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IN THIS ISSUE:

IEA HEAT PUMP CENTRE

NEWSLETTER
VOL. 32
NO. 1/2014

Policy and standards

Heat Pumps - A key technology for the future

IEA Heat Pump CENTRE
NEWSLETTER
Volume 32 - No. 1/2014

In this issue

Heat Pump Centre Newsletter, 1/2014
Standardisation of heat pumps is important, for more than one reason. It makes it possible to implement energy and environment policies, such as directives and regulations. It is also very useful for manufacturers, giving them the opportunity to declare the energy performance of their products.

The topic of this issue of the HPC Newsletter is Policy and standards. The Foreword provides some aspect of the topic. An overall view of standards for heat pumps is then provided for Japan and Europe, respectively. This issue also contains a market report from Japan.

Enjoy your reading!

Johan Berg, Editor

COLOPHON

Published by IEA Heat Pump Centre
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Publisher:
IEA Heat Pump Centre
PO Box 857, S-501 15 BORAS
SWEDEN
Tel: +46-10-516 55 12
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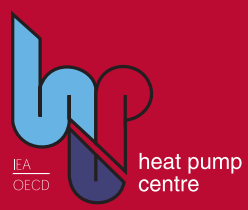
Editor in chief: Monica Axell
Technical editors: Johan Berg, Roger Nordman, Caroline Stenvall - IEA Heat Pump Centre
Language editing: Angloscan Ltd.



Performance of heat pump systems in building applications

Olli Seppänen
Professor
Federation of European Heating, Ventilation and Air-conditioning Associations (REHVA)

Recent years have shown tremendous improvements in the performance of heat pumps, particularly in the efficiency of compressors and heat exchangers. Significant standardisation has helped this development.

However, the compressor is only one component in a heat pump system. Only with good overall design and operation of the system can the predicted energy efficiency and good indoor environment be achieved. When used in building applications, heat pumps are part of the heating and air-conditioning system with fixed boundary conditions. In building applications, a major challenge is to maintain good performance under varying conditions and temperature levels of heat source and sinks as well.

A major advantage of heat pumps is their reversible operation. The need for cooling has been a driving force in the increasing use of residential heat pump applications, and particularly of air-to-air systems. However, there is still a significant need for improvement in these applications as regards their high noise level and draughts, to conform to commonly accepted standards for indoor environments. Heat pumps are, in principle, at their best in building applications when replacing direct electrical heating; the saving in primary energy use is significant. However, there is a major obstacle: how to distribute heat in a building to be renovated, as each room currently using direct electrical heating has its own radiator or convector. Standardised solutions for integration of heat pumps in the heating systems are needed.

Often, heat pump manufacturers inform customers only of the peak performance efficiency of heat pumps. This is misleading in many cases, as operating hours at peak capacity are quite limited and heat pumps operate most of the time at part-load conditions. This is why the European Union now requires data on the seasonal efficiency of the products sold in the EU area.

The effective use of heat pumps in buildings needs close cooperation in the development of applications between manufactures and building designers. Designers are represented nationally and internationally in several engineering associations. Standards should increasingly cover building applications, and not only the primary components of heat pumps. Cooperation between designers and manufacturers is needed.

For the user of heat pumps, reliable performance data is crucial when making the purchase decision. For this purpose, third-party independent certification is necessary. Such certification procedures are available in several countries, some of which, such as European certification, are used in more than one country. Unfortunately for the manufacturers, all national certification systems have their own procedures and test conditions, and any one certification is not necessarily accepted in another country. Hopefully, in the future, certification process can be standardised internationally and rationalised. This would benefit manufacturers and customers.

Column

The new F-gas Regulation – affecting a whole industry

Per Jonasson
Alternate delegate for Sweden in ExCo
Member of the Board of the Air-conditioning and Refrigeration European Association, AREA
MD Swedish Heat Pump Association
MD Swedish RACHP Contractors Association

As we now know, the European Parliament has now voted in favor of the F-gas the agreement reached by the Lithuanian Presidency, the European Parliament rapporteur and the European Commission.

AREA (Air conditioning and Refrigeration European Association), which has been closely involved since the review of the current regulation started, is satisfied with the outcome, and welcomes the agreement. It will provide certainty for the RACHP sector, which will be able to plan its decisions and investments accordingly. However, it is indisputable that this new F-gas Regulation will affect our whole industry when it comes into force. I would like to point out the following areas of concern for the heat pump industry.

Phase-down
The compromise ended up by using the time period proposed by ENVI (2009-2012) to calculate the baseline, while the phase-down schedule remained as proposed by the commission.

Pre-charging bans
Ever since the review of the current regulation started, the pre-charging ban has been the most discussed and disputed issue. However, this has been resolved in the compromise by being replaced with a new paragraph stating "Non-hermetically sealed equipment charged with HFC placed on the market shall only be sold to the end user where evidence is provided that the installation shall be carried out by an undertaking certified in accordance with Article 8". This is a procedure that is used in France, and AREA fully supports the wording.

Legal basis
The present regulation is based on two legal bases; namely, the internal market and the environment. The internal market legal basis states that a product or service approved in one EU state is automatically approved for use in all other EU states. The environmental legal basis, on the other hand, sets only minimum requirements, in addition to which any state can add its own rules – as long as they do not fall below the level set out in the regulation. In the new proposal, only the environmental basis is mentioned. This is particularly unfortunate, as a consequence could be that a product approved in one EU state could be banned in another.

Training and personal skill on new and natural refrigerants
The RACHP business as a whole faces a huge need for training, as new or old/new refrigerants such as HFOs and natural organic and inorganic refrigerants will be more commonly used. They will in the future be used not only in large industrial plants, but also in a variety of applications such as supermarkets, domestic heat pumps, split units and other systems.

The RACHP industry faces a challenging but very interesting future. However, it is already time to start preparing for it, as the future will be here sooner than might be expected.

IEA Heat Pump Programme News

11th IEA Heat Pump Conference – Preliminary Program Now Available

The preliminary program of the 11th IEA Heat Pump Conference that will take place in Montréal from May 12-16, 2014 is now available on the conference website at www.iea-hpc2014.org. One noticeable change to the program this year is the addition of a third parallel track. The addition of a third track was decided to reflect the very strong content of the 300 + abstracts received but also to add a business oriented dimension to attract more participants interested in heat pump applications in buildings as well as industrial and manufacturing processes.

As part of the conference on Monday, May 12, there will also be a number of workshops for many of the Heat Pump Programme Annexes. So far, workshops for Annex 35, Annex 36, Annex 39, Annex 40, Annex 41 and Annex 42 are scheduled. A workshop for Annex 38 is yet to be confirmed.

Conference organizers are also planning a special workshop of the Canadian NSERC Smart Net-zero Energy Buildings strategic Research Network on May 12. This workshop is intended for PhD and master's candidates from Canada and overseas to present their work. A program is currently being developed and will be posted on the conference website shortly.

For those interested in ground source heat pumps, the Canadian GeoExchange Coalition will be hosting its 7th Canadian Geothermal Heat Pump Business & Policy Forum on May 16, immediately after the core conference. This year's conference focuses on the challenges of technical and financial optimization in commercial applications.

The National Organizing Committee is now firming up site visits in and around Montréal which will take place in the afternoon on Wednesday May 14. Among them, there will be a visit to the CanmetENERGY Research facility in Varennes which leads programs in Buildings and Communities, Renewables, Industrial Processess and manages the world leading RETScreen International Clean Energy Decision Support Centre. A visit to a nearby local university active in ground source heat pump research is also on the program. To be confirmed are visits to some local landmark buildings such as the Montreal Olympic facilities now housing the Montreal Biodôme which features the five ecosystems of the Americas. The full program should be posted shortly on the conference website.

General

Eight countries may exceed US in AC use

The United States uses more energy for air conditioning (AC) than all other countries combined, but that distinction might not remain true for long. Several developing countries rank among both the most populated and hottest areas in the world. As personal incomes rise in those countries, air-conditioning use is also likely to go up, which could lead to significant increase in energy demand.

A study by U-M Transportation Research Institute shows that if the rest of the world adopts the same AC usage patterns found in the US, eight nations (India, China, Indonesia, Nigeria, Pakistan, Bangladesh, Brazil and the Philippines) have the potential to surpass the US. *Source: IIR Newsletter, No. 57, January 2014*

http://www.americanscientist.org

EU28 energy consumption: Renewables share up to 14 % in 2012

Recent Eurostat data reveals that the share of renewables in EU energy consumption has increased up to 14 % in 2012. The European Member States are to reach a share of 20 % of renewable energy sources (RES) in gross final energy consumption by 2020. The contribution of renewable energy from heat pumps is also covered for the Member States for which this information was available.

Source: www.ehpa.org

iPhone may use more electricity than a refrigerator

According to a new report by Mark Mills, the CEO of the Digital Power Group, a medium-size refrigerator that qualifies for the Environmental Protection Agency's Energy Star rating will use about 322 kWh a year.

