IEA Heat Pump CENTRE
NEWSLETTER
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Air Source Heat Pumps

Air source heat pumps for retrofit in existing buildings

Existing seasonal performance indices for air-to-air heat pumps

Trends in the European Air Source Heat Pump Market

Two new member countries

IEA heat pump centre
IEA OECD

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In this issue

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In this issue

Air is wonderful, and not only by Bach. Not only does it provide us the oxygen that we breathe, but its heat content can also be used to heat our homes and provide our hot tap water. The only thing needed is an efficient heat pump to upgrade the free energy to useful heat. Reversible air-source heat pumps have been used for many years in air conditioning applications. In recent years, the market for heat pumps for heating has grown considerably, and even in cold climates as the technology comes of age. However, there are still many aspects that need to be improved. In this issue, you can read about various aspects of air-source heat pumps development.

The HPP would also like to welcome Italy and South Korea as new member countries of the HPP! Read more about this, and an interview with Mr. Park, ExCo delegate for South Korea, on the IEA HPP pages. An interview with Mr Restuccia from Italy will be published in the June issue of the newsletter.

By the way, I hope to see you all at the IEA HPP Conference in Zurich in May!! The conference program is very interesting, and the workshops look exciting too. Don't miss it!

Roger Nordman
Editor, HPC Newsletter

Heat pump news

Features

Topical article

Air Source Heat Pumps

Jerry Groff
President, Groff Associates – USA; past-Chairman of the IEA HPP Advisory Board and past-President of IIR Section E – Heat Pumps and Air Conditioning

The theme for this edition of the Newsletter is Air Source Heat pumps. The large majority of the estimated 150 million heat pumps installed world-wide utilize outdoor air as the primary source of heat. This preference evolved following World War II, driven by a huge pent up housing market in North America. In this period other areas of the world were primarily concerned with reconstruction of their economies and infrastructure. In the U.S. air source heat pumps were a response to the need for easily installed, economical residential air conditioning, and in the south, heating systems. The lower installed cost of air distribution systems and shortage of qualified hydronic installers made the air-cooled air conditioning system, with combined heat pump heating in warm climates, the system of choice for large housing projects. With high land costs and increasingly rigorous environmental requirements for ground and water heat source and sink alternatives, this preference continues despite the lower heat content of outside air as temperatures drop. Today air source systems are available in a variety of forms: ducted, ductless, split-system and single-package units with air or water heat distribution systems.

The topical articles for this Newsletter provide an interesting perspective on current heat pump matters, internationally; Neil Hirst considers the role of heat pumps in reducing CO_2, and the policy and technology needs to enable a greater heat pump contribution. Roger Hitchen and Christine Pout discuss expected trends in the European market for air-to-air heat pumps and compare typical efficiencies with those in Japan. Onno Kleefkens describes a new initiative in the Netherlands for air-source heat pumps combined with gas boilers for retrofit of existing homes. A team of authors from Japan describe one manufacturer's approach to reduction of residential energy use and the associated global warming through a new line of high energy efficiency Room Air Conditioners and Philippe Rivière and L. Grignon-Massé review the existing indices used to represent seasonal energy use and efficiency of air-to-air heat pumps. All of these articles are addressed to the increasing interest around the world in accelerating market introduction of more energy efficient heat pump technology. With more than 50 years of solid technological improvement and market growth, air source heat pumps represent one of the most tried and tested, economical and market-ready energy efficiency technologies available to policy-makers today. This Newsletter can hopefully assist in the much-needed effort to "bring heat pumps' light out from under the basket."

Jerry Groff

From evolution to revolution

Neil Hirst
Director
Office of Energy Technology and R&D
International Energy Agency

The threat of a 130% rise in CO_2 emissions between now and 2050 is alarming. Soaring oil prices remain a persistent worry. Today's energy challenges are now truly critical. They are so critical that the normal evolutionary advances in ways energy is supplied and used are too slow to prevent irreversible damage to the global climate and unsustainable pressure on the world's natural resources. In short, we have reached the stage where only a global revolution in the energy sector can steer us back on course.

Daunting though it sounds, such a revolution is possible, so long as industrialists are convinced of governments' commitment to low-carbon technologies, and so long as all the major energy-consuming countries are on board. Using already existing technologies, together with well advanced new technologies, we could bring global CO_2 emissions back to current levels by 2050.

What are the implications of such a scenario for heat pumps? Their energy efficiency would need to improve by 25% between now and 2020. By 2050, heat pumps would have to be installed in around half of all homes in OECD countries.

But current levels of CO_2 emissions would be just as unsustainable in 2050 as they are today. Much more vigorous steps will certainly be needed. The Intergovernmental Panel on Climate Change advocates a major CO_2 emissions reduction of between 50% and 85% – against 2000 levels – by 2050 to prevent the world's temperatures from rising by more than 2.4°C. At their Summit Meeting in Heiligendamm in 2007, G8 leaders agreed to seriously consider targeting a global 50% reduction in emissions by 2050. What would it take to reduce CO_2 emissions to 50% below current levels by 2050?

Greater energy efficiency, as we know, offers the largest and least costly savings in energy use, and thus in CO_2 emissions. Efficiency improvements in buildings, appliances, transport, industry and power generation constitute the single most important category of improvements. Clearly, heat pumps have a very large role to play here. They are available today and are already widely used for both heating and hot water. Realising the full potential of heat pumps can be regarded as one of the most rational approaches within the mix of options that must be applied, across all sectors, around the world. The IEA estimates that heat pumps could save 770 megatonnes of CO_2 by 2050 compared to a business-as-usual scenario, as part of a drive to reduce global emissions by 50% compared to today's emissions.

But such a performance would need concerted efforts among governments and industry. By 2020, the market would need to be offering energy-efficient heat pump and policies would need to be in place to support wide deployment of heat pumps for heating and cooling. Market penetration would be 75% greater than today. Heat pumps would be installed in up to 70% of all homes in OECD countries by 2050. 25% of industrial waste heat would be upgraded by heat pumps, which would be reducing energy use in commercial buildings by 25%. By 2020, all installers and equipment would have been certified. Getting to this point technologically would need continued steady improvements in coefficients of performance and in the effectiveness of air-to-air systems for low-temperature environments, building on significant recent advances.

The implications are clear regarding RD&D, but also regarding the need for policy environments where all buildings codes promote energy conservation and efficiency. More countries will need to recognise the major benefits of heat pumps if the necessary changes are to come about.

Facilitating the circulation of information is one of the most effective ways of promoting change. As one of the leading providers of information on heat pumping technologies, their applications and their markets, the IEA Heat Pump Centre (IEA HPC) is making very considerable contributions to broadening awareness of the huge benefits of heat pumping technologies. IEA HPC is addressing a crucial need to promote demonstration and circulate objective information on performance and product quality.

We applaud the international collaborative efforts of IEA HPC and address all our good wishes to the organisers of the 9th IEA Heat Pump Conference in Zurich on 20-22 May. This conference will provide yet another excellent opportunity for this IEA programme to highlight the huge potential of heat pumps at an event drawing key figures from the heat-pumps community and from the circles where heat pumps can make a real difference in future. This event will make another welcome contribution to fostering the changes that are crucial if we are to preserve a world that we are proud to bequeath to our children and our grandchildren.

Neil Hirst

R-744/CO_2 as an alternative refrigerant for MAC

The Editor, IEA Heat Pump Centre Newsletter,
Dear Roger,

I was most interested to read the paper by Hans Fernqvist of Sweden on the above subject.

I agree with his diagnoses of the problem but I totally disagree with his conclusion.

Mobile Air Conditioning for cars requires a very robust, leak free system which must be capable of operating over a wide range of capacities in ambients of up to 40 deg C.

If R-744 is to be used as the refrigerant, the system will have to be capable of operating in trans-critical mode at the higher ambients. Discharge pressures under these conditions could be as high as 150 Bar a.

In my opinion, this predicates the use of a hermetic or semi-hermetic compressor because shaft seals are likely to be unreliable at such high pressure differences.

Requirement for varying capacity from a hermetic compressor suggests that the compressor should be driven from an alternator arranged to produce power at varying frequencies.

Carbon dioxide is different from other refrigerants and it does not seem sensible to replicate the type of engine driven compressor that has been used for conventional car air conditioning. Nor does it seem sensible to use complex mechanical devices such as swash plates to produce variable capacity. If the compressor is to be hermetic then the power supply should be of variable frequency.

I do not agree that carbon dioxide is particularly leak prone. We have used it on an industrial and on a commercial scale without serious problems. The type of connection, already used for car air-conditioning, which compresses a thick-walled tube onto the pipes to be connected has already been used to join pipes for carbon dioxide in locations where it was not possible to use welding.

Some years ago I developed a method of improving efficiency of trans-critical refrigerating systems by what is known as the "parallel compression" method. This method was described by Ian Bell in a paper at the Gustav Lorentzen Conference in Glasgow in 2003 and it was also described by me in a paper to IIR in Vicenza in 2005.

Use of the parallel compression system, which is a form of "economising" can increase thermodynamic efficiency by up to 50% thus making trans-critical CO_2 systems comparable to R-134a systems in terms of efficiency.

It seems clear that carbon dioxide can be used for car air-conditioning without problems provided that the parallel compression system is used in a hermetic compressor driven at variable speed via an alternator and frequency changer.

I suspect that Hans Fernqvist's objection to the use of CO_2 in cars is mainly on grounds of the cost of doing it properly. Cost of copper for motors and large alternators would undoubtedly be a factor but the public is not likely to be parted from their cars by the relatively minor cost increases associated with the introduction of carbon dioxide refrigerant. Current methods of using R-134a are unsustainable and are to become illegal after 2011. They are also unsatisfactory and have not reached necessary standards of reliability.

Air conditioning of cars can produce damaging effects on the environment. I would be willing to pass on relevant know-how to parties interested in applying the parallel compression system to MAC.

S. Forbes Pearson.

A communication gap?

Will intelligent decision-makers come into contact with the **Saving Energy in Refrigeration, Air Conditioning and Heat Pump Technology** guide from IIR?

If they do, will they take the opportunity to read it and will they grasp the possibilities?

Experts must make the outcome of this communication process sustainable.

It is a fact that the electricity industry and its related manufacturers of components and systems is very powerful, creating a strong lobby. The energy efficiency business is much more scattered, with no real lobby. This is illustrated by the fact that, when looking for a body to address for efficient use of energy, the EU Commission turned to the electricity industry and tried to get it to take responsibility for the use of its product. In other words, a seller of a product was asked to limit the use of its product.

The Kyoto focus on F-gases is based on the total of 1 % of the GWP coming from F-gases 2004. The result of the F-gas legislation in Europe is expected to reduce about 25 % of the 2-4 % of the GHG from F-gases inside the EU in 2010.
With energy saving using simple existing technology, 4 % of the total electricity produced on our planet will not be needed. This figure does not take account of the vast possibilities of well designed heat recovery from existing systems, if heat pumps were suitable for all kinds of heating.
There are hurdles to overcome, some of which are non-technical. Examples of hurdles are:

- Main contracting. The buyer of physical systems generally never runs the system, and is therefore only looking for the lowest possible first cost. Operation of the system will be more expensive than needed.
- The level of knowledge in the refrigeration and air conditioning industry is low, due to the structure of the business with many small companies.
- Knowledge of heat pump systems should be better, especially for larger systems.
- Packaged refrigeration and chiller units are manufactured by a few large companies, and are designed for the market parameters. Those parameters are low purchase cost, with very little consideration of operating cost.

Academics are looking for resources for their research activities. There is always a need for more basic research to make systems and components even more efficient. General use and deployment of research results are not always as good as the results deserve. Good local examples of existing technology are particularly needed. There is a lack of good, well-documented examples. Perhaps this work is regarded as being less fun and less glamorous? Nevertheless, it is very important that objective reports exist. Good examples do exist: the challenge is to identify them and get them out to a larger community.

The IIR Guide serves as a pointer to existing experience. If practical energy efficiency work picks up momentum, the need for more research will become evident.

The political decision-makers are interested in industries creating jobs and activities creating votes. Changes in existing systems must always be done on site, even if hardware for control systems and new components are imported. Technical and other constraints mean that it is more difficult to change an existing installation than to build a new one. New jobs could be created by a well functioning service sector for upgrading existing systems, and such jobs ought to be interesting for young people. New factories making special components could also be founded locally.

In future, all activities aiming at a better climate will be interesting for a broad public. How can the public be made aware of climate factors in daily life, and respond to them, not by returning to the Middle Ages but through promotion of best practices and products?

What can be done in the near future?

- The existence of the IIR Guide is a first step, pointing to existing technology.
- Make political and business leaders aware that technology exists to reduce as much as 20 % of the energy used even in existing systems.
- Make business leaders aware of the economies that can be achieved, even when applying their own investment rules. Prices of electricity, gas or oil are not going to fall in the long term.
- Point out the existing hurdles.

There is a need for legal minimum performance standards, mainly for systems. The public sector could well specify special purchasing requirements, such as permitting the use only of natural refrigerants for air conditioning of government buildings in the UK. SEER standards, as used in the US, incorporating this limitation, are coming and should be used, possibly with modifications to suit local climate conditions where necessary.

Energy and heat pump experts
Start thinking, and find ways and concepts to reach decision-makers. Get them to understand that:

- technology existing today is a good starting point. Look at the IIR Guide.
- energy efficiency applies to both new and existing systems
- the level of knowledge in the field is inadequate
- standards and rules are needed to overcome some market restrictions.

Lennart Rolfsman

If you have any questions or comments, please contact lennart.rolfsman@telia.com

General

ASHRAE service life and maintenance cost database

Accurate and usable building ownership and operating cost data is vital for our industry. Every day, engineers are asked to advise building owners and managers on strategic decisions involving the life cycle and functionality of their buildings. The current lack of valid data leaves engineers without a solid basis for making these decisions.
The purpose of this database is to provide current information on service life and maintenance
Source: www.ashrae.org/database

New research network launched in the UK

SIRAC is a networking organisation for promoting new technology in refrigeration and air conditioning. We help to increase the flow of information between those with problems that need solving and those having the ideas for solving them. The site was launched on 7th February 2008.
See http://www.sirac.org.uk/home for further information on this network.

Green buildings: EU must get the private sector involved, says report

Financial barriers, including high initial cost barriers and an inadequacy of traditional financing instruments, are a key element preventing private actors from becoming more involved in making the residential building sector more energy-efficient, according to a study from the International Energy Agency (IEA), published on 20 March.

Existing buildings are responsible for over 40 % of the world's total primary energy consumption, and account for 24 % of world CO2 emissions, according to IEA, which argues that "an impressive amount" of this energy could be saved by applying energy-efficient technologies and practices.

