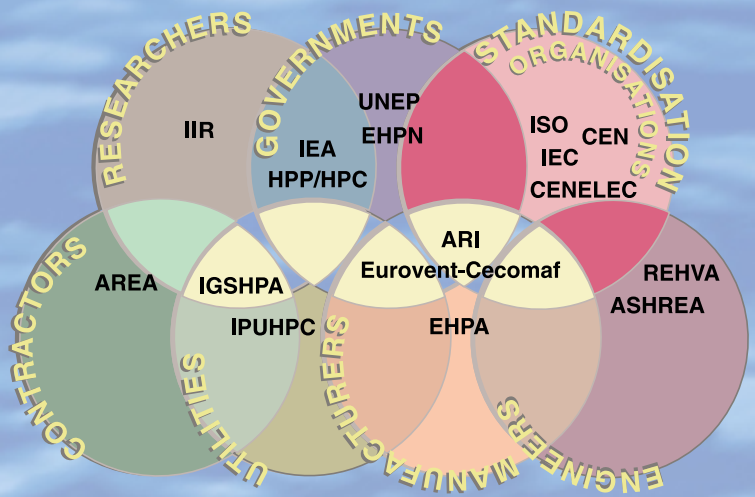
IEA Heat Pump CENTRE
NEWSLETTER
VOLUME 18
NO. 2/2000



Heat Pump Programmes and International Heat Pump Organisations

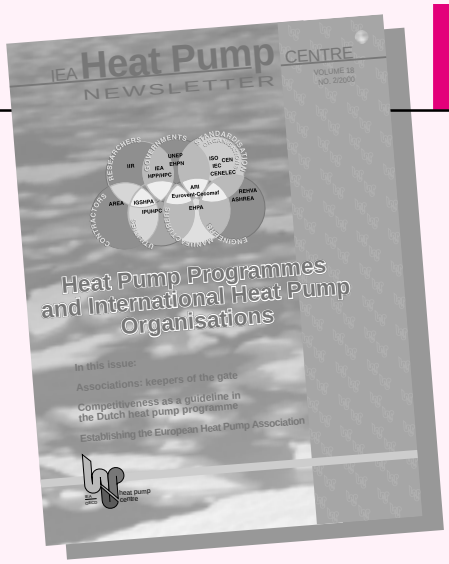
In this issue:

Associations: keepers of the gate

Competitiveness as a guideline in the Dutch heat pump programme

Establishing the European Heat Pump Association

IEA OECD heat pump centre



In this issue

Heat pump programmes and international heat pump organisations

Many national and international organisations stimulate the implementation of heat pump technology. This IEA Heat Pump Centre Newsletter focuses on these organisations: who are they, what are their main activities and how do they interact? Programmes and organisations include promotional and R&D programmes, manufacturers' and standards organisations and associations focusing on a particular technology, for example ground-source heat pumps.

Front cover:
International heat pump organisations: all winners, each with their own background and mission

COLOPHON

Publisher:
IEA Heat Pump Centre
PO Box 17, 6130 AA Sittard
The Netherlands
Tel: +31-46-4202236, Fax: +31-46-4510389
E-mail: hpc@heatpumpcentre.org
Internet: http://www.heatpumpcentre.org

Editor in chief: Jos Bouma
Technical editing:
Gerdi Breembroek, IEA Heat Pump Centre
Jac. Janssen, Derix*Hamerslag*
Production: Novem Support Group
de Vormgeverij, Meerssen

Frequency: quarterly
Printed June 2000

HPC Newletter subscriptions are automatically renewed unless written cancellation is received by 1 October

ISSN 0724-7028

TOPICAL ARTICLES

HEAT PUMP NEWS

FEATURES

Heat Pump Programmes and International Heat Pump Organisations

I am especially pleased to introduce this "International" issue of the Heat Pump Centre Newsletter, reflecting the global recognition of heat pumps as an important energy conservation and environmental strategy. With an estimated 100 million heat pumps installed throughout the world, and the demand for these products and systems growing at double-digit figures, the prospect for the future of heat pumps is indeed bright.

From the outset the International Energy Agency has provided an opportunity for international R&D collaboration and networking as major elements in its energy conservation programme. Through such collaboration within the IEA community and with other national and international organisations, the IEA Heat Pump Programme has provided a focal point for production and dissemination of high-quality information concerning heat pumps for over 20 years. The Heat Pump Centre and its publications have become a highly valued source of information and coordination, recognised throughout the world. Today, with the advent of e-mail and the Internet, information transfer can occur with dimensions and speed hardly imaginable even a decade ago. These advances make it essential that organisations such as the IEA Heat Pump Programme reinvent themselves to ensure an appropriate and necessary function. The fact that there are numerous organisations, such as IIR, ASHRAE, the new European Heat Pump Association, etc. interested in heat pumps makes it more important than ever for these organisations to carefully define their roles and establish a formal basis for collaboration as we enter the new millenium.

The formulation of strategic alliances is noted as a priority in new strategy plans adopted by the IIR and proposed by the IEA Heat Pump Programme. Discussions concerning such collaboration have begun and will, I am sure, provide a stronger and more vital basis for future heat pump activities. I am particularly pleased to see the articles included in this Newsletter from several national and international organisations concerned with heat pumps. As Chairman of the Heat Pump Programme Advisory Board, I can assure Newsletter readers of the continued importance the Programme places on strengthening the IEA Programme's global collaborative role.

Jerry Groff
Chairman Heat Pump Programme Advisory Board

Heat pump news

Highlights from ASHRAE winter meeting 2000

USA – The ASHRAE winter meeting 2000, held in Dallas, attracted HVAC/R specialists from all over the world.

Ground-source systems
Ground-source heat pump systems continue to dominate discussions at ASHRAE meetings. The thermal behaviour of the soil package immediately surrounding vertical coils or collector pipes is of great importance. Thermal conductivity and borehole resistance are the key properties in any ground-coupled heat pump system design. A new one-dimensional method of determining the properties from in-situ tests was presented. The validated model was found to agree well with line-source and cylindrical-source thermal conductivity estimates.

Design length and performance of vertical coils strongly depend on the thermal conductivity of the backfill material, usually a cementitious grout. Significant improvements in grout conductivity through appropriate materials selection and mix design were reported. Favourable fillers include silica sand, alumina grit, steel grit and silicon carbide. Filled cementitious grouts appear to have better retention of conductivity under drying conditions (heat rejection) than bentonites and neat cements. The reduction in bore length possible with cement-sand grouts ranges from 22-37% for a typical heat pump system.

Improperly designed loop systems can suffer from pipe squeezing or collapse by the radial expansion of soil due to freezing and ice lensing during heat extraction. One paper assessed an installation where this had happened. The backfilling practices used at that site had produced susceptible soils in the collector holes causing damage at subzero operating temperatures. These problems can be prevented by using a grout containing little free water (Tremie grouting) in the annular space between collector pipes and drill hole.

The effects of groundwater flow on closed-loop ground-coupled heat pump systems were analysed using a finite element numerical method examining the Peclet number of the flow. It was shown that groundwater flow significantly enhances heat transfer in geological materials with high hydraulic conductivity, such as sands, gravels and rocks exhibiting fractures and solution channels.

Micro-channel technology
In the US micro-channel components have been considered for absorption systems. The results of a preliminary model of the absorption process for ammonia-water absorbers using this micro technology under typical operating conditions demonstrated the potential for extremely small absorption system components. This novel concept is compact, modular and versatile, and easy to design and fabricate. The technology is suitable for almost all absorption heat pump components. Extremely high coolant-side heat transfer coefficients were measured. This technology could considerably improve the market opportunities for small residential absorption units.

Source: Jos Bouma, IEA Heat Pump Centre

Energy labels to be introduced in Japan

Japan – The Ministry of International Trade and Industry (MITI) revised the Japanese Industrial Standard (JIS) in April 2000. It is now strongly recommended that household electrical appliances be labelled to show the energy-saving effects of each model. Products covered include: air conditioners, fluorescent lamps, TVs, refrigerators and freezers. By comparing the labels on various products, consumers can easily choose the most efficient models. Since sales of less efficient products may decrease, MITI expects an acceleration of technological improvements.

Based on the revised energy conservation law of April 1999 (see Newsletter 17/3), MITI has allocated reference values for energy savings, with the years 2003-2006 as the goal years. The new JIS labels show the extent to which the energy-saving effects approximate this reference value. For example, if the energy-saving effects of a certain product are only 80% of the reference value, the label is marked “80%”. Products that save more energy than the reference value may be labelled using a different colour or design, so that they are easily identified.

Whether or not to apply energy-saving labels is left to each manufacturer’s judgement. However, if they are used, they must comply with MITI’s requirements.

Source: JARN, February 2000

UK Heat Pump Network on Internet

UK – The UK Heat Pump Network now has its own website (http://www.heatpumpnet.org.uk**)**. The UK Heat Pump Network was launched in July 1999 to help the UK heat pump market develop according to best practice on environmental and economic grounds. The government is working through the Network in partnership with manufacturers, specifiers, and user groups to develop independent and authoritative advice on using heat pumps. Government backing is arranged via the DTI and DETR, with industrial support via the Heat Pump Association. The Secretariat of the UK Heat Pump Network (managed by BSRIA) aims to bring the best of that international perspective to its UK members.

Source: Sandra Gómez, UK National Team

Heat Pump Association Student Awards 2000

UK – The annual Heat Pump Association (HPA) Student Awards were presented at the Federation of Environmental Trade Associations Annual Luncheon for the sixth consecutive year. These are awarded to the students who, according to the panel of judges, provide the best solution to a hypothetical, but realistic, heat pump design project.

This year's project required entrants to provide dehumidification and heat recovery to an existing swimming pool installation using a heat pump system, and also to provide dehumidification to an adjacent sports hall with heating and cooling via a heat pump to a cafeteria/relaxation area.

First prize (nearly) USD 3,200 went to Jason Curle of Heriot-Watt University, Edinburgh, for what the judges described as a professional presentation that fully appreciated the precise competition brief. It proposed commercially viable solutions with a good feel for the constraints imposed by plant room location, the different environments of the three areas and the budgetary limitations of any such refurbishment project. Jason shares the prize equally with his university department.

Second prize was awarded to Richard Monksmith of the University of Nottingham. Richard shares nearly USD 1,600 with his university. Third-placed student Andrew K. Halm-Owoo shares USD 800 with his department at University College London.

Source: Tony Bendall, Manager HPA
E-mail: info@feta.co.uk
Information 2001 awards: http://www.feta.co.uk

ARI international trade directory online

USA – The Air Conditioning & Refrigeration Institute (ARI) has added an electronic version of its 2000 Directory of North American Air Conditioning & Refrigeration Equipment to the "CoolNet" website.

The directory contains information on air conditioning and refrigerant equipment manufacturers and provides a comprehensive listing of all major air conditioning and refrigeration companies in the USA and Canada. It helps facilitate trade opportunities between ARI members and those seeking to do business with North American companies in the industry.

The directory is divided into two parts. The first section contains general information on member companies, including the name of the primary international trade contact and, in some cases, also a regional contact. The second section contains a product matrix, which categorises the companies according to the products they manufacture.

More information:
http://www.ari.org/intl/tradedir.html

Heat pumps versus solar collectors

Germany – Both heat pumps and solar collectors are considered primary energy-saving options with future potential. However, for a current German case, it was found that combining solar collectors with a condensing gas-fired boiler uses slightly less primary energy (3%) than electric heat pumps, for space heating and domestic hot water production. In future, when the percentage of electricity generated from renewable energy sources increases, heat pumps may easily become the number one option.

The comparison was made in a PhD work. A residence with 70 kWh/m^{2}year heat demand was modelled. In the heat pump case, a ground-source heat pump supplied space heating (floor system, 35-30ºC, SPF 4.1) and an air-source heat pump produced domestic hot water (SPF 3.26). The alternative was a combination of solar collectors and a condensing gas-fired boiler, both connected to a stratified thermal storage tank. The study did not include an economic comparison.

Source: CCI, March 2000
More information: S. Schraps,
University of Hanover
Fax: +49-511-7625495

Green power marketing

UK – By mid-1999 utilities were offering green tariffs in Australia, the USA, the UK, Germany, the Netherlands, Finland and Sweden. A worldwide survey of the deregulating energy market identified the status and consumer perception of green power in various countries.

For example, Californian residents were asked for their views of green tariffs and the possibility of switching provider. The electricity market in California is already fully deregulated. The second most popular incentive for Californians to switch provider was a commitment not to pollute the atmosphere. Over 30% were willing to pay a premium of 10% or more for green power. Among UK residents, 8% were willing to do the same.

While it remains difficult to generalise on green energy marketing along global lines, it seems fair to assume that this will be an increasingly important area for utility companies over the next few years. As the environmental benefits of electric heat pumps largely depend on the energy mix for power generation, developments in this field are of interest to the heat pump community.

More Information: Andrew Evans
E-mail: aevans@datamonitor.com
Fax: +44-171-3720130

ASHRAE issues buildings energy standard

USA – ASHRAE recently issued ASHRAE/IESNA Standard 90.1-1999 entitled *Energy standard for buildings except low-rise residential buildings.* The standard provides minimum requirements for the energy-efficient design of buildings, including a number of energy-efficient technologies. When applied by designers and engineers in plans for office and retail buildings, the revised energy standard should produce site energy savings of up to 16% and source energy savings of up to 20% above the previous 1989 standard.