The average iPhone, according to Mills' calculations, uses about 361 kWh a year once the wireless connections, data usage and battery charging are tallied up.
Source: IIR Newsletter, No. 57, January 2014
http://science.time.com

Policy

UK's Heat Pump Incentive broadened

The UK's Department of Energy and Climate Change (DECC) has finally agreed to include non-domestic air-to-water heat pumps in its Renewable Heat Initiative (RHI) concessions list, intended to encourage the use of non-fossil fuel systems. Installations will now qualify for a low-cost tariff in electricity supply providing they achieve a seasonal performance factor of at least 2.5. Geothermal and water-source installations have already been approved but air-to-air heat pumps have not yet been listed.
Sources: JARN, January 25, 2014
www.racplus.com

Heat pump heating subsidised up to 50 % in Beijing

Beijing has announced heat pump subsidies. The aim is to reduce coalfired and oil-fired heating systems and to promote heat pump systems. For deep geothermal heat pump installation as well as replacement of coal-/oil-fired heating systems with heat pumps, subsidy up to 50 % of initial cost will be offered. Until 2017, subsidy of 30 % of initial cost will be offered to heat pumps utilizing heat sources such as recyclable water exhaust heat and geothermal.
Source: JARN, February 25, 2014

India's RAC Energy Efficiency standard to rise from 2014

India's Bureau of Energy Efficiency (BEE) announced its first set of efficiency standards and labels for room air conditioner (RAC) in July 2006. The RAC labeling program introduced Minimum Efficiency Performance Standards (MEPS) and comparative labels simultaneously. BEE defined several successive program phases of increasing stringency. A phased approach has been adopted, wherein the rating plan has been upgraded every two years until an internationally benchmarked energy efficiency level is achieved. From January 2014, the energy efficiency level of RACs will enter the third stage of this plan.
Source: BEE; JARN, December 2013

New guide: HFC taxes & incentives on natural refrigerants in Europe

An increasing number of countries in Europe are adopting environmental taxes on HFCs or other fiscal incentives that could encourage the adoption of natural refrigerants.
Shecco's new publication "GUIDE+: HFC taxes & fiscal incentives for natural refrigerants in Europe" provides an overview of existing and proposed fiscal measures in key European countries, aimed at reducing the use and emissions of HFCs in HVAC&R sectors while encouraging the switch to climate-friendly technologies. This can be particularly interesting in the framework of the reviewed F-gas regulation in which the amount of HFCs placed on the EU market will have to be reduced by 79 % by 2030.
Source: www.ehpa.org

US Senators re-introduce Energy Efficiency bill

Recently, US senators Jeanne Shaheen (D-NH) and Rob Portman (R-OH) reintroduced their Energy Savings and Industrial Competitiveness Act. The new bill incorporates ten amendments that are intended to broaden support among Democrats and Republicans. According to analysis, this bill would support more than 190,000 net jobs in 2030, result in cumulative net savings of almost $100 billion from 2014 to 2030, and reduce CO_2 emissions by approximately 650 metric tons. The new version of this bill would, for example, support energy efficiency retrofits and renewable energy installations in schools, and help homeowners by including a home's expected energy cost savings when determining the value and affordability of energy efficient homes.
Source: www.ashrae.org

Working fluids

European Parliament ratifies partial ban on F-gases

The European Parliament has adopted an agreement struck in December to phase-down the use of F-gases. Members of the European Parliament voted 644 in favour, with 19 opposing and 16 abstentions.
The move has been welcomed by the Environmental Investigation Agency (EIA) and the European Environmental Bureau (EEB) as a significant step forward for the climate.
Clare Perry, head of EIA's Global Environment Campaign, said: "This is a hugely encouraging lead from Europe in the fight against climate change. With the EU showing a progressive lead in this field, this decision should act as a catalyst for future international negotiations in pursuit of a global deal to address

HFCs which, if achieved, could avoid emissions of up to 100 billion tonnes of CO_2-equivalent by 2050."
The European Heat Pump Association (EHPA) says it is very likely that the Regulation will be published before summer. Such a quick finalisation is favourable to the heat pump industry as it creates a clear framework to go forward, regarding research and development as well as investment decisions.
EHPA strongly believes that the members of the European Parliament's plenary have taken the right decision in adopting the consolidated F-gas text with a large majority. This only leaves the Council to formally endorse the Regulation before the text can go into translation and publication.
Source: www.acr-news.com and www.ehpa.org

EPA proposes transition plan to low-GWP refrigerants

The U.S. Environmental Protection Agency (EPA) has proposed a plan for a transition to "climate-friendly alternatives" to replace high-global warming potential (GWP) refrigerants. This was in response to President Obama's Climate Action Plan, which calls on the agency to use its authority under the Significant New Alternatives Policy (SNAP) program to identify and approve alternative refrigerants, while prohibiting some uses of the most harmful chemicals.
The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) reports that EPA announced that it was planning two separate proposed rulemakings. The first rule will be proposed in the spring and will expand the list of low-GWP alternative refrigerants for air conditioning and refrigeration. The second rule, which will be proposed this summer, will likely change the status of some common refrigerants to "unacceptable".
Source: www.achrnews.com

New guide tracks natural refrigerants market

shecco has launched the second edition of its GUIDE Europe, entitled "GUIDE 2014: Natural Refrigerants - Continued Growth and Innovation in Europe". The publication provides an overview of the market evolution of HVAC&R applications, using CO_2, ammonia, hydrocarbons, water and air.
Featuring data on the latest market trends, a business directory, new supermarket maps, and survey results from 376 European HVAC&R industry experts, the GUIDE EU 2014 builds on the 2012 edition.
The GUIDE Europe 2014 can be downloaded here.
Source: www.acr-news.com

DuPont responds to EC review on testing of HFO-1234yf

DuPont has responded to the European Commission's final report by the Joint Research Centre (JRC) on its review of testing of HFO-1234yf.
Thierry Vanlancker, president of DuPont Chemicals & Fluoroproducts, said: "DuPont is pleased with the final conclusions of the JRC, as they reinforce our high level of confidence that HFO-1234yf can be used safely in automotive air conditioning.
Source: www.acr-news.com

Technology

Phase change materials in domestic fridges

The application of phase-change materials (PCMs) in domestic refrigerators could be a novel solution to improve appliance thermal stability and efficiency. A team from the Department of Urban Engineering, London South Bank University, modeled compressor performance of domestic refrigerators equipped with PCM slabs of various sizes and positions. It was demonstrated that efficiency increased when a larger compressor was used in order to accumulate high cooling capacity in a PCM, thus increasing the refrigerator autonomy, i.e. off-cycle period, without power supply from a few minutes to several hours.
Source: IIR Newsletter, No. 57, January 2014,
www.ior.org.uk

Air-source heat pump waterless floor heating

Three enterprises in Henan Province, China, have collaborated to develop an air-source heat pump waterless floor heating system. Compared to traditional air-source heat pump floor heating, this technology could save energy by over 50 %. It combines direct expansion with a heat pump, to realise mild floor heating.
Sources: JARN, February 25, 2014

Markets

World air-conditioning market

Recently released figures by BSRIA concerning the 2013 global air-conditioning market showed total market value reached USD 89.9 billion for 117.2 million units. Unducted standard split systems constitute an overwhelming majority of units sold, representing 71.3 % of the market in terms of volume, followed by window systems at only 11 %, US ducted splits (5.4 %), fan coils (4.7 %) and ducted standard splits (2.2 %).
China represents 39.5 % of the market in terms of volume, the USA 13.9 %, Japan 7.6 % and Brazil 4.6 %. Other significant markets include India (2.9 %), Indonesia (2.2 %), Russia (2 %), Thailand, Saudi Arabia and South Korea, each with figures around 1.5 %.
Source: IIR Newsletter, No. 57, January 2014

Green Building Movement in India

The 11th edition of the Green Building Congress 2013, Asia's largest green building conference and exhibition, was held in Chennai, India, in October, including a conference on green homes, existing buildings, green interiors and green hospitals. With over 2,350 registered green building projects, amounting to about 0.17 billion m^2 of building footprint, India is one of the top three green building countries in the world. The government announced plans to construct over one million green homes in various municipalities all over the country within the coming four years.
Source: JARN, January 25, 2014

Heat pumps could bring 3 billion euro to Finland

A study by The Finnish Heat Pump Association (SULPU) and Gaia Consulting looks at the economic and environmental impacts of 320,000 Finnish households switching to heat pumps. Switching to ground source heat pumps would improve Finland's trade balance by 260 million euros.
A switch from oil and electric heating to ground source heat pumps would reduce household heating costs by 2.3 billion euros in the next 20 years.
Source: www.gaia.fi

Polish heat pump sales increased by 20 % in 2013

According to EHPA, the Polish heat pump market could confirm its strong growth path of the previous years. In total, 15 061 units have been sold in 2013 - an increase of 20 %. In recent years it has become clear that demand for air source heat pumps is growing. Especially popular are sanitary hot water (SHW) heat pumps with an increase in sales of approximately 39 % in 2013. This segment not only exhibits the fastest growth but also is the biggest one in absolute terms. With 7800 units sold, SHW heat pumps accounted for more than half the total sales in 2013. Compared to Western countries, the Polish market is still in the early stage of development; however; it looks very promising.
Source: www.ehpa.org

Japanese manufacturers keep watch on world market of heat pumps during HFC phase-down

Kenji Matsuda, Japan

Expansion of the heat pumps market has caused a surge in energy consumption, and many countries are focusing on adopting energy-saving technologies and schemes. Japanese manufacturers are making a big point of offshore production, as a result of which their share of the heat pumps market is approximately 30 %. Japanese manufacturers have a part to play in contributing to reducing world energy consumption. Japan has begun to move to low-GWP refrigerants for global warming prevention.

Introduction

Energy demand for heating, cooling and hot water production in Japan accounts for a high proportion of energy consumption by households and the commercial sector. Energy carriers/sources for heating, cooling and hot water production are electricity, gas and kerosene. Fossil fuels account for a large proportion of the energy sources used for production of these three energy carriers/sources.

Heat pump technology is useful for reducing energy consumption. In Japan, heat pumps are regarded as renewable energy technology. Looking at the history of heat pumps, the technology is not new: in fact, it goes back 100 years. Japanese manufacturers have developed many kinds of highly efficient refrigeration and air conditioners that are used worldwide.

Trend of world demand for air conditioners

Until 2012, the global air conditioning and refrigeration market grew rapidly (Figure 1). However, growth in emerging markets slowed in 2012 for the first time in several years. In the world market, there are signs of a shift to moderate growth after the last several years of high growth.

In its '2012 Estimates of World Demand for Air Conditioners', JRAIA (the Japan Refrigeration and Air Conditioning Industry Association) forecast an estimated total global air conditioner demand (RAC & PAC) of about 89,534 thousand units; a year-on-year decrease of 8 %. In 2012, although the air conditioning industry suffered from electricity shortages, post-earthquake reconstruction demand led to steady levels of air conditioner shipments.