Despite the proven cost-effectiveness of energy efficiency technologies, their potential remains untapped in the building sector "due to numerous market barriers", states the IEA, based on the results of case studies of the residential sector in France, Germany, the UK, Japan and the US.
Source: Euroactiv newsletter

Divorce is bad for the environment, say researchers

High divorce rates are taking a toll on the environment, a recent Michigan State University study published in the online edition of Proceedings of the National Academy of Sciences found. The researchers found that households with fewer people are simply not as efficient as those with more people. A household uses the same amount of heat or air conditioning regardless of whether it consists of two or four people. However, two people living apart require two sets of energy-consuming appliances instead of just one. The study estimated that, in the United States in 2005, divorce resulted in the consumption of an extra 73 billion kWh of electricity and 627 billion gallons (2.4 trillion l) of water compared to married households.
Source: The HVAC&R Industry

U.S. EPA partners refrigeration industry to reduce GHGs

The U.S. Environmental Protection Agency (EPA) and representatives of the supermarket, refrigeration equipment and chemical refrigerant industries have launched the GreenChill Advanced Refrigeration Partnership—a voluntary program to promote sustainable technologies, strategies and practices that protect the stratospheric ozone layer, reduce greenhouse gases and save money. The ten founding companies, as well as any that join the partnership in the future, must pledge to exceed regulatory requirements by establishing an inventory of current refrigerant emissions that may affect climate change and the stratospheric ozone layer, and then setting reduction targets for emissions.
Source: The HVAC&R Industry

Germany gets tough on climate: 40% reduction by 2020

Germany has issued the world's most ambitious climate target: a 40% greenhouse gas emissions reduction by 2020. The plan includes key initiatives to phase out HFC refrigerants, and promote energy-efficient heat pumps and mobile air conditioning.
Security of supply, cost-effectiveness and climate protection are the key pillars of Germany's integrated energy and climate programme, launched on 5 December. The package, containing 14 separate legislative initiatives, is built around an overall target to reduce greenhouse gas (GHG) emissions by 40 % by 2020. If all measures are implemented in time, the Ministry for the Environment hopes to double Germany's GHG emission reductions by 2020 from currently 18 % to 36 % compared to 1990 levels. This would be the world's most ambitious national environment package so far, with which Germany hopes to reinforce its environmental leadership, reduce its dependency on energy imports, and foster productivity and innovation.
The climate package, to save up to €5 billion, focuses on sustainable heating, as well as reduction of emissions of high global-warming refrigerants and automotive GHG emissions
Source: www.r744.com

EU states handed ambitious renewable energy targets

The European Commission put forward ambitious targets on January

23rd to boost the EU's overall consumption of renewable energies to 20 % by 2020. But while the plans to promote technologies such as solar and wind power were largely welcomed, Brussels faces widespread criticism over controversial biofuels targets.

In March 2007, EU leaders committed to increasing the share of renewable energies in the EU's final energy consumption to 20 % by 2020, and promised to increase the use of biofuels in transport to 10 % by the same date. Since then, the Commission has been charged with formulating policy proposals to reach the targets, triggering a flurry of stakeholder activity.

Differentiated targets for EU member states

A proposal for a new EU directive, published on 23 January, mandates each member state to increase its share of renewable energies - such as solar, wind or hydro power - in an effort to boost the EU's share from 8.5 % today to 20 % by 2020. separate target to increase the use of biofuels to 10 % of transport fuel consumption is to be achieved by every country as part of the overall EU objective.

To achieve these objectives, every nation in the 27-member bloc is required to increase its share of renewables by 5.5 % from 2005 levels, with the remaining increase calculated on the basis of per-capita gross domestic product (GDP). EU countries are free to decide their preferred mix of renewables in order to take account of their different potentials, but must present national action plans (NAPs) outlining their strategies to the Commission by 31 March 2010. The plans will need to be defined along three sectors: electricity, heating and cooling and transport.

Buildings and district heating

While the focus of the directive is on the promotion of large-scale renewable energy installations, member states are nevertheless requested to use "minimum levels of energy from renewable sources in all new or refurbished buildings", and the text makes provisions for the mutual recognition of certifications for technicians who install renewable technologies in buildings.

Architects and planners are also to benefit from member state 'guidance' when planning new constructions, while local and regional administrative bodies should be required "to consider the installation of equipment and systems for the use of heating, cooling and electricity from renewable sources and for district heating and cooling when planning, designing, building and refurbishing industrial or residential areas".

Biofuels and sustainability

Brussels has come under acute pressure from green politicians, NGOs and the scientific community to provide robust sustainability criteria to ensure that the 10 % biofuels target does not lead to ecosystem loss, deforestation, population displacement, food price increases or even higher CO_2 output.
The Commission's text includes the following criteria:

- Land use - old forest with no or limited human intervention cannot be used for biofuels cultivation, nor can 'highly biodiverse grasslands', or lands with a 'high carbon stock' such as wetlands or 'pristine peatlands';
- CO_2 impact - the overall greenhouse gas (GHG) savings from biofuels production - must be at least 35 % in order for cultivation to be considered sustainable.

The Commission will put forward sustainability criteria for energy use of biomass by the end of 2010.
Source: Euroactiv newsletter

BFFF asks government to raise frozen food temperature

THE British Frozen Food Federation (BFFF) has begun talks with the government about the possibility of increasing the frozen food storage temperature in an attempt to reduce the food industry's environmental impact.

BFFF Director-General Brian Young opened preliminary discussions with DEFRA and food minister Lord Rooker at a meeting before Christmas.

As one of the major energy users, the food industry is coming under increasing pressure to reduce its environmental impact. The BFFF claims that a higher temperature for storage would greatly reduce energy use and greenhouse gas emissions.

Current food safety regulations state that frozen food must be stored at -18 °C or below. The BFFF is seeking to raise this to -15 °C.

Speaking at the Federation's annual luncheon, President Stephen Waugh called for radical thinking to effect carbon reductions. "The best example I can give is the absolute necessity to deliver products at -18 °C, even though we know that food is safe at -5 °C and that, excepting ice cream, preserving quality generally is achieved at around -11 °C.

"We need, in the short term, to ensure that we are all working at the right tolerances; in the medium term, we need to build solid independent scientific evidence to be able to move regulators' minds, perhaps a degree at a time, and in the longer term to change custom and practice and hearts and minds towards slightly warmer temperatures".

The BFFF maintains that although microbial growth stops below -5 °C, it is common practice for frozen foods to be stored at temperatures as low as -25 °C.

"The prize in reduced carbon usage could be enormous and is well worth pushing for," he added.
Source: ACR Newsletter 2008-01-07

Working Fluids

ARKEMA has unveiled its website www.forane427a.com to promote Forane 427A

From December 31, 2009, European regulations require a ban on the use of HCFC-22 fluids for the maintenance of air-conditioning and refrigeration equipment.

Forane 427A refrigerant fluid can be used as an alternative to extend the life of existing installations, while complying with current regulations.

Through its latest website, www.forane427a.com, Arkema provides end users in Europe with technical and environmental information on Forane® 427A to assist them with the retrofitting of their refrigeration equipment.
Source: ACR newsletter

Note from the editor: Forane427a, a mixture of R134a, R125, R32 and R143a, has a GWP value of 2000.

D-TEK CO_2 refrigerant leak detector

As the first accurate, reliable, highly sensitive, cordless refrigerant leak detector, the original D-TEK revolutionized the field. The D-TEK CO2 is the only hand-held refrigerant leak detector designed especially to detect carbon dioxide, the next generation refrigerant.

The D-TEK CO2 uses an innovative infrared absorption sensing cell which is extremely selective to carbon dioxide, yet its circuitry allows the instrument to ignore the CO2 present in the atmosphere, so there is minimal risk of false alarms. D-TEK CO2 maintains its sensitivity over time for consistent, accurate and reliable performance. Its specialised infrared sensor cell lasts for approximately 800 hours, so you buy fewer replacement parts.
Source: http://www.inficonrefrigerantleakdetectors.com/en/dtekco2.html

Technology & Applications

US unitary air conditioners available with SEER as high as 23

The minimum permissible efficiency for most new unitary air conditioner (AC) products in the USA was raised from 10 to 13 SEER or Seasonal Energy Efficiency Ratio (cooling seasonal performance factor of 2.93 to 3.81). According to the AHRI, systems are now available with certified SEER ratings of up to 23 for 7 kW cooling capacity systems. As reported by the Air Conditioning, Heating, and Refrigeration News, these high-efficiency units make use of inverter-driven compressor technology. The maximum SEER available in non-inverter systems is about 21. The article goes on to note that manufacturers are continuing to seek ways to provide their customers with even more energy-efficient equipment. Some are offering integrated systems that preheat domestic hot water using waste energy from the air-conditioning operation (generally using an optional desuperheater device). Unfortunately, there is not at present any accepted method of objectively rating the efficiency of such combined systems. Despite the fact that very high SEER systems are available, the article notes that only about 14 % of unitary ACs shipped in 2006 had a SEER of 14 or higher.
Sources: www.ahridirectory.org and *The Air Conditioning, Heating, and Refrigeration News www.achrnews.com*

UK supermarket giant invests in new technology for optimising refrigeration plant

Tesco, the world's number two supermarket chain, with more than 3000 stores in the UK alone, is using ground-breaking technology to check on the performance and efficiency of its store-based refrigeration systems.

It is part of the company's environmental programme to ensure that stores operate as efficiently as possible, and minimise the company's carbon footprint.

The retailer is using the revolutionary ClimaCheck performance analyser to carry out onsite checks on large store refrigeration systems that cool display cases and cold rooms. Such plant can account for more than 50 per cent of a store's energy usage.

The company will also use the system accurately to compare the performance of environmentally friendlier cooling technologies being trialled by Tesco, to help assess which operate most efficiently.

ClimaCheck performance analysers are already in use in Scandinavia, but their fame is now spreading across Europe – and beyond. The state-of-the-art system is based on non-invasive technology, as it does not require large-scale intrusion into the refrigeration circuit. Instead, it uses simple measurements from working plant to calculate essential parameters of system performance. With a few basic measurements, it can calculate the overall efficiency of both cooling and heating, system capacity, compressor efficiency – as a measure of wear, superheat in the evaporator, sub-cooling in the condenser, and flow in the condenser and evaporator.
For more details, ClimaCheck can be contacted on +46 8 55 61 55 75.

U.S. EPA developing data centre energy benchmark

The U.S. Environmental Protection Agency (EPA) has announced that it is developing a benchmark to help IT managers compare energy consumption in their facilities with that of other data centres. About 100 companies have reportedly said they will provide raw power data and other information to the EPA for use in developing its new benchmark, which is expected be available in about two years.
Source:www.ashrae.org

IKEA aims for 100% renewable energy

All IKEA buildings will be equipped with renewable energy systems. At the same time, the energy consumption should be cut by 25 %, says IKEA in a press release

Performance of ground-source heat pumps for the newly opened Karlstad store and other buildings has been favourable. These results made IKEA go for GSHP in the Helsingborg and Uppsala stores as well.
Globally, IKEA has 130 stores using renewables, of which 13 have GSHPs installed.

Energy consumption in the IKEA Karlstad store was reduced by 76 %, resulting in annual CO_2 emissions reduction of 2200 tonnes in comparison with the use of oil.
Source: www.ikea.se

New heat pump-driven air curtain

AC manufacturer Mitsubishi Electric has collaborated with Thermoscreens to produce a heat pump-driven air curtain which can cut running costs and CO_2 emissions by 67 %.

Developed with the Nuneaton-based air curtain manufacturers, the PHX DX product range comprises eight models which can link to a Mr Slim R410A outdoor heat pump compressor unit that uses advanced inverter technology.

Air curtains positioned over doorways act to prevent heat escaping from open doors and stop dust entering by warming and cleaning the air. They are used by businesses, particularly retailers, keen on an open-door policy to entice passing trade.

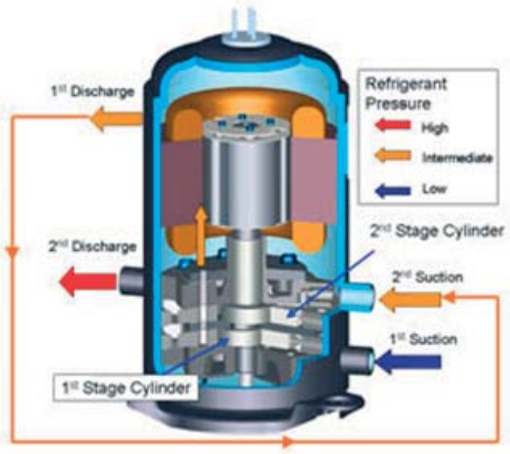
Thermoscreen and Mitsubishi Electric hope that their range of heat pump-driven air curtains will tap into an estimated £20m air curtain market. The new range was developed as one of many solutions put forward to meet Mitsubishi's Green Gateway initiative, aimed at reducing energy consumption and CO_2 emissions.
Source: ACR newsletter

New SANYO CO_2 rotary compressor

SANYO's $C0_2$ rotary compressor was the world's first hermetic compressor to use two-stage compression to spread the differential pressure and compression load. By dividing one compression into two, high reliability and efficiency can be obtained. Its internal intermediate-pressure structure makes it easy to design the shell while considerably reducing its thickness. This innovative shell design and a compact concentrated winding motor ensure compact size and light weight.

The combination of a DC brushless motor, which helps to improve the motor efficiency, and an optimised dimension of the two-stage compression mechanism leads to a higher overall system efficiency. The compressor is also resistant to high working pressures and large pressure differences occurring in transcritical CO_2 cycles. By adding intermediate cooling through the two-stage compression mechanism and a suction line heat exchanger, it is an optimal solution for refrigeration and cooling purposes, where CO_2 compressors in the past showed lower levels of performance compared to conventional models.

SANYO's innovative two-stage rotary compressor technology will be an integral part of 5000 beverage coolers installed at the Beijing Olympic Games this summer, following its successful application during the Olympics in Athens and Torino, as well as the FIFA World Cup. Moreover, SANYO's compressors have been successfully applied in thousands of Japanese vending machines.
Source:www.r744.com



DOE supports creation of an enhanced geothermal system

As part of multiple cooperative agreements, the U.S. Department of Energy (DOE) has formed a multi-disciplinary team with ORMAT Nevada Inc., GeothermEx Inc., the University of Utah, USGS, and the national laboratories to enhance or create an Enhanced Geothermal System (EGS) at Desert Peak hydrothermal field in Nevada.
Analyses are directed toward developing and executing a hydraulic stimulation program for an in-field, non-productive well of high temperature (>205 °C). The team will try to create or enhance the permeability by injecting high-pressure water. The objective is to develop a large and complex underground heat exchanger that is capable of supporting an additional 2-5 MWe power generation.
Source: EERE News

Technical CO_2 heat pump report by Mitsubishi Electric

Mitsubishi Electric, a leading Japanese manufacturer of CO_2 heat pump systems, has dedicated the latest edition of its global research magazine exclusively to technical achievements in R744 heating and cooling systems, with a special focus on compressors and heat exchangers.

In the December 2007 edition of its quarterly R&D magazine "ADVANCE", Mitsubishi Electric Corporation (Melco) describes the current status and future trends in heat pump technologies using the natural refrigerant CO_2 (R744). Focusing specifically on scroll and rotary compressors, as well as on microchannel heat exchangers, the global R&D report also examines industry and legislative trends influencing the use of energy-efficient heating and cooling solutions. Given that hydrofluorocarbons (HFCs) in air-conditioners, water heaters or refrigerators are increasingly subject to use restrictions in both Asia and the EU, Melco announces its intention further to intensify the development of CO_2 heat pump systems, known under the name of "Eco Cute" in Japan. According to the company report, Mitsubishi's "Diahot" model has currently the largest share of the heat pump hot water heater market in Japan, due to its high coefficient of performance (COP) of 4.9 and new foam insulation, increasing the heat insulation capacity of the tank unit by 15 %.

The report lays special emphasis on two R&D activities carried out by Melco under the "New Energy and Industrial Technology Development Organization" (NEDO) project from fiscal year 2005-2007 to promote HFC-free technologies:

- Double-stage compressor heat pump for cold regions: The former low COP and water-heating capacity of heat pumps working in cold districts were improved by a mechanism that divides compression into two stages, and the refrigerant injection at intermediate pressure.
- Multi-air conditioner for buildings: This R&D project focused on achieving a high performance for air conditioners through the combination of a recovery function for cooling exhaust heat, an energy re-utilisation function with a power recovery expander, and a gas cooler radiation mechanism.

Technical reports

Melco's R&D report updates on technical challenges in the development of rotary compressors for CO_2, based on an improved conventional R410A refrigerant compressor. Moreover, it describes wear-reducing technologies for single rotary compressors by coating the vanes.

In a second article, Mitsubishi presents its prototype of a large-capacity R744 scroll compressor based on a mass-produced R410A scroll compressor. Since the cooling capacity of CO_2 is higher than that of R410A, the stroke volume of the air-conditioning compressor could be reduced by one third. Mitsubishi is now working on further improvement of the compressor performance, using a quantitative loss analysis based on a simplified test.

