all these laws have lately been under review.

Recent amendments to laws on energy conservation

Japan's energy conservation law, the "Law Concerning the Rational Use of Energy", was revised in August 2005, to be effective in April 2006. Still under way is the review of criteria for such appliances as refrigeration equipment. Japan's energy conservation law requires effective use of energy in factories and offices, transportation, housing and buildings and designated energy-using products, from the viewpoints of users' behavior and objects' criteria. As far as refrigeration equipment is concerned, it is closely related to the energy conservation regulations for, in particular, housing and buildings as well as designated energy-using products. The explanation of these two categories is given below.

1) Assessment of effective use of energy for air conditioning in housing and buildings
The amended law requires notification to the competent authority of the energy conservation measures to be taken for housing and buildings covered by the law, which applies to all buildings with a floor space of more than 2000 m^2, including those that are newly constructed, enlarged, or refurbished on a large scale. This energy conservation measure is intended to achieve a higher overall energy efficiency of a building and its accompanying facilities, such as air conditioners and heat pumps. It applies not only to central-type air conditioning systems, but also to individually-installed air conditioning systems.

The assessment is based on the sum of the points acquired in various items, such as COP value, piping length and height difference between indoor and outdoor units of the system. In addition, the points are corrected by adjustment factors for moderate, cool, or hot climate zones and differences in altitude. The points are calculated for individual systems, and the weighted mean value of the total points is used as a tool of evaluation.

2) Energy efficiency of designated energy-using products
Japan's energy conservation law for designated energy-using prod-

ucts is such that;
- selection is made from products with a great influence on energy due to energy consumption and the total number of units in use; and
- manufacturers of the selected products are required to produce high energy efficiency versions of them by the designated year.

At present, there are 17 groups of products covered by this law. They include (of course) refrigeration and air conditioning equipment (which includes air conditioners with cooling capacity of 28 kW or less), household refrigerators and vending machines. Commercial refrigerators are being considered for inclusion in this group. The distinctive feature of this law is the way that the target value of energy efficiency is determined. Since a target COP value is decided on the basis of a model with the highest energy efficiency among those shipped when the target value is set, this method is called the 'Top Runner Method." The target values of air conditioners vary, depending on their cooling capacities and configurations, and therefore these values are established by the categories as shown in Table 2. The value of COP is the average of the values obtained from the rated cooling and heating capacities at standard temperature and humidity conditions, divided by power input.

Table 2. Target COP of current wall-mounted mini-split air conditioners and heat pumps

Cooling capacity	Under 2.5 kW	Under 3.2 kW	Under 4.0 kW	Under 7.1 kW	Under 28 kW
COP	5.27	4.9	3.65	3.17	3.1

Air conditioners and heat pumps with cooling capacities of 4 kW or less were required to meet their target in 2004, and did so, while those with cooling capacities of 4 28 kW are expected to achieve their target in 2007. These air conditioners are assessed with the weighted harmonic mean of COP values of the total products shipped by each manufacturer for a year. Whether the claimed energy efficiencies of products shipped by manufacturers are justified or not is confirmed by testing the products at the Testing Laboratory of the JRAIA, and thus the performance of the products is verified.

Weighted harmonic mean = $\Sigma Ni / [(1 / COPi) \times Ni]$ where
Ni: shipments in number of each model,
COPi: COP value of each model

The next new targets are being examined for air conditioners with a cooling capacity of 4 kW or less. The present approach is focused on the introduction of an index called APF (Annual Performance Factor), which permits a simple comparison of seasonal efficiencies with measurement of capacity and power consumption at only five points. The stated value of APF is confirmed by testing products that are randomly purchased on the open market. As almost all air conditioners and heat pumps in Japan are of the inverter-controlled type, which makes a great contribution to energy savings, APF is defined as follows;
- a typical Japanese house is used as a model, where an air conditioner with the rated capacity corresponding to its room space is installed;
- basic data are power consumption and capacities, which are measured at five different points, which specifically are two points where rated cooling and heating capacities are obtained, another two points where half of the rated cooling and heating capacities are obtained, and the remaining one where the rated heating capacity under the low-temperature condition is obtained;
- characteristics under other conditions are estimated using linear functions; and
- weighting is applied depending on the occurrence frequency of outdoor temperatures in Tokyo during cooling or heating operation.

APF is therefore determined from electric power consumed and cooling and heating capacities calculated in the respective operation periods.