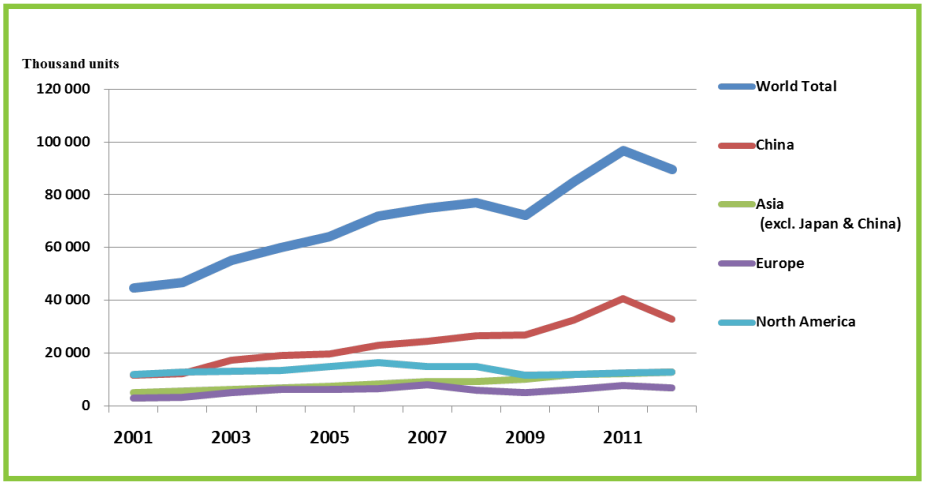


Fig1. Trend of World Demand for Air Conditioners (RAC & PAC)

Japanese share of world heat pump market

The Japanese market is small (Figure 2), so Japanese manufacturers increase their offshore production. Japanese manufacturers produce about 30 % of world production.

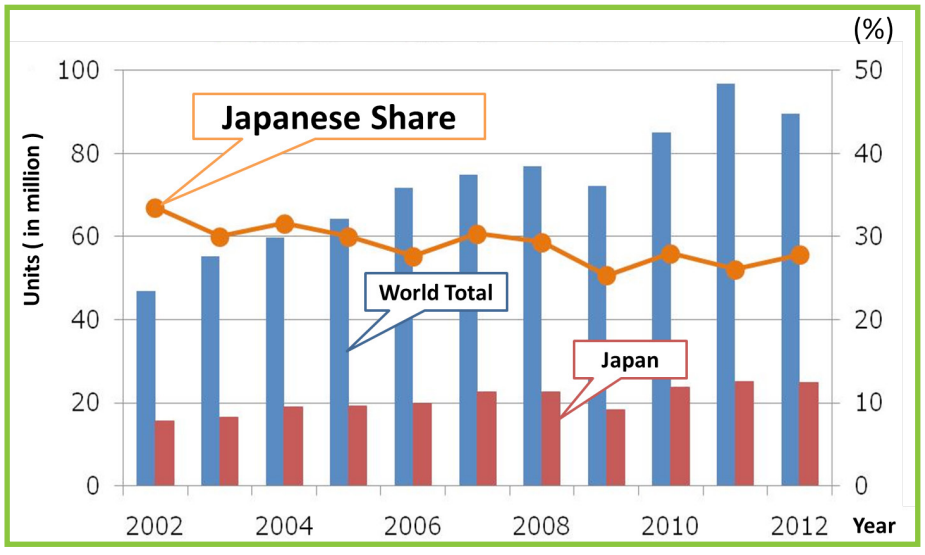


Fig 2. Japanese share of Heat Pump Market in the world

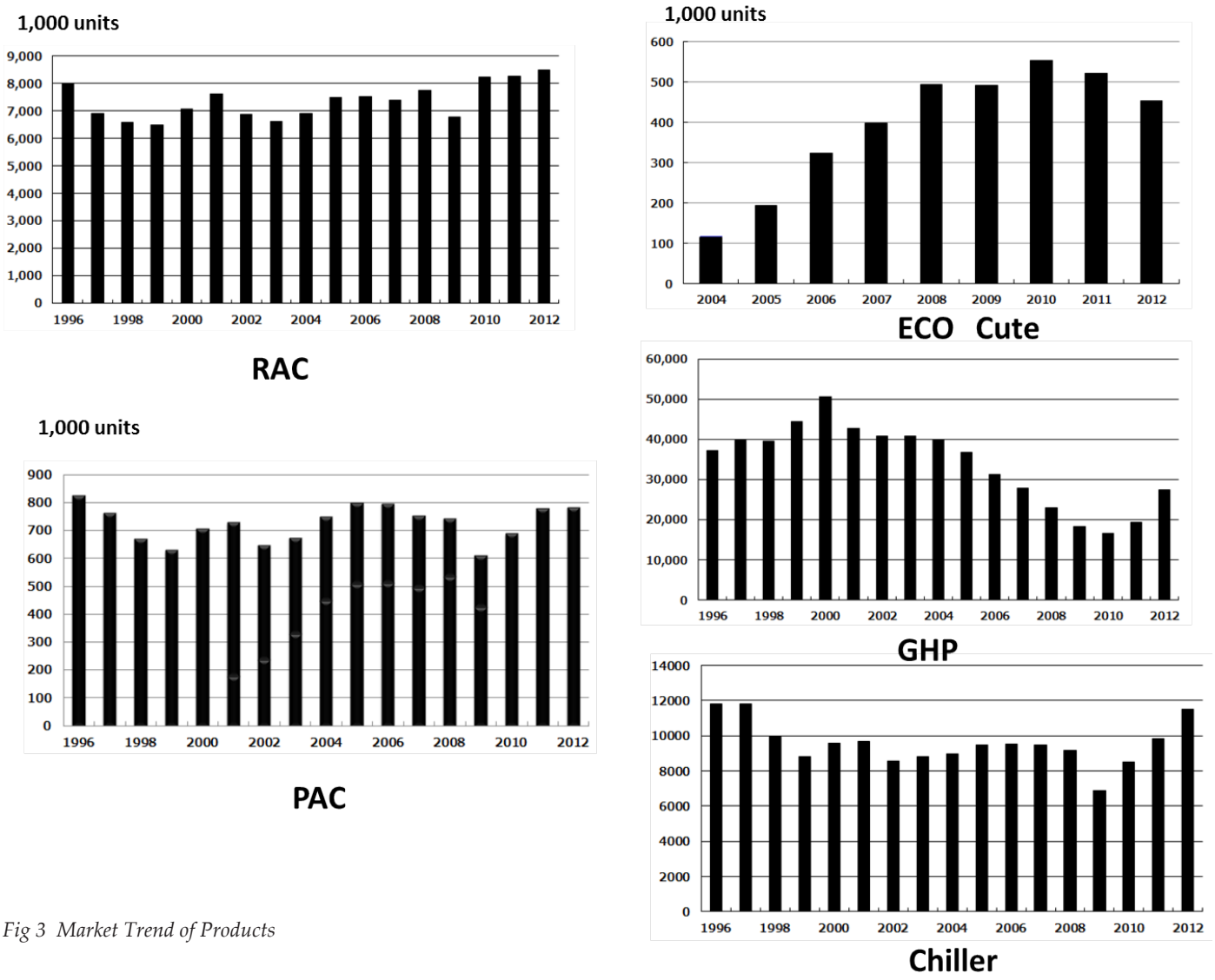


Fig 3 Market Trend of Products

Japanese manufacturers have a leading role to play in helping to reduce world energy consumption.

Product market trends

In 2012, domestic shipments of RACs amounted to a total of 8,486,555 units, up 2.5 % over 2011 (Figure 3). RACs are increasingly regarded as a year-round product. RAC displays by electronics retailers used to shrink in winter, but recently retailers are maintaining the same size display space in winter as in summer.

VRF demand for 2012 exceeded demand in 2011. The Japanese market size is estimated as amounting to about 130,000 units, an increase of 10 % over 2011.

GHP (Gas Heat Pumps) were commercialised in Japan 25 years ago, and are once again enjoying the spotlight as Japan re-evaluates its energy use and policy. Annual GHP sales peaked at roughly 50,000 units in 2000, and trended downward thereafter, but now the market is showing an impressive V-shaped recovery. Interest in using GHPs - which consume less power than electrically driven systems - in commercial air conditioning installations has grown as a way of contributing to smoothing electricity demand. After the disaster, the market began to grow due to restoration demand for rebuilding.

'Eco Cute' is a name given to residential and commercial heat pump water heaters in Japan that use carbon dioxide (CO_2) as refrigerant. Commercial air-to-water (ATW) heat pump water heaters also include those that use HFC refrigerant (R410A). Since their debut in 2001, Eco Cute heat pumps continued to sell well until 2008. However, in fiscal year 2009 (ending March 2010), Eco Cute sales showed only a slight increase, before falling sharply in 2011, to 12.3 % less than in the previous year, due to the earthquake and tsunami that struck Japan in March, the subsequent disaster at Tokyo Electric Power's nuclear power plant, and the electricity shortage caused by suspended operations at other nuclear power plants undergoing inspection. Eco Cute units are attracting attention for their high energy saving performance, their ability to heat water mainly by night-time electricity, which serves to reduce peak power consumption, and the

ability to use the water stored in the tank in the event of an earthquake or other disaster that disrupts the water supply.

The Japanese ATW (Air to Water heat pump) market reached 454,000 units in 2012, being a 12.8 % decrease from the previous year.

Displacement-type (screw, scroll and rotary) chillers were down about 4.0 % in fiscal year 2012 compared with the previous year, when 12,238 units were shipped. The Japanese centrifugal chiller market has shown a downward trend in recent years. In Japan, the number of air-cooled scroll chillers with inverter control is rising, as they can be used in modular systems that offer easier delivery and installation.

Shift to R32 refrigerant in the Japanese market

Last year, Daikin was the first to launch residential air conditioners using R32 refrigerant for the Japanese market. Following this, Mitsubishi Electric, Hitachi and Panasonic announced their new models using R32 in 2013.

The total market share of these four companies accounts for about 80 % and cumulative sales of R32 air conditioners have exceeded 800 000 units. Seeing this momentum, the next generation refrigerant of residential air conditioners for the Japanese market will most likely be R32.
JRAIA and JSRAE (the Japan Society of Refrigerant and Air Conditioning Engineers) are jointly conducting a risk assessment of L2L refrigerant (R32, R1234yf, R1234ze), and publish progress reports every year. On the basis of these reports and other risk assessments, the manufacturers concluded that R32 can be used for wall-mounted RACs without problems, if suitable counter-measures are taken to deal with any R32 leakage. With this conclusion, they all announced R32 air conditioners. Needless to say, the Government or industry association does not make a decision on the use of R32, but leaves the decision to each air conditioner manufacturer. However, R32 has the advantage in cost and cooling performance over R410A. In addition to this advantage, switching to R32 is worthwhile from the global warming prevention point of view, as the GWP of R32 is one-third of that of R410A. In addition, R32 is easy to recover and reclaim, as it is a single-component refrigerant. The above-mentioned risk assessment of the mild flammability of R32 for PACs, VRF systems, chillers and other equipment is still in progress. If the completed assessment concludes that there is no critical problem, then manufacturers would step forward to use R32 in those products.
However, Japan has its High Pressure Gas Safety Law, and legal interpretation of the position of R32 is vague. It is difficult to use R32 in systems requiring more than three statute tonnes of R32, unless the R32 is defined as an inert gas for the purposes of the legislation. The industry is now requesting relaxation of the regulations.