The last section of the technical report is dedicated to the prototype of a refrigerant-refrigerant microchannel heat exchanger, which features reduced size and improved performance through microchannel tubes joining the low and high-temperature fluid flows.

High-efficiency EcoCute models launched

Leading Japanese brands showcased their latest CO_2-based heat pump water heaters (EcoCute) at an industry show in Tokyo last week. Sanyo and Daikin received special awards for their new high-efficiency performing units.

After hitting the first 1 million sales in 2007, momentum is growing for EcoCute water heaters in Japan, with constant innovations entering the market every year. Leading manufacturers chose the ENEX (Energy and Environment Exhibition) in Tokyo this week to showcase their latest models, featuring increased efficiency in different conditions, therefore contributing to reducing overall greenhouse gases emissions.

Sanyo presented its innovative new heat pump, able to operate efficiently under extremely low ambient temperature conditions (-20 °C), which therefore makes it suitable for cold areas such as the Hokkaido region in north Japan. The unit, developed in co-operation with the Hokkaido Electric Power Company, won the Chairman's Prize of the Energy Conservation Centre of Japan (ECCJ), under the category of Low Ambient Multifunction EcoCute.

Sanyo's new CO_2 heat pump uses a split cycle system, permitting a 50% increase in heating capacity and 20 % improvement in COP at -20 °C ambient temperature, when compared with a conventional cycle Sanyo model.

Daikin, on the other hand, also won the Chairman's Prize of ECCJ for its CO_2 heat pump. With a COP of 5.1, its latest EcoCute unit uses a special water/CO_2 heat exchanger.

The exhibition showed a trend towards high efficiency heat pumps, with the majority of new models having a COP of over 5.0. This is a significant increase since the launch of EcoCute in 2001, when the best models had a maximum COP of 3.5. Physical sizes of EcoCute units have also decreased in order to fit into smaller spaces, and new models have been developed to suit various needs (i.e. large integrated systems, industrial installations, extreme weather conditions, etc.).

Companies exhibiting new models included:

- Chofu: its new Eco Cute heat pump achieves a COP of 5.1, combined with silent operation, with maximum operating noise of only 38 dB.
- Corona: with similar efficiency, it offers an attractive slim design to fit in residential buildings.
- Panasonic (National): last year's winner of the ECCJ award displayed a new model using a vacuum insulation panel, with overall improved efficiency.
- Hitachi (see picture in image gallery)

Source: R744.com

Hydro features new internal heat exchanger

Hydro, a leading manufacturer of aluminium products, presents its high-performance internal heat exchanger for R744 automotive air conditioning. The product features low weight, high resistance and a compact design.

Hydro's new aluminium internal heat exchanger system can be used in a variety of air-conditioning applications, with the present design being specifically optimised for the use in R744 (CO_2) mobile air conditioning. The "CO_2AX" features a low weight (less than 240 gram/metre), a compact design of only 16 mm outer diameter, and a narrow bending radius of less than 15 mm. Moreover, it ensures safe and efficient operation of any R744 A/C system due to its high burst pressure and low pressure drop.

The cost-optimised co-axial product is the result of extensive computational fluid dynamics (CFD) and finite element methods (FEM) modelling work. It is available in several designs and alloy combinations to meet all market demands. In addition, Hydro's internal heat exchanger offers good forming and machining features and can also be delivered in different designs and cross-sections upon request.

Basic specifications

- Capacity (W/m): 1999,08
- Pressure drop, high pressure (HP) side (bar/m): 0.04
- Pressure drop, low pressure (LP) side (bar/m): 0.06*
- Burst pressure, HP side: 650 bar
- Burst pressure, LP side: 421 bar
- Burst pressure, HP and LP side simultaneously: 370 bar**

Source: R744.com

Markets

German MAP supports direct expansion heat pumps too

The European Heat Pump Association has succeeded in getting heat pumps based on a direct expansion systems included in the German Market Incentive Programme (MAP) in future. The decree has passed the Federal Environment Ministry, as we were informed by the president of the Federal Office of Economics and Export Control (BAFA), Dr. Arnold Wallraff.
In addition to brine-to-water, water-to-water and air-to-water systems, direct-expansion heat pumps are now supported if they guarantee at least the following seasonal performance figures (SPF):
- New buildings: 4,0
- Existing building stock: 3,7

Increased innovation support is granted for:
- New buildings: 4,7
- Existing building stock: 4,5

This decision was a further step towards treating heat pumps equally to other renewable energy systems in terms of support criteria, and further promoting market penetration of this highly efficient sustainable energy technology for heating and cooling of buildings.
Source: EHPA Website: http://ehpa.fiz-karlsruhe.de

New Zealand: Use of heat pumps rises rapidly

Heat pumps are rapidly gaining popularity in New Zealand, first findings from a new study by construction research group Branz has shown. The full report, to be released later this year, indicates that New Zealanders are moving away from solid-fuel heating to equip their homes with electrically-driven heat pumps all across the country. Branz's research shows that now about 45 % of all new homes have a heat pump installed, with overall sales doubling from those of three years ago to 80 000 units sold in 2007. While the majority of heat pumps is still used in the cold regions of New Zealand, summer usage has increased throughout the country.

The national survey on how New Zealanders used heat pumps also showed that, although the use of heat pumps could mean higher annual electricity consumption, their high efficiency will make up for these costs: "Most users of heat pumps are very happy with their decision, despite the trend towards an increase in the overall use of electricity," Branz energy scientist Lisa French said. As a result, 40 % of all homes in New Zealand have replaced their wood burner or gas heater with a heat pump unit.
Source: www.r744.com

France: New tax breaks for heat pumps

As from January 2008, there are new regulations for tax breaks in relation to heat pumps in France. All heat pump models must achieve a minimum COP of 3.3 at exactly defined temperatures in order to qualify for the national tax concession. What was known as the "Crédit d'Impôt" was introduced by the French government in 2005 to promote sustainable heating solutions and the most energy-efficient equipment. The latest decree, from 13 November 2007, has increased the necessary COP by 0.3 from 3.0, and included air-to-air models for the first time. Hitherto, only new and refurbished buildings with geothermal and air-to-water units have received financial support.
Source: www.r744.com

IEA Heat Pump Programme

IEA Heat Pump Programme welcomes two new members

We are proud to announce that Italy and South Korea have joined the IEA HPP Implementing Agreement, effective from the beginning of 2008. Both countries have strong industries in heat pumping technologies, and we look forward to having them in the programme.

HPC Newsletter has interviewed representatives from both countries, and in this issue we present the interview with Mr. Park from South Korea. In the next issue of the newsletter, the interview with Mr. Restuccia from Italy will be presented.

Interview with Mr Seong-ryong Park, representing South Korea in the IEA HPP

Dear Mr. Park, welcome to the IEA Heat Pump Programme (HPP).
We'd like to know a bit more about South Korea, and we're also interested in knowing more about your expectations of HPP.

The heat pump market in South Korea

1. Could you briefly describe South Korea's heat pump scene today? Which industries are there, and what products are manufactured?
>> The HVAC market of Korea has been expanding for the last three decades. The systems related to HVAC industries have progressed from conventional systems to advanced systems with higher performance, compactness, and easy installation with multi-purpose applications. Among these systems, heat pump systems were regarded as being one of the most effective systems for heating and cooling applications due to their high performance, with multiple functions and moderate operating costs.

Fact sheet: Seong-ryong Park
Name: Seong-ryong Park
Affiliation: Korea Institute of Energy Research
Lives in (city): Taejeon, Korea
Interests (apart from heat pumps): Energy conversion, Renewable energy

2. What does the market look like? Is it mainly reversible heat pumps for heating and cooling that are sold, or are there other technologies?
>> Air source HVAC systems in Korea are mostly classified into two groups : split room air-conditioners (SRAC) and split packaged air-conditioners (SPAC) which made up 86 % of HVAC systems in 2005. However, heat pump systems have only 2 % (38 million USD) of market share.

3. Market share for different types of heat pumps (air-to-air, air-to-water, GSHP, other?)
>> Water-source heat pump market share is 74 million USD, but mostly biased toward gas engine heat pump (GHP) systems for school and public buildings. Recently, the multi-zone air-conditioning heat pump system market has been growing rapidly for LG Electronics and Samsung Electronics.

4. Are heat pumps mainly installed in single-family houses or multi-family houses?
>> The popularity of heat pumps is not so common because of geographical, economical and technical reasons. In Korea, temperatures during the winter are very low (about -5 °C), and the cost of electricity is expensive. Direct heating from boilers costs less than that of a heat pump system, and so heat pump systems are mostly used in the commercial sector.

5. Are there any subsidy schemes, favourable loans or other actions in South Korea to stimulate market growth?
>> There is an obligation for public buildings to use alternative and renewable energy. There is also a subsidy for distribution of alternative and renewable energy: GSHPs qualify for the subsidy.

Acceptance of heat pumps in South Korea

6. What is the general opinion about heat pumps? Are they well known to the public?
>> Heat pumps are not well known to the public.

7. Are heat pumps considered renewable energy in South Korea?
>> No.

Research in South Korea

8. What research activities are in progress in South Korea related to heat pumps? Are there any specific areas of research that are "hot" at the moment?
>> Research in the heat pump field has been mostly concentrated on high-temperature generating system design, improvement of energy efficiency, larger sized system manufacturing, and alternative technology to reduce greenhouse gas emissions.

Types of organisations covered	Newly constructed buildings with floor areas exceeding 3000 m2 for government organizations, local government, government-invested organizations, and government-funded institutes
Types of buildings covered	Public buildings, cultural and convention facilities, medical centers, sports complexes, social welfare facilities, memorial parks, leisure facilities, hotels and accommodations, recreational facilities and office buildings
Requirements	Minimum 5 % of the total construction cost

Capitol: Seoul
Population: 49.045.000

South Korea 's membership of the Heat Pump Programme

9. What was your main reason to join IEA HPP?
>> Cooperation with other countries
>> To exchange information

10. What kind of research project (HPP Annex) do you hope for in the near future that would suit South Korea ?
>> Korea is interested in "High-temperature heat pumps for the industrial sector".

Mr. Park, thank you for taking your time to answer these questions, and once again, welcome to the IEA HPP!

Annex 29

Annex 29 investigates the present status of ground-source heat pump systems, which varies widely all over the world, and identifies systems - depending on climate and application - that could improve the performance and market attractiveness of such systems. The objective is to demonstrate the economic and environmental benefits of ground-coupled heat pump systems.

The final workshop of Annex 29 will take place in combination with the 9th International IEA Heat Pump Conference, 20-22 May 2008, Zürich, Switzerland. The date is May 19, 2008.

For more information on the work of the annex, please visit the Annex 29 website at www.annex29.net
Hermann Halozan, Operating Agent, Annex 29.

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, UK, US
Annex 32 Economical heating and cooling systems for low-energy houses.	32	CA, CH, DE, NL, SE, US, JP, AT, NO
Annex 33 Compact Heat Exchangers In Heat Pumping Equipment	33	UK, SE, US, JP
Annex 34 Thermally Driven Heat Pumps for Heating and Cooling	34	AT, **DE**, NL, US

IEA Heat Pump Programme participating countries: Austria (AT), Canada (CA), France (FR), Germany (DE), Japan (JP), The Netherlands (NL), Italy (IT), Norway (NO), South Korea (KR), 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.

News from HPP Annex 30 "Retrofit Heat Pumps for Buildings"

HPP Annex 30, "Retrofit Heat Pumps for Buildings", which started in April 2005 with eight companies/organisations from four countries, and which will be terminated in October 2008, is looking back over a successful 2007:

Members of HPP Annex 30 actively participated in the International Heat Pump Symposium "Possibilities and limits of heat pumps in existing private and commercial buildings" in the Congress Centre Nuremberg from 18-19 September 2007 as organizers and speakers, and used the opportunity to present the first results of the work of the Annex. The symposium was organised by DKV, and offered 200 experts from eleven countries an outstanding platform for information, trends and exchange of views.

The HPP Annex 30 workshop and meeting was organised in connection with the DKV Annual meeting on 23rd November 2007 in Hanover, with presentations of the results of the Annex and the present trends for retrofit heat pumps in France, The Netherlands, Sweden and Germany.

Now we are looking forward to our HPP Annex 30 workshop "Retrofit Heat Pumps for Buildings" at the 9th IEA Heat Pump Conference on 20-23 May 2008 in Zurich. Here we will present the major findings of the Annex as well as new developments related to the annex.

Last not least, the HPP Annex 30 Final Report and Executive Summary will be published at the end of 2008.

Prof. Dr. H.J. Laue
IZW e.V.

A successful round table discussion of HPP Annex 30 on 13. 02. 2008 in Utrecht, the Netherlands

HPP Annex 30 - Retrofit heat pumps for buildings - is already in its final stage of work. Detailed material, information, experience and future trends of retrofit heat pumps in the major European countries have been collected, discussed and documented, and will be presented at two open meetings in 2008

The eighth meeting of HPP Annex 30 on 13.02.2008 in Utrecht /The Netherlands, invited and organised by SenterNovem, was of particular interest, as the present market development of heat pumps in Europe is clearly dominated by two facts:

A certain slowdown of sales of units for new buildings / dwellings and an ever-increasing market for the renovation of existing buildings. As heat pumps form an important part of the renovation process, with structural alterations, insulation upgrading and technical improvements, the heat pump community should be concentrated on producing and delivering equipment for existing buildings.

For the first time, the annex meeting was organised in the form of a round table discussion, with the following results:

- In addition to a published executive summary and the internal full report, special reports will provide information to specific target groups, e.g. politicians, the heat pump industry and housing corporations
- Heat pumps are only one part of the renovation process, and structural alterations and insulation upgrading are no less important.
- Heat pumps should be particular appraised for their role in improving eco-efficiency.
- A strategy road map has been proposed for the development of renovation schemes for private and publicly or commercially owned domestic and commercial buildings.

The final results will be discussed in two workshops in 2008:

- IEA HPP Heat Pump conference 2008 Workshop HPP Annex 30, 19.05.2008, Zurich, Switzerland.

Programme see: http://www.hpc2008.org /workshop/Annex 30

- IEA Annex 30 final event, 14. October 2008, Congress Centre, Nürnberg/ Germany. (The day before the new Chillventa Fair)

Prof. Dr. H.J. Laue
IZW e.V.

Annex 32 working meeting held in Kyoto, Japan

IEA HPP Annex 32 is to investigate multi-functional heat pump systems for application in residential low-energy houses, covering all the different building services of space heating, DHW production, ventilation and space cooling, including de-/humidification.

The 4th Annex 32 working meeting has been held in Kyoto, Japan on Dec. 5-7, 2007. The meeting schedule comprised a one-day expert meeting, a workshop and a technical tour. The expert meeting was to exchange the actual results of the national projects in Annex 32. Table 1 gives an overview of national activities in Annex 32.