More information: http://www.ashrae.org

Comfort, efficiency and integrated control in Thermo-Staete building

The Netherlands – The Thermo-Staete office building in Bodegraven, the Netherlands, was officially opened by the Dutch Minister of Economic Affairs in February 2000. The building houses two consulting engineers and architectural companies. The innovative features make this building the most energy-efficient office in the Netherlands. A LON (Local operation network) integrates control of all technical installations, and the building was elected LON project of the year 1999.

The energy concept for the building includes heat pumps, thermal storage in an aquifer, a tight building envelope, high efficiency (90%) heat recovery from ventilation air, displacement ventilation, passive solar energy and solar collectors for water heating, maximum use of daylight, and efficient lighting. The building uses 'green' electricity from renewable energy sources.

Distribution of heating and cooling is through the ceiling in the offices and through the floor in the atrium. The piping is integrated into the prefabricated concrete floors and ceilings, which also contain other technical components (wiring etc). Three small water-source heat pumps heat the building in winter. In summer the heat source is recharged by using the aquifer water directly for cooling. The required heating capacity was lower than that generally used for aquifer thermal storage in offices: only 55 kW for the 2,000 m^2 office. The Thermo-Staete installation features the first simplified installation with only one variable-speed submersible pump specially developed for small heating and cooling demands.

Source: DWA Actueel, Spring 2000
More information: dwa@dwa.nl

Zeolite thermal storage in Munich's district heating network

Germany – A zeolite thermal storage system is used to heat a Munich school whenever there is a peak demand for district heating. The system was installed in 1997 and, from 1998 onwards, this technology was used to cool a cultural institution housed in the lower part of the building as well.

The loading and discharge operations (desorption/adsorption) of the thermal storage system are initiated fully automatically. Described very simply, (heat) loading operation refers to supplying heat to the zeolite and removing the adsorbed water. Heat discharge operation means that cold moist air loses its moisture and is heated by the exothermal adsorption process.

Source: Euroheat & Power – Fernwärme International 11/1999

First successes in DAHP field test

The Netherlands – The first results of the residential diffusion absorption heat pump (DAHP) field tests in the Netherlands showed an average PER (primary energy ratio) of 1.3 LHV (low heating value). Some installations even reached up to 1.5. The field test was first mentioned in HPC Newsletter 17/1 1999 and includes around 70 residences.

The heat pumps used various heat sources: mostly outside air or the ground, with exhaust air and ground or surface water being used in only a few cases. Heat distribution temperatures differed in the various cases: some houses had floor heating, while others used 50-70ºC radiators. System efficiency was far better at lower distribution temperatures. In all cases, a gas-fired condensing boiler was installed as backup on very cold days or in case of problems during the field test. Acting on these results, the DAHP will be optimised and the size reduced.

Source: Nefit Fasto
Tel.: +31-570-678585, Fax: +31-570-678586

Environment-friendly grout revives ground-source heat pumps in New Jersey

USA – A novel grout formulation, which is acceptable under New Jersey's strict environmental standards, reopens the way for ground-source heat pumps in that state. An award-winning three-year research programme at Brookhaven National Laboratory in the US has made this possible.

If the grout surrounding the pipes of a vertical ground-source heat exchanger cracks or shrinks, the boreholes housing the pipes can channel surface runoff contaminants directly into the groundwater. This concern, plus the poor performance of conventional grouts, led the New Jersey Department of Environmental Protection (NJDEP) to ban their use in 1998, which meant that the ground-source heat pump industry could not develop further.

Brookhaven National Laboratory was already working on grouts with increased thermal conductivity. These grouts also had advantages in terms of sealing capability, reduced shrinkage and improved crack resistance. The novel formulation 'Mix 111' was tested to ensure that it would meet the NJDEP requirements. This new product has now been approved for use in New Jersey and has already been applied in several residential and commercial projects throughout the US.

More information: Karen McNulty
Fax: +1-631-3443368
E-mail: kmcnulty@bnl.gov

Emissions of CFCs, HCFCs and HFCs in the Netherlands

The Netherlands – The Dutch Ministery of Housing, Spatial Planning and the Environment (VROM) has completed a study to track the stocks and emissions of CFCs, HCFCs and HFCs from various sources in the Netherlands. **Figure 1** shows estimated CFC, HCFC and HFC emissions from refrigeration, air conditioning and heat pump technologies.

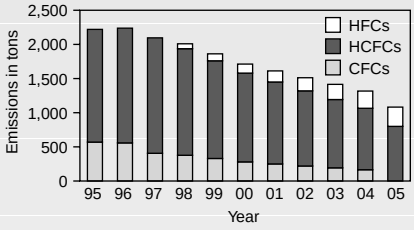
Figure 1 uses an average leak percentage of 10%. It should be noted that there is a clear difference between old installations, built before the 1993 laws concerning leak-tightness, and the newer ones. The newer ones have leakage rates under 5%, and in specific categories (industrial air conditioning, process industry) even under 1% or 2%. Today, marine refrigeration installations exhibit most leakage, sometimes more than 100% per year.

The report commented on several aspects of refrigerant use and management in the Netherlands:

- In 1996, refrigerant reclaim from residential appliances was only 20% efficient. In Switzerland and some Scandinavian countries this efficiency is more than 75%.
- Air-conditioned cars are rapidly gaining market share and currently represent around 50% of the market for new cars. With steady growth, 40-50% of refrigerant emissions will be from private cars in 2010.

The report compares imports, exports and use of CFCs, HCFCs and HFCs. It suggests paying for the cost of disposing of the considerable CFC stock (approximately 1,200 tons) in existing installations by levying a tax on new goods containing refrigerants.

Source: RCC Koude & Luchtbehandeling, March 2000
More information: E. Dijkstra, Ecozone
Fax: +31-23-5259526
E-mail: ecozone@ecozone.nl



Note: HFCs: excluding stationary cooling

▲ *Figure 1: Estimated Dutch CFC, HCFC and HFC emissions from refrigeration, air-conditioning and heat pumps, 1995-2005.*

NH_3 and hydrocarbons: safety and liability issues

Switzerland – The Swiss Federal Office of Energy (SFOE) has initiated a study that assesses the risks of using natural working fluids in heat pump installations. The study draws conclusions on safety and liability issues under Swiss law for three systems: one residential heat pump application and two supermarket refrigeration cases.

Single-family house
The risk to the owner of a propane or NH_3 heat pump in a single-family house is calculated to be acceptable. Model working fluid charge was 1 kg propane or 1 kg NH_3 and the assessed heat pump was placed in the basement in a mechanically ventilated housing. The risks are even smaller than those connected to operating a conventional gas-fired heater.

Central supermarket systems
The risk to clients of a supermarket with a central refrigeration system is acceptable, providing that the refrigeration system is placed in a separate machine room. The working fluid charge is 20 kg propylene or NH_3, compared to 40 kg HFC (R-404A).

Decentral freezers in supermarkets
The results for decentral freezers in a supermarket, with 0.2 kg propane, NH_3 or HFC (R-404A) each were not unequivocal, and this application needs to be studied in more detail.

Installers
The risk for installers was found not to be negligible, and it is recommended that much attention should be paid to training installers. However, the risk of installing a domestic heat pump with natural refrigerants is still smaller than that for installing a gas-fired boiler.

Manufacturers
Under Swiss law, the use of NH_3 or hydrocarbons cannot be considered as flawed, as there are good ecological reasons for choosing these instead of ozone-depleting or climate-changing substances.
Manufacturers will not be held liable if they meet the following conditions:

- products must be state of the art and comply with the relevant standards and regulations;
- the manufacturer must be certain that additional safety measures would not be cost-effective;
- a quality management system must be in place;
- there are visibly attached warnings concerning the refrigerant contents of the equipment;
- there are correct installation and operation instructions.

These conclusions can be extended to other European countries.

The (German) report can be downloaded from http://www.waermepumpe.ch/fe or ordered from ENET, report number 9934024. Orders by e-mail: conny.saladin@novaenergie.ch

Source: Dr Martin Zogg, SFOE
E-mail: martin.zogg@bluewin.ch

York into HCs and CO_2

Denmark – York refrigeration (formerly Sabroe) is extending its range of chillers to include CE-certified compressors using hydrocarbons (HCs) as the refrigerant. The company says that markets already exist for HC-based machines in Scandinavia, Germany and the UK. The range offers the choice of water-cooled or air-cooled condensers. York has also introduced a new compressor using CO_2 as the working fluid.

Source: JARN, January 2000

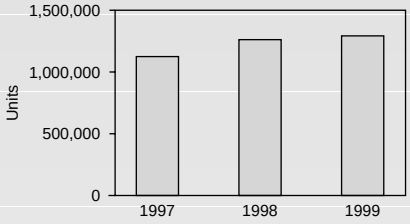
Another record year in the US

USA – In 1999 shipments of unitary air-source heat pumps and central air conditioners jumped 6% to a record of over 6.6 million units, according to ARI (Air Conditioning and Refrigeration Institute) statistics. Heat pump shipments of 1,293,395 units set a new yearly record with a 3% increase over 1998.

Despite higher interest rates, housing construction remains strong, following two record years of growth. Approximately 83% of new homes have central air conditioning. The replacement market is also huge and accounts for over half the annual shipments. The hot 1999 summer provided a strong incentive to install new high-efficiency equipment with a short payback period. As a result of slow institutional construction, packaged terminal heat pumps showed a slight decline.

Forecasters also expect positive results for 2000, as the economic climate is still very good. The US entered its 108th consecutive month of economic growth in March 2000.

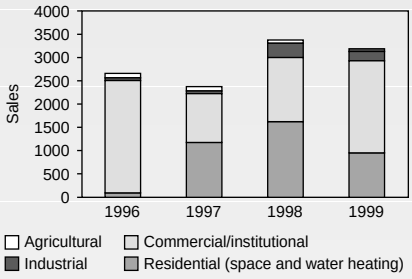
Source: Koldfax, March 2000



▲ *Figure 1: Air-to-air heat pump shipments*

Changeable Dutch market in 1999

The Netherlands – The 1999 Dutch heat pump sales totalled 3,174 units, a slight drop compared to 1998, see **Figure 2**. The commercial/institutional market expanded for the second consecutive year, but the residential market was changeable. Sales of residential heat pump water heaters declined significantly (from 1,300 in 1998 down to 500 in 1999) but annual sales of (heating-only) heat pumps for space heating remained stable at around 230. Reversible heat pumps for residences recorded 258 units sold. For commercial buildings, all heat pump types prospered, with the exception of dedicated heat pump water heaters. Reversible heat pumps dominate this sector.



▲ *Figure 2: Dutch heat pump market.*

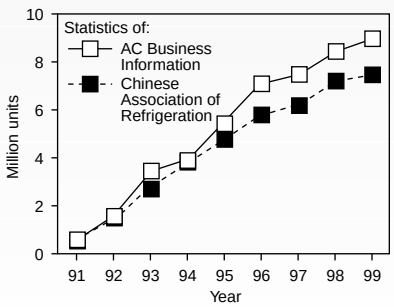
The primary energy savings by heat pumps increased by 3% relative to 1998, up to a total of 3.5 PJ primary energy. Industrial heat pumps account for the largest savings.

Relevant market parties and the government signed the Heat Pump Covenant on 12 April 2000, which aims to promote the residential heat pump market. Read more about the Covenant in the article on page 16.

Source: Netherlands National Team

China's air-conditioner industry

China – Mass production of air conditioners (ACs) started in China during the mid 1980s. Before this, China depended mainly on assembly systems, based on imported components and production lines introduced from abroad. Purely Chinese brands evolved during the first half of the 1990s and have now secured leading positions in the global AC industry.



▲ *Figure 3: Shipments of room air conditioners in China 1991-99.*

Over the last eight years the average annual growth rate of AC sales has been 37.5%, with relatively stable growth over the past two years. According to figures produced by AC manufacturers, total Chinese AC production was 17 million units in 1999. However, according to the trade journal *Air Conditioning Business Information*, the market demand was only 7.5 million units. Statistics from two sources are shown in **Figure 3**. Reversible ACs represent a significant share of the AC market (an estimated 30-60%).

Chinese manufacturers are successfully improving their product quality and offer excellent service. In the meantime, the growth of foreign capital enterprises has been impeded due to the price gaps with local Chinese enterprises and insufficient preparation for the Chinese domestic market. Small and medium-sized Chinese companies are also entering the market, offering excellent local service.

Source: JARN, 25 March 2000

Sustained growth in Switzerland

Switzerland – Some 5% heat pump market growth (to 6,499 units) was realised in 1999, according to the Swiss heat pump association FWS (see figure on page 22). Thirty-six percent of new residences are currently heated by heat pumps, and this is the dominant market segment for heat pumps. Heat pumps for retrofit totalled only 973 in 1999, which is more than 100 less than in 1998. Most of 1999 heat pump sales are air-to-water (53%), closely followed by brine-to-water (43%).