The next generation of refrigerants will be a key theme at the International Symposium on New Refrigerants and Environmental Technology 2014, to be held in November 2014, organised by JRAIA.

Conclusion

The Bill for amendment of the Fluorocarbons Recovery and Destruction Law passed the Diet (the Japanese Parliament) in June 2013.
The Ministry of Economy, Trade and Industry (METI), and the Ministry of the Environment (MOE), are jointly to submit the Bill to this session of the Diet. The Bill aims to encourage the move away from fluoro-carbons currently in use for (mainly) air conditioning and refrigeration units, to the low-GWP or non-fluorocarbon refrigerants. JRAIA welcomes this amendment, because it accords with JRAIA's policy for global warming prevention. Japanese manufacturers will make another leap towards energy-saving and global environmental issues.

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References

[1] Japan Air Conditioning, Heating & Refrigeration News Serial No. 529-539

Ongoing Annexes

IEA HPP Annex 35 / IETS Annex 13 Application of Industrial Heat Pumps

Annex 35, a joint venture of the IEA "Industrial Energy-related Technologies and Systems" (IETS) and "Heat Pump Programme" (HPP) Implementing Agreements, is due to be concluded on 30th April 2014. The framework of the programme has consisted of the following tasks:

1. Market overview and barriers for application
2. Modelling of calculation and economic models
3. Technology
4. Application and monitoring
5. External communication

At this stage, work is concentrated on preparation of the final reports of the different tasks:
Final reports for Task 1 (Market overview), Task 3 (R&D), and Task 4 (Case Studies) are nearly completed, with contributions from the majority of member countries.
Task 2, "Modelling of calculation and economic models" is still concentrated on analysis and appraisal of possible contributions of heat pumps to energy efficiency and reduction of greenhouse gas emissions in industrial processes. At present, only some results are at the presentable stage.
Task 5, "Communication and Presentation of the Annex Reports and Results" is still at an early stage of production.

As the next IEA Heat Pump Conference will take place on 12-16th May 2014 in Montreal, Canada, it has been decided to organise a final Annex 35 Workshop on 12th May in Montreal.

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IEA HPP Annex 36 Quality Installation / Quality Maintenance Sensitivity Studies

Annex 36 is evaluating how installation and/or maintenance deficiencies cause heat pumps to perform inefficiently (i.e., decreased efficiency and/or capacity). Also under investigation are the extent that operational deviations are significant, whether the deviations (when combined) have an additive effect on heat pump performance, and whether some deviations (among various country-specific equipment types and locations) have greater impact than others. The focus and work undertaken by each participating country is presented in the table below.
The intended audience for the Annex 36 output includes:

- HVAC practitioners responsible for designing, selecting, installing, and maintaining heat pump systems in varied applications.
- Building owners/operators interested in achieving improved comfort conditioning and efficiency performance from their HVAC equipment.
- Entities charged with minimizing energy utilization in varied heat pump applications and geographic conditions (i.e. utilities, utility commissions, energy agencies, legislative bodies, etc.)

The three-year effort is drawing to a close and results are to be presented at an Annex 36 workshop held in conjunction with the upcoming 11th IEA Heat Pump Conference (Montreal, Quebec, Canada; 12 – 16 May 2014). The Annex 36 final report is to be completed and submitted to the IEA HPC by mid-2014.

Contact: Glenn C. Hourahan,
Glenn.Hourahan@acca.org

Annex 36 Participants	Focus Area	Work Emphasis
France	EdF – Space heating and water heating applications.	Field: Customer feedback survey on HP system installations, maintenance, and after-sales service. Lab: Water heating performance tests on sensitivity parameters and analysis.
Sweden	SP – Large heat pumps for multi-family and commercial buildings KTH/SVEP – Geothermal heat pumps	Field: SP – Literature review of operation and maintenance for larger heat pumps. KTH/SVEP - investigations and statistical analysis of 22000 heat pump failures. Modeling/Lab: Determination of failure modes and analysis of found failures (SP) and failure statistics (KTH/SVEP).
United Kingdom	DECC – Home heating with ground-to-water, water-to-water, air-to-water, and air-to-air systems.	Field: Replace and monitor five geothermal heating systems Lab: Investigate the impact of thermostatic radiator valves on heat pump system performance.
United States (Operating Agent)	NIST – Air-to-air residential heat pumps installed in residential applications (cooling and heating).	Modeling: Examine previous work and laboratory tests to assess the impact of ranges of selected faults covered augmented by seasonal analyses modeling to include effects of different building types (slab vs. basement foundations, etc.) and climates in the assessment of various faults on heat pump performance. Lab: Cooling and heating tests with imposed faults to model the performance of a heat pump operating under those faults.

ACCA Air Conditioning Contractors of America
DECC Department of Energy and Climate Change (UK)
EdF Electricité de France
KTH Royal Institute of Technology (Sweden)
NIST National Institute of Standards and Technology (US)
ORNL Oak Ridge National Laboratory (US)
SP Technical Research Institute of Sweden
SVEP Swedish Heat Pump Association

IEA HPP Annex 38 Solar and heat pump systems

The objective of Annex 38 of the Heat Pump Programme (which is also Task 44 of the IEA Solar Heating and Cooling Programme), is the assessment of the performance and suitability of combined systems using solar thermal collectors and heat pumps.

Annex 38 was concluded in December 2013. All reports are being completed during the first months of 2014, and the final handbook will be published by Wiley-VCH Editor around June 2014. The main conclusions of the work can be summarized as :

Systems:

- More than 80 manufacturers from eleven countries provided information on their systems available on the market in 2010-2012.
- The survey showed that the idea of combining solar heating and heat pumps is a fascinating idea in the HVAC industry, since a clear market aim is to supply complete systems rather than components, and the SHP combination represents a system that can deliver both heating and domestic hot water all year long.
- A great variety of combinations of solar collectors and heat pump was found.
- The work of Annex 38 has brought some order by establishing a clear classification of solutions, as follows: Parallel, Serial, Regenerative, and More Complex systems (P, S, R and C).
- We also have established a way to represent any combinations in a systematic energy flow chart diagram that simplifies understanding of a system without losing information. This chart is available as a simple Excel tool from our web site.
- Surveys showed also that there was a need for test methods and performance factor definitions, since a combination of solar heating and heat pumps was still a complex system.

Simulation

- Annex 38 has shown that basic models for simulating components in solar and heat pump systems are available. Features have been analysed and reported, and recommendations for choosing an adequate model have been formulated.
- Simulations and field monitoring have shown the great importance of storage in a combined system, and of storage stratification for better performance.
- We also showed that there is a need of data for modelling variable-capacity or variable-speed heat pumps, and special heat pumps based on advanced concepts.
- There is a lack of simulation models for complex effects appearing in storage tanks: namely, the mixing of heated water and the loss of exergy due to high velocities of incoming flow or poor introduction geometry.
- Annex 38 has set up a framework for simulating SHP systems in different climates and for different loads. The framework is an international collaborative work and will be very useful for national work as well.
- Participants in Annex 38 simulated more than 20 different system concepts using the common tools.
- Simulation results show that the solar benefit contribution to an SHP system can be substantial.
- Design recommendations were formulated based on simulation results.

Performance assessment

- In terms of reporting performance of an installation, we showed that there is a need for different performance figures for different purposes, such as energy evaluation, environmental analysis or economic aspects.
- There is also a need to take all components into account in any performance calculation (pumps, controllers, displays, fans, valve actuators, etc.), since this can make the difference between a good system and an unacceptable one. i.e. with too low a seasonal performance factor (SPF) when auxiliary electricity is considered, as it should be.
- System boundaries have been defined in order to calculate all relevant performance indicators. The method that we have derived from the energy flow chart description of a system can be applied to any kind of system, and not only to solar and heat pump systems.
- We have derived the correct definitions for System Performance Factors that take the overall system into account. Engineers and manufacturers can refer to our work to specify the SPF within common boundaries: a necessary basis for a system comparison.

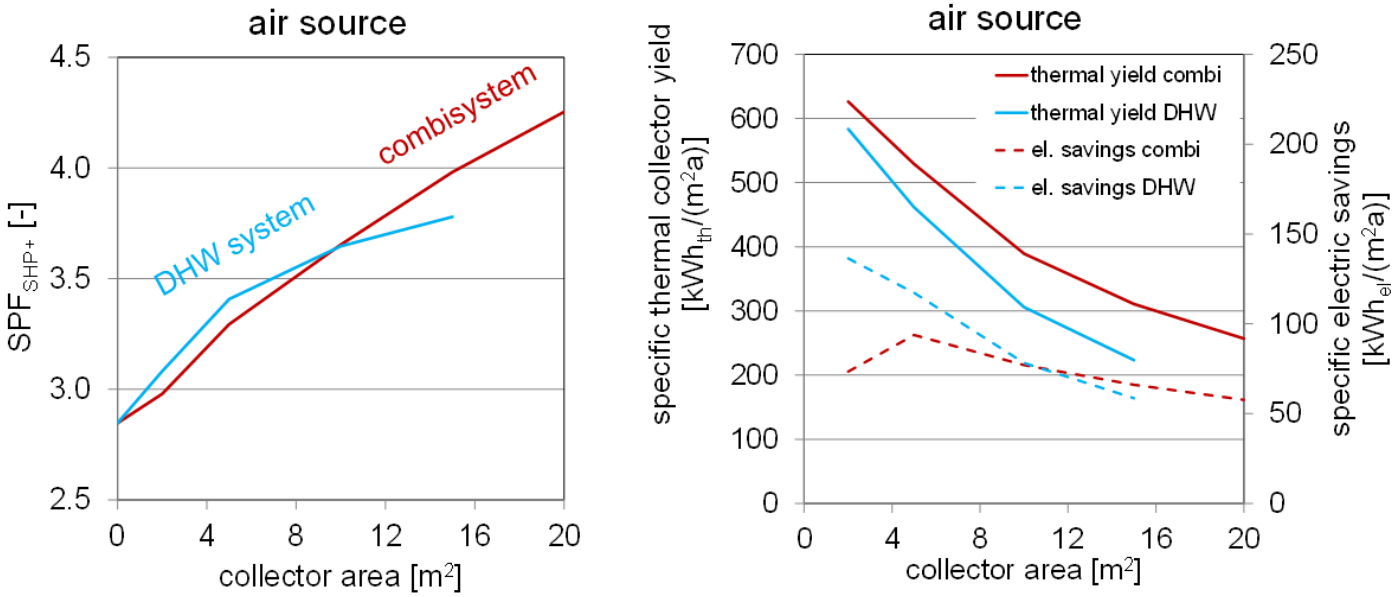
Laboratory testing

- Laboratory testing is important, since SHP are complex systems with complex dynamic interactions. System testing is fundamental to the process of developing SHP systems and can provide relevant information for performances, failures, default behaviour etc. in a short time.
- There are different methods of testing SHP in laboratories over a defined cycle of twelve days. We have described the main ones used in European laboratories.