APF = *(CSTL + HSTL) / (CSTE + HSTE)* where
CSTL, HSTL, CSTE & HSTE: Seasonal total load or energy in cooling or heating operation

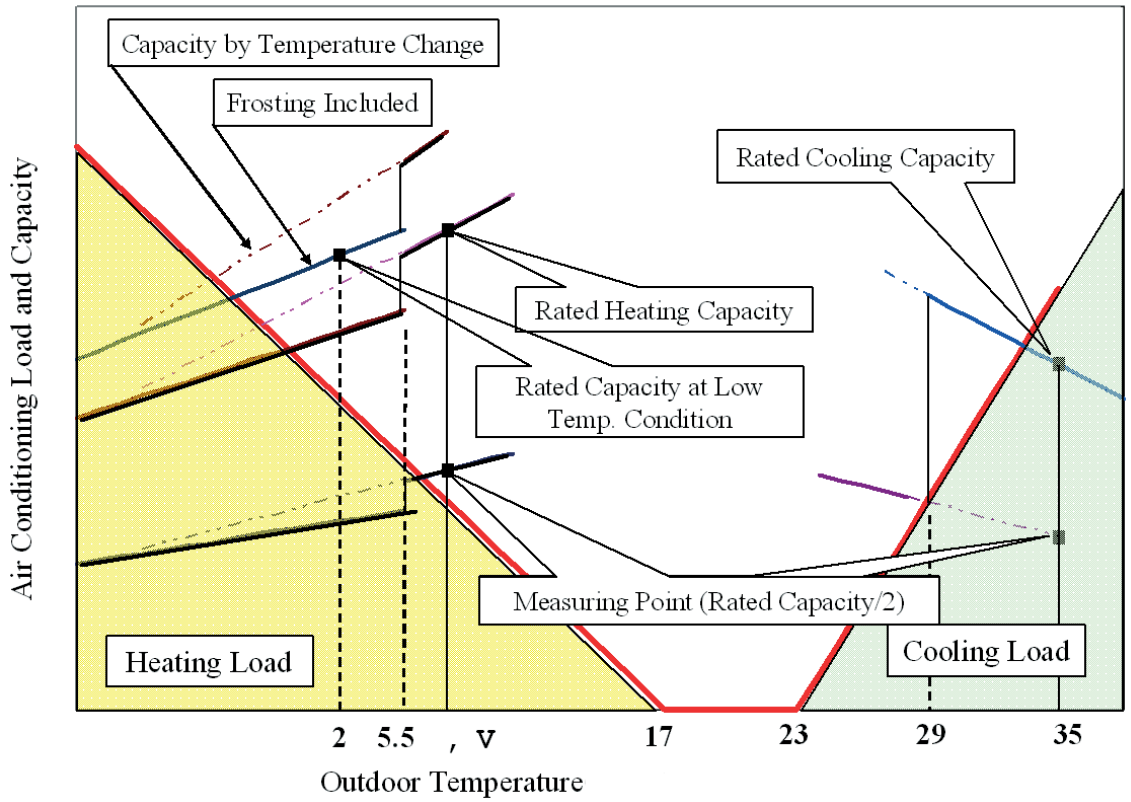
Figure 2 shows a conceptual illustration of model conditions and heating and cooling characteristics which affect the determination of APF.

For air conditioners and heat pumps covered by the current energy conservation law, consideration is being given to improving energy efficiency by 22.4 % by 2010, in comparison with the present efficiency level through the use of this index. Concurrently, household refrigerators, including an index, are under review.

Recent amendments to laws and regulations for emission control of refrigerants

The most effective and immediate way of reducing emissions of greenhouse gases in refrigeration systems is to ensure proper recovery of refrigerants from the equipment during servicing, maintenance, repair or at final disposal. Recovery of refrigerants has so far been carried out by categories (household, commercial, and mobile air conditioners) when these products reach the end of their life. The amount of recovered refrigerants is reported and totalled for public announcement. However, in Japan, the distribution channels of commercial air conditioning and refrigeration equipment in their lifecycle are quite complicated, and the recovery rate of refrigerants in connection with final disposal is estimated to be only 30 to 40%.