'Highly satisfied' was the opinion of the overwhelming majority (78%) of 218 Swiss heat pump users when asked about their heating system.

Source: http://www.fws.ch

Far-reaching decisions at ExCo meeting in Mexico City

Mexico – A new Programme strategy and universal membership of a base Heat Pump Centre (HPC) were agreed in principle at the spring 2000 Executive Committee (ExCo) meeting. The meeting was held in Mexico, the latest country to participate in the IEA Heat Pump Programme (HPP).

A new Programme strategy plan with a clear vision, mission, objectives and strategies was approved. The HPP will now carry the subtitle: *International collaboration for energy-efficient heating, refrigeration and air conditioning* to emphasise the fact that refrigeration and air conditioning are essential parts of it. The international overview on page 10 describes the new Programme strategy.

To support the new strategy, the autumn 1999 meeting had decided that a broadly supported, strong HPC was essential. Recommendations to achieve this were discussed at the spring 2000 meeting. The ExCo has now endorsed the intention to introduce universal membership of the HPC, which implies that each HPP participating country automatically joins the HPC. The new HPC will not only act as an international information centre, it will also offer technical support and services to the Programme. An ExCo subcommittee is currently defining the tasks and functions of the new HPC. Implementation is scheduled for 2002.

News from other Annexes: Annex 24 will be completed by autumn 2000. The UK is currently developing an Annex proposal for a follow-up, mainly focusing on absorption cooling and CHP (combined heat and power). Annexes 26 and 27 are both organising an international workshop in autumn 2000 (see page 27 for dates and details).

An audience consisting mainly of Mexican ministry officials, representatives from industry and academia, and HPP representatives attended a pre-meeting workshop. HPP speakers presented results and achievements of the HPP and Mexican officials gave an overview of the national heat pump and air-conditioning market, the industry and current R&D activities. The workshop ended with a panel discussion, which focussed on how the Heat Pump Programme can best serve Mexico's needs.

Source: IEA Heat Pump Centre

Searchable news archive online

The Netherlands – The HPC Internet site now features a searchable news archive. News items from all HPC Newsletters, from 16/3 (1998) onwards, can now be accessed via the 'search' function. This allows you, for example, to quickly find a former Technology and Applications item. Newsletter articles remain searchable via the HPP Library.

Source: IEA Heat Pump Centre
Internet: http://www.heatpumpcentre.org

Advanced supermarket refrigeration/ heat recovery systems

USA/Sweden – The Swedish Royal Institute of Technology (KTH) will host the forthcoming Annex 26 workshop entitled: *Advanced supermarket refrigeration/heat recovery systems*. This event will present the R&D activities, case studies and field tests being conducted by the Annex member countries. Presentations will discuss the current state of supermarket refrigeration technology development. The workshop will be held in Stockholm, Sweden, on 2-3 October 2000.

Workshop sessions on systems, equipment, modelling and analyses, and field results are planned, with approximately 16 invited presentations. The workshop is expected to last one and a half days, plus a study tour of two supermarkets in the Stockholm area featuring innovative systems. A more detailed brochure on the workshop, including a preliminary programme and list of invited speakers, will be available in the summer. This information will also be posted on the HPC and Annex 26 websites.

This workshop offers an excellent opportunity for those involved in supermarket refrigeration and heating systems RD&D to keep track of the latest developments and exchange ideas with other experts.

Source: Mr D. Van Baxter,
Oak Ridge National Laboratory, USA
Tel.: +1-865-574-2104, Fax: +1-865-574-9329
E-mail: vdb@ornl.gov

Ongoing Annexes

Red text indicates Operating Agent.

Annex 16 IEA Heat Pump Centre	16	AT, JP, NL, NO, UK, US
Annex 24 Ab-Sorption Machines for Heating and Cooling in Future Energy Systems	24	CA, IT, JP, NL, NO, SE, UK, US
Annex 25 Year-round Residential Space Conditioning and Comfort Control Using Heat Pumps	25	CA, FR, NL, SE, US
Annex 26 Advanced Supermarket Refrigeration/Heat Recovery Systems	26	CA, SE, UK, US
Annex 27 Selected Issues on CO_2 as a Working Fluid in Compression Systems	27	JP, NO, SE, UK, US

IEA Heat Pump Programme participating countries: Austria (AT), Canada (CA), Denmark (DK), France (FR), Germany (DE), Italy (IT), Japan (JP), Mexico (MX), The Netherlands (NL), Norway (NO), Spain (ES), Sweden (SE), Switzerland (CH), United Kingdom (UK), United States (US).

Heat pump programmes and international heat pump organisations

Gerdi Breembroek, IEA Heat Pump Centre

In various countries heat pump programmes stimulate the implementation of heat pump technology. Several international organisations also contribute to this goal. Their objectives, activities and target groups are briefly presented in this article.

National programmes and organisations

Governments and utilities in various countries implement programmes to promote heat pumps. **Table 1** presents an overview of the current status. Information was taken from the most recent communications and the HPC report International Heat Pump Status and Policy Review 1993-96.

Heat pumps are accepted as renewable energy technologies in Denmark, German states, Norway, Netherlands (except industrial waste heat) and Switzerland. In Norway, the trend is to increase heat pump support from environmental programmes rather than from energy-saving programmes. However, this trend is not worldwide: it is not seen in the Netherlands and Switzerland, and Sweden and Japan report the indirect influence of environmental policies on existing heat pump programmes. Some countries see decreasing governmental funds for heat pump support.

Governments

Governments that support heat pumps generally aim to contribute to CO_2 emissions reduction and improve the countries' energy efficiency. A concern is the global environmental problem of ozone depletion and global warming by CFC, HCFC and HFC refrigerants.

▼ *Table 1: Governmental and national heat pump initiatives.*

Country	Governmental	Utilities' programmes and acronyms of associations and consortia
Austria	-	most provincial utilities; LGW
Canada	certification and regulation	some provincial utilities; Canadian Heat Pump Council
China	-	Heat Pump Chapter of China Association of Refrigeration
Denmark	part of renewable energy policy and general energy research programme	Danish heat pump association
Finland	-	heat pump association SULPU
France	industrial heat pumps as part of energy efficiency programme	EDF, GDF and others; ADPM
Germany	financial incentives of four federal ministries and four states	around 75 utilities (40% supply); IWP
Greece	-	Manufacturers' joint advertising campaigns
Italy	subsidies for replacing electric heat and waste heat utilisation	reduced electricity tariffs by ENEL
Japan	energy efficiency standards	HPTCJ
Netherlands	heat pump programme	some utilities; heat pump association SWP
Norway	heating with renewable energy supported by government	heat pump association NOVAP
South Korea	energy efficiency standards	Heat Pump Technology Society of Korea
Spain	incentives for reversible air conditioners	limited utility action; AFEC, AFIBCA
Sweden	Swedish Council for Building Research and Energy Administration support heat pump research	utilities for energy services; heat pump associations: SVEP, VET
Switzerland	R&D programme, pilot and demonstration installations	many utilities; FWS
UK	support of UK Heat Pump Network	UK Heat Pump Network and HPA
USA	energy efficiency standards	many utilities; GHPC; IGSHPA

IEA Heat Pump Programme

The IEA Heat Pump Programme (HPP) is an intergovernmental collaboration of 15 countries. The recently adopted strategy states the following Vision: *"The Programme is the foremost source of independent information and expertise on heat pump, refrigeration and air-conditioning systems for buildings, commerce and industry. Its international collaborative activities to improve energy efficiency and minimise adverse environmental impact are highly valued by stakeholders"*. Objectives include environmental, market and deployment, technology, and information management elements. **Table 2** presents the objectives and strategies. One of the activities of the Programme is the IEA Heat Pump Centre (HPC).

IEA Implementing Agreements

Some (Annexes of) other IEA Programmes are particularly interesting for the heat pump community:

- Solar Heating and Cooling Programme (SHC), Task 25: Solar Assisted Air Conditioning of Buildings;
- Energy Conservation in Buildings and Community Systems (ECBCS), Annex 37: Low Exergy Systems for Heating and Cooling of Buildings;
- CADDET Energy Efficiency (Centre for Analysis and Dissemination of Demonstration Energy Technologies)

and Energy Technology Data Exchange (ETDE) offer additional sources of heat pump information, besides those already available through the Heat Pump Programme.

Internet addresses of organisations discussed in this article are shown in **Table 3**.

EU heat pump activities

The EU heat pump activities are part of the Directorate General (DG) of Energy and Transport (Directorate New Energies and Demand Management) and DG Research. These two DGs manage the non-nuclear programme under the Fifth Framework Programme (FP5), which is relevant for heat pumps. In the last few years, heat pump R&D and activities to distribute information, such as the European Heat Pump Network (EHPN) were supported under the framework of various programmes, such as THERMIE-B and SAVE. EHPN was established and extended through two projects, and focused on information exchange via the Internet. Last year's topics included natural working fluids, and heat pump training and certification.

UNEP Ozone Action Programme

UNEP's (United Nations Environment Programme) Ozone Action Programme provides a clearing house function to assist the phase-out of ozone depleting substances (ODS) in developing countries. Efforts are financed from the Multilateral Fund for the Implementation of the Montreal Protocol. This clearing house function includes:

- supporting global and regional information exchange;
- conducting workshops and facilitating the dissemination of experience and information between countries.

UNEP also assists with the development of national strategies and action plans to phase out ODS. The programme accomplishes this by delivering a range of need-based services, including information exchange, to help decision makers to make informed choices on policies and investments. Training and networking activities provide platforms to exchange experience, develop skills and tap into the expertise of specialists in the global ozone protection community. The programme currently operates seven regional and sub-regional networks of ODS officers over more than 80 countries. Country programmes and institutional strengthening support the development and implementation of national ODS phase-out strategies and programmes, particularly for countries using few ozone depleting substances.

The HPC collaborates with UNEP by exchanging publications that deal with refrigerants, and by contributing to the Montreal Protocol re-assessment reports of the Technical Options Committee.

Objectives	*Strategies*
Environmental *quantify and publicise the environmental and energy efficiency benefits of heat pumps*	• get heat pumps on national and international political agendas • align programme activities with contemporary environmental and energy priorities, such as the Kyoto agreement
Market & deployment *develop and deliver information to support deployment of appropriate technologies*	• provide material in a form usuable by designers, utilities and policy- and standards-making organisations
Technology *maintain and develop international technical collaboration that furthers the environmental and market objectives*	• capitalise on the strengths of the Programme so as to develop information in support of the environmental strategy, resolve apparent market impediments, and encourage international collaboration on emerging technical issues
Information management *provide effective collaboration and flow of information to, from and between stakeholders and other relevant bodies*	• develop an information and communication plan that supports the Programme's environmental, market and technical strategies

▲ *Table 2: HPP objectives and strategies.*

IIR

The International Institute of Refrigeration (IIR) was established in 1908 as an intergovernmental organisation. Since then, the Institute has provided a positive and useful way for scientists to cooperate internationally and promote refrigeration technology transfer to their countries' industry and general public. IIR activities include:

- international refrigeration congresses held every four years;
- conferences organised by Commissions, and IIR co-sponsored conferences;
- publication of the bibliographical Bulletin and the scientific journal *International Journal of Refrigeration*;
- publication of proceedings and manuals;
- setting up working parties to provide informed advice on specific issues;
- maintaining an information resources department;
- training sessions and awarding of prizes.

For the years 2000-2003 the Institute has adopted a new strategy, recognising that it must provide services to a wider range of stakeholders. In order to do so, it must provide highly valued services in an open-market competitive trading context. New information technologies such as the Internet should be exploited to the full.

The IIR Scientific Council has established several Commissions, including E2 *Heat pumps, Energy recovery*. The HPC is an associate member of IIR and is active in Commission E2. For several years both organisations have fruitfully collaborated in various areas, including scientific

▼ *Table 3: International heat pump-related organisations on the Internet.*

IEA	www.iea.org
IEA ECBCS	www.ecbcs.org
IEA SHC	www.iea-shc.org
CADDET	www.caddet-ee.org
ETDE	www.etde.org
IEA HPC	www.heatpumpcentre.org
UNEP IE	www.unepie.org
IIR	www.iifiir.org
EHPN	www.ehpn.de
IGHSPA	www.ighspa.okstate.edu
AREA	www.area-eur.be
ARI	www.ari.org
ASHRAE	www.ashrae.org
Eurovent-Cecomaf	www.eurovent-cecomaf.org
REHVA	www.rehva.com
IEC	www.iec.ch
CEN	www.cenorm.be
ISO	www.iso.ch
CENELEC	www.cenelec.be
EHPA	www.ehpa.org

review of HPC publications, joint studies and publications, and representations at meetings. Both organisations are working to develop a formal agreement for international collaboration.

Manufacturers

International manufacturers' associations, or collaboration among associations have mostly developed in countries with similar markets and where joint efforts on certification and promotion are feasible. Examples of such collaborations are **DACH** (Germany, Austria, Switzerland, see page 22) and the collaboration in the **Nordic Heat Pump Forum**, where Sweden (SVEP), Norway (NOVAP), Finland (SULPU) and the Danish test centre for heat pumps collaborate. The recently established **European Heat Pump Association** (EHPA) introduces itself on page 19. The International Ground Source Heat Pump Association (**IGSHPA**) in which manufacturers, researchers and utilities play an important role, presents its aims and successes on page 14.