Systems monitored in-situ

- Participants have provided 1 to 2 years of monitored results from 50 different systems in seven countries, covering not only the variety of systems on the market but also prototype systems. The variance of results was found to be large (from SPF 1.5 to 6).
- Reasons for the variety of results have been analysed.
- Although Parallel systems are the most common and the simplest to operate, well-performing systems were found in all categories (P/S/R/C), and good integration of all components was shown to be possible. Some best practice examples have been reported.

Annex 38 has delivered much information on the performance of combined solar and heat pump systems.



Annex 38: What does solar heating add to the whole? Performance of air-source solar and heat pump systems, where solar heating is used for DHW only (DHW) or for a combined system with combined storage (combi). (Simulations of SPF in reference conditions.) For more results refer to the Annex book to appear in 2014.

It has developed tools to simulate any system combination, as well as performance indicators that should be calculated for fair comparisons between systems. Comprehensively monitored systems have shown that high SPF values can be delivered if design and commissioning are carefully carried out.
Solar heating can be a good heat source for heat pumps as an alternative or a complement to air and ground sources.

References http://task44.iea-shc.org/
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References http://task44.iea-shc.org/

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IEA HPP Annex 40 Heat pump concepts for Nearly Zero Energy Buildings

The objective of IEA HPP Annex 40 is to investigate and improve heat pump systems used in Nearly or Net Zero Energy Buildings (nZEB). Six countries - CH, JP, NL, NO, SE and US - started the work of Annex 40 at the beginning of 2013, and were joined by Canada and Finland at the end of 2013.

Task 2 and Task 3 are concerned with analysis of nZEB heat pump concepts, technology developments, and field monitoring. Canada is represented by Hydro-Québec: CANMET Energy, of Natural Resources Canada, is also interested in joining. The participating institutions will deliver a state-of-the art overview of installed nZEB in Canada containing field test results, which will be followed by a techno-economic analysis of heat pumps in different building types (new building/retrofit) and uses (single and multi-family residential buildings, office buildings). Another focus is that of system integration of the heat pump with other heat sources, such as CHP and solar technologies. In addition, components will be lab-tested, and field results will be contributed, resulting in identification of best-practice systems for nZEB in Canada.

Finland is represented by Green Net Finland, the country's research institute VTT, and Aalto University, as well as by the Finnish Heat Pump Association, SULPU. Finland will investigate energy-efficient and cost-effective solutions for different heat pump types in three building envelope categories (new building standards and retrofit) by simulation modelling. The results will provide a basis for field testing and recommendations on heat pump technologies for Finnish nZEB.

Interim results from IEA HPP Annex 40 will be presented at the IEA Heat Pump Conference 2014 in Montréal, within the framework of a workshop.

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IEA HPP Annex 41 Cold Climate Heat Pumps

Heat pump technology provides a significant potential for CO_2 emissions reduction. Annex 41 will revisit research and development work in different countries to examine technology improvements leading to successful heat pump experience in cold regions. The primary focus is on electrically driven air-source heat pumps (ASHP) with air (air-to-air HP) or hydronic (air-to-water HP) heating systems, since these products suffer severe loss of heating capacity and efficiency at lower outdoor temperatures. Thermally activated (engine-driven, absorption, etc.), ASHPs and ground-source heat pumps (GSHP) may also be included in individual country contributions, if desired. The main technical objective is to identify solutions leading to ASHPs with heating SPF ≥ 2.63, recognized as a renewable technology. The main outcome of this Annex is expected to be information-sharing on viable means to improve ASHP performance under cold (≤ -7°C) ambient temperatures.

During the past quarter Canada became the 4th HPP member country to join the Annex. The Annex web site is http://web.ornl.gov/sci/ees/etsd/btric/usnt/QiQmAnnex/index-Annex41.shtml. The next planned meetings of the Annex are a workshop and brief business meeting to be held at the 11th International Heat Pump Conference in Montreal. A draft program for the Workshop has been submitted to the conference organizers. The final Annex meeting and workshop are planned for August 2015 in Yokohama, japan during the 2015 International Congress of Refrigeration. The Annex officially began in July 2012 and is expected to run through September 2015.

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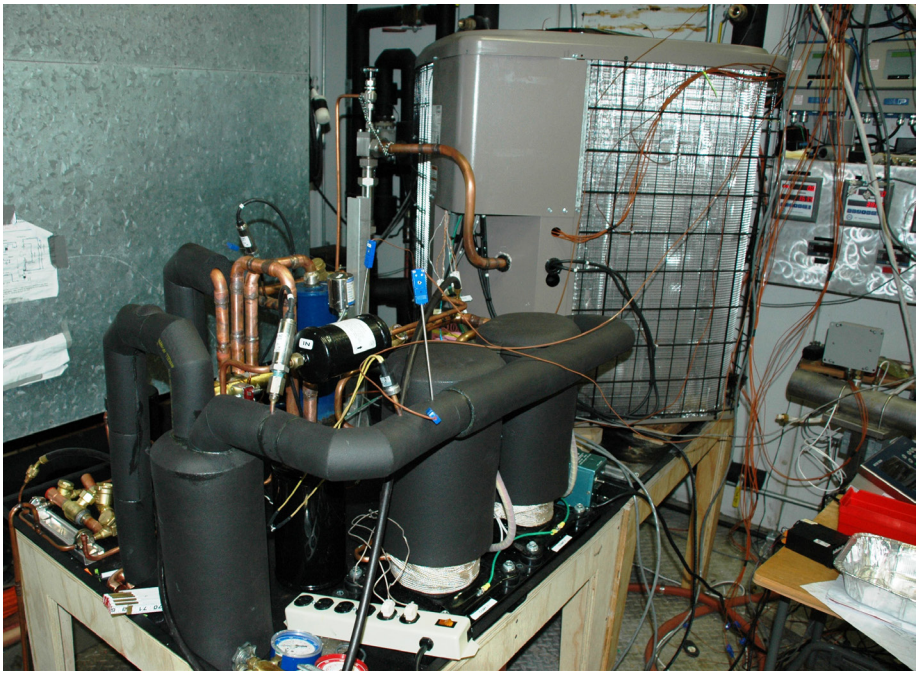
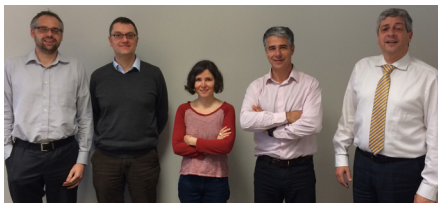


Annex 41: Dual-compressor lab prototype CCHP test system at ORNL – compressor subassembly in foreground

IEA HPP Annex 42 Heat Pumps in Smart Grids

We had a successful meeting in Nürnberg on 16th October 2013 and, as the operating agent, are making steady progress on the work. Although it might seem that 'no real work' has been done yet, we think that actual results are already visible. A growing number of countries - confirmed participants being the United Kingdom, The Netherlands, South Korea, the USA, Switzerland and France, with Denmark, Sweden, Finland, Austria and Germany in the process of becoming full members - are interested in joining the annex.



During the last meeting, progress was made on gradually consolidating the annex into a more defined shape. Task leaders have been appointed, with task descriptions, expected outputs, planning and a table of contents of the task report being subject to further discussions.

This work was continued at the meeting on 13th and 14th February 2014 at EDF in France. During our meeting progress was made on task description and execution. In connection with this meeting, we also visited EDF's sophisticated smart-grid simulation facilities, which was of great interest for the participants.

A workshop meeting was held at EDF in January 2014 as preparation for the main meeting in February, and also to familiarise EDF personnel with the content of the project.

As Operating Agent, we will also participate in the tri-annual heat pump conference in Montreal, including a workshop on heat pumps in smart grids, accompanied by a regular Annex 42 project meeting.
We intend, in the not too distant future, to launch an Annex 42 website.

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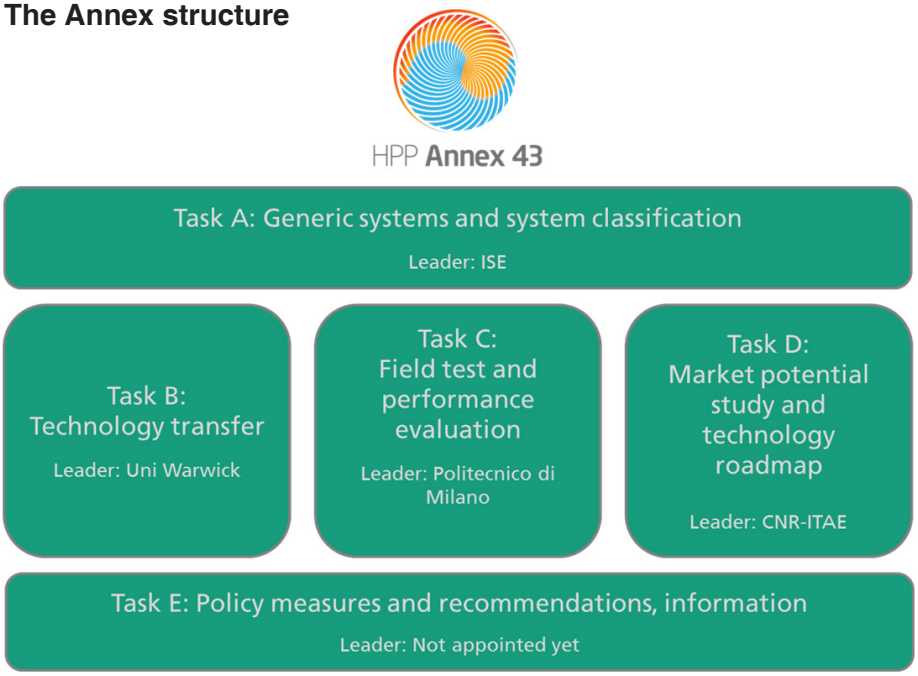
IEA HPP Annex 43 Fuel-driven sorption heat pumps