The second day was dedicated to a public workshop, which was a good opportunity to exchange project information of Annex 32 participant countries and the activities of the numerous members of the Japanese

Table 1: Overview of national contributions to IEA HPP Annex 32

Country	Institution	Focus of work
AT	IWT/TU Graz	• Development of A/A or A/W heat pump for the small capacity range • Prototyping and lab-testing of the best solution of pre-studies
CA	LTE/Hydro-Québec	• Design, construction, monitoring and optimisation of two EQuilibrium low-energy houses
CH	IEBau/FHNW	• Design guidelines of energy-efficient heat pump systems for space heating and cooling. • Field test of a heat pump system for space heating and cooling
DE	FhG ISE, Viessmann GmbH	• Field testing of more than 100 state-of-the-art residential heat pumps in co-operation with seven manufacturers and two utilities. • Field test of 70 retrofit heat pumps for replacement of boilers in dwellings with high supply temperature requirements, in co-operation with the German Utility E.ON
JP	University of Hokkaido, TEPCO	• Optimisation of systems in terms of capacity range and part load operation for use in moderate climate zone (central Honshu, Tokyo and Osaka area). • Feasibility studies and field tests of ground-source heat pumps for the cold climate zone (Hokkaido)
NL	SenterNovem, various Dutch market players	• Promotion of market introduction of low-energy houses, establishment of certification/subsidy schemes, system development, possibly field tests in the frame of Dutch low-energy house projects
NO	SINTEF Energy research in co-operation with NTNU	• Technology assessment of suitable heat pumps for Norwegian low-energy houses (cold climate conditions) • Evaluation of performance of compact ventilation units with exhaust air heat pumps, for the Norwegian climate • Field test of novel water/water heat pump with propane refrigerant installed in a passive house
SE	SP and Swedish manufacturers	• Assessment and redesign of Swedish heat pump systems (capacity range, auxiliary consumption) • Further development of Swedish heat pumps for application in low-energy houses (e.g. exhaust air heat pumps with hybrid source, combined space cooling/DHW)
US	DOE, ORNL	• Development of a multifunctional heat pump system for space heating, cooling, DHW, ventilation incl. de-/humidification for Net Zero-Energy Houses • Component tests, prototyping and field test of the system

national team in Annex 32. The Japanese national team consists of three universities, four organisations and 16 companies represented by the University of Hokkaido and the Tokyo Electric Power Company (TEPCO). Presentations and papers from the workshop can be downloaded from the Annex 32 website.

The third day was devoted to a technical tour to SEKISUI House, Ltd. and DAIKIN Industries Ltd. The Comprehensive Housing R&D Institute of SEKISUI House Ltd. carries out research into architectural and energy issues for residential buildings, and has a large information area for the interested public.

The visit to the SAKAI plant of DAIKIN Industries, provided an opportunity to see the latest developments in air-conditioning, and see the production process in the factory.

Outlook

Interim results of the national projects will be presented at an Annex 32 workshop in connection with the 9th IEA HP Conference in Zurich on Monday, May 19, 2008, 13.30 h – 17.30 h.

The preliminary workshop program-

Fig. 1: Technical visit to the Comprehensive Housing R&D Institute of Sekisui House Ltd.

me can be downloaded from the HP Conference website at http://www.hpc2008.org, under the category of „Workshops“, and also from www.heatpumpcentre.org.

Continuously updated information on the IEA HPP Annex 32 project and the national contributions, publications and links is provided on the Annex 32 website at http://www.annex32.net.

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IEA HPP workshop activities at the HPC Conference

- Monday, May 19th : Workshops, Annex 29, Annex 30 , Annex 31 and Annex 32
- Tuesday, May 20th : Workshop, Annex 34
- Wednesday, May 21st : Workshop, Annex 33

Workshop programmes can be downloaded from the Annex websites, the conference website or from www.heatpumpcentre.org.

Trends in the European Air Source Heat Pump Market

Roger Hitchin and Christine Pout, BRE, United kingdom

This article describes expected trends in the European market for air to air heat pumps and compares typical efficiencies with those in Japan. It then explains how the technology that provides the high efficiency products in Japan is now being applied to air to water heat pumps for European markets

Introduction

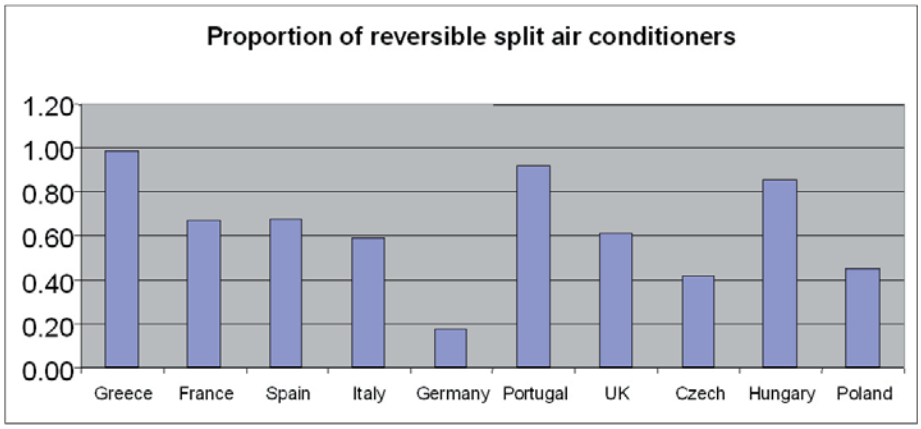
The UK has more than half a million space heating heat pumps. They are better-known as reversible room air conditioners. Europe as a whole has about 6 million.

That may sound a lot compared to the numbers of heating-only heat pumps (perhaps a few hundred in the UK and half a million across Europe) but compared to the number of heating boilers, it is tiny. The UK has over 20 million boilers and Europe more than three times this number. So, in principle, the potential for market growth for heating-only heat pumps is very large.

The market for reversible air conditioners is usually seen as a subset of the market for cooling, rather than of the market for heating, though of course it is part of this market too. As we will see, there are overlaps in technology as well as customer base.

The European Market for Reversible Room Air Conditioners

Compared to markets in some other parts of the world, the European market for air-conditioning is in an early, rather immature stage of development. Only 18% of single-room air conditioners are replacements, with most sales (54%) being new installations into existing buildings (in a mature market most sales are replacements). We examined the dynamics of the market as part of a European study [i]. To do this, we estimated future sales in each of the EU-27 countries with an established market penetration model



(previously used amongst other things to characterise the American air conditioning market), calibrated against historical sales figures. This allowed us to project future annual sales, retirals and installed stock size in different types of building. These were then used to estimate the total environmental impact under different scenarios of equipment performance. Details can be found at the project website [ii].

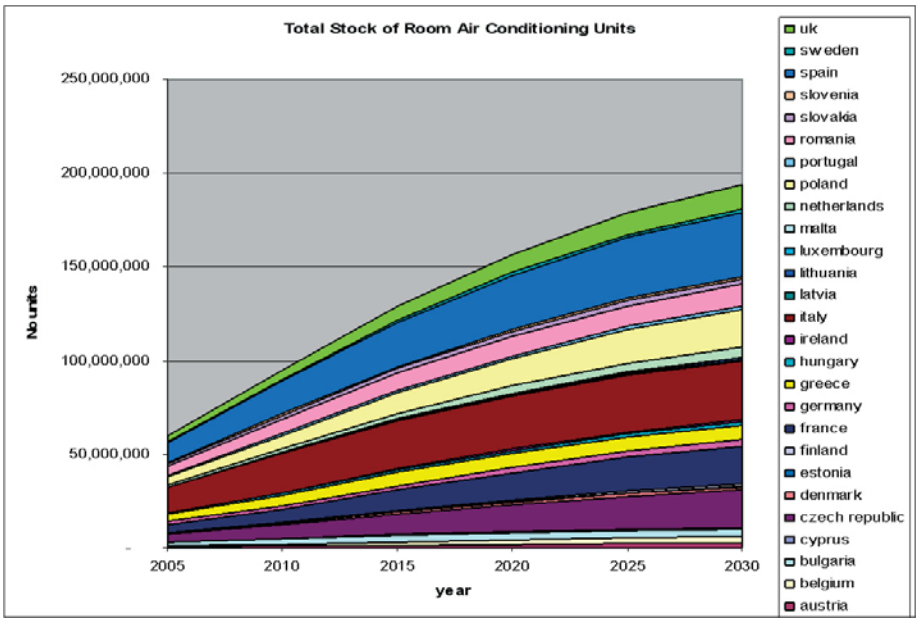
Only a proportion of room air conditioners are heat pumps, but in most countries the majority are reversible and the proportion is increasing. Currently about half of reversible systems (measured by total cooling power) are in housing and half in commercial buildings. In the cooler climates, existing buildings will usually already have heating systems and so there is less often a need to provide reversibility, but in new buildings a heat pump is often a cost-effective and carbon-efficient heating option. In warmer countries, where central heating is not an automatic choice, reversibility is an obvious alternative to a separate heating system.

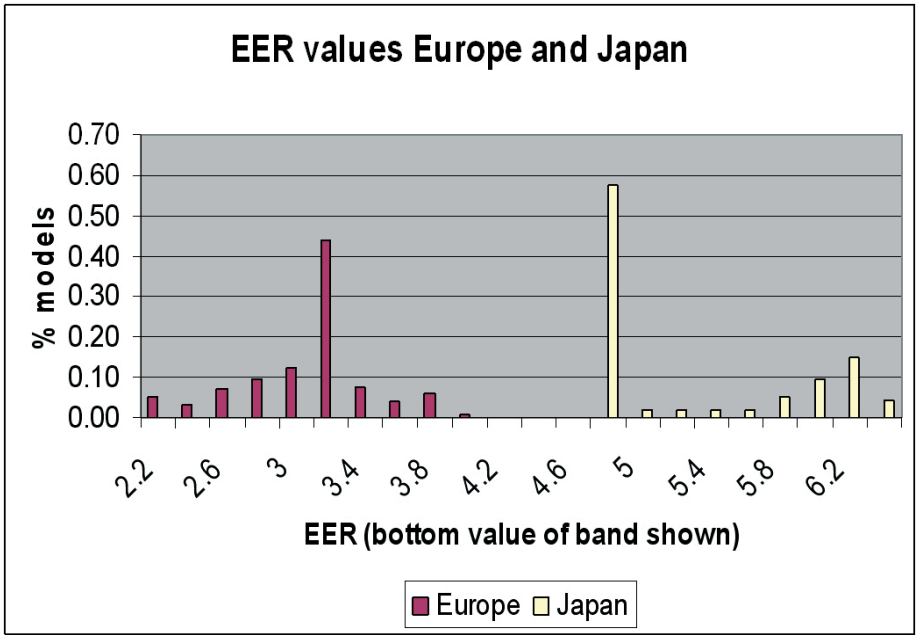
Previous studies [iii] have shown that an air-conditioning market (in housing at least) does not really start to develop below a certain level of national wealth. It then continues to grow until ownership reaches a saturation level that seems to be determined mainly by climate [iv]. On this basis, all EU countries have sufficient wealth for a market to develop. Our estimates show that current European ownership levels vary between 2% of estimated saturation for Germany to 53% for Greece. This means that, in most countries, current sales rates can be maintained for several decades before saturation effects come into play. Even these figures may underestimate the market potential since the saturation levels were derived from American data for the proportion of households with air-conditioning, but the sales figures are for single-room units. In Japan, the average household owns more than two air conditioners. It is possible, though, that as the market develops multi-room systems may become more widespread.

Comparison with Japan

Japan has a mature air-conditioning market and therefore provides an insight into how European markets might develop. In addition to the higher ownership levels, the Japanese market (for household air conditioners) is characterised by second- or third-time buyers for whom the question is not so much "shall I buy an air-conditioner?" but rather "which one shall I buy this time?" First cost is an issue, but not the only one. In this sense it is more like the European car market than the European air conditioning market. The market is characterised by having a number of large, well-established, competing suppliers working within a framework of strong efficiency regulations. This leads to a substantial amount of competitive technical development and, in consequence, high levels of energy efficiency.

The efficiency levels achieved show that the technology already exists to substantially reduce energy consumption compared to that of existing European products (many of which are Japanese brands). Although the figures below are for cooling efficiency, there are similar differences in heating performance (most products are reversible). Typical measures are variable speed compressors, well-managed defrost control and carefully designed heat exchangers and fans. This does not come without cost, though. For similar sized models there is price range of more than 2:1, with the most efficient products being the most expensive. Not all the cost increase is due to efficiency though. "Top of the market" products have other market-enhancing features such as self-cleaning filters. Koizumi [v] has estimated that 20% to 25% of the price increase is the result of features not related to energy efficiency.





Technology Transfer to Heating-only products

How does this relate to the heating-only heat pump market?

Air conditioning and consumer product manufacturers have recognised that using the same energy efficiency techniques in air to water heat pumps can produce products that balance performance levels and cost in a way that makes them an attractive market proposition. This is particularly useful for climates like the UK's as the relatively mild winters present fewer challenges for air-source systems. (Though the dampness does mean that defrost energy needs to be carefully managed).

Market Issues

For a viable product, technical feasibility has to be matched by market opportunity. The main market driver in the short run is the ever more demanding carbon emissions requirements for new buildings, driven by the EU Energy Performance of Buildings Directive. These mean that, while heat pumps may be more expensive than gas heating systems, they can also be an economic way of reducing carbon emissions – provided that the performance is sufficiently good. Air source systems are inherently cheaper than ground-source systems and although their inherent efficiency is in principle lower, manufacturers believe that in practice they can offer a competitive package. Many of the same technologies used in air-source systems can also be applied to ground-source systems, but the latter still remain signifi-

cantly more expensive than air-source systems and are likely to enter different market sectors.

There are a few challenges however. One of these is the efficient provision of a hot water service (HWS) at an adequate temperature. In new housing in the UK (in particular), the annual energy requirement for HWS is comparable to that for space heating. While temperatures of around 55 °C or less may be adequate for actual use at the tap, temperatures of 60 °C are needed to avoid the risk of legionella. Manufacturers have found ways of providing this at reasonable efficiency, for example, by boosting the water temperature from say 55 °C to 60 °C time to time with a direct heater. Another constraint is the need to find space for an outdoor unit and a hot water cylinder. Space constraints are already driving the gas boiler market towards physically small, wall-mounted boilers providing instantaneous hot water (combination boilers).

While the use of underfloor heating provides the best heating efficiency, the ability to provide higher temperature for hot water means that the new heat pumps are also able to operate with radiators. In the longer term, this opens up the possibility of a boiler replacement market – especially if radiators have been oversized (or become so through insulation of the building), or can be replaced by lower temperature emitters. Outside the UK, there may well be a market for air –water heat pumps to operate alongside existing oil boilers as bivalent systems.

Consumer confidence is another key market issue. While the appearance of familiar brand names should help, there is still a role for independent "approval" of products and installers. This is being addressed in the UK by the development of voluntary standards. These are voluntary in the sense that there is no general obligation to meet them, but compliance will be a requirement for all government-supported programmes. As they have been developed in conjunction with the relevant trade associations it is expected that they will be generally recognised as good practice. They cover all types of heat pump: air-source, ground-source and water-source.

The carbon-saving benefits of heat pumps will only be recognised in building regulations if the regulatory calculation procedures reflect their performance correctly. Currently, the UK software for dwellings, SAP, contains generic system performance factors for different types of heat pumps, but does not have a route for using product-specific performance figures. Manufacturers feel that the generic figures do not adequately reflect the performance of their innovative products. In order to introduce product-specific seasonal performance figures, there needs to be an agreed, robust way of determining them.

European standard prEN 15316-4-2, developed from work carried out in IEA Heat Pump Programme Annex 28, provides a framework for such calculations but there are differing views as to whether it has been sufficiently field-validated, especially for the latest types of products. In particular, there are doubts about the reproducibility of part-load efficiency tests, especially with variable-speed compressors, and of the sensitivity of HWS service performance to draw-off pattern. A series of small draw offs for handwashing, for example, imposes very different demands from a large draw off for a bath. These are issues that may well be addressed in the proposed Annex "Calculation Method for SPF for Design and Labelling Purposes" and by comparing laboratory-based test results and field experience (for example in the proposed Annex "Field Measurements"). Alternatively, given the scale and cost of field large enough to have statistical significance, other approaches such as test houses with simulated occupancy, may be more practicable

Conclusions

The move to more stringent carbon emission requirements for new buildings in Europe has produced a significant potential market for heat pumps. Manufacturers are responding by developing new air-to-water products that they perceive as being likely to offer some customers better value for money than current systems. This has required technical development that, in part, builds on work already applied in the highly competitive and energy-conscious Japanese market for room air conditioners.