The US-based Air-conditioning and Refrigeration Institute (**ARI**) and the European organisation **Eurovent/ Cecomaf** are also essentially manufacturers' organisations. Their activities include equipment standardisation (ARI) and certification. However, ARI's activities are much broader and include publication of market data, training and support of research activities. Members of Eurovent/Cecomaf include manufacturers associations of refrigeration and air-conditioning equipment throughout Europe.

ARI recently began to operate more internationally. In November 1998 the institute decided to adopt international standard ISO 13256 for the water-source heat pump certification programme. Since 1999 ARI certification programmes have also been open to foreign manufacturers that do not sell in North America.

Standardisation organisations

Worldwide there are a number of standardisation organisations that issue standards relevant to heat pumps. The most important are ISO (International Organisation for Standardisation) and IEC (International Electrotechnical Commission). The next issue of the HPC Newsletter will focus on *Refrigerants – standards, regulations, safety and liability issues* and will include more information on the work of these standardisation organisations.

Utilities

The **IPUHPC** (International Power Utility Heat Pump Committee) is an international heat pump platform of power utilities. The committee was established in 1985 to exchange information on research, development and market activities concerning heat pumps as an end-use technology. It focuses on practical issues concerning the penetration of heat pumps into the marketplace.

IPUHPC aims to form a worldwide network of electric power utility contacts involved with heat pumps. Present members include electric power utilities from Japan, France, Sweden, Netherlands, Switzerland, Germany, Austria, Finland and Canada. Others are welcome to join (contact Mike Bell, E-mail: bellfamily@sprint.ca)

Engineers and contractors

ASHRAE, the American Society of Heating, Refrigerating and Air Conditioning Engineers is a strong, comprehensive international organisation of 50,000 individual members with Chapters (sections) throughout the world. ASHRAE aims to advance the science of heating, ventilation, air conditioning and refrigeration through research, standards writing, continuing education and publications. Semi-annual meetings with broad-based technical programmes bring together many ASHRAE members. Selected heat pump issues from the winter meeting are presented on page 4.

A statement by ASHRAE president Mr Goodman is published on page 21.

The HPC is active in three ASHRAE Technical Committees (Absorption and Heat-Operated Machines; Combustion Engine-Driven Heating and Cooling Equipment; Applied Heat Pump/Heat Recovery Systems) and the International Committee.

REHVA is the Federation of European Heating, Ventilation and Air-conditioning Associations, and currently consists of 24 member associations. Activities include publication of multilingual directories, congress and seminar organisation, activities related to design practice, guides and (CEN) standards.

AREA, the Air Conditioning and Refrigeration European Association is the focal point for European installers and contractors. Its principal goal is to create and maintain a favourable business climate for HVAC&R contractors, in terms of quality, safety, employment, fair competition and profitability in Europe. One of the current main objectives is to obtain a minimum level of certified competence for refrigeration companies and personnel across Europe. AREA also hopes to obtain positive recognition of the trade and professional skills required, and to monitor technical and legal standardisation.

Conclusion

National and international collaboration is an important factor in developing heat pump technologies and markets. Organisations from all relevant market parties have their international counterparts within their specific working area. Manufacturers associations focus on equipment certification and training while governments, for example, support research that contributes to achieving environmental targets. In their own way all these organisations support the appropriate deployment of heat pumping technologies.

Gerdi Breembroek
IEA Heat Pump Centre

UK Residential heat pump promotion

Tony Bendall, UK

The UK Heat Pump Association (HPA) is leading a market drive to stimulate the use of ground-source heat pump technology in the UK. Working together with other heat pump associations on both a national and international level helps provide a stronger platform for future markets.

Market research

As part of the HPA's effort to stimulate the use of ground-source heat pumps in the UK, the HPA asked energy suppliers (utilities) about applying heat pump technology in the residential market. From the utilities' point of view this could help improve energy efficiency and reduce peak load problems, which is particularly important to them. The user would benefit from reduced energy costs and would also be helping to reduce environmental damage.

The utilities indicated that, if system efficiencies of 3:1 or better are achievable, the potential for heat pumps in the residential sector will definitely be worth exploring. This is particularly the case with electrically driven equipment, mostly at the executive end of the market.

Based on this market assessment the HPA and a number of its members reviewed the various types of equipment and energy sources that could provide both space heating and water heating to acceptable levels. Research indicated that many users would be interested in a reverse-cycle heating/cooling system, as more and more people are benefiting from air conditioning in their car and workplace and wish to enjoy the same comfort at home. Another encouragement was an unexpected awareness among end-users and their interest in the ground-source (coupled) systems.

The Association then considered how best to develop this apparent market opportunity. In order to broaden its understanding the Association decided to take advantage of the knowledge and expertise available abroad.

National and international contacts

The HPA contacted several like-minded organisations, particularly the International Ground Source Heat Pump Association (IGSHPA) in the USA. Their willingness to provide help and guidance resulted in a close relationship.

Since undertaking this market review the UK has joined the IEA Heat Pump Centre, giving worldwide promotion and greater access to relevant information. The UK Heat Pump Network, co-founded and sponsored by the HPA and two government departments (DTI & DETR), has recently been established. The HPA is also a founder member of the newly formed European Heat Pump Association.

The availability and range of information and support has never been better. This will undoubtedly provide a strong platform for future market development. Of particular interest is the European market transformation study *Electrical Heating & Cooling of Residential Dwellings* produced by SciotecH and sponsored by the EU SAVE programme.

Barriers, gains and government support

Barriers are removed with every new market initiative, but to increase heat pump sales we must address these barriers and offer variable solutions that are acceptable to all, from the decision makers and members of the supply chain to the potential customer.

The importation of state-of-the-art installation technology for ground-coupled heat pumps has dramatically reduced trenching, boring and coupling costs to acceptable levels. This is just one of the reasons for today's successes.

The ways in which heat pumps can increase energy efficiency and reduce environmental impact are still not fully recognised or accepted in the UK. Achieving this recognition is one of the main goals of the Association, and it is working hard to obtain government support for:

- subsidies for heat pump installations;
- incentive schemes for installers;
- exemption or reductions on the Climate Change Levy;
- reduced VAT for installations.

Heat pumps can make a constructive and worthwhile contribution to the UK's tough climate change commitments. The government hopes to obtain 10% of all electricity from renewable sources by the year 2010. To achieve this, it will need all the help it can get.

Clearly the UK heat pump industry should receive government support such as that available in many other countries, perhaps even more so considering the low cost of domestic energy in the UK.

The HPA is confidant that heat pumps have exceptional merits in providing energy-efficient solutions to many residential needs. This fact will in time be fully appreciated, but a great deal of hard work will be needed first.

Tony Bendall
UK Heat Pump Association
Tel.: +44-1491-578674
Fax: +44-1491-575024
E-mail: tonyb@feta.co.uk
Internet: http://www.feta.co.uk

Associations: keepers of the gate

Lisa McArthur, USA

The true legitimisation of an idea, cause or industry comes with the establishment of an association in its honour. This is definitely true in the ever-growing world of the ground-source heat pump industry. Some 16 groups around the globe help to carve out a niche for this technology in the enormous heating, ventilation and air-conditioning (HVAC) community.

Most associations educate their industry members, support research and development of innovations and try to create a market. Associations, although inherently egocentric, try to fulfil a perceived need in their community. The association can provide the kind of camaraderie one may find in a college alumni group. Members join this community in order to achieve a personal goal of continuing education or networking with other professionals. In the August 1998 issue of *Association Management*, 'Defining the Value of Associations', Kristin Starboa stated aptly that "chief executive officers believe that teaching members and the public is one of the association's most important jobs".

Foundation and mission

The International Ground Source Heat Pump Association in the US was initiated by a couple of researchers, two utility companies and four manufacturers. In 1987 they saw a need to validate their basic belief that geothermal technology was truly renewable and environmentally friendly. This notion produced an industry that has since grabbed a small percentage of the HVAC marketplace.
As Dr James E. Bose, IGSHPA Executive Director, said in Volume 17 of this Newsletter: "These organisations exist solely to increase the quantity and quality of installations".

The founding members of IGSHPA established their association to promote their belief in a simple, yet revolutionary idea of using the earth to provide heating and cooling for homes and businesses. IGSHPA's mission was to promote the growth of the ground-source industry through continual work in areas such as the development and promotion of industry-related standards. The Standards Committee of IGSHPA is part of its governing body. Issues of importance to the entire industry are discussed twice a year. From this cooperative effort, IGSHPA has been responsible for developing standards for plastic pipes, antifreezes and the grouting of boreholes.

IGSHPA and other associations have achieved significant progress into the heating, ventilation and air-conditioning sector through effective marketing campaigns. Public awareness programmes have been successful at educating people about the environmental benefits of the technology. A colouring book, produced to introduce youngsters to this new resource for heating and cooling, features the groundhog IGGY, the IGSHPA mascot.

Figure 1: Japanese delegation

Training and research

IGSHPA has made a huge investment in support of training and research, whereby the association forms the bridge between academia and industry. IGSHPA began educating the HVAC community about the business potential of the technology in 1989. The education process added to IGSHPA's efforts to create a marketplace for the equipment. IGHSPA representatives attended other association conferences and published papers to promote the technology. Today IGHSPA has 5,776 accredited installers and 185 trainers internationally. It is engaged in a new programme with the Geothermal Heat Pump Consortium (GHPC) and the Association of Energy Engineers (AEE) to provide training for engineers who will eventually be accredited as Certified GeoExchange Designers. This programme will bring a whole new sector into the geothermal community.

Publications, meetings and conferences

To educate the target audience and increase funding, members have

developed and distributed a variety of educational materials. IGSHPA currently has 22 published documents, ranging from software programs to training manuals and marketing materials. The authors of these materials come from every area of the geothermal industry.

Associations also provide platforms where information is exchanged, ideas are developed and friendships flourish. Since 1989, people from varying backgrounds have been meeting at IGSHPA workshops and sharing their common interest in geothermal technology. Since it set up business in Stillwater, Oklahoma, the IGSHPA corporate office is *the* place for international delegates to study the benefits of ground-source heat pump technology. A Japanese delegation first visited Stillwater in 1990. A second delegation of six energy technology professionals returned to Stillwater this year to expand their knowledge (See **Figure 1**).

Delegates from the Swedish drillers' association Geotec attended the 1999 GeoExchange Technical Conference and Exposition. Although ground-source heat pump technology has been utilised in Sweden for more than two decades, the delegates came to IGSHPA to see what new innovations might expand the market potential in Sweden and Europe.

A delegation from the Trane Company, the Geothermal Heat Pump Consortium, the University of Missouri and IGSHPA ventured to the People's Republic of China: IGSHPA Executive Director James E. Bose, GHPC Executive Director Conn Abnee and Dr Yung Sheng Xu, Adjunct Associate Professor of the University of Missouri. This was a follow-up to a visit to the US by two delegates from the Chinese Ministry of Science. China is currently in the midst of a construction explosion. In a country where coal is still widely burned for heat, there are virtually no contractors or engineers trained to install ground-source heat technology. Through this effort, the groundwork was laid for cooperative exchange of education and technology. An investment by members from the geothermal industry could help to jump-start the technology in China.

To spread the geothermal gospel, IGSHPA holds conferences twice a year. In the last two years, 38 representatives from nine countries have made the journey to Stillwater. Training courses are currently being developed for scientists and industry personnel from Chile and the Netherlands.

Developing the industry

It is hard to place a dollar value on the benefit of participating in an organisation like this. Associations offer a look at the industry through the common eye of the membership. From this, trends are identified that propel the technology forward and expand the marketplace. The synergy of the union between academia, government and industry helps to generate research that turns into sellable products.

Under the direction of Dr James E. Bose, researchers at Oklahoma State University Construction Management Department investigated the viability of ground-source heat pump technology during the energy crisis of the 1980s. The oil crunch stimulated research in all kinds of potential cheap energy. This crisis set the stage for the perfect partnership between academia, government, and industry.

In 1990 Dr Marvin Smith, Professor at Oklahoma State University Mechanical Engineering Department, received a grant from the Oklahoma Centre for the Advancement of Science and Technology (OCAST) to find the best way to store ice using heat pump systems. The initial work from this study resulted in the development of the now famous 'Slinky' configuration for pipe placement. From this initial research the product has made the technological transfer to the private sector. It is widely used by geothermal installers today.

Regulation

With the development of any industry comes regulation. An association serves its members by responding to regulatory encroachment by local, state and federal legislatures. By serving as the bridge between the industry and regulators, an infrastructure under which the industry is governed can be outlined with input from every sector. For example, IGSPHA members recently requested a new commercial licensing category for installers of geothermal equipment. The existing classifications did not cover the skills needed to install and maintain high-density polyethylene (HDPE) pipe. IGSHPA representatives appeared before the Oklahoma State Department of Health's Mechanical Licensing Board and Committee to present evidence and answer questions in support of the additional license section.