During the work in Annex 34 "Thermally Driven Heat Pumps for Heating and Cooling", there was a rising interest in the area of fuel driven sorption heat pumps, and more and more products came closer to market. Since we learned during the process of Annex 34 that the fields of solar thermal cooling and fuel driven heat pumping need different measures for a wider market penetration, there was a common understanding to continue this work in two different Annexes or Tasks. Therefore, the work of Annex 34 regarding solar thermal cooling is continued within the IEA SHC Task 48 "Quality assurance and support measures for Solar Cooling", while for the continuation of the fuel driven heat pumps part, a new Annex "Fuel driven sorption heat pumps" was proposed to the ExCo in March 2012. After an Annex definition meeting, a legal text was written, and as draft accepted by the Exco, so Annex 43 started officially in July 2013 with a duration of four years. A kick-off meeting was held on October 9-10, 2013 in Freiburg, Germany, with participants from six countries. The main topics were the finalisation of the Legal Text and the work plan and setting up the organisational framework

Objectives

The scope of the work under this Annex will be the use of fuel driven sorption heat pumps in domestic and small commercial or industrial buildings or applications. If applicable, the additional possibility of supplying cold will also be considered. The main goal is to widen the use of fuel driven heat pumps by accelerating technical development and market readiness of the technology, as well as to identify market barriers and supporting measures. A field test, as well as proposing performance evaluation figures and optimal system layouts, are among the means of this Annex.

The Annex structure



The tasks are further specified as folows.

Task A: Generic Systems and System Classification
Available sources and heating systems
Existing market and regulatory boundary conditions
Control strategies
Evaluate different fuels (oil, gas, wood -> no hot water)

Task B: Technology Transfer
Link research to industrial development for faster market penetration of new technologies
Novel materials (e.g. MOFs for adsorption heat pumps)
Novel components (integrated evaporators/condensers, compact heat exchangers)
System designs (e.g. façade collector as heat source)

Task C: Field test and performance evaluation
Measurement/monitoring procedures standardisation (e.g. how to cope with different fuel quality, system boundaries, aux. energy, etc.)
Continue work from Annex 34 and Task 44 and extend standards to seasonal performance factors at a system level
Develop quality insurance procedures in cooperation with IEA SHC Task 48

Task D: Market potential study and technology roadmap
Simulation study to evaluate different technologies in different climate zones, different building types and building standards
Combine with market data and actual building stock for technology roadmap

Figure 1 Group picture from the Kick-off meeting held in Freiburg, Germany, October 2013

Task E: Policy measures and recommendations, information
Dissemination
Workshops for planners, installers and decision makers
Develop recommendations for policies, e.g. building codes and funding schemes

Within Task A, a template for the country report was prepared by ISE and send out to the participants.
A presentation about this Annex was given at the Heat Pump Summit 2013 (15-16. October 2013 in Nuremberg, Germany, and an abstract was submitted in to the International Sorption Heat Pump Conference in March 2014, in Maryland, USA

So far, four countries confirmed joining the annex (DE,UK, FR, IT), several more have expressed their interest (Austria, USA), but of course more participants are welcome.

The next Annex meeting is planned into be held in May 2014 in Milan.

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IEA HPP Annex 44 Performance indicators for energy efficient supermarket buildings

The second Annex 44 meeting was held on November 25th, 2013 in Utrecht, The Netherlands, with participants from Sweden and The Netherlands. The meeting venue was provided by Agency NL – which has since changed its name to "Netherlands Enterprise Agency" (RVO.nl) as of January 1st, 2014.

The Swedish team gave a presentation at the meeting of the Swedish reference group for the Annex, which brings together trade associations, supermarket chains, supermarket owners, suppliers and consultants. The Dutch team presented an overview of the Dutch supermarket sector, including the possible supermarket chains from which data can be collected.

An important choice has been made concerning the form which the central formula (for relating supermarket energy consumption to performance indicators) will take. We aim to develop a formula that allows a flexible number of performance indicators to be included, and to provide an estimate of accuracy (for the calculated energy consumption) for each set of performance indicators that can be chosen. In this way, it will be possible to obtain accurate results when many performance indicators are known, and still to obtain an estimate – albeit less accurate - when only a few indicators are available.

The next Annex meeting will be held alongside the International Conference on Sustainability & the Cold Chain (ICCC 2014, June 24-25, London). By then, we expect to have broadened participation to also include Norway, alongside the current participation from Sweden and The Netherlands. Annex 44 is still open for additional participants.

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Ongoing Annexes

Bold text indicates Operating Agent. ** Participant of IEA IETS or IEA SHC

Annex 35 Application of Industrial Heat Pumps (together with Task XIII of "Industrial Energy-Related Technologies and Systems" (IEA IETS))	35	AT, CA, **DE**, DK, FR, JP, KR, NL, SE
Annex 36 Quality Installation/Quality Maintenance Sensitivity Studies	36	FR, SE, UK, **US**
Annex 37 Demonstration of Field measurements of Heat Pump Systems in Buildings – Good examples with modern technology	37	CH, NO, **SE**, UK
Annex 38 Solar and Heat Pump Systems	38	AT**, BE**, CA**, **CH**, DE, DK**, ES**, FI, FR**, IT**, UK
Annex 39 A common method for testing and rating of residential HP and AC annual/ seasonal performance	39	AT, CH, DE, FI, FR, JP, KR, NL,**SE**, US
Annex 40 Heat Pump Concepts for Nearly Zero-Energy Buildings	40	CA, **CH**, DE, JP, NL, NO, SE, US
Annex 41 Cold Climate Heat Pumps (Improving Low Ambient Temperature Performance of Air-Source Heat Pumps)	41	AT, CA, JP, **US**
Annex 42 Heat Pump in Smart Grids	42	FR, KR, **NL**, UK, US
Annex 43 Fuel Driven Sorption Heat Pumps	43	**DE**, FR, IT, UK, US
Annex 44 Performance Indicators for Energy Efficient Supermarket Buildings	44	**NL**, SE

IEA Heat Pump Programme participating countries: Austria (AT), Canada (CA), Denmark (DK), Finland (FI), France (FR), Germany (DE), Italy (IT), Japan (JP), the Netherlands (NL), Norway (NO), South Korea (KR), Sweden (SE), Switzerland (CH), the United Kingdom (UK), and the United States (US).
All countries are members of the IEA Heat Pump Centre (HPC). Sweden is the host country for the Heat Pump Centre.

Outline of the building energy standard in Japan and evaluation of heat pumps in the standard

Hisashi Miura, Japan

Primary energy consumption in the commercial and residential building sectors in Japan represents approximately 34 % of the country's total energy consumption, and has been increasing steadily. With the aim of decreasing energy consumption, a new building energy standard was implemented in 2013: the Government has announced that it will become mandatory by 2020. This article presents an outline of the standard and how energy performance of heat pumps is evaluated in it.

Outline of the Building Energy Standard

In Japan, the Energy Conservation Act was implemented in 1979 and, based on it, the first Building Energy Standard was enforced in 1980. The standard consisted of two parts: one for commercial buildings, and the other for residential buildings. The commercial buildings standard evaluated the energy performance of the building envelope and five types of energy demand, for air conditioning, lighting, ventilation, hot water and elevators, separately. The residential standard evaluated only the performance of the building envelope. These standards were substantially revised in 2013, and introduced a new common index "Designed Primary Energy Consumption" (GJ / year) (Fig. 1), to represent the energy performances of both commercial buildings and residential buildings. When constructing or renovating large buildings, with floor areas of 300 m^2 and more, reporting the energy performance based on the standard is mandatory. On the other hand, reporting is voluntary for small buildings. However, buildings which apply the standard can receive various benefits such as tax benefits and subsidies. Although these energy standards are at present voluntary for some buildings, compliance with them will be mandatory by 2020.

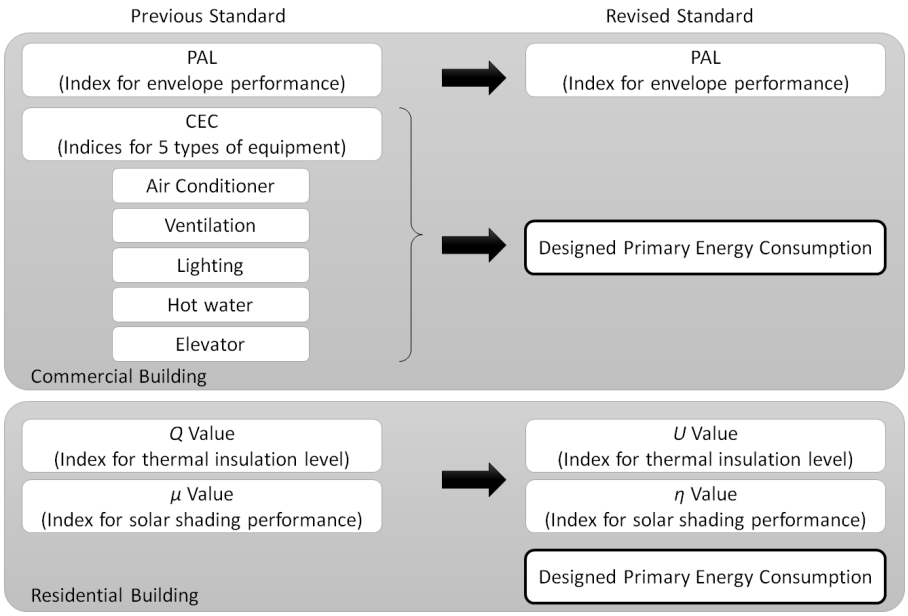

Fig. 1 Indices for energy performance in the standards

Design primary energy consumption

In order to comply with the standard, the design primary energy consumption calculated for a applied building should not exceed the reference primary energy consumption. Both the design and the reference primary energy consumptions are based on the same method of calculation. The design primary energy consumption must be calculated based on the building envelope and equipment specification of the building, while the reference primary energy consumption must be calculated based on the building envelope and equipment specification defined in the standard, which are of equivalent performance to the corresponding features of the building as normally used in Japan (Fig. 2). Occupants' behaviour, such as how length of occupation per day, and duration and frequency of use of the building services, is previously defined for each building/space usage in the standard, and it can be therefore said that the design primary energy consumption is a kind of benchmark test value for energy conservation at the design stage.