There are still some outstanding issues in terms of consistent and reliable testing and performance characterisation of products, which proposed IEA HPP annexes would be well-placed to address.

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Existing seasonal performance indices for air-to-air heat pumps

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Introduction

The USA have been the leaders in the adoption of seasonal energy efficiency indices for air-to-air units, in cooling and in heating modes, recently followed by Japan, Korea and China (IPLV for package units).
Since seasonal performance indices allow the effect of temperature variations and heating load variations on performance to be included, they are likely to give a better indication of the real efficiency of the products in the field than do present EER and COP figures at full load under rated conditions. At least, this enhances the comparison of the energy performances of different products by taking more variables into account.

1. "Seasonal" performance standards

In the USA, the ARI 210/240 [1] seasonal performance standard is used for "unitary" air-to-air heat pumps with heating capacities less than 65000 Btu/h (19 kW), and defines a seasonal performance COP with the name of HSPF. Japan also defines an HSPF, for small split units with capacities less than 10 kW[1] [2], and also for commercial air-to-air units for larger capacities up to 28 kW[2] [3]. A third country, Korea, has adopted a seasonal performance standard, KS C 9306. However, this article does not describe this latter standard in more detail.

What variables are taken into account in existing standards?

The energy consumption of air-to-air heat pumps varies with outdoor air temperature and humidity, indoor air temperature and heating load. Indoor conditions in the existing ARI 210/240 [1] and JRA 4046 standards [2] are specified as constant: only outdoor air temperature and loads are varied. In the heating mode with sub-zero outdoor temperatures, humidity ratios are not specified for a specific location, although default ISO 5151 [4] H1 to H3 outdoor humidity ratios or equivalent are used. Nevertheless, establishing the conditions of operation is not straightforward, because the relationship between the outdoor and indoor conditions and the thermal load depends on climate, on the building and on occupancy characteristics.

How are these variations in temperature and load taken into account?

The ARI 210/240 and JRA 4046 standards are based on a specific **load curve** (annual duration of outdoor temperature and resulting thermal load) and a sizing hypothesis. The durations of each combination (n_j) of load, BL, and outdoor air temperature, T_j, during the heating season are summed in order to calculate the frequency of occurrence of a given temperature. The HSPF is computed as the sum of the heating energy supplied, divided by the electricity consumption required with the following formula, where X_j is the ratio of the building load to the design capacity. The computation of HSPF includes auxiliary resistive heating required at low outdoor air temperatures ($RH(T_j)$), when the building load exceeds the space-heating capacity of the heat pump condenser.

$$HSPF = \frac{\sum_j BL(T_j)\frac{n_j}{N}}{\sum_j \left(\frac{BL(T_j)}{COP(T_j, X_j)} + RH(T_j)\right)\frac{n_j}{N}}$$

2. Load curves

Following the latter formula, the **performances of the units** have to be established for the different operating conditions (combinations of temperature and load).

The **ARI standard** defines six climatic zones for the USA. Nevertheless, only the heating seasonal performance factor of Zone IV has to be published in the ratings, the zone that we consider here. The building load curve is a straight line against outdoor air temperature, with heating beginning when outdoor temperatures falls below 65 °F (18.3 °C).

C = 0.77 is a correction factor which "tends to improve the agreement between calculated and measured building loads, dimensionless." [1]. It is a simplified way of taking into account internal gains (solar, lighting, …). T_{OD} is the outdoor design temperature, and

$$BL(T_j) = \frac{(65 - T_j)}{65 - T_{OD}}.C.DHR$$

depends on the climatic zone: for Zone IV, it is 5 °F (-15 °C). "Design Heating Requirement (DHR) is the amount of heating required to maintain a given indoor temperature at a particular outdoor design temperature." [1]; in the USA, it is used to design the heat pump for a specific installation. Manufacturers have a certain degree of freedom concerning DHR: they can declare a large DHR (up to twice the rated capacity) but with reduced performance because of more resistive heating, or a lower DHR with better HSPF. This latter is the strategy generally adopted. The lower DHR[3] value leads to the following formula with Q_H^{rated} the heating capacity at rated conditions (equivalent to ISO H1conditions[4]).

---

[1] Heating units are reversible in Japan and capacity if the cooling capacity: the scope is defined as: cooling capacity inferior to 10 kW and electric power < 3 kW.
[2] Cooling capacity inferior to 28 kW.

$$BL(T_j) = \frac{(65 - T_j)}{60}.C.Q_H^{rated}$$

Heat load and repartition of energy are shown in Figure 1. For the heating load, percentages refer to the rated heating capacity at full load. Energy weighting is the normalized product of the hours and load ratio values. Average equivalent operating conditions at minimum DHR are about 42 % of rating capacity and 0 °C and 84 % at maximum DHR.

In the **JRA standard**, the heating load curve is also a straight line as a function of outdoor air temperature. The load at 0 °C is equal to 0.82 times the rated capacity in heating mode[5]. The load curve is shown in Figure 1.

To compute a number of hours of use, the heating season is set as Nov - mid April in Tokyo, and hours when outdoor temperature falls below 17 °C are entered as a function of outdoor air temperature. The average equivalent operating point is about 57 % load, 7 °C. The JRA 4046 load curve slope is intermediate between the minimum and maximum DHR load curves of the US standard, and the energy weighting shows a milder climate in Tokyo than in the USA Zone IV.

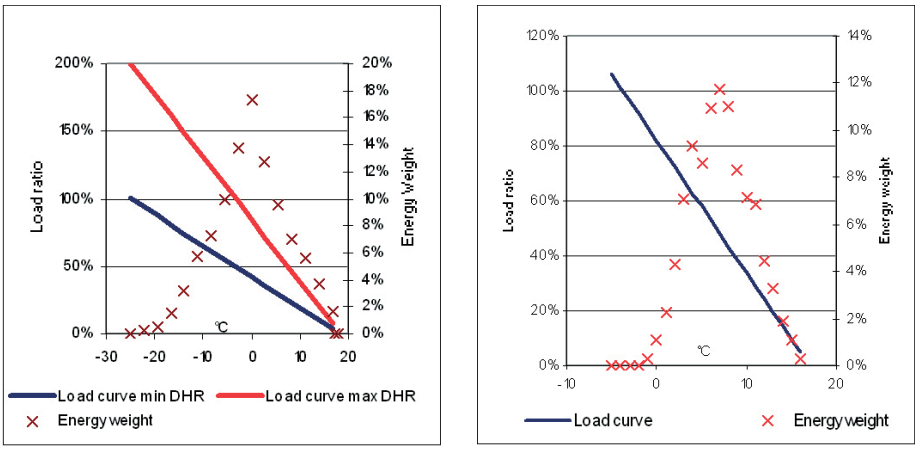

Figure 1: Heating load and energy repartition as a function of outdoor air temperature, ARI 210/240 left [1], and JRA 4046 [2], right.

3. Testing and performance

How is the performance of a heat pump calculated?

Performance of the unit is computed for load points (outdoor air temperature and load) along the load curve for all temperature bin j.

Let's begin with a **single capacity stage unit**. Outside the frost range, heating capacity and power input vary linearly with outdoor air temperature. This is determined from two test points at 8.3 °C and –8.3 °C outdoor air temperature. In the frost range, between –8.3 and 7.2[6] °C, the heating capacity and power input are straight lines computed between performances at –8.3 °C and 2.8 °C. Finally, three full load test points are required.

Three cases may be encountered:

1) If the heating capacity exceeds the required load, the unit cycles. Manufacturers have the opportunity to perform a supplementary test to measure a cyclic degradation performance factor Cd, or a default value of 0.25 is used – it means the unit COP is reduced by 25 % at 0 % load and not altered at 100 % load.
2) The load is higher than the available capacity. In that case, electric heating is added to the power input of the input to supply the load.
3) The heat pump is stopped at low outdoor air temperature and only electric heating is accounted.

In the case of a two capacity stage heat pump, the procedure is similar except the load may fall between the capacity of the two stages. This means that the performances of the two capacity stages must be determined, for which six testing points are required. For high outdoor temperature, a supplementary testing point is required at 16.7 °C on the smaller capacity stage, and so seven points are required in total. When the load lies between the two capacity steps, the running time of each stage is calculated from the capacities of both stages and the required load and power input can be calculated.

Inverter-driven heat pumps are considered as triple capacity stage units. In order to minimize the number of testing points, frequencies are tested only for a limited temperature range. Minimum frequency is tested only at high outdoor air temperature, 8.3 °C and 13.3 °C, maximum frequency is tested at –8.3 and 8.3 °C. Intermediate frequency (Intermediate frequency = Min freq + (Max freq – Min freq) / 3) is tested only at 2.8 °C. The slope of heating capacity and power input at this latter frequency are calculated from the minimum and maximum frequency slopes. The COP at the different frequencies between minimum and maximum is supposed to be a second-order polynomial function of the outdoor temperature determined from the intersections of the load curve with the three frequency performance curves. This limits the number of testing points to five.

What are the differences in the JRA 4046 standard?

The JRA standard tends to limit the number of testing points used with a number of default assumptions to model the performances of the units. The comparison of the number of testing points between the two standards is shown in Table 1.

For single-stage units, only the rated ISO H1 testing point and the performance at 2 °C (1 °C WB) are measured. The performance at – 7°C can be deduced from the test point at 2 °C with

3 The DHR values should be standardized to the closest 5000 Btu/h value [1].

4 The rated heating capacity at full load (the source conditions are slightly different from the ISO 5151 H1 test point, outdoor 8.3 °C DB and 6.1 °C WB, indoor 21.1 °C DB and maximum 15.6 °C WB.

5 In fact, it is defined in function of the rated capacity in cooling mode, 0.82 is the value to be kept for a unit with rated capacity in heating mode 25 % higher than in the cooling mode.

6 4.4 °C for 2 step and inverter units.

the following assumption for heating capacity and power input:

The frost range is supposed to be

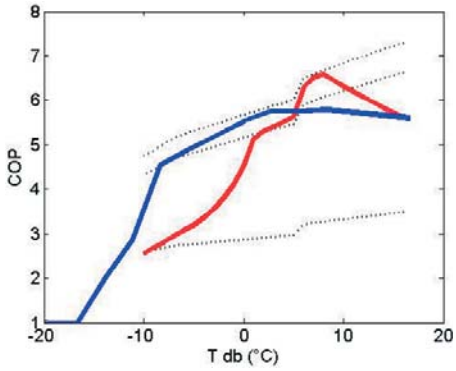

Figure 2: COP of model 4 versus outdoor air temperature

P_H(-7 °C)/ P_H(7 °C) = 0.64	P_H: heating capacity
P_e(-7 °C)/ P_e(7 °C) = 0.82	P_e: heating power

the same for all units, and extends from – 7 °C to 5.5 °C. In this zone, performance is calculated from the testing point at 2 °C and the extrapolated point at – 7 °C. It is not possible to have a cyclic test, and so a default Cd=0.25 is used.

For inverter-driven heat pumps, three capacity stages are considered. The rated frequency and intermediate frequency (typically half the rated capacity) stages are tested at 7 °C, while a higher speed may be set at 2 °C. Performances are modelled with the same slope as above for single capacity stage units outside the frost range for rated and intermediate capacity, while in the frost range, performances are modelled by a capacity decrease of 12 % and an electric input decrease of 6 %. For the high speed, the slope outside the defrost range is different, but frost is accounted in the same manner.

$P_{H,high\ speed}$(2 °C)/ P_{def} (2°C) = 1.12 $P_{e\ high\ speed}$ (2 °C)/ $P_{e\ def}$ (2°C) = 1.06
$P_{H,high\ speed}$ (-7 °C)/ $P_{H,high\ speed}$ (2 °C)= 0.734 $P_{e\ high\ speed}$ (-7°C)/ $P_{e\ high\ speed}$ (2 °C) = 0.877
$P_{H\ high\ speed}$: heating cap at highest speed $P_{e\ high\ speed}$: heating power at highest speed P_{def}: heating cap at high speed and 2 °C $P_{e\ def}$: heating power at high speed and 2 °C

ARI 210/240	ARI 210/240		JRA:4046
Nb of testing points	Min	Max	and JRA:4048
Single speed compressor	3	4	2
Two capacity stages	7	8	3 (JRA 4048 only)
Inverter	5	8	3

Table 1: Number of testing points required and optional

The third stage at maximum speed and low outdoor air temperature allows the impact of resistive heating to be reduced (the impact is little for the Tokyo climate, but may be important in other climates proposed in JRA 4048 [3]).

4. Some figures

It would be interesting to carry out more testing to assess the precision of the simplified modelling in the JRA standard versus the ARI standard. However, it would require detailed information on the heat pump performances that are not presently available.

What is the difference in terms of HSPF results ?

Two default models with COP of 3.4, one single stage compressor (Model 1) and one with inverter drive (Model 2), are used to compute the HSPF of both indices. Model 3 represents a best EU unit with COP of 4 and inverter drive, while Model 4 represents a best Japanese unit with COP of 6.5. The intermediate speed efficiency is 36 % higher than rated efficiency for Models 1 and 2, 32 % higher in Model 3 but only 10 % higher for the best Japanese unit. In the case of the US standard, simulations are done for the minimum DHR; 4 % of the heating demand and about 18 % at maximum DHR. The minimum DHR is only 0.1 % of the heating demand in the case of the Japanese standard and hence can be neglected. Results for the simulations of the four models are presented in Table 2.

HSPF JRA	2,91	3,90	4,66	6,00
% Elec / heating needs	0,2%	0,2%	0,0%	0,0%
HSPF ARI	2,25	2,81	3,26	3,94
% Elec / heating needs	4,3%	4,3%	4,3%	4,3%

Table 2: HSPF results for the four heat pump models

ARI HSPF amounts to between 77 % and 66 % of the JRA HSPF. The difference increases with higher HSPF. It appears that the best Japanese products would be ranked to about 4 on the American market, higher than is presently seen.

The stage performances of the heat pumps are shown in Figure 2, which also shows the COP of the heat pump following the two standard load curves. Resistive heating accounts for about one third of the difference in HSPF, while the remaining part is linked to the difference in load curve and operating hours at different outdoor air temperatures. It can be seen that final COP curves are relatively complex, and without more information than the HSPF indices it is very difficult to predict what could be the energy consumption for a specific installation, another climate …

"Small" things

In both standards, only the time when heating is required is considered, but this does not cover all the energy consumed by heat pumps. In the Cd degradation coefficient at part load, the linear trend catches the energy lost to re-establish pressures after a stop but also includes constant power consumption [5]. This power consumption - for electronics, indoor fan, standby etc. - is also active for part of the year when there is no heating demand. It is difficult to evaluate what might be the likely losses, because these values are not declared by manufacturers.

Let's take the example of the crankcase heaters, that seem to be a common solution for reversible air-to-air split units. For a 2.8 kW unit, a 30 W value might seem quite small, but could be drawn all year long if it is not controlled by the outdoor air temperature and/or the oil temperature. In the ARI standard, there are 2250 heating hours and 800 cooling hours, while the JRA standard uses corresponding values of 1400 and 600 hours with compressor operation. With an SEER value of about 4, the Model 2 unit would consume about 1500 kWh/year for both standards, and crankcase operated all year long would be respectively about 8 % and 12 % of the total heating plus cooling consumption, and 12 and 22 % for model 4. Of course, this could be greatly reduced for little cost, maybe by a factor 2 to 3, by implementing some kind of temperature control, but since it is not measured or published, there is at present no incentive to do so. Adding standby power, and hours with the fan running to sense indoor air temperature when the unit is on with no heating or cooling needs, these values could well double and could explain why the results of some field measurements of the performance of split and multi-split do not look like seasonal standard values [6].