Conclusion

The market has developed slowly but steadily with every new innovation. As the potential of the industry unfurls, more entrepreneurs have joined the geothermal community. With each major industry change, installation costs are reduced and the technology comes closer to becoming part of the main stream for environmental comfort.

The IGSHPA is in the business of selling an idea and an industry. Like other associations, it has to listen to its members and the benefits of membership must reflect economic and industrial changes. Associations serve as the impartial 'keeper of the gate' for their particular product. Here, the ideas of today become the technology of tomorrow.

Lisa McArthur, Assistant Director
International Ground Source Heat Pump Association
490 Cordell South
Stillwater, OK 74078, USA
Tel.: +1-800-6264747
E-mail: mcarthl@okstate.edu
Internet: http://www.igshpa.okstate.edu

Competitiveness as guideline in Dutch heat pump programme

Leon Wijshoff, the Netherlands

The year 2000 marks the start of a new, four-year heat pump programme for the residential, commercial/ institutional buildings and agricultural sector in the Netherlands. The main goal is to increase the competitiveness of heat pump systems.

The Dutch government aims to save 32 PJ in 2020 through heat pump applications: 16 PJ in residences, 12 PJ in commercial buildings and 4 PJ in the agricultural sector. Before 2000, the Dutch heat pump programme planned only short-term (one-year) research, demonstration and marketing activities. Annual renewal allowed fast reaction to changes in market needs or progress in product and system development. However, despite these efforts the introduction of heat pumps faced major problems, especially in the residential sector.

Covenant for residential heat pumps

In 1999 the Ministry of Economic Affairs, together with Novem, initiated a Covenant for residential heat pumps, which was designed to show the commitment of market parties to actively support the deployment of these systems. The signatories agree on common goals and strategies. The ministry will support the activities of Covenant partners for four years, with a budget of USD 19,500,000 (NLG 40 million).

The first step was made in May 1999 with a Declaration of Intent, signed by 25 parties, including representatives of all relevant market parties. The final Covenant text was signed by 52 organisations on 12 April 2000 (**Figure 1)**. The focus is on improving the *quality* of heat pump *systems*. The Covenant's overall target is to develop, optimise and demonstrate favourable product market combinations (PMCs) for heat pumps, to enable large-scale market introduction from 2004 onwards.

Covenant signatories range from government departments, heat pump suppliers, installers and housing developers to utilities, trade organisations and research institutes. Each is committed to working on certain tasks (e.g. suppliers will focus on optimising products to reduce costs and improve quality, and installers will concentrate on introducing a quality assurance system and price reduction)

Market analysis

One of the activities undertaken in 1999 to support the Covenant, was an analysis of the competitiveness of heat pump systems in various residential market segments. Segments were sought where heat pump systems would provide an added value compared to the condensing gas-fired boiler, the main Dutch baseline system. The concept of free 'top-cooling', (i.e. using the cold stored in the heat source (ground, aquifer) in the winter for space cooling in summer), substantially increases the competitiveness of heat pumps for new houses. The energy required to provide this additional comfort is very small.

Table 1 shows the assessment of the various market segments in terms of projected annual energy savings in 2020. The C-score (competitiveness score) applies to the future market and is determined by averaging opinions of experts. Scores from 1-5 (unacceptable to highly favourable) describe price, benefits, image and additional cost (retrofit cases) for the heat pump compared to its competitors. A C-score of 3-3.5 is interpreted as reasonably competitive for a limited market; scoring 3.5-4 shows decisive market prospects. Above 4, the option promises a strong market position. The assessment states that heat pumps will not be competitive for large collective systems (not in the table) as distribution losses hinder high overall energy efficiencies.

From annual to four-year approach

Parallel to the establishment of the Covenant, the heat pump programme has moved from an annual to a four-year programme. The programme applies to all application sectors, except for industrial applications which are now part of another programme. The four-year programme supports the Covenant since most activities require support on a long-term basis.

Priority areas for the residential sector heat pump programme were derived from **Table 1**, based on energy savings and competitiveness. These include new private houses, both (semi-) detached and terraced, full renovations of private houses, replacement of gas-fired boilers and replacements of various water heaters with heat pump water heaters

▲ *Figure 1: Ms Bertram, Dutch Ministry of Housing, Spatial Planning and the Environment, signing the Heat Pump Covenant.*

(HPWHs). This last option is largely in the market introduction phase, but can improve the general awareness of heat pumps as an energy-efficient technology using sustainable energy sources. For the other market segments, field tests are still necessary to develop options tailored to the Dutch market.

A large share of the budget will be used for demonstration projects. A general incentive scheme will be made available for heat pumps, and HPWHs will be the first type eligible for a subsidy scheme.

Commercial buildings

Commercial building applications contribute substantially to the energy-saving potential of heat pumps. Most of the Dutch heat pumps are installed in commercial/institutional buildings. Competitiveness of heat pumps was analysed for:

- large and medium-sized office buildings with cooling demand, small offices, assembly buildings;
- homes for the elderly, nursing homes, hospitals;
- public swimming pools, sports centres;
- schools;
- the hotel and catering industry;
- shops and miscellaneous buildings.

Market prospects for heat pumps in the commercial sector are fair. Selected for their potential energy savings, priority areas include offices with cooling demand, nursing homes and homes for the elderly, public swimming pools and hotels.

Agriculture

Priority market segments are all in horticultural applications, including growing vegetables, flowers, products requiring cooling and closed greenhouses. Absorption and electric heat pumps, in combination with CHP (combined heat and power), can serve these market segments. The market in this sector is currently characterised by major shifts, as energy prices are volatile. The government also aims to restructure the greenhouse sector, by developing new areas so that new greenhouses can be built.

Conclusion

Financial support for heat pumps has more than doubled as a result of the Covenant for residential heat pumps and the new four-year programme applying to all sectors, excluding industry. This is expected to give heat pumps a huge impetus: first in terms of quality, then quantity. Monitoring activities will help to control this process. Maximum market development is sought by focusing on a selective group of PMCs. In future, successful PMCs will also promote heat pump applications in other segments. The new four-year approach plus the positive impact of the Covenant will ensure that heat pumps are better positioned in the Dutch market.

Further information: Novem BV, L. Wijshoff
Tel.: +31-46-4202273
E-mail: l.wijshoff@novem.nl

▼ *Table 1: Market analysis of various heat pump product/market combinations for residences.*

Application	Annual construction volume (#/year)	Heat pump type[1]	Future C-score[2]	Market status[3]	Annual savings in 2020 (PJ)
NEW HOUSES					
Detached or semi-detached, private	25,000	Ground-source, integrated[4]	3.7	1	1.64
Luxury apartment block, private or rented	9,000	Collective water-source HPs for space heating/top-cooling and individual HPWHs	3.7	1	0.47
Terraced houses, private	25,000	Collective water-source or air-source; individual integrated[4] HPs	3.6	1	0.88
Terraced houses, rent ('small collective')	10,000	Collective water-source HPs for space heating/ top-cooling and individual HPWHs	3.6	1	0.22
RENOVATION					
Collective renovated terraced houses, rent	25,000	Solar-collector (source) integrated[4] gas-fired heat pump, existing radiators	3.3	1	0.41
Full renovation private houses	50,000	Ground-source integrated[4]	3.7	1	1.64
REPLACEMENT					
Any, private, with gas-fired heating	180,000	Solar-collector (source) integrated[4] gas-fired heat pump, existing radiators	3.3	1	1.78
Any, rent, with electric boiler:					
a) individual,	a) 12,000	Exhaust air-source HPWH, a) individual or	a) 3.5	a) 3	a) 0.29
b) collective	b) 8,000	b) collective (small apartment blocks)	b) 3.8	b) 1	b) 0.14
Any, rent, with open gas-fired boiler for DHW	25,000	Exhaust air-source HPWH	3.6	3	0.15
Collectively heated apartment blocks	3,000	Collective water-source gas-fired or absorption HP for space heat; individual exhaust air HPWHs	3.3	1	0.04
Collective DHW in apartment blocks	3,000	Individual exhaust-air HPWHs	3.6	3	0.06
NO CONNECTION TO THE GAS GRID					
Any type, mostly private	6,000	Integrated[4] ground-source or water-source heat pump	3.8	3	0.59

[1] Electric heat pumps when not otherwise specified, [2] Competitiveness score, see text, [3] Market status: 1 = development phase, 2 = demonstration phase, 3 = market introduction, [4] Integrated: includes domestic hot water.
Abbreviations: HP = heat pump, HPWH = heat pump water heater, DHW = domestic hot water

Heat pump activities in Japan

Takeshi Yoshii, Kisuke Yamazaki, Xiaomei Li, Japan

Since the oil crisis of the 1970s, the Japanese government has stimulated energy conservation. Heat pumps have played a central role in this policy, and several parties have helped create a market for heat pumping technologies.

Heat pump technologies in Japan have played a significant role in energy conservation, improving living conditions and enhancing the quality of products. The Japanese government has helped to develop heat pump technology and promoted the use of heat pumps. 'Energy conservation' has been important in coping with escalating oil prices ever since the 1973 oil crisis. Japan depends heavily on imported energy as indigenous energy resources are very limited. The growing concern over global environmental issues means that heat pump technologies should not only bring social and economic benefits, but should also contribute to environmental preservation.

Background

As part of these government activities, the Agency of Industrial Science and Technology (part of MITI, Ministry of International Trade and Industry) has participated in the IEA Heat Pump Programme Implementing Agreement (HPP) since 1979. The Japanese National Team was formed under AIST/MITI, as shown in **Figure 1**. Japan has so far actively participated in 17 Annexes, including three ongoing tasks, Annex 16 being the core Annex activity. The Japanese National Team was proud to host the 3rd IEA Heat Pump Conference in Tokyo in 1990.

HPTCJ

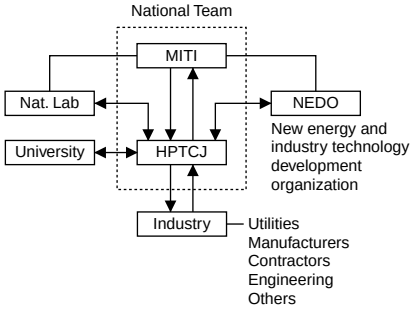
The Heat Pump Technology Center of Japan (HPTCJ) was established in 1986 to implement the HPP more effectively by collaborating with specialists from universities, research institutes, utilities, manufacturers, general contractors and engineering companies.

The HPTCJ's activities are to develop and promote heat pump technologies and to stimulate international collaboration. HPTCJ currently has around 120 supporting members from a wide range of industrial sectors, such as electric and gas utilities, equipment manufacturers, general contractors, subcontractors and engineering companies.

In 1997 Heat Pump Technology Center changed its name to the Heat Pump & Thermal Storage Technology Center of Japan, corresponding to the growing need for thermal energy storage technology, mostly used in combination with heat pumps. The HPTCJ is also operating the IEA Energy Storage Implementing Agreement (ECES IA) in which Japan has participated since 1997. Thus HPTCJ's activities have been extended to both heat pump and thermal storage technologies.

HPTCJ's International collaboration

HPTCJ plays an important role in carrying out activities related to the IEA Heat Pump Programme. HPTCJ organises committees for each Annex (except for Annex 16), including experts from universities, research institutes and industry, to implement the tasks of the Japanese National Team. HPTCJ contributes to the IEA Heat Pump Centre Newsletter, and collects and analyses Japanese heat pump market data required for their Analysis Reports.



▲ *Figure 1: Japanese National Team and HPTCJ.*

HPTCJ also exchanges information with other countries, sending study groups to Europe, North America, Asian and Oceanic countries, as well as organising international seminars.

Promotion and dissemination

For many years large commercial and industrial heat pumps have been included in the government's energy-saving programme. Tax incentives are given so that investors can choose either a tax credit or a special depreciation rate.

Current promotion focuses on increasing the use of ice thermal storage systems named 'Eco-ice systems'. **Figure 2** shows the promotion cartoon. Financial government support through HPTCJ promotes the use of split-type heat pump systems equipped with an ice thermal storage tank, mainly used for small commercial and institutional buildings. The government subsidises half the installation costs of these systems. The promotional activity aims to solve the electricity peak-load problem, which is mainly caused by extensive use of air conditioners on hot summer days. These promotion activities are successful and the market for ice thermal storage systems is growing rapidly. HPTCJ uses a variety of promotional campaigns and organises seminars for customers and installers.

R&D

Another important HPTCJ activity is research and development of advanced

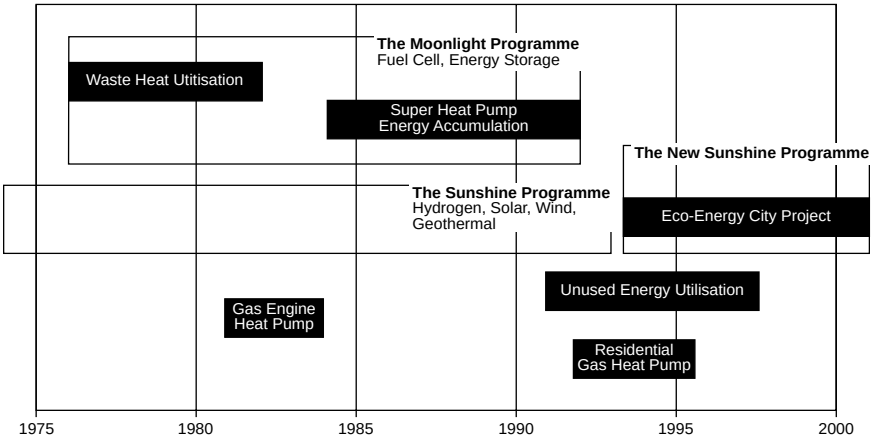
heat pumps. HPTCJ works on national R&D programmes together with NEDO (New Energy and Industrial Technology Development Organization), established by the Japanese government to promote new energy technologies.