Methods for calculating the design primary energy consumption are published in textbooks and on the web page of the Building Research Institute (BRI) (Fig. 3). Since these methods are very complex, web-based calculation programmes have also been developed and are available on the BRI home page (Fig. 4). The programmes are hosted on web servers: local computers simply send the input data to the servers and receive

the results from them, which means that designs can be calculated by any computer, including tablet-type devices. Applicants normally calculate and prepare application forms by utilizing these programmes.

Estimation of energy performance of heat pumps

Energy consumption for space heating and cooling is calculated on an hourly basis, with design primary energy consumption being the sum of these hourly energy consumptions over a period of one year (Fig. 5). Since the efficiency of heat pumps depends strongly on the outdoor temperature and the heating or cooling load, efficiency curves for various systems are defined in the standard. These efficiency curves were developed based on various experiments and simulations (Fig. 6) in a research project by BRI and the National Institute for Land and Infrastructure Management (NILIM). Outdoor temperatures are also defined in the standard. Building areas in Japan are divided into eight climate zones, based on the number of heating degree-days: the tables of standardised hourly outdoor temperatures are updated for each revision. The hourly heating and cooling loads are calculated based on the data given in the standard for the building envelope performance and the intended use of the building or space.

Based on this calculation, the differences in the efficiency of heat pumps between the different climate zones can be considered. The reduction in average efficiency resulting from mismatching of the heat pump capacity with the heat load, such as overcapacity of the equipment, can also be evaluated. Additionally, operating conditions such as climate and building usage are identical for various types of the equipment (e.g. gas boilers, heat pumps, electric heaters), thus enabling users and designers to compare the energy performance of any types of equipments by using this calculation program.

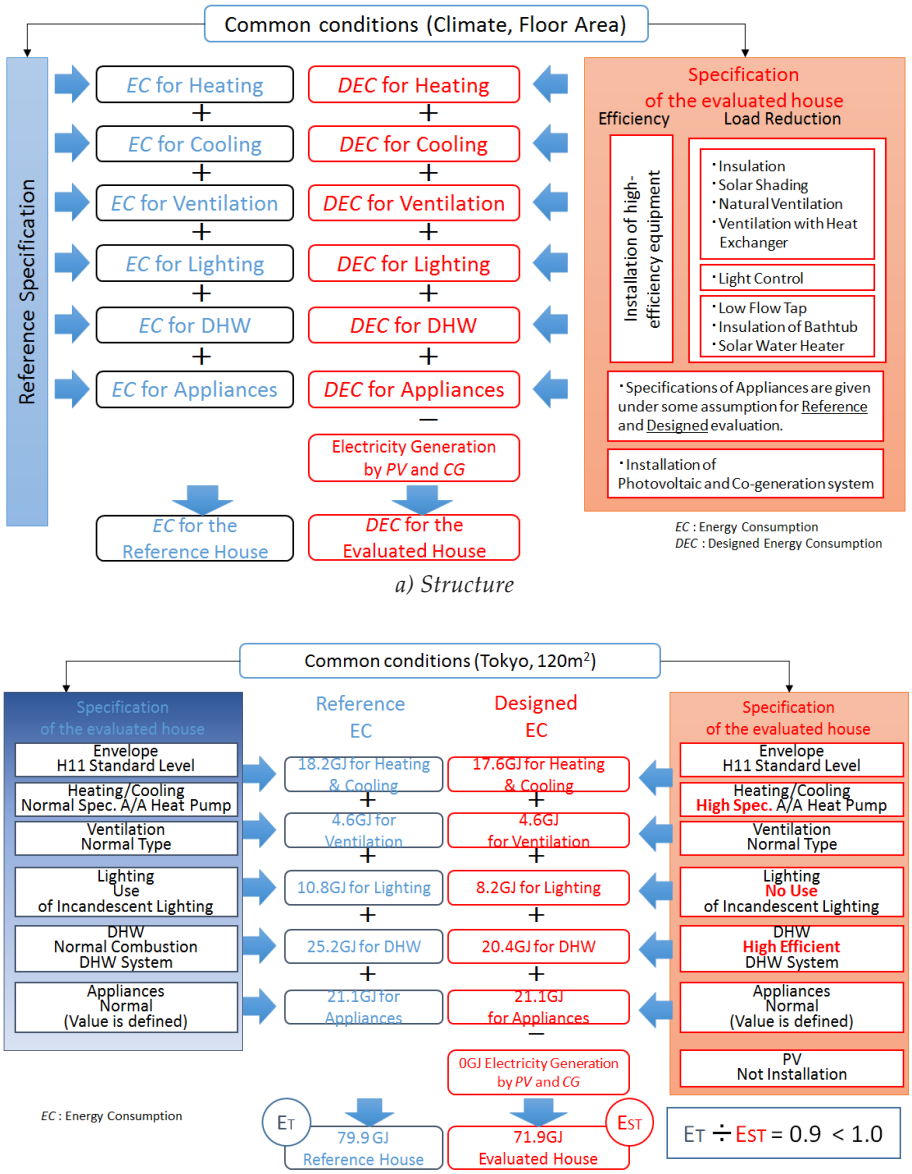

*Fig. 2 Reference and design primary energy consumption**
** For residential buildings. For commercial buildings, the energy consumption for elevators is added.*

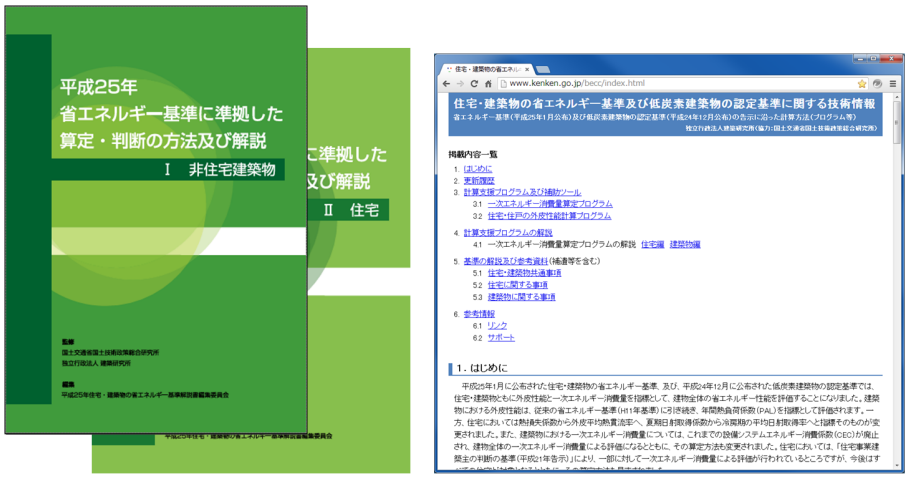

Fig. 3 Textbooks and BRI web page for the standard*
** http://www.kenken.go.jp/becc/*

Conclusions

This report described the outline of the recently revised building energy standard and its energy calculation tools, and also described how to estimate the energy performance of heat pumps.

There are many indices to represent the energy efficiency of heat pump such as APF, COP and EER. These indices can be measured values under rated test conditions, or calculated values assuming the given operating conditions. Alternatively, designers can investigate the effects of changing various building characteristics such as envelope performance, climate, utilisation of cross ventilation and heat exchangers, and can also compare the performance of various types of heating systems such as combustion boilers or electric heating.

We can say that indices based on a specific and defined set of conditions, such as APF, COP and EER, can be used for comparing the performances of heat pumps of the same type, and so promoting competition in terms of technological development. "Designed Primary Energy Consumption" can also be used by designers and users for designing and selecting the equipment for a given building.

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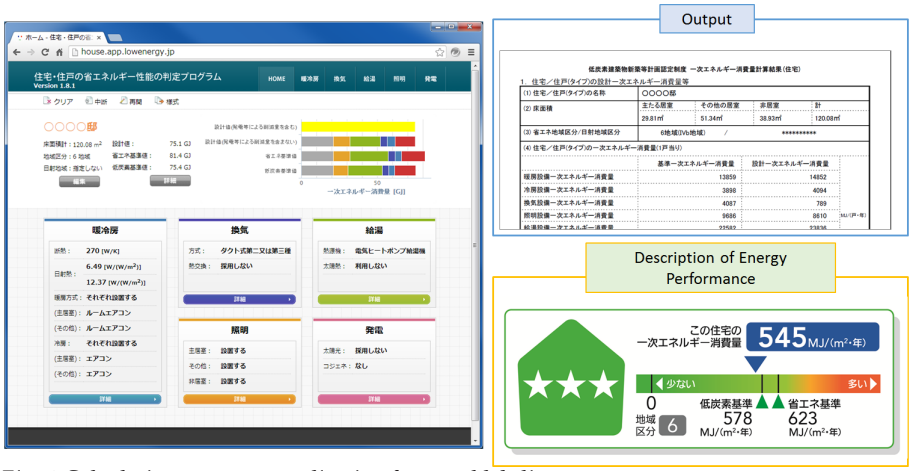