Figure2. Model Conditions & Air Conditioning Characteristics



The existing law is now under review with the aim of raising this final disposal recovery rate and reducing emissions of refrigerants during maintenance or repair. The latest amendments are; (1) recovery at servicing or repair is required along with its reporting, although the present law relates only to final disposal; (2) establishment of a manifest system covering all stages from owner to recovery operator, with contracts between undertakings being mandatory; and (3) administrative guidance is to be given to all those concerned, including owners, starting from October 2007. These revisions require the average recovery rate of refrigerants to be raised to 60% or higher from 2008 to 2012. As a result, a reduction of 12.4 million tons- $CO_{2\ eq}$ would be possible if recovery from mobile air conditioners is improved substantially.

Other measures

Other laws and measures which may affect manufacturers and users of heat pump equipment in reducing GHG emissions are;

1. Report and announcement by manufacturers and users of the amount of GHG emissions, including HFCs. (Public reporting system of emitted amount, PRTR)
2. Greater use of equipment with high energy efficiency, such as heat pump water heaters using CO_2 as the refrigerant, and improvement of their energy efficiency. (Increased shipments are expected to register more than 5 million units in use by the end of 2010.)
3. Investigation of the possibility of equipment using natural refrigerants being carried out, technology development, establishment of standards for safety and evaluation procedures. (16 projects are under way in the government-supported R&D program.)

Conclusion

There is still a potential for further improvements in energy savings through the use of heat pumps, not merely through design refinements but also through fundamental process changes. If heat pump equipment is promoted for wider use, together with accelerated recovery of the refrigerants, it would greatly contribute to the reduction of GHG emissions. In addition, as shown by heat pump water heaters, conversion from equipment using fossil fuels would improve the effectiveness of heat pump equipment. Development of equipment and technology which takes into account characteristics of refrigerants, including natural refrigerants, would make a great contribution to the global environment in the years to come.

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'06 ASHRAE Handbook: Carbon Dioxide Cycles Around in Refrigerant Usage

ASHRAE have recently published the 2006 update of the ASHRAE Handbook. Guidance on the use of CO_2 has been added to the Handbook of Refrigeration.

The Handbook covers the refrigeration equipment and systems for applications other than human comfort. It includes information on cooling, freezing, and storing food; industrial applications of refrigeration; and low-temperature refrigeration. Primarily a reference for the practicing engineer, the volume is also useful for anyone involved in cooling and storage of food products.

Other additions to the volume include:

A new chapter, "Refrigerant Containment, Recovery, Recycling, and Reclamation;"
Chapter 10, "Cooling and Freezing Times of Foods," has extensive updates, new geometric shape factors, and a new section comparing freezing time estimating methods;
Chapter 13, "Refrigeration Load," has new material on heat gain from cooler floors and coil defrosting;
Chapter 46, "Retail Food Store Refrigeration and Equipment," has new discussions on self-contained versus remote systems, energy efficiency, storage rooms, and interaction with supermarket air-conditioning systems;
Chapter 47, "Food Service and General Commercial Refrigeration Equipment," has new content on refrigerated cabinets, vending and ice machines, and energy efficiency.

The report can be ordered from ASHRAE at www.ashrae.org/bookstore
Price 195$ (paper copy, I-P or SI units) / 155$ (CD with both I-P and SI)

Energy Technology Perspectives -- Scenarios & Strategies to 2050
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The work is a response to the 2005 Gleneagles G-8 summit, where G-8 leaders called upon the International Energy Agency to provide advice on scenarios and strategies for a clean and secure energy future.

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Report on Refrigeration Sector Achievements and Challenges – Johannesburg 2002

In this report, IIR have looked on the achievements and challenges of the refrigeration sector within the framework of sustainable development. The main topics covered in this report are: The 3 dimensions of sustainable development: social, economic and environmental dimensions - Implementation means: strategies, achievements and limits - Challenges

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6th International Conference on Compressors and Coolants – Compressors 2006
27- 29 September
Casta Papiernicka, Slovak Republic
Contact: Peter Tomlein
Tel: +421 2 4564 6971
Fax: +421 2 4564 6971
E-mail: zvazchkt@isternet.sk
http://www.isternet.sk/szchkt/

Klima 2006
28-29 September
Ljubljana, Slovenia
IKK 2006 Nürnberg - 27. International Trade Fair
18 - 20 October Nürnberg, Germany
Refrigeration, Air Conditioning, Ventilation
E-mail: http://www.ikk-online.com/main/

ASME International Mechanical Engineering Congress and Expo
5 - 10 November Chicago, Illinois, USA
Contact: Dr Ahmad Fakheri
E-mail: ahmad@bradley.edu http://www.asmeconferences.org/Congress06