Some of the national R&D programmes have been very successful in developing large commercial and industrial heat pumps (see **Figure 3**). These include the programmes *Waste heat utilisation* (1976–81), *Super heat pump energy accumulation* (1984–92) and *Unused energy utilisation* (1991–97). The ongoing programme *Eco-energy City* (1993–2000) also contains a number of items dealing with heat pump technology development. The *Super Heat Pump Energy Accumulation* project is probably the most well known.

Future prospects

There is a certain conception that heat pump technology in Japan has matured, with its high penetration rate achieved so far. However, growing concern over global environmental issues is expected to change the situation.

Japan is currently the only official IEA Heat Pump Programme participant in the Asian and Oceanic region, but it is hoped that many other countries in this region will join the programme. As the first step in this direction, HPTCJ is trying to build up an information network among potential members in this region.



▲ *Figure 3: National R&D projects.*

Takeshi Yoshii, Kisuke Yamazaki, Xiaomei Li
Heat Pump & Thermal Storage Technology Center of Japan
Tel.: +81-3-56432404
Fax: +81-3-56414501
E-mail: yamazaki@host2.hptcj-unet.ocn.ne.jp

▲ *Figure 2: Illustration from ice thermal storage promotion campaign.*

Establishing the European Heat Pump Association

Rayner Mayer and Jean-Yves Cherruault, UK

The European Heat Pump Association (EHPA) was recently established in Brussels. Its main aim is to promote the technology and develop the emerging European market. Where does it come from, how is it formed, what are its initial activities?

Background

There has been an interest in developing heat pumps in Europe for the past 100 years. The technology has developed slowly and steadily and some applications (e.g. heat recovery) have developed faster than others. However, the low price of oil for most of the past 50 years has meant cheap energy, and therefore cheap electricity.

However, when oil prices rose sharply to 40 Euro per barrel (USD40) in the early 1970s, there was a sudden rush to exploit more efficient technologies. Heat pumps were installed in large numbers, particularly for residential heating. Market trends then split between the USA and Europe.

The core meltdown in 1979 at the Three Mile Island nuclear plant in Pennsylvania, USA resulted in no further nuclear plants being completed. Consequently, American utilities offered consumers incentives to save energy, and the market for heat pumps surged to somewhere near its present level. However, in Europe the market could not be sustained as oil prices dropped back to 10 Euro per barrel by 1986. But the accident at the Chernobyl nuclear power plant, plus increasing concern

about greenhouse gas emissions, has recently provided new incentives to develop the European heat pump market in a sustainable manner.

European Union and SAVE

The European Union (EU) also signed the Kyoto agreement on greenhouse gas emissions. The EU established the SAVE programme to ensure that energy efficiency would be increased. In the residential sector SAVE initially implemented a strategy for saving energy in domestic appliances through a variety of mandatory directives and voluntary agreements. Priority was given to space and water heating.

In 1997 Sciotech carried out a study on 'Electrical heating and cooling in residential buildings', which concluded that there was a very large potential for saving electricity (in the order of 100 TWh per year) by 2020. (See HPC Newsletter 16/4 1998.)

EHPA

The Sciotech study recognised that, with a few noticeable exceptions, the industry was very fragmented, with many small manufacturers serving local markets. The industry needed to grow and concentrate on providing a full range of models for all sectors of the emerging European markets. A European Heat Pump Association (EHPA) was recommended to transform the European market.

Two meetings were held in Brussels, hosted by the Directorate General for Energy and Transport. The formation of the EHPA was agreed at the first meeting (mid-October 1999). Statutes were drafted and circulated for comment, and the final draft was approved at the second meeting (18 February 2000).

The EHPA was formed as a European Economic Interest Group (EEIG), the only type of company allowable under European rather than national law. Full membership is open to all legally registered organisations within the EU. Organisations in other European countries can achieve associate membership. EHPA's initial membership consists of national heat pump associations, utilities, manufacturers and consultancies. Three managers have been appointed: Rayner Mayer (chair), Axel Lehmann (secretary) and Jean-Yves Cherruault (treasurer).

The work of the EHPA will be carried out in technical committees, two of which have already been formed: planning and strategy, and labelling. Other committees will follow in due course as membership increases. Close links will be sought with related organisations, some of which are located in Europe (e.g. the IEA Heat Pump Centre, Eurovent), with others in the USA.

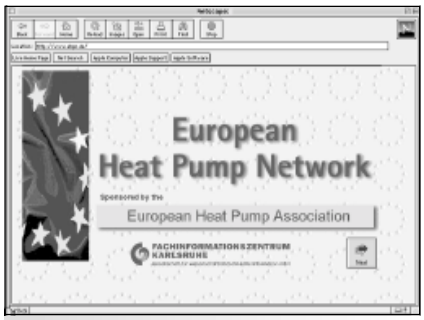
Activities

- The EHPA, like other European organisations, will only undertake activities at a European level, not on a national or local basis.
- FIZ, Karlsruhe will develop the EHPN website (see box) to provide information on all countries represented within the EHPA. FIZ will also provide links to national home pages.
- A four-page newsletter will appear every three months, describing current and future activities. The newsletter will be available in English and other major European languages.
- Workshops on topical themes will be organised. The first two are planned in Perth (Scotland) and Paris during autumn 2000.
- EHPA will be working with DG Energy to set meaningful targets and strategy for penetrating heat pumps into the European markets, particularly for electrically heated homes.
- EHPA will develop a European product endorsement mark for residential heat pumps, based on the DACH scheme (see article on page 22).
- EHPA will act as a dissemination partner in EU projects involving energy efficient heating and cooling systems.

Conclusions

Concerns about environmental pollution and rising oil prices have resulted in new market opportunities for heat pumps in Europe. The EHPA will be an active participant, working together with other bodies to transform the market for energy-efficient heating and cooling systems such as heat pumps.

Rayner Mayer and Jean-Yves Cherruault
Sciotech Projects Ltd, UK
Tel.: +44-1252-873564
E-mail: rayner@sciotech.demon.co.uk



EHPN website

The European Heat Pump Network (EHPN) website results from the two THERMIE projects *European Network on Heat Pumping Technologies* and *Concerted Actions for the Promotion of Heat Pumps in Europe.* These projects were mainly aimed at supporting market penetration by disseminating information on nearly all aspects of heat pump technology.

FIZ Karlsruhe, the operator of EHPN, is currently modifying the website. This task is mainly directed towards introducing a special home page for the European Heat Pump Association (EHPA). FIZ is also looking European-wide for partners that are willing to act as so-called Focal Points, coordinating the national contributions to the EHPN website.

Website address: http://www.ehpn.de
Administrator: Dr.-Ing. Axel Lehmann
E-mail: ale@fiz-karlsruhe.de

ASHRAE's role in the global community

Harley W. Goodman Jr, USA

As we enter a new century, the HVAC&R industry faces one of the most significant challenges in its history, as well as one of the richest opportunities. The world continues to grow closer together, making each country's economy dependent on other countries. ASHRAE is prepared to play its role in the global community.

Global player

For the past year ASHRAE has focused on its role in this new global community to generate discussion about international issues.

ASHRAE is one of the world's foremost publishers and educational resources of design and application information for the HVAC&R industry. It has achieved this through an intricate network of individual involvement and knowledge-sharing by thousands of volunteers. In this high-tech age, it is really the human touch of personal interchange – whether in person, on paper or via computer – that advances understanding.

Creating standards is an important way to fulfil ASHRAE's obligation to transfer HVAC&R technology to engineers around the world, as standards are a crucial part of the global economy. They not only advance technology but also facilitate international commerce by ensuring that everyone operates within the same parameters. Worldwide use of the same standards ensures that markets are open and competitive for equipment and systems, regardless of where they are made. This also ensures a minimum standard of quality.

Worldwide standards

At the ASHRAE winter meeting in February, I highlighted two of our recent successes relating to standards. Earlier this year, we published revised ASHRAE/IESNA Standard 90.1-1999, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, which addresses energy conservation in buildings. We also recently published Standard 62-1999, *Ventilation for Acceptable Indoor Air Quality*, which sets ventilation rates and other requirements for commercial and institutional buildings.

We are also committed to advancing heat pump technology worldwide, primarily through research, education and development of standards. Last year, the society reaffirmed and published Standards 16 and 58:

- Standard 16 is entitled *Method of Testing for Rating Room Air Conditioners and Packaged Terminal Air Conditioners*;
- Standard 58 describes a *Method of Testing for Rating Room Air Conditioner and Packaged Terminal Air Conditioner Heating Capacity*.

Both standards establish test methods for obtaining rating data and specify types of test equipment for performing such tests.

On the global level, the society has reached an agreement with the Air-conditioning and Refrigeration Institute (ARI). Both jointly adopt the standards developed by the International Organization for Standardization (ISO) relating to water-to-water and water-to-air heat pump testing and rating. ASHRAE and ARI are processing approvals under a joint project committee.

Research and education

ASHRAE's efforts include funding research projects related to heat pumps. Several projects have been co-sponsored with the Geothermal Heat Pump Consortium. One proposal would create a commissioning and troubleshooting guide for ground-source heat pump systems. In another project, researchers studied the capacity and power requirements of unitary air conditioners and heat pumps under extreme temperature and humidity conditions.

In addition, ASHRAE's continuing education programme recently added a new course on ground-source heat pumps. Programmes on heat pumps are also included in the technical programmes at ASHRAE meetings and at co-sponsored conferences, such as this autumn's Dublin '2020 Vision' conference.

Our efforts in research, standards development and education over the past century have enabled ASHRAE to become a vigorous global player. Around 15% of the members come from outside the US and Canada. To serve this worldwide audience, ASHRAE regularly co-sponsors conferences in countries throughout the world and will continue to consider preparing some publications in different languages. Associate agreements have been reached with other societies around the world to secure reciprocal membership benefits for publications and conferences. Our website (http://www.ashrae.org) offers access to all major activities, events and publications.

Conclusion

ASHRAE is a global society that is moving forward in our standards development and other areas to become more active in advancing the science of HVAC&R and serve the evolving needs of the general public. This is ASHRAE in the new millennium's global community.

Harley W. Goodman, Jr, P.E.
President
American Society of Heating, Refrigerating and Air-Conditioning Engineers
Internet: http://www.ashrae.org

Swiss heat pump programmes relating to international organisations

Thomas Afjei, Switzerland

The Swiss governmental programmes, the association for the promotion of heat pumps (FWS), the DACH quality label, Swiss Federal Office of Energy (SFOE) research programmes, the European Heat Pump Association (EHPA), international collaboration in the IEA Heat Pump Programme and standardisation organisations all contribute to a favourable market for heat pumps in Switzerland. This article explains how.

E2000, the programme of the Swiss government

The Swiss government introduced the Energy 2000 (E2000) Renewable Energy Programme almost 10 years ago, as a result of the public consensus on a 10-year moratorium on new nuclear power plants. In E2000, global warming reduction and stabilisation of electricity usage are combined.

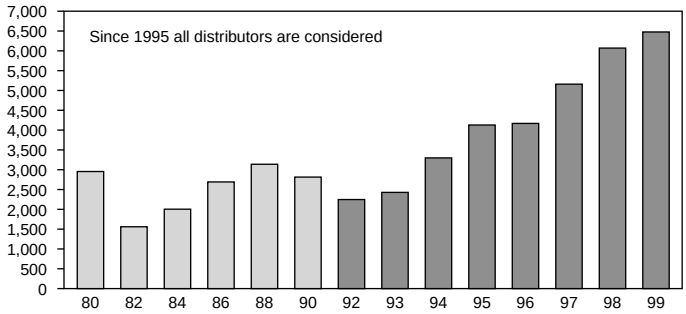
The department for renewable energies (RRE) coordinates activities relating to E2000, see website: http://www.e2000.ch/Regenerierbare/Default.htm. The three focal areas of E2000 RRE are solar energy, ambient or waste heat and biomass, i.e. mainly wood. Supporting all renewable energy sources is crucial for a success of the E2000 programme.

Ambient heat used by heat pumps is considered renewable energy. However it is important to consider the source of the electricity that drives the heat pumps.

The E2000 strategy includes:

- *savings due to substitution* of direct electric resistance heaters (approximately 6% of Swiss homes);
- *increased electricity production by waste incineration plants*;
- *combined heat and power plants*, operated according to heat demand.

The amount of electricity used by heat pumps in Switzerland is much lower than from the above sources, i.e. no additional fossil-fuel electricity production is required.