These parasitic energy losses will become more important with increasing efficiencies in heating and cooling mode and decreasing energy needs in buildings. It could be the right time to include them in a seasonal performance index.

Conclusion

Two seasonal index performance standards in use in the USA and in Japan have been described. The climatic conditions and the load curves differ greatly between the two. Average operating conditions are 0 °C outdoor air temperature and 42 % of the rated heating in the US standard (minimum DHR), and 7 °C outdoor air temperature and 60 % of the rated heating capacity in the Japanese standard.

Resistive heating, while taken into account in both standard methodologies, has an impact between 4 % and 18 % in the US ARI standard, depending on the DHR hypothesis used, and no impact in the Japanese standard because of the milder Tokyo climate. In addition, for colder climates, the JRA standard offers the possibility to declare higher inverter frequencies at low outdoor temperature than at rated capacity, which is not allowed in the USA standard.

These standards show how complex seasonal performances may be, and also that a relatively small number of testing points can be used to compute seasonal performances for a given load curve. However, since only the seasonal figures of merit are known, it is very difficult to assess what would be the performance of the same unit in another climate or for a specific installation.

Finally, it appears that with increasing efficiencies and decreasing building energy needs, minor electrical loads might become an important issue where energy gains could be easier than on the primary function performances.

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Energy-saving Air Conditioner - TOSHIBA "DAISEIKAI™ BDR" series

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Reduction of residential energy consumption is increasingly important in order to help tackle global warming. One contribution to such reduction is presented by the new Toshiba "DAISEIKAI™ BDR" range of room air conditioners, which have achieved high energy efficiencies. The RAS-402BDR model, in particular, won the Japanese Energy Conservation Grand Prize. Its annual energy consumption is estimated to be 34 % less than that of a similar model of ten years ago. This article describes the features and technologies of the BDR range.

1. Introduction

Annual shipments of room air-conditioners in Japan are stable at about 7 million units, made up to replacement sales and sales of new units. According to government statistics, there are 2347 room air-conditioners per 1000 households in Japan, which means that room air-conditioners are one of the most common home appliances. Almost all room air-conditioners in Japan are split-type, with an indoor unit and an outdoor unit, and used for both cooling and heating. In addition, most of them have inverter drive systems for the compressor, so that it can change its power in response to the heat load. Further statistics show that the energy consumption of room air-conditioners is the largest consumer among home electronics accounting for about 25% of home energy consumption. So in order to reduce CO_2 emissions from homes, developing low-energy-consumption room air-conditioners is one of the most important issues. Legislation requires manufacturers to improve the energy consumption efficiency of their products according to the index called APF ("Annual Performance Factor"). The calculating formula and target standard value are shown below.

$$APF = \frac{\text{Cooling Seasonal Total Load + Heating Seasonal Total Load (kWh)}}{\text{Annual energy consumptions (kWh)}}$$

Table 1. Target standard value of room air-conditioners (APF)

Target year		2010	
Category (Cooling capacity)		Wall-hung type	
		~3.2 kW	~4.0 kW
Target standard value (APF)	Dimension-defined type (width of 800 mm or less, height of 295 mm or less)	5.8	4.9
	Free-dimension type	6.6	6.0

We have developed the "DAISEIKAITM BDR" range with the aim of achieving high energy-saving efficiency. The RAS-402BDR (cooling capacity 4.0 kW) in particular, with its APF of 6.2, exceeds the target standard value (6.0), and has been awarded the "Energy Conservation Grand Prize, Director-General Prize of Agency for Natural Resources and Energy". This article describes the features and technologies of the BDR series in achieving high energy-saving efficiency.

2. Product Features

The "DAISEIKAITM BDR" range has been developed as luxury models. There are eight different models, ranging in size (in terms of rated cooling capacity) from 2.2 kW to 7.1 kW. The article describes the features and technologies of the RAS-402BDR as a main model. Figure 1 shows the appearance of the unit.

Figure 1. Appearance of RAS-402BDR (left; indoor unit, right; outdoor unit)

2.1 Specifications

The specifications of the RAS-402BDR are shown in Table 2. Annual energy consumption is reduced by 34 % compared with that of same type of model of ten years ago, as shown in Figure 2. This reduction is equivalent to 229 kg of CO_2 emissions. In addition, the APF of 6.2, which exceeds the target standard value for 2010, is the best performance of any product in the Japanese market (as of January 2008).

2.2 Air purification system

With growing health consciousness, awareness of the importance of indoor air quality is increasing. There are many sources of indoor air pollution, such as tobacco smoke, house dust, pollen in early spring, and airborne bacteria and virus. In addition, pollution by volatile organic compounds or formaldehyde is becoming another new problem. Air purification is therefore one of the common functions of

room air-conditioners today. Figure 3 shows the air purification system of the RAS-402BDR. The "Plasma Ion Charger" emits negative charged ions into the air, thus charging airborne pollutants such as dust. Charged pollutants are collected on the surface of the aluminium fins of the heat exchanger. The fins are coated with a hydrophilic substance, with the result that particles on them are washed off by condensate draining off the fins in cooling mode. Air purification performance is measured by the floor area of the room in which the conditioner can decrease the concentration of tobacco smoke by a third within 30 minutes*. For the RAS-402BDR, this is 29.2 m2 (18 mat-room) which is the largest for any 2008 model air conditioners from a Japanese manufacturer. This system also contributes to improving energy-saving efficiency, as described later, because of its lower air resistance. It has two kinds of sensors, called "Double Monitoring Sensors", as shown in Figure 3. The dust sensor detects airborne particles such as house dust, while a gas sensor detects smells. The air purification is operated effectively and efficiently even with changing types of air pollution.

* According to the JEM 1467 standard by The Japan Electrical Manufactures' Association

Table 2. Specifications of RAS-402BDR

	Rated cooling capacity	Rated heating capacity
Capacity	4.0kW	5.0kW
Power consumption	845W	880W
Annual energy consumption	1293 kWh	
APF	6.2	

	Size(mm)	Weight
Indoor unit	H318×W840×D218	14 kg
Outdoor unit	H550×W780×D290	36 kg
Dimension type of indoor unit	Free-dimension type	

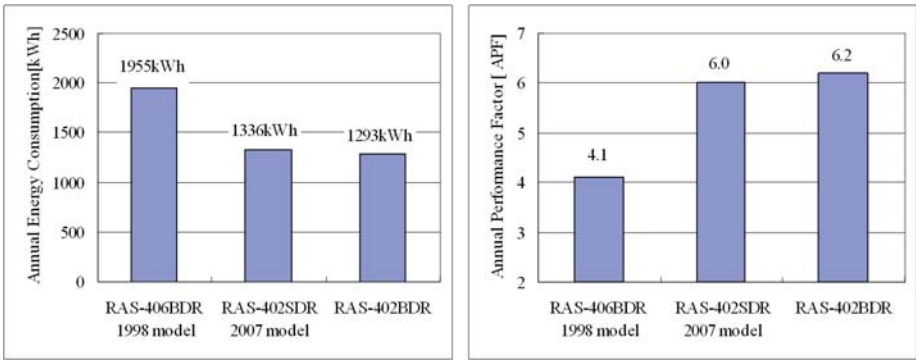

Figure 2. Comparing RAS-402BDR with past models (Left: annual energy consumption, right: APF)

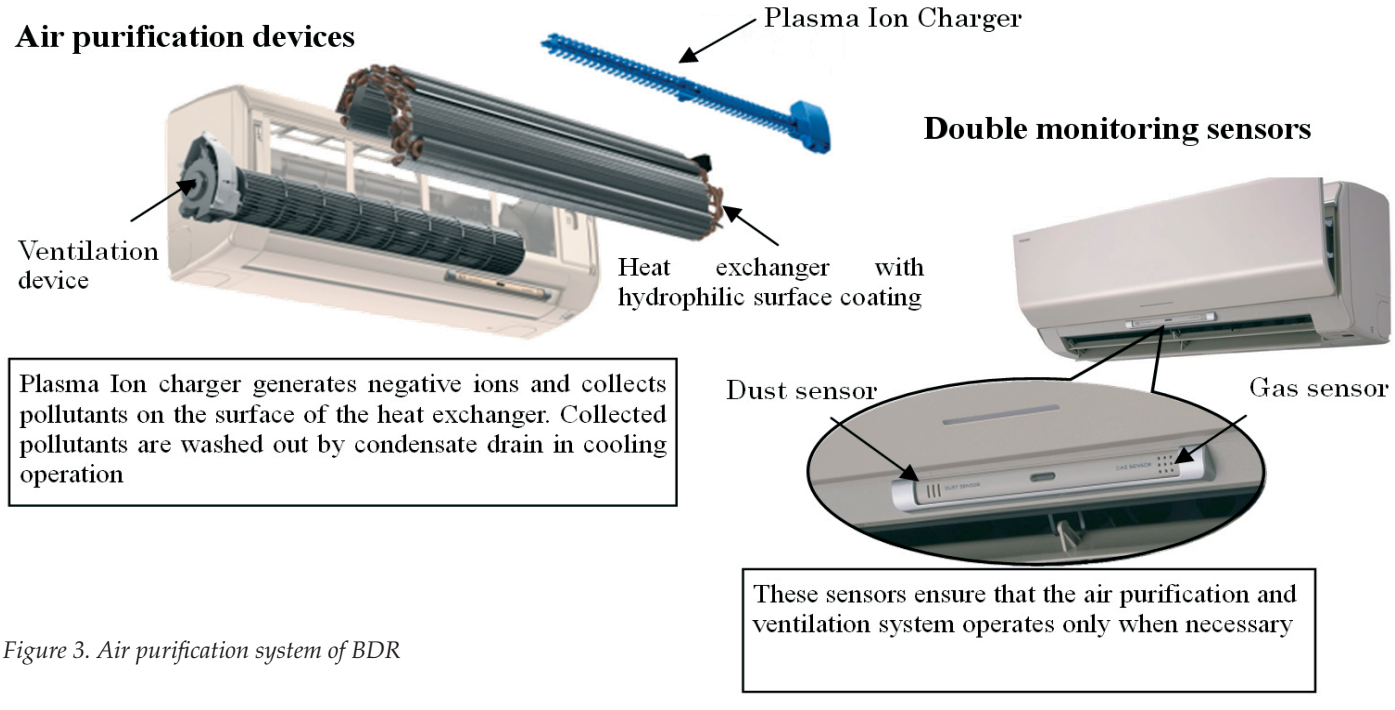

Figure 3. Air purification system of BDR

2.3 Other features

The RAS-402BDR has other several features for energy saving.

2.3.1 Self-cleaning air filter system for maintaining high energy-saving efficiency

If an air conditioner is used for a long time without any maintenance, a lot of dust will accumulate on the surface of the filters, and can reduce performance. The RAS-402BDR has a self-cleaning air filter system, which removes dust from air filters and exhausts it to outdoors automatically after each 24 hours of operation time. This system can prevent energy-saving efficiency from falling. It is estimated that the system improves efficiency by up to 20% compared with systems in which the air filters are cleaned only twice per season.

2.3.2 Spot mode operation - Comfortable and energy-saving air flow operation

Generally, a room air-conditioner cools and heats the whole of a room. But this is not always necessary, because occupants tend to stay in a specific part of a room. If the air conditioning area can be limited to a certain part of the room, energy consumption is expected to be lower. The spot mode operation creates a comfortable space, of limited area, with lower energy consumption.

2.3.3 Teach-me button of the remote controller - Promoting energy-saving

The remote controller of the RAS-402BDR has a "Teach-me" function button to provide information on operation time and energy consumption, indoor and outside air temperature and indoor humidity, which are estimated and detected by the unit's micro-computer. The function assists more efficient use of the air conditioner.

3. Technologies for energy-saving

One of the big challenges for us in developing the RAS-402BDR was to reduce energy consumption without any increase in size or weight, for the sake of natural resources saving. To accomplish this challenge, we have developed core components such as a compressor and an inverter system. The target of development was that it is more important to improve part-load performance, because the units run mainly in the intermediate region of cooling/heating capacity, and so annual energy consumption mainly depends on efficiency in this region. The improvement in the air purification system which reduces air resistance is based on the same idea. Figure 4 shows these core technologies.

3.1 One Suction Twin Rotary Compressor

We have developed the technology of twin rotary compressors. Recent advances were obtained by adopting the high efficiency DC motor with improvement of the motor windings (concentrated winding), introducing low-loss steel laminations and a neodymium magnet. To achieve further improvement, we focused on the reduction of friction and leakage losses which, in the intermediate region of cooling/heating capacity, are estimated at 61% of the total loss occurred in the compressor. We recently redesigned the mechanical structure of the twin rotary compressor, as follows.

- A thinner cylinder has been introduced, with less contact area at the boundary between the high-pressure area and the low-pressure area, separated by a roller and a blade. This reduces friction and leakage at the boundary.
- The conventional twin rotary compressors have had two separate suc-

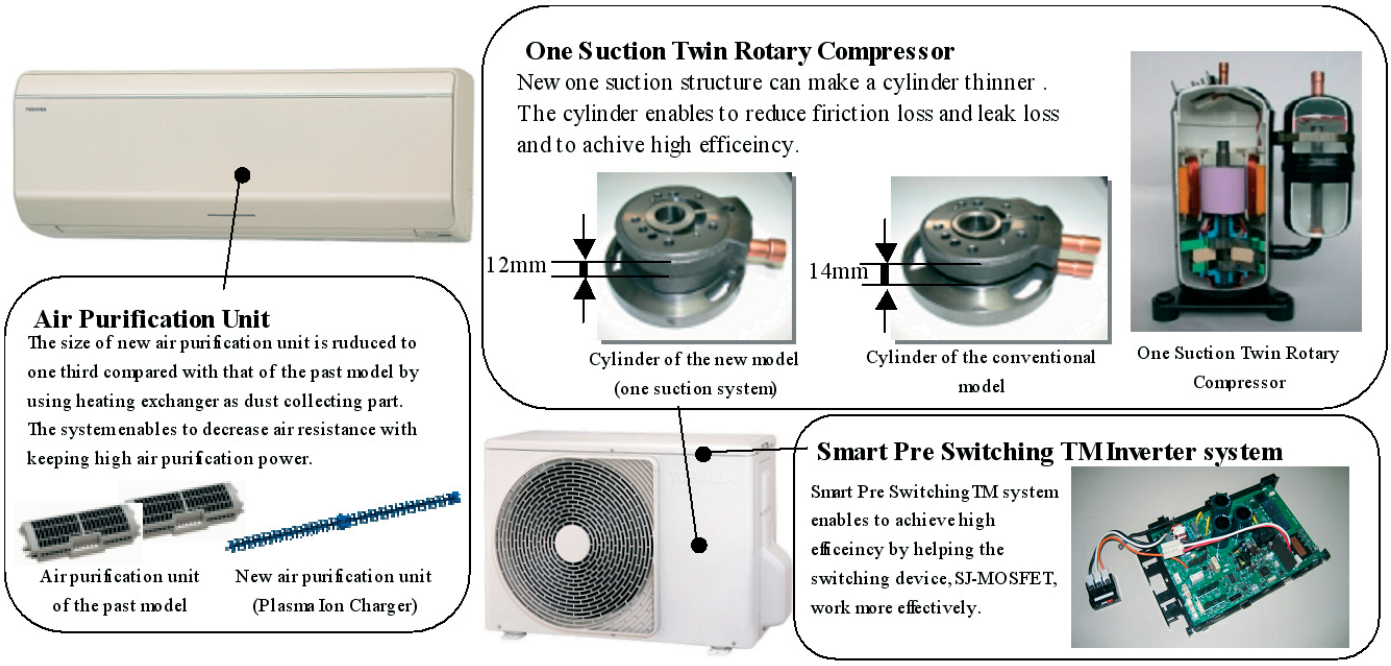

Figure 4. Core elemental technologies of RAS-402BDR

tion pipes for more than 20 years. So making the cylinder thinner requires each suction pipe to be of smaller diameter. In order to avoid increasing the suction pressure drop as a result of this change, the two pipes have been replaced by a single, larger diameter, suction pipe, diverging internally to each cylinder.