EPIC 2006 AIVC
29 November - 1 December
Lyon, France
Conference Secretariat:
Tel: + 33 (0)4 72 04 70 27
Fax : + 33 (0)4 72 04 70 41
E-mail: epic2006aivc@entpe.fr
http://epic.entpe.org

7th International Conference on System Simulation in Buildings (SSB)
11-13 December
Liège, Belgium
SSB'2006 Secretariat: Vincent Lemort
Tel: +32 (0)4 366 48 00
Fax : +32 (0)4 366 48 12
E-mail: thermoap@ulg.ac.be
http://www.ulg.ac.be/labothap/ (Go to: Meetings/SSB'2006)

2007

The 4th International Workshop on Energy and Environment of Residential Buildings (IWEERB2007)
15 - 16 January
Harbin, China
Contact: PhD Jianing Zhao
School of Municipal & Environmental Engineering
Harbin Instisute of Technology
Tel: 86-0451-88776496
Fax: 86-0451-6282123
E-mail: iweerb2007@hit.edu.cn or sky-lcy@163.com
http://indoorair.hit.edu.cn

Natural Refrigerant Heat Pumps Theory and design of CO2 systems
25 - 26 January
Lyon, France
E-mail: info@greth.fr
www.greth.fr

ASHRAE Winter Meeting
27 - 31 January
Dallas, USA
E-mail: jyoung@ashrae.org
www.ashrae.org

HEAT - SET 2007 Heat transfer in components and systems for sustainable energy technologies
18 - 20 April
Chambery, France
E-mail: info@greth.fr
www.greth.fr/heatset

Ammonia Refrigeration Technology for Today and Tomorrow
19 – 21 April
Ohrid, Republic of Macedonia
Contact: Risto Cikonkov
Tel.: +389 2 3064 762
Fax: +389 2 3099 298
E-mail: ristoci@ukim.edu.mk
www.mf.ukim.edu.mk/web_ohrid2007/ohrid-2007.html

CLIMA 2007
10-14 June
Helsinki, Finland
E-mail: info@clima2007.org
http://www.ashrae.org/clima2007

22nd IIR International Congress of Refrigeration (ICR2007)
21 – 26 August
Beijing, China
Contact: Qiu Zhongyue
Tel: +86 10 6843 4683
Fax: +86 10 6843 4679
E-mail: icr2007@car.org.cn
http://www.iifiir.org

2nd International Conference SOLAR AIR-CONDITIONING
18 - 19 October
Tarragona, Costa Dorada, Spain
Organisation Commitee:
Das Ostbayerische Technologie-Transfer-Institut (OTTI e.V.)
Regensburg, Germany
Tel: +49 941 29688-29/-37
Fax +49 941 29688-17
E-mail: gabriele.struthoff-mueller@otti.de
britta.haseneder@otti.de

2008

8th IIF/IIR Gustav Lorentzen Conference on Natural Working Fluids Refrigeration and Energy - The Natural Choice
7 - 10 September
Copenhagen, Denmark
Tel: +45 72 20 12 67
E-mail: poul.jeremiassen@teknologisk.dk
www.iir-gl-conference-2008.dk

In the next Issue

In the next Issue
The latest developments on the use of CO_2 as refrigerant

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International Energy Agency

The International Energy Agency (IEA) was established in 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among its participating countries, to increase energy security through energy conservation, development of alternative energy sources, new energy technology and research and development.

IEA Heat Pump Programme

International collaboration for energy efficient heating, refrigeration and air-conditioning

Vision

The Programme is the foremost world-wide source of independent information & expertise on heat pump, refrigeration and air–conditioning systems for buildings, commerce and industry. Its international collaborative activities to improve energy efficiency and minimise adverse environmental impact are highly valued by stakeholders.

Mission

The Programme serves the needs of policy makers, national and international energy & environmental agencies, utilities, manufacturers, designers & researchers. It also works through national agencies to influence installers and end-users.
The Programme develops and disseminates factual, balanced information to achieve environmental and energy efficiency benefit through deployment of appropriate high quality heat pump, refrigeration & air-conditioning technologies.

IEA Heat Pump Centre

A central role within the programme is played by the IEA Heat Pump Centre (HPC). The HPC contributes to the general aim of the IEA Heat Pump Programme, through information exchange and promotion. In the member countries (see right), activities are coordinated by National Teams. For further information on HPC products and activities, or for general enquiries on heat pumps and the IEA Heat Pump Programme, contact your National Team or the address below.

The IEA Heat Pump Centre is operated by

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heat pump centre

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