▲ *Figure 1: Sales figures of residential heat pumps in Switzerland, see http://www.fws.ch (German/French).*

Energy Law and CO_2 Law

The new Swiss Energy Law and CO_2 Law (effective January 1999 and May 2000 respectively) provide a legal basis for further steps towards a sustainable energy policy. The CO_2 law requires CO_2 emissions reductions of 10% by the year 2010, to be accomplished by voluntary measures. A CO_2 tax may be introduced if these measures prove insufficient. In autumn 2000 Swiss voters will decide on a support tax for renewable energies.

FWS, the Swiss network for ambient heat

The Swiss Association for the Promotion of Heat Pumps (FWS) coordinates the promotional activities concerning the use of ambient heat. FWS, founded as a network within the E2000 programme, has had remarkable success over the past few years. This resulted from strong support by the utilities and the open-minded governmental point of view that heating via heat pumps uses mainly renewable energy or, in other words, heat pumps should not be considered just as electrical heaters fed by nuclear power plants. **Figure 1** shows the increasing sales of residential heat pumps.

But it is not just the number of installed units that is increasing – quality has also been greatly improved. This is largely due to the work of the heat pump testing and training centre in Winterthur-Töss. The unbiased depiction of the tested performance of various heat pumps has inspired public confidence and is crucial to its choice. Test results and activities are available from http://www.wpz.ch (German/French/Italian/English).

D-A-CH for quality

The D-A-CH association also achieves quality assurance. D-A-CH is an acronym for the three participating countries: Germany (D), Austria (A) and Switzerland (CH). The test centres and the promotional associations of these three countries work continuously on this unique heat pump quality label.

▲ *Figure 2: D-A-CH heat pump quality label*

Manufacturers and testing organisations define the requirements for the heat pump quality label. Due to ongoing improvements, the minimum COP requirements for the D-A-CH quality label will be increased after 1 January 2001 (measurement points according to EN255):

Brine-to-water:	4.0 for B0/W35
Water-to-water:	4.5 for W10/W35
Air-to-water:	3.0 for A2/W35

(B0 = brine temperature 0ºC, etc.)

Several additional conditions are required, e.g.:

- clear installer and user manual;
- two-year warrantee, 10-year delivery of parts;
- CE conformity;
- on-site service within 24 hours.

The quality label has become an important instrument for inspiring confidence in heat pumps. The next step is a *quality label for the complete heat pump system*, since system integration is very important. A recently completed THERMIE project entitled 'Heat Pump Training Programmes for Targeted Groups' and a SAVE II project called 'Certification of Heat Pumping Technologies and Installers' are the first steps in this direction.

SFOE for increased knowledge

The research programme of the ambient heat sector at the Swiss Federal Office of Energy (SFOE) has developed a strategy plan for the years 2000-2003. The main objective is to use a much higher ratio of low-temperature heat. Space and tap water heating could be increasingly provided from ambient and waste heat sources. Promising concepts can be demonstrated in pilot and demonstration plants supported by SFOE. In 1999 a heat pump was installed in 35.5% of the newly built single-family houses. Great efforts are required to reach a similar dissemination level in the retrofit market, where the market potential is much higher.

The following ongoing projects demonstrate the Swiss research programme approach to ambient heat, see http://www.waermepumpe.ch/fe (German/French) for further information:

- Swiss retrofit heat pump (SRHP);
- low-cost low-temperature heat pump system;
- short testing method;
- model-based pulse-width modulation control;
- standardised hydraulic schemes.

EHPA for EU-liaison

The European Heat Pump Association (EHPA) was established on 18 February 2000, when 10 full and 2 associate members (including Switzerland) joined. The association represents mainly manufacturers, promotional organisations and utilities. The range and intensity of EHPA's activities are largely dependent on the EU financial support. The EHPA gives heat pump manufacturers/suppliers and lobbying organisations an access point to the EU, providing a good chance to 'Europeanise' the D-A-CH heat pump quality label. Further information can be found in the article on page 19 and on http://www.ehpn.de/.

Standardisation for an open market

CEN and CENELEC, as well as ISO and IEC are the standardisation organisations representing the equipment manufacturers and testing organisations. These international standards are usually accepted as a national standard, so equipment has to meet clear requirements. Equipment from one country can easily be sold in another, since most of the requirements are standardised across Europe.

Equipment test centres follow these internationally acknowledged standards (e.g. EN255). Natural refrigerants and safety issues are treated in the standards EN378 and IEC335-2-40. The basic content of the Swiss safety standard SN 253130 for L3-refrigerants (e.g. propane) is derived from these standards. The SFOE is actively involved in several technical commissions, e.g. CEN TC182 and CEN TC113, thereby helping the increased use of natural refrigerants in high quality and safe equipment.

IEA Heat Pump Centre

The IEA Heat Pump Programme (HPP) is one of the few implementing agreements with its own information centre, the IEA Heat Pump Centre (HPC), which is operated as an Annex under the HPP. Since only around half the HPP members also belong to the HPC, the membership fee is relatively high and 'free riders' are a problem.

Switzerland was one of the countries that suggested a mandatory HPC membership in a base programme for all HPP members, providing a clear structure at an attractive cost/benefit ratio. At the recent ExCo meeting in Mexico City it was decided that such a structure will be implemented from January 2002 onwards (see page 9).

The HPC base programme, which still has to be defined in detail, will be a valuable complement to the Swiss national activities. To increase the impact of the HPC, Switzerland recommends the following changes:

- the HPC should be more business-like, thereby attracting new members;
- in addition to the mandatory base programme, each country may decide on a project base, if it wishes to participate in projects additional to the HPC base programme.

Switzerland believes that these measures increase the attractiveness of the HPC so that more members may join in the future.

Further information:
Dr Thomas Afjei
BFE/UAW Int. activities
Tel.: +41-1-4610834
Fax: +41-86076-3860140
E-mail: afjei@eutacon.ch
Internet: http://www.waermepumpe.ch/hpc

Heat pump with heat recovery: efficient supply of 100% outside air

John McNab, Australia

A simple and efficient combination of a heat pump and a heat exchanger for air conditioning in both hot and cold climates has been developed and tested in Australia. The system, known as a Dual Indirect Cycle Energy Recovery (DICER) system, uses a heat pump in an indirect configuration with a crossflow polymer plate heat exchanger. It supplies only outside air and recovers energy from exhaust air. Monitoring has shown that the system uses significantly less energy than conventional systems.

Design objectives

Three issues of considerable community concern, which the DICER system remedies at low cost with no energy penalty, are to:

- improve indoor air quality;
- reduce ultraviolet light by slowing depletion of stratospheric ozone;
- reduce consumption of fossil fuels considered a cause of global warming.

Supplying 100% fully conditioned outside air to cool or heat a building guarantees a hygienic supply, as bacteria and other pathogens from exhaust air cannot cause contamination of the supply air within the DICER unit.

General description

The DICER system comprises two thermal cycles; one using a heat pump and the other using a polymer plate heat exchanger (PPHE) acting as an energy recovery ventilator or as a wetted indirect evaporative cooler. The heat pump heats or cools exhaust air being drawn from a building. This is then passed through one set of passages in the heat exchanger, while the supply air to the building is passed through a separate adjacent set of passages (see **Figure 1)**.

The DICER design includes both the evaporator and condenser coils of the heat pump in the exhaust air stream; one before the stream enters the PPHE and the other after it leaves the PPHE. This is a unique feature. A conventional heat pump can be modified for optimum efficiency by adding extra rows in the coils or omitting the fans, as the fans of the PPHE unit are selected to provide sufficient air movement. The arrangement is flexible, and a split (modified) heat pump system or a self-contained packaged heat pump can also be used. These latter arrangements require interconnecting ducts, but can be convenient for some sites. The system can use hydrocarbon and ammonia refrigerants, because the indirect arrangement ensures that any leaked refrigerant enters the exhaust (not the supply) air.

Heating, cooling, (de)humidification

Figure 2 illustrates the heating and cooling modes.

In **heating** mode, the supply air is indirectly heated by the exhaust air through the plates in the PPHE, which alone, by heat recovery, can provide all heating needed for much of the season in Australia. When required, the heat pump heats the exhaust air and hence further heats the supply air through the plates. Outside air does not contact the evaporator and no frost forms until the ambient temperature has almost reached –15ºC. Below this point supplementary heating may be needed.

In 'dry' **cooling** mode, the PPHE recovers cooling energy from the exhaust air. For increased cooling a film of water is supplied to the exhaust air passages. The partly evaporating water and air mixture cools the supply air through the PPHE plates. Surplus water falls into a basin for recycling. The PPHE alone cools sufficiently for much of the season but, when required, the heat pump can provide extra cooling.

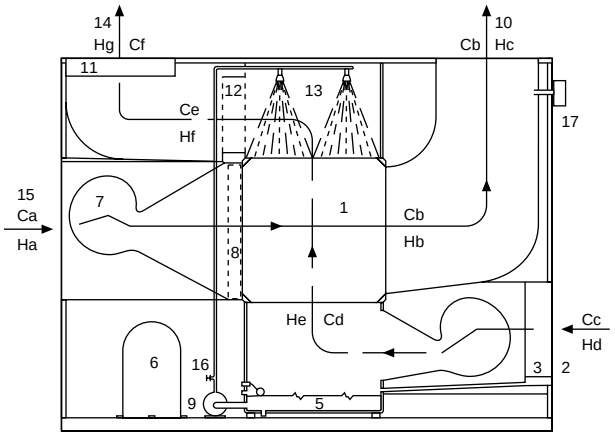
Supply air is **dehumidified** when its moisture content becomes too high. Condensate gravitates to a basin and its cooling potential is used for damping and cooling the exhaust air. When a precise upper level of indoor air relative humidity is required, the DICER system uses a refrigerant condensing coil in two parts, with the first part providing reheat of the supply air downstream from the PPHE. This avoids the extra energy used by conventional re-heat systems.

Humidification can be applied in both cooling and heating modes through an electric or gas-heated water vapour generator, which adds moisture to the supply air downstream of the PPHE.

Polymer plate heat exchanger

The PPHE was designed and developed in 1970-80 by Don Pescod of the Australian CSIRO [1] (Commonwealth Scientific and Industrial Research Organisation). The author's company was licensed in 1980 to manufacture and develop the system further. Later, the DICER system was developed.

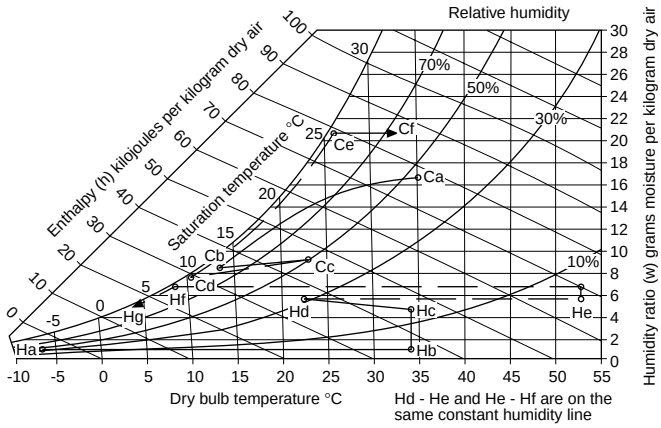
Polymers have lower heat conductivity than metals. However, measurements found that the films of air on the plate surfaces dominate overall conductivity.



Note: letters correspond to conditions in fig. 2

1 PPHE
2 Exhaust air from building
3 Coil – cooling mode: evaporator
heating mode: condenser
4 Exhaust air fan
5 Water basin
6 Compressor
7 Supply air fan
8 Supply air filter
9 Pump
10 Supply air to building
11 Coil – cooling mode: condenser
heating mode: evaporator
12 Eliminator
13 Water sprays
14 Exhaust air to outside
15 Supply air from outside
16 Bleed
17 Humidifier

▲ *Figure 1: Diagram of DICER system arranged in a single housing.*



Cooling mode:
Ca - Cb = Cooling and dehumidifying 100% outside supply air in the PPHE
Cb - Cc = Supply air cooling and absorbing humidity within the building
Cc - Cd = Reducing enthalpy of exhaust air within the heat pump's evaporator
Cd - Ce = Wetting and heating exhaust air as it cools and dehumidifies the supply air within the PPHE
Ce - Cf = Spray cooling and then heating exhaust air as it cools the heat pump's condenser

Heating mode:
Ha - Hb = Heating 100% outside supply air within the PPHE
Hb - Hc = Humidifying supply air at constant temperature
Hc - Hd = Supply air heating and absorbing humidity within the building
Hd - He = Increasing enthalpy of exhaust air within the heat pump's evaporator
He - Hf = Cooling exhaust air as it heats the supply air within the PPHE
Hf - Hg = Cooling exhaust air as it ads heat to the heat pump's evaporator

▲ *Figure 2: Heating and cooling processes.*

Air turbulence promoters on the plates lessen the thermal resistance. The plate materials are of a type approved for use with food and pharmaceuticals, and do not contaminate air. Today the plates are thermally formed and welded in an automated continuous machine. Effective plate passage lengths available are 500 mm and 1,000 mm. The spacing between the plates that form the air passages can be varied to suit different applications.