The conventional and the new designs of the cylinders are shown in Figure 4. The efficiency measurements are carried out under the same pressure conditions as air conditioners' cooling/heating capacity measurements. The efficiency of the new compressor is expected to increase by up to 2.8% compared with the previous model. This includes 3% increase in mechanical efficiency by the reduction of friction loss, and 1% improvement of compression efficiency, with other improvements such as optimisation of motor windings.

3.2 Smart Pre-Switching™ Inverter system

As a key component of the compressor drive system, an inverter system must also have high efficiency. We developed the highly advanced "Smart Pre-Switching™" inverter system (S•PRE•S™), with sensorless position vector control. The system uses a metal-oxide semiconductor field-effect transistor with a super-junction structure (SJ-MOSFET) as the switching device for the first time in the industry. S•PRE•S™ helps SJ-MOSFET work more effectively in the switching operation, especially in the range below intermediate capacity, where air-conditioners are operated more frequently. The efficiency in this region is up to about 98%.

3.3 Low air resistance obtained by the new air purification unit

The air purification unit of the past model covers a large area in front of a heat exchanger. We invented the system that uses the surface of the fins of a heat exchanger as a dust-collecting part, as described in Section 2.2. This system removes the need for dust collecting plates from an air purification unit, with the result that the cover area of the new air purification unit is reduced to a third of that of the previous model. Air resistance is decreased by 10%, and the energy consumption of the fan motor is decreased by 9%. As the proportion of total unit power taken by the fan motor is not small, especially in the low-load operation region, the effect of this system for energy-saving efficiency is very significant.

4. Conclusions

This article has described the RAS-402BDR as the representative model of "DAISEIKAI™ BDR" range, which won the "Energy Conservation Grand Prize". We shall continue to develop products which have higher energy-saving efficiencies than BDR range. In addition, we also pursue products that need less natural resources and have high recycle rates, in order to make an active contribution to achieving a sustainable society.

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Air source heat pumps for retrofit in existing buildings

Peter Wagener, Director, BDH, Harderwijk,
Onno Kleefkens, Senior Advisor, SenterNovem, Utrecht, the Netherlands

Energy conservation in existing domestic buildings with existing technology and systems is possible by the application of air source heat pumps as add-ons to existing installations, optimising the performance of condensing heating boilers. This is a reliable technology which can be linked to an existing energy infrastructure, whether it is in the Netherlands, France or Germany. If we are to meet the exacting targets for reduction of CO2 and the use of renewable energy, much must be done in this market segment. However, this is possible and realistic with existing technology and knowledge!

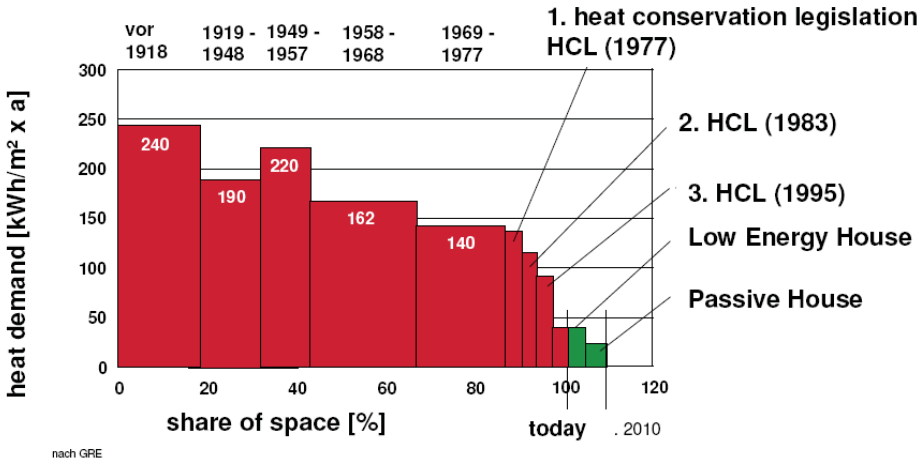
1 Introduction

At present, space heating and water heating is responsible for almost 80 % of the energy demand in residential and utility buildings, with energy use for cooling growing steadily. If we are to achieve the general objective of 20 % of energy from sustainable sources by 2020, much greater efforts will have to be made than have been the case over the past few years.

Most of the heating energy demand comes from existing buildings, to which about 70 000 – 80 000 new residential buildings are added each year (forecast value). In recent years, most effort for sustainable energy supplies has been concentrated on this segment. However, it is imperative that energy supplies to existing buildings must come from sustainable energy generation in order to reach the objectives.

With existing technology, the heat pump - whether gas or electrically powered - can introduce substantial sustainability of energy supply (and thus savings) in existing houses. It offers a means of achieving substantial reductions in energy use for low investment costs. No higher degree of sustainability in existing buildings can be achieved than that achieved by heat pumps.

Each year, well over 420 000 boilers are installed, of which 370 000 are replacements, individually and in large-scale corporative renovation projects. This is the largest potential market segment for heat pumps.



Heat demand of the building stock Germany

To upgrade existing buildings effectively, whether in terms of their energy use or in terms of structural aspects, requires innovative solutions which, for the greater part, are not applied by individual property owners, but mainly by housing corporations. More widespread application of heat pumps in this segment has still to occur, and is dependent on cost reduction, technological breakthroughs and/or the organizational ability of market parties.

2 Renovation of existing building stock

The first thing to do (see TRIAS Energetica) is to upgrade the building envelope with wall, floor and roof insulation, double and triple glazing, and draughtproofing, whether around openings or through air leaks in the structure. Regardless the type of building, these measures, in combination with a ventilation and heat recovery system, yield a significant reduction in energy use, and can contribute considerably to the conservation goals in the Netherlands.
With such an approach, assisted by available energy technologies, it has been shown in Germany that renovation of existing buildings is possible, bringing their energy use down to the level of a Passive House (DENA - 'Besser wie Neubau').

Almost 50 % of the existing building stock in countries such as Germany and the Netherlands is collectively owned, i.e. by building corporations and investment funds. The other 50 % is privately owned. Large-scale renovation occurs mainly on collectively owned buildings. Four levels of renovation can be distinguished:

- o Demolition and rebuilding
- o Envelope and outer wall renovation, maintenance of the main load-bearing structure and complete retrofit of the interior.
- o Large scale replacement and renovation of the energy system, with minor renovation of the envelope, in addition to double glazing and crack filling
- o Replacement of existing heating boilers at the end of their lives.

Several large-scale renovation projects have already been carried out in the Netherlands and Germany, and new projects are under development.

The main renovation activities in privately owned buildings tend to be measures that do not go further then the last two levels, i.e. the replacement of existing heating boilers or hot water tanks and, if carefully planned, of existing heating systems by floor and convector heating systems, offering better comfort. Double glazing is also favoured in these situations.

The potentials for retrofit with renewable energy systems and heat pumps are in this area. A considerable potential exists for a fitting technology that can be installed at low cost and with no added trouble or considerations.

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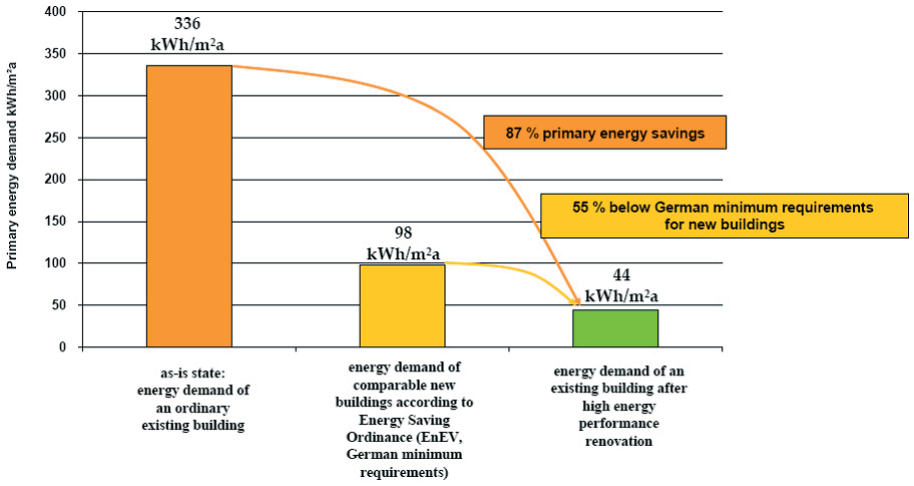
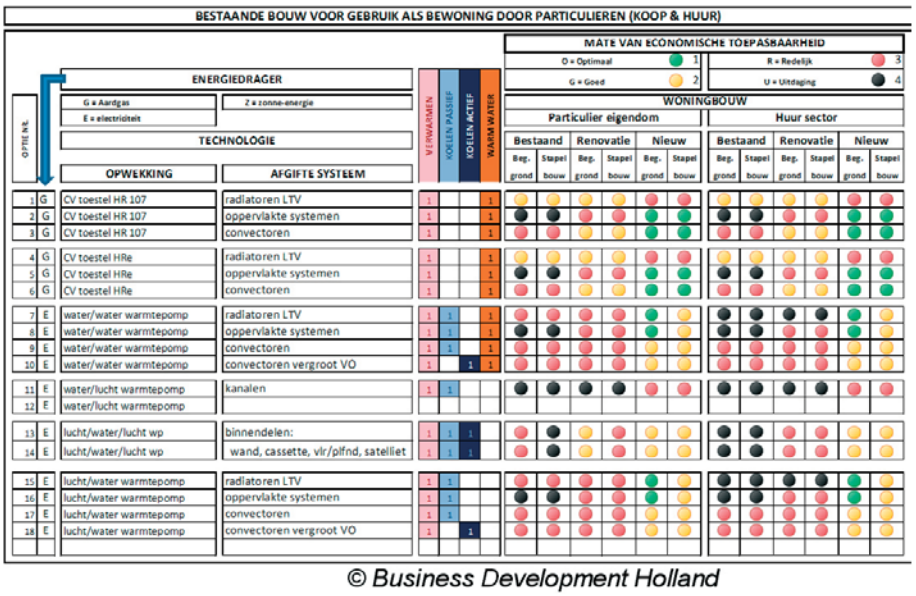


3 Heat pumps for existing buildings

Electrically driven ground-source heat pumps are very much favoured as a 'standard' and well-proven solution for energy conservation and renewable energy in larger new domestic building projects. However, this is not as easy or attractive for existing building stock, with much less freedom of design or economy. This is especially the case in the Netherlands, where heating systems are based on high-temperature hydronic distribution systems with radiators, delivering heat from gas-fired boilers installed at the top of the buildings. This means that not only is there the cost of providing a ground source heat source, but there is the technical complication of delivering heat at the high temperature needed by a hydronic system. It therefore seems unlikely that heat pumps can be introduced for retrofit on a large scale.

The obstacles associated with ground-source heat pumps can be overcome by choosing a heat pump with an air source. In areas wit a relatively mild winter, this type of heat pump has a sound potential and some have already established themselves.

Best performance from a heat pump will obviously be obtained if the insulation performance of the building envelope has been improved. However, a heat pump can also be considered when not all of these measures have been taken. Under such conditions the heat pump would deliver the base load, supported by some other heat sources for peak loads, preferably in the form of a high-efficiency gas



© Business Development Holland

boiler[1]. A well designed active control mechanism supports this system to guarantee optimal performance.

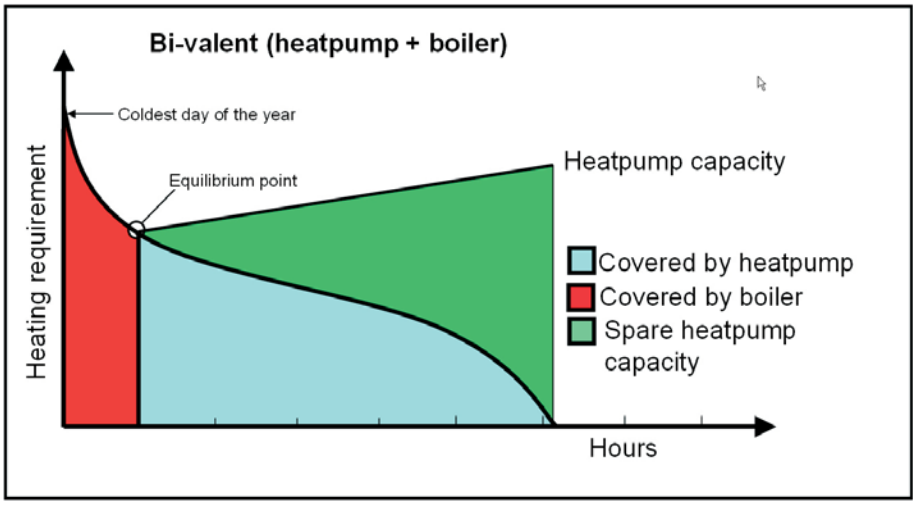
Using a backup source able to supply heat at higher temperatures avoids having to redesign the heat distribution system to make it suitable for use with a low-temperature source. Of course, if the system can be modified so that high-temperature radiators can be replaced by low-temperature convectors will improve the performance of the heat pump and assist conservation of resources.

It is also advisable to increase the level of insulation of the building, so that the heat pump can supply a greater proportion of the heating.
It can be concluded that, in addition to large-scale renovation, a viable heat pump solution is available in the Dutch context for any type of renovation.

4 Energy conservation

Depending on the required temperature for space heating and the amount of insulation, the heat pump can supply between 65 – 85 % of the demand for space heating and approximately the same for water heating. The rest of the demand is covered by a high-efficiency gas boiler.

An average domestic single-family house uses about 1700 m3 of natural gas per year, of which:
o 1400 m3 are for space heating, and
o 300 m3 are for domestic hot water.



If 65 - 80 % of this is for space heating, and with a COP of 3.6 - 4.0, gas savings amount to about 300 - 400 m3 for space heating and about 100 m3 for domestic hot water production.

With an expected installation rate of getting on for 150 000 units per year in 2015, savings should amount to about 2 - 2,4 PJ per year (or 50 million m3 gas equivalent) from the existing building stock. This will further increase as a result of the increasingly higher efficiency of power generation and an increasing proportion of renewable electricity.

5 Turning vision into action

With available technology, heat pumps can achieve 20 – 30 % savings in existing houses. With 30 % market penetration, this means 150 000 heat pumps per annum and an annual increase in energy savings of approximately 2.5 PJ.

Well over 450,000 boilers are replaced each year in existing buildings, both on an individual basis and in large-scale corporative renovation projects. This being the case, it is by far the largest market segment.

The starting point for any renovation is improvement of the building envelope and of the heating system. Although upgrading existing buildings to the level of low-energy houses is not practical for individual property-owners, it is both possible and economically feasible for collective implementation by housing corporations. The renovation process, real estate management, housing expenses for residents and sound indoor environments are important motivations for housing corporations to achieve further sustainability.

There is a clear dichotomy in this market between collectively owned houses (the rental segment) and individual property (privately-owned properties).

o Transition path 1 – Application in existing buildings with boiler replacement in collective systems: For collective systems in large apartment buildings, or in the event of large-scale district renovation, absorption- and gas-engine driven heat pumps can be used, or larger electrical heat pumps supported by a gas boiler. These concepts then replace the boilers (block heating) in the central boiler house. Various projects of this kind have already been realised, and serve as an example for the motivation of new projects.

o Transition path 2 – Application in existing buildings, with boiler replacement in individual systems: Economically attractive technological options for the replacement market, specifically for individual, private owners, are not yet available, but they are realisable. Because of its dominance, and the fact that the gas-boiler is taken for granted,

there is no demand as yet, and so such systems are not yet being supplied. Deploying such systems in large-scale renovation projects with corporations will provide experience, and production can be got going. Experience from these "breeding grounds for innovation" will lead to a wider market acceptance and development of concepts that will eventually find their way into the market for private, individual owners.