A special feature is the high efficiency of PPHEs when used as indirect evaporative coolers, due to the:

- unique design of the openings in the exhaust air passages;
- means of delivering the required amount of water into the openings;
- favourable spreading of the water over the plates.

Monitoring the operation and energy consumption

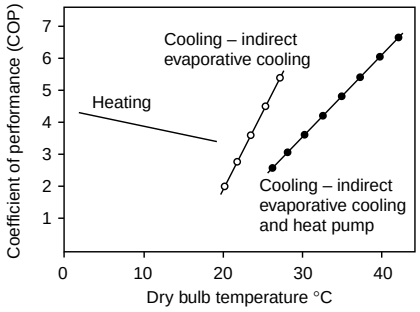
A DICER system and an equivalent conventional heat pump were installed in 1994, to air condition adjacent zones of a building. The building used for the demonstration installation is heritage listed and most of the ductwork had to be placed on the outside rear wall (see **Figure 4)**.

The systems were monitored continuously and coincidentally for two years. An indoor air temperature of 22.5°C (± 0.5°C) was maintained, with relative humidity of 30-60%. Outdoor temperatures ranged up to 42°C in the summer, with periods of high humidity at 30°C. Winter temperatures fell to 0°C but no frosting of the evaporator coil occurred. Extrapolation of the measurements determined that no frosting would occur at -15°C. The measured COPs of the various operating modes are shown in **Figure 3** [2].

The DICER system supplies air at 3.7 m^3/s and exhausts air at 2.6 m^3/s, which pressurises the building to limit infiltration. The monitored conventional heat pump system supplies 3.1 m^3/s of conditioned air, with less than 10% outside air. Under such conditions, the conventional system consumes 11% more energy annually than the DICER system. The more outside air required, and the more humid the climate, the more efficient the DICER system becomes relative to a conventional heat pump.

Cost

A PPHE assembly with fans for energy recovery and indirect evaporative cooling operation, costs around USD 17,000 for a 6 m^3/s system. The DICER's heat pump component is typically 25% smaller than the air-sourced heat pump required for the same application (but supplying only 10% of outside air for ventilation). The extra cost of the DICER system, compared to the conventional system,



▲ *Figure 3: Measured COPs in various operating modes.*

$$COP = \frac{\text{thermal energy from PPHE to supply air, kW (incl heat pump)}}{\text{electricity input (incl pumps and fans, kW)}}$$

results in a simple payback period of approximately two years, at present day power costs (Australia) of USD 0.08 per kWh.

Summary

The DICER system is a new configuration of a highly effective energy recovery polymer plate heat exchanger with a smaller heat pump than would otherwise be used for the same application. On-site independent monitoring showed that the DICER system's annual COP, while supplying only outside air, is higher than that of a comparable conventional air-sourced heat pump supplying minimal outside air. For schools, nursing homes, health care facilities, meeting places and many industrial buildings that require high rates of outside air, the DICER system would use around 50% less energy and repay the extra capital in less than two years.

References

1. Pescod D. (1980), *An Advance in Plate Heat Exchanger Geometry Giving Increased Heat Transfer*, ASME Conference Proceedings HTO Vol. 10, New York, USA
2. Vince S. (1995), *Monitoring the Performance of a Dual Indirect Evaporative Reverse Cycle Air Conditioning System*, Thesis for ME Degree University of South Australia

John McNab
Ficom Pty Ltd
PO Box 855
Glenelg, SA 5045
Australia
Tel.: +61-8-83509898
Fax: +61-8-83509191

- *The DICER system is subject to patent.*

▲ *Figure 4: Demonstration system and external ductwork at the back of the heritage building.*

Absorption literature database
Available from http://www.enme.umd.edu/ceee/ssc free of charge. Contact: Keith E. Herold, E-mail: mailto:herold@eng.umd.edu
This searchable database, maintained by the University of Maryland, Center for Environmental Energy Engineering, contains approximately 1,800 entries including around 360 patents plus the proceedings from the major absorption conferences, with abstracts for most entries.

ECA loop calculation software for Windows®
Available from Elite Software, USA. Price: USD 495. Evaluation version can be downloaded from http://www.elitesoft.com. Call +1-808-648-9523 for more information.
The new Windows® version of the Earth Coupled Analysis (ECA 4.0) program helps simplify ground loop design. The program calculates the required pipe loop length necessary for heating and cooling a building with a given heat pump, soil and water conditions. It can analyse both vertical and horizontal pipe systems and generate a complete bill of materials with cost estimate. The program also computes pressure losses through the equipment room, heat pump, header pipe and earth coil as well as purge pressure and flow requirements.

Fourth PassivhausTagung, March 2000
Available from Passivhaus Dienstleistung GmbH, Ms A. Fingerling, Lange Strasse 18, Kassel, Germany. Price: DM 150 (USD 75), 714 pages, Tel.: +49-561-33125, Fax: +49-561-33124, Internet: http://www.passivhaus-info.de. German language.
The fourth Passive house congress included sessions on architecture, ventilation, building practice, users experiences, economic and environmental assessments, space and hot water heating. At least 10 papers present the use of heat pumps in these very-low-energy buildings.

EnergyPlus energy simulation program
Beta-2 version available from http://www.eren.doe.gov/buildings/energy_tools/energyplus.htm free of charge.
EnergyPlus is a new generation building energy simulation program that builds on the most popular features and capabilities of BLAST and DOE-2 software. EnergyPlus includes innovative simulation capabilities, including time steps of less than an hour, modular systems simulation modules that are integrated with a heat balance-based zone simulation, and input and output data structures tailored to facilitate third-party interface development. Other planned simulation capabilities include solar thermal, multizone air flow, and electric power simulation including photovoltaic systems and fuel cells.

INTERNET SITE
For a list of all publications and events, visit the HPC Internet Site at
http://www.heatpumpcentre.org

Available from the HPC

PLEASE USE THE ATTACHED RESPONSE CARD WHEN ORDERING HPC PRODUCTS

Annual report 1999 – IEA Heat Pump Programme
Annual report, March 2000
Order No. HPP-1999, free of charge

Natural Working Fluids – a challenge for the future
Workshop Proceedings, February 2000
Order No. HPC-WR-21, NLG 180 or
NLG 60 in HPC member countries

International Heat Pump Status and Policy Review: 1993-1996
Analysis Study, August 1999
Order No. HPC-AR-7, NLG 480 or
NLG 160 in HPC member countries

Environmental Benefits of Heat Pumping Technologies
Analysis Study, April 1999
Order No. HPC-AR-6, NLG 240 or NLG 80 in HPC member countries

Guidelines for Design and Operation of Compression Heat Pump, Air Conditioning and Refrigerating Systems with Natural Working Fluids
Final Report, December 1998
Order No. HPP-AN22-4, NLG 100 in CA, CH, DK, JP, NL, NO, UK and US.
(Not available for other countries until 5 June 2001)

Ab-Sorption Machines for Heating and Cooling in Future Energy Systems Workshop Proceedings, April 1999
Order No. HPP-AN24-2, NLG 180 or NLG 60 for HPC member countries and CA, IT and SE.

Heat Pump Systems for Single-Room Applications
Final report, January 1999
Order No. HPP-AN23-2
Price NLG 300, or NLG 100 for HPC member countries and CA, FR and SE.

For further publications and events, visit the HPC Internet site at http://www.heatpumpcentre.org

ASHRAE Annual Meeting
24-28 June 2000 / Minneapolis, USA
Contact: ASHRAE Meetings Section
1791 Tullie Circle NE
Atlanta, GA 30329, USA
Fax: +1-404-3215478
E-mail: jyoung@ashrea.org

4th IIR-Gustav Lorentzen Conference on Natural Working Fluids *and*
8th International Refrigeration Conference *and*
15th International Compressor Engineering Conference
25-28 July 2000 / West Lafayette, USA
Contact: Cynthia Quillen, Purdue University
1077 Ray W. Herrick Laboratories
West Lafayette, IN 47907-1077, USA
Fax: +1-765-4940787
E-mail: herlconf@ecn.purdue.edu

4th International Conference on Heat Pumps in Cold Climates
17-18 August 2000 / Ottawa, Ontario, Canada
Contact: Caneta Research Inc.
7145 West Credit Avenue
Suite 102, Building 2
Mississauga, Ontario
L5N 6J7 Canada
Fax: +1-905-5423260
E-mail: caneta@compuserve.com
http://www.heatpumpcentre.org

Heat pipes, heat pumps and refrigerators
4-7 September 2000 / Minsk, Belarus
Contact: CIS Countries Association Heat Pipes
Luikov Heat and Mass Transfer Institute, 220072
P. Brovka 15, ITMO, Minsk, Belarus
Fax: +375-172322513
E-mail: allusr@avtlab.itmo.by

International Conference Sustainable Building 2000
22-25 Oct. 2000 / Maastricht, the Netherlands
Contact: Conference Secretariat SB 2000
PO Box 1558
6501 BN Nijmegen, the Netherlands
Fax: +31-24-3601159
E-mail: sb2000@novem.nl

ACHRB 2000 - Air conditioning in high-rise buildings
24-26 October 2000 / Shanghai, China
Contact: IIR, 177 Boulevard Malesherbes
75017 Paris, France
Fax: +33-1-47631798, E-mail: iifiir@iifiir.org

Cold Climate HVAC 2000
1-3 November 2000 / Sapporo, Japan
Contact: Tohru Mochida, Hokkaido University
Fax: +81-11-7067890

2001

2nd International Heat Powered Cycles Conference – Cooling, Heating and Power Generation Systems
5-7 September 2001 / Paris, France
Contact: Dr Pierre Neveu, CNAM, Paris
E-mail: neveupi@cnam.fr
Information: http://www2.cnam.fr/iffi/hpc.htm

2002

International Sorption Conference 2002
24-27 September 2002 / Shanghai, China
Contact: Dr Wang Wen
Institute of Refrigeration & Cryogenics
Shanghai Jiao Tong University
1954 Huashan Road
Shanghai 200030, China
Fax: +86-21-62933250
E-mail: ISHPC@sjtu.edu.cn

IEA Heat Pump Programme events

CO_2 Technology in Refrigeration, Air Conditioning and Heat Pump Systems
18-19 September 2000 / Trondheim, Norway
Annex 27 Workshop
Contact: Ms Marit Brånås
SINTEF Energy Research
Tel.: +47-73-593746, Fax: +47-73-593950
E-mail: Marit.Branas@energy.sintef.no

Advanced supermarket refrigeration/ heat recovery systems
2-3 October 2000 / Stockholm, Sweden
Annex 26 Workshop
Contact: Mr Per Lundqvist / Anita Elksne
KTH (Royal Institute of Technology), Stockholm
Tel.: +46-8-7907450, Fax: +46-8-203007
E-mail: elksne@egi.kth.se

Next Issue

Refrigerants: Standards, Regulations, Safety and Liability Issues

Volume 18 - No. 3/2000

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

Set up by the IEA in 1978, the IEA Heat Pump Programme carries out a strategy to accelerate the development and use of heat pumps, in all applications where they can reduce energy consumption for the benefit of the environment. Within the framework of the programme, participants from different countries collaborate in specific heat pump projects known as Annexes.

IEA Heat Pump Centre

A central role within the programme is played by the IEA Heat Pump Centre (HPC), itself an Annex. 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

Novem

Netherlands agency for energy and the environment

IEA Heat Pump Centre
Novem, P.O. Box 17
6130 AA Sittard,The Netherlands
Tel: +31-46-4202236
Fax: +31-46-4510389
E-mail: hpc@heatpumpcentre.org
Internet: http://www.heatpumpcentre.org

National Team Contacts

Austria
Mr Hermann Halozan
TU Graz, Inffeldgasse 25
A-8010 Graz
Austria
Tel.: +43-316-8737303
Fax: +43-316-8737305
E-mail: halozan@iwt.tu-graz.ac.at

Japan
Mr Takeshi Yoshii
Heat Pump & Thermal Storage
Technology Center of Japan
Kakigara-cho F Bldg.(6F)
28-5, Nihonbashi Kakigara-cho 1-chome
Chuo-ku, Tokyo 103-0014, Japan
Tel.: +81-3-56432401
Fax: +81-3-56414501
E-mail: yoshii@host2.hptcj-unet.ocn.ne.jp

The Netherlands
Mr Onno Kleefkens
Novem, PO Box 8242
3503 RE Utrecht
The Netherlands
Tel.: +31-30-2393449
Fax: +31-30-2316491
E-mail: O.Kleefkens@novem.nl

Norway
Ms Trude Tokle
SINTEF Energy Research
Refrigeration and Air Conditioning
N-7465 Trondheim, Norway
Tel.: +47-73-591636
Fax: +47-73-593950
E-mail: Trude.Tokle@energy.sintef.no

United Kingdom
Mr Jeremy Tait
ETSU
Harwell, Oxon
Oxfordshire OX11 0RA, UK
Tel.: +44-1235-433611
Fax: +44-1235-433727
E-mail: jeremy.tait@aeat.co.uk

USA
Ms Julia Kelley
Oak Ridge National Laboratory
Building 3147, PO Box 2008
Oak Ridge, TN 37831-6070, USA
Tel.: +1-865-5741013
Fax: +1-865-5749329
E-mail: j4u@ornl.gov