6 Road mapping

A heat pump working group consisting of different market players has been started up in order to focus on generating practical solutions for the application of bivalent heat pump systems in existing buildings. The working group sees the first applications in 'protected' environments, installed by building corporations in close collaboration with suppliers, institutes and consultants, and supported by government subsidies in order to monitor and evaluate the performance and acceptance of such systems.

The members of the working group are part of larger networks that have already established positive contacts with city councils and corporations and it is expected that installation of the first demonstration projects will be started in August 2008, in order to monitor the systems in the winter of 2008/2009. At the same time, a working group of manufacturers has been set up in order to solve the main institutional barriers.

Many basic questions concerning the technology still have to be answered, dealing with technical, economical, organisational questions and experience.

During the next stage of the work, until 2009, both groups will work together on:

- Development of renovation schemes
- Development of three main heat pump concepts acceptable for the installer
- Development of computer models for use by consultants in existing buildings. This is an important element, as in almost all software for existing buildings there is no mention of heat pump technology
- Developing a methodology for quality assurance of technology and systems at European level (ECO-label). This is important in the light of the lack of interest from the European Commission in air-source heat pumps, mistaking them for split aircons!
- Analysis of the challenges for financing by corporations and individual house owners. Is it economically attractive to change from gas to electricity, and how can this be solved?
- Development of a subsidy scheme
- Developing demonstration projects and procedures

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Mind the Gap - Quantifying principal-agent problems in energy efficiency

Energy efficiency presents a unique opportunity to address three energy-related challenges in IEA member countries: energy security, climate change and economic development.

Yet an energy-efficiency gap exists between actual and optimal energy use. That is, significant cost-effective energy efficiency potential is wasted because market barriers prevent countries from achieving optimal levels. Market barriers take many forms, from inadequate access to capital, isolation from price signals, information asymmetry, and split incentives. Though many studies have reported the existence of such market barriers, none so far has attempted to quantify the magnitude of their effect on energy use and efficiency.

Mind the Gap is an unprecedented attempt to quantify the size of one of the most pervasive barriers to energy efficiency – principal-agent problems or, in common parlance, variations on the 'landlord-tenant' problem. In doing so, the book provides energy analysts and economists with unique insights into the amount of energy affected by principal-agent problems. Using an innovative methodology applied to eight case studies (covering commercial and residential sectors, and end-use appliances) from five different IEA countries, the analysis identifies over 3800 PJ/year of affected energy use – that is, around 85 % of the annual energy use of a country the size of Spain.
Source: www.iea.org

CO_2 emissions from fuel combustion - 2007 Edition

In recognition of fundamental changes in the way governments approach energy-related environmental issues, the IEA has prepared this publication on CO_2 emissions from fuel combustion. This annual publication was first published in 1997, and has become an essential tool for analysts and policy makers in many international fora such as the Conference of the Parties to the Climate Change Convention.
The thirteenth session of the Conference of the Parties to the Climate Change Convention (COP 13), in conjunction with the third meeting of the Parties to the Kyoto Protocol (COP/MOP 3), will be meeting in Bali from 3 to 14 December 2007.
The data in this book are designed to assist in understanding the evolution of the emissions of CO_2 from 1971 to 2005 for more than 140 countries and regions, by sector and by fuel. Emissions were calculated using IEA energy databases, and the default methods and emission factors from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.
Source: www.iea.org

World's first CO_2 refrigeration course online

A new e-learning course aims to educate students and users of CO_2 refrigeration systems on design, installation and maintenance issues. Launched by the British supplier, Star Refrigeration, it is the first certified online course on R744 technology.

The two-module course introduces the basics of working on carbon dioxide systems and helps prepare students for advanced studies of CO_2 (R744) refrigeration systems. Divided into "CO_2 Refrigeration Fundamentals" and "CO_2 Refrigeration System Basics", the course covers design, installation and maintenance issues. Explaining the advantages and challenges of using R744, it educates on leak and pressure testing, as well as charging and venting. In addition, the course describes the basic components and functionality of CO_2 systems, including volatile secondary (with direct expansion and cascade), trans-critical and direct expansion.
The course fee is £250.
Source: www.elearning-training.com

ASHRAE launches High Performing Buildings magazine

High Performing Buildings is a new quarterly magazine published by ASHRAE and distributed to building owners, facility managers, architects, contractors and engineers. The magazine helps decision makers in the building community learn about the benefits of innovative technologies and energy-efficient design and operation. Case studies of exemplary buildings, developed through the support of leading practitioners in the sustainability movement, present measured performance and lessons learned to promote better buildings.
Source: The HVAC&R Industry newsletter, November 2007

Japanese study urges world to adopt heat pumps

Widespread use of heat pumps could slash 10 % of Japan's total CO_2 emissions, according to Japanese experts. Focusing on technical developments and applications of heat pumps, they urge suppliers and consumers worldwide to switch to the energy-saving technology.

The study "Heat Pumps – Long-Awaited Way out of Global Warming", released by the Heat Pump & Thermal Storage Technology Center of Japan (HPTCJ) in October, explains in detail the current technical conditions of heat pump technology, its application fields, and energy savings. Based on latest market studies and performance data, the document urges business, policy makers and end-users to adopt heat pumps as a global solution.

Drawing attention to technical and policy developments regarding heat pumps in Japan, the study focuses more specifically on "Eco Cute" hot water heaters using the natural refrigerant CO_2 (R744). The "epoch-making product" is currently a key pillar of industry and government efforts to reduce greenhouse gas (GHG) emissions under the Kyoto Protocol Target Achievement Plan and the New National Energy Strategy.

Download the full study at:
http://www.hptcj.or.jp/about_e/contribution/pdf/hpe-all.pdf

Promoting Energy Efficiency Investments -- Case Studies in the Residential Sector, 324 pages
Existing buildings account for over 40 % of the world's total primary energy consumption. An impressive amount of energy could be saved simply by applying energy-efficient technologies. However, various market barriers inhibit energy efficiency improvements in existing buildings and result in energy savings that are significantly less than the potential savings. Financial barriers - including the initial cost barrier, risk exposure, discount factor issues and the inadequacy of traditional financing mechanisms for energy-efficient projects - play a major role. Policies that may help to overcome financial barriers to improving energy efficiency in existing residential buildings are the focus of this study.

The publication provides illustrations of policies and measures implemented in five IEA member countries and the European Union. Each case includes relevant background and contextual information, as well as a detailed evaluation of each policy according to five pre-defined criteria: relevance, effectiveness, flexibility, clarity and sustainability.

Promoting Energy Efficiency Investments aims to inform policy-makers and offers ideas on the most effective policies, programmes and measures available to improve energy efficiency in existing residential buildings.
Source:www.iea.org

Energy Policies of IEA Countries – United States -- 2007 Review
The United States is the largest economy and energy user in the world. Significant developments have taken place in its energy policy since the last IEA review in 2002. The most important of them is the Energy Policy Act 2005 – comprehensive energy legislation which has set new directions, including opening the way for a nuclear renaissance.

Two closely connected challenges shape all debates on the nation's energy policy path: how to increase security by reducing the dependence on imported supplies; and how to address growing emissions of greenhouse gases. The United States national strategy is to find solutions largely through technology. It is a world leader in R&D and is driving development of carbon capture and storage and second-generation biofuels. However, no federal government policy is as yet in place to establish as a target an absolute reduction of CO_2 emissions. The resulting uncertainty risks holding back investments into new technologies and may delay projects that are urgently required.

The transport sector will be a key to sustainable success. In the short to medium term, reduced fuel demand through higher vehicle efficiency will increase security and reduce CO_2 emissions. Yet the policy for the revision of CAFÉ (the Corporate Average Fuel Economy) standards will leave consumers with vehicles that fall short of the technological possibilities.

This review takes an in-depth look at these issues and provides recommendations on how the United States can do more to answer the challenges of both improving its security of energy supply and lowering its emissions intensity, demonstrating the significant improvements that can already be realised through existing technologies.
Source:www.iea.org

Energy policies of IEA countries - Austria -- 2007 Review
Since the last review in 2002, Austrian energy policy has seen many positive developments. Today, Austria counts among the IEA member countries with the highest share of renewable energy supply, thus increasing energy security and reducing CO_2 emissions. Great progress has also been made in the utilisation of biomass for heat and electricity production. Nevertheless, many challenges remain.

The climate strategy revision in 2007 is commendably realistic, but uncertainty remains as to whether it will be sufficient, and whether renewables and energy efficiency are well-balanced within it. While Austria strongly promotes an increase of renewables production by adopting challenging targets, it is less ambitious in the area of energy efficiency. To achieve the renewables target, their supply will have to double, leading to significant increases in costs. In energy efficiency, while Austria is leading in developing efficient building solutions, there are concerns about implementation, especially about the lack of ambition and divergence in building codes. Overall, energy intensity has increased in recent years, and the government will have to put a strong focus on reversing this development.

Despite the early opening of the energy markets, effective competition has failed to emerge. This is partly

due to systemic weaknesses, such as dominant incumbents, lack of transparency in price formulation and a weak regulatory system with the potential for conflicts of interest.

This review thoroughly analyses Austrian energy policy and identifies the key challenges that need to be addressed. With recommendations for improvements, it is an important guide for Austrian policy makers toward a safer and cleaner energy future.
Source: www.iea.org

Energy policies of IEA countries – Finland -- 2007 Review
Faced with considerable challenges related to its geography and size, Finland's sound energy policies do much to overcome its situation. The country leverages its small market where it can – such as by adopting or harmonising with EU directives and policies. To counter its relative isolation, Finland strengthened its position by becoming part of the larger Nordic electricity market and reinforcing energy linkages. At the core, however, the country ensures energy security by relying on transparency and sound market signals to investors and customers, as well as by making good use of domestic sources of biomass and nuclear power.

As Finland continues to refine and enhance its energy policy, there are some areas that warrant special attention. As nearly all fossil fuels are imported, and all natural gas comes through a single interconnection, the government should continue to explore ways to diversify import sources and routes. The new nuclear power plant currently being built – the first in a liberalised market – will help safeguard energy security, though the construction delays necessitate continued monitoring. Subsidies for peat, a fuel in abundance in Finland, should be reconsidered, as they do not enhance energy security. On the other hand, the government should continue to explore ways to expand new renewables, building on the current stock of biomass and hydro.

This book takes an in-depth look at Finland's energy policy today and, through comparisons with good examples in other IEA countries, provides critiques and recommendations for improvements to guide the country towards a sustainable energy future. While the review provides comprehensive coverage of all topics, this thematic report highlights energy efficiency and energy R&D.
Source: www.iea.org

ASHRAE publishes updated version of energy efficiency standard
Energy reduction through new requirements related to lighting, façades, and mechanical systems is achievable in the latest energy efficiency standard from ASHRAE and the Illuminating Engineering Society of North America (IESNA).

Just published, the 2007 version of ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, sets out minimum requirements for the energy-efficient design of buildings other than low-rise residential buildings. The standard contains changes made through 47 addenda to the 2004 standard.

"One of the best ways to reduce building energy consumption is to reduce, or eliminate, the cooling or heating loads," Mick Schwedler, Chair of the Standard 90.1 Committee, stated. "By doing so, the systems installed in buildings become smaller and use less energy. For example, on a hot, sunny day, having more insulation in the roof and better glass on the southern and western façades of a building reduce the air conditioning necessary as well as its resultant energy use. Two of the addenda do this by enhancing the insulation and fenestration (or window) requirements for the building exterior."

The standard also addresses reduction of electrical and cooling loads, and thus electricity, by allowing less power for lighting. An addendum of revised lighting allowances for retail displays allows more flexibility for designers and better reflects actual retail lighting function.
Source: www.ashrae.org

Saving energy in refrigeration, air-conditioning and heat-pump technology
This guide presents, in a concise and didactic manner, solutions making it possible to reduce the energy consumption of refrigeration and air-conditioning systems, including heat pumps. This is a vital issue, as these systems consume approximately 15 % of worldwide electricity. The solutions apply to the design, operation and maintenance of various systems (compressors, condensers, expansion devices, evaporators, etc.), and take refrigerant selection into account. Several practical cases of highly energy-efficient systems are presented, as well as an extensive bibliography and an overview of the main applicable regulations and standards.

It is hoped that you will be able to improve the efficiency of your refrigeration system, reduce running costs and increase profits by using the practical suggestions contained in this guide.

Topics:
- Theory of refrigeration
- Reducing heat loads
- Choice of refrigerant
- Design opportunities
- Energy-efficient operation
- Heat recovery opportunities
- Energy storage and natural cooling
- Standards and regulations
- Case studies
- References - Bibliography

Source: www.iifiir.org

2008

IKK 2008 is cancelled
THERE will be only one international trade fair for the air conditioning and refrigeration industry in Germany this year after all.
It's official - IKK 2008 will not take place

After nearly 30 years' existence, and having grown to be the major European event in air conditioning and refrigeration, the organisers of IKK have cancelled this year's event in Stuttgart.

A statement on the organisers' website says simply "IKK 2008 will not take place - detailed information will soon be available"
The show, which was due to take place from October 8-10, found itself up against strong competition from a rival show, Chillventa, which was established by an influential breakaway group of exhibitors pushing for a biennial event in Nuremberg.

IKK 2008 had attracted pledges from around 200 companies, mainly German and Chinese. The rival Chillventa exhibition, by comparison, has attracted major support from most of the major international manufacturers and suppliers.

Chillventa currently boasts an exhibitor list of 524 companies.

ISK SODEX 2008
8 - 11 May Istanbul, Turkey
http://www.biztradeshows.com/trade-events/isk-sodex.html

IEA HPP 9th Conference
20 - 22 May, Zyrich, Switzerland
www.hpc2008.org

ASHRAE Annual Meeting
21 - 25 June, Salt Lake City, UT, USA
http://www.ashrae.org/

HVAC Asia 2008
2 - 4 July, Singapore
www.hqlink.com

International Conference on Building Energy and Environment (COBEE2008)
14 - 16 July, Dalian, China
Endorsed by ASHRAE
http://ceae.colorado.edu/cobee

Purdue International Compressor Conference
14 - 18 July, W. Lafayette, IN, USA

Purdue International Refrigeration Conference
14 - 18 July, W. Lafayette, IN, USA

11th International Conference on Indoor Air Quality and Climate
17 - 22 August, Technical University of Denmark
E-mail: info @ indoorair2008.org
http://www.indoorair2008.org/

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

7th Minsk International Seminar "Heat Pipes, Heat Pumps, Refrigerators, Power Sources"
8 - 11 September
First Announcement ›››
www.minskheatpipes.org

International Conference on Compressors and their Systems
10 - 12 September London, UK
www.imeche.org/events/compressors

HVAC Energy Efficiency Best Practice Conference
IIR Commissions E1 with E2
18 - 19 September, Melbourne, Australia
Information coming up on www.airah.org.au

International Sorption Heat Pump Conference 2008 - ISHPC08
23 - 26 September Seoul, South Korea
http://www.iifiir.org or http://web.khu.ac.kr/

For more events, check out the heat pump centre website, www.heatpumpcentre.org

In the next Issue

Heat pumps for low energy buildings

Volume 26 - No. 2/2008

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 worldwide source of independent information and expertise on environmental and energy conservation benefits of heat pumping technologies (including refrigeration and air conditioning).

The Programme conducts high value international collaborative activities to improve energy effi ciency and minimise adverse environmental impact.

Mission

The Programme strives to achieve widespread deployment of appropriate high quality heat pumping technologies to obtain energy conservation and environmental benefi ts from these technologies. It serves policy makers, national and international energy and environmental agencies, utilities, manufacturers, designers and researchers.

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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