Fig. 4 Calculation program, application form and labeling

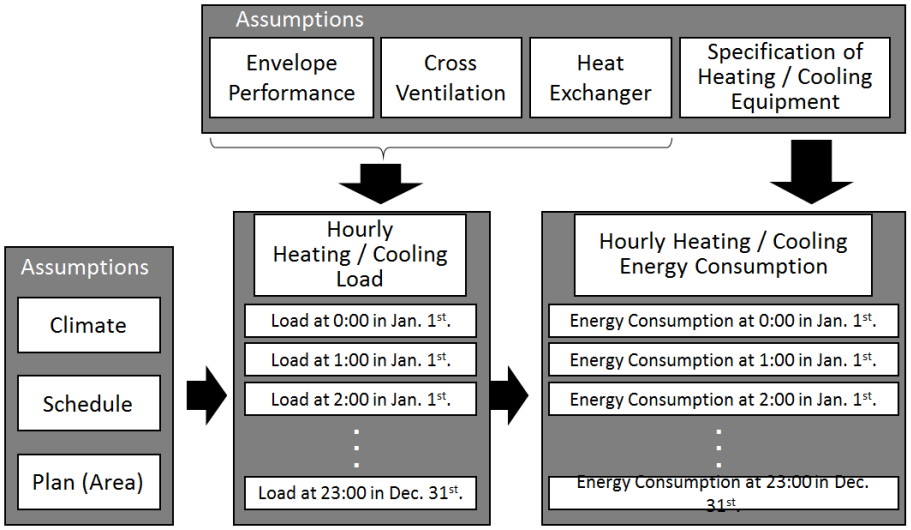

Fig. 5 Scheme of calculating space heating / cooling energy Consumption

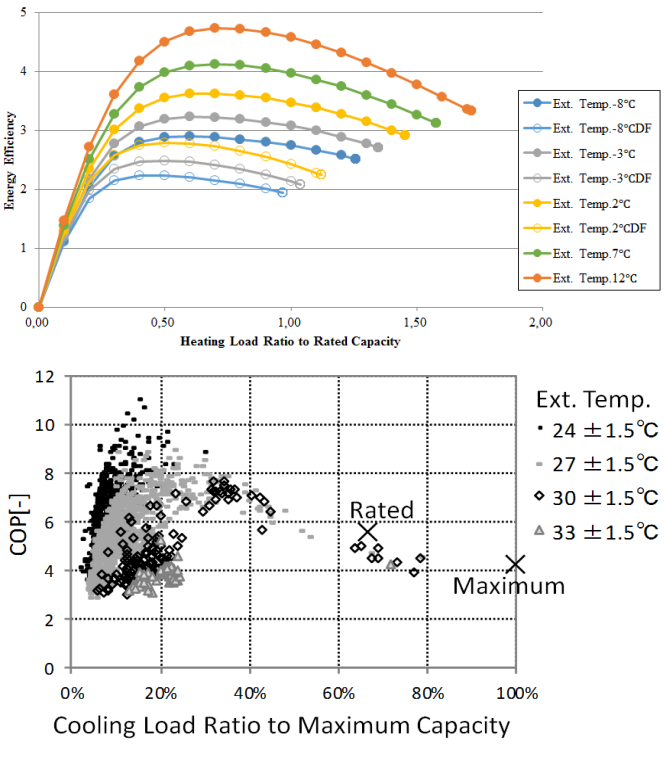

Fig. 6 Examples of heat pump efficiency curves
Top: Curves for calculation
Bottom: Experimental results

Status and Application of Heat Pump Energy Performance in the EU

Michèle Mondot, CETIAT, France

This article describes the process of standard development and the significant role that manufacturers may play to ensure the adequacy and benefit of the use of these standards for their products and needs.
It also shows how standards are useful tools for conformity assessment to mandatory energy requirements from European Directives or voluntary certification schemes

Introduction

Standards are very useful tools for manufacturers to enable them voluntarily to declare the energy performance of their products in local geographic markets where these standards apply.
In the European Union, standards also play a very important role in the implementation of directives and regulations.

CEN and ISO standards

Today, standards are mainly developed on two levels: European standards (CEN), and international standards (ISO).

European standards are developed by Technical Committees (CEN TCs) dedicated to product groups. These committees are split into working groups (WG) to deal with specific topics related to the products. Once ratified, these European standards must be implemented as national standards and published in national standards lists.

Draft standards are prepared by the working groups, and are then circulated for comments as prEN XXXX for five months. After consideration of the received comments by the working group, a final draft, FprEN XXX, is circulated for a two-month formal vote for final approval of the document by the national standardisation organisations.

If the formal vote result is positive, CEN ratifies the standard. Each Member State has then six months to implement it as a national standard (as [for example] NF EN XXX, BSI EN XXX, UNI EN XXX, DIN EN XXX, etc.) and to withdraw all existing national standards covering the same product

If a European standard exists, it is not possible for a member state to develop its own, country-specific, standard on the same topic.

Members of working groups, who are appointed by their National Standardisation Organisation, are experts in the field of the standard to be developed. They are generally manufacturers, test laboratories, end-user organisations, energy suppliers …

The main work of drafting a standard is performed in the working groups, offering manufacturers a real opportunity to ensure that their products will be correctly understood, that the testing and/or calculation methodologies will be fair for all technologies, and that they will not restrict the development of new products. It is also essential that both manufacturers and test laboratories validate the feasibility of the test methods and their acceptance by all parties. If active participation is not possible, then manufacturers still have the opportunity to study the draft standard at the circulation stage and provide comments and input for its improvement.

In the field of heat pumps and air conditioners, CEN TC113 is responsible for the development of standards related to performance rating of energy efficiency and acoustics.

Several working groups are involved in developing standards requiring different areas of expertise, and thus different experts' contributions. For example, WG8 is responsible for "Rating and Performance of Heat Pumps, Air Conditioners and Liquid Chilling Packages", WG7 for "Heat Pumps, Air Conditioners and Chilling Liquid Packages - Testing and Rating at Part-Load Conditions", WG 10 for "Heat Pumps for Domestic Hot Water Production", WG9 for "Sound Rating of Heat Pumps, Air Conditioners and Liquid Chilling Packages", and WG11 for "Direct Expansion-to-Water Units". CEN TC113 also includes a Working Group dealing with compressors (WG6) and another with fan coil units (WG14).

The list of CEN TC113 standards related to heat pumps is given at the end of the article.

International standards are developed by ISO (International Standard Organization). These are worldwide-recognised standards which may be used as national standards in countries where no national standards already exist or will be developed.

The standardisation process is very similar to that of CEN, with the Technical Committees (TC) being split into sub-committees (SC) and then into working groups (WG) to deal with specific topics related to the products. Working group members are delegates from different countries participating in the development of the standard, and who bring their own expertise.
The draft standard prepared by a working group is first circulated for technical and editorial comments as a Draft International Standard (DIS). Comments received are discussed

within the working group, and a new version is prepared. The Final Draft International Standard (FDIS) is the final stage for acceptance of the document through a vote among ISO members.

In the field of heat pumps, ISO standards are developed within ISO TC86 SC6 "Refrigeration and Air Conditioning - Testing and Rating of Air Conditioners and Heat Pumps" which covers all performance standards relating to heat pumps and air conditioners in cooling and/or heating mode.

A list of the most relevant standards is given at the end of this article.

When a subject is of interest at both ISO and CEN levels, what is known as the "Vienna Agreement" may apply. This means that one of the two Technical Committees, CEN or ISO, is in charge of development of the standard. ISO DIS and CEN enquiries are conducted in parallel, and in the same way are the ISO and CEN formal votes. The standard is then named ISO EN XXX.

The role of standards in the implementation of EU directives and regulations

What are known in Europe as "New Approach Directives" are directives that use harmonised standards as a way for fulfilling the specified requirements.

The recent 2009/125/EU Directive on Ecodesign of Energy-related Products (ErP), and 2010/30/EU Directive on Energy Labelling (EL), and their associated implementing regulations, offer the option of employing harmonised standards to show compliance with the energy performance requirements and labelling requirements of the products.

Harmonised standards are developed in accordance with a mandate given by the European Commission to CEN, a kind of technical road map. Additional communications from the Commission in connection with regulations may make reference to existing standards and/or describe transitional methods for determination of the performance (energy, sound, NOx emissions etc.) and require these methods to be incorporated into existing or new standards for harmonisation. A harmonised standard will include an Annex ZA, which specifies the relationship between the requirements of the directive or regulation and the clauses of the standard.

As an example, the publication and coming into force by 2015 of ErP Regulation 813/2013 and EL Regulation 811/2013 for space heaters make it necessary to revise EN 14825 which is the basis of the transitional method for calculation of seasonal performance (SCOP) and energy efficiency ηs, in order for the revised standard to be considered as a harmonised standard from the point of view of these regulations. A similar process is required in order to harmonise EN 16147 for heat pump water heaters with ErP Regulation 814/2013 and EL Regulation 812/2013 for water heaters.

At national levels, implementation of the Directive on Energy Performance of Buildings (EPBD) may also rely on methods which are partly or fully described in standards for compliance with different requirements. In France, for example, building code RT2012 for calculation of the energy consumption of new buildings requires performance data for HVAC equipment to be declared in accordance with European standards, where appropriate standards exist.

The role of standards in a certification scheme

Certification is mainly driven by the need to rely on third-party approval of the performance declared by the manufacturers, and/or to prove a minimum energy performance.

Several certification or quality label schemes exist at national or European levels. In the field of heat pumps, these schemes are NF PAC in France, MCS in the UK, the P-mark in Sweden … and the EHPA Quality Label or EUROVENT certification at the European level. It can also be noted that the European Ecolabel can also be applied in respect of the energy efficiency requirement if minimum COP values, determined in accordance with EN 14511, can be reached. These certification or labelling schemes are based on European standards, which means that all performance data are comparable.

The standards are normally used as reference documents, already agreed on by all the manufacturers, although some additional tests or requirements may be considered.

Initially, certifications or labels were based on the "nominal performance", i.e. the performance of the heat pump under standard and/or application rating conditions as specified in EN 14511. It was agreed that these performance figures do not fully reflect the behaviour and performance of a heat pump in real operating conditions. The recent development and publication of EN 14825, on seasonal performance, taking into account part-load operation of the heat pump integrated over a climate temperature profile, will allow better assessment of the performance of the unit by mean of seasonal coefficient of performance (SCOP) calculations. It is therefore likely that most of the certification schemes and labels will extend their scope to cover seasonal performance of heat pumps. These calculations will hopefully be based on harmonised standards, and should be very helpful to manufacturers by giving greater confidence in their declarations of conformity with ErP regulations.

Conclusions

Although standardisation work may appear as a very long and energy-consuming process, standards are very important and useful tools on a market where manufacturers need to be competitive. They enable the manufacturers to be confident in their declared performances, and in the compliance of their products with European regulations.

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List of standards on heat pumps under CEN TC113

EN 14511 (4 parts): Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling

EN 14825: Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling - Testing and rating at part load conditions and calculation of seasonal performance

EN 12102: Air conditioners, liquid chilling packages, heat pumps and dehumidifiers with electrically driven compressors for space heating and cooling - Measurement of airborne noise - Determination of the sound power level

EN 16147: Heat pumps with electrically driven compressors - Testing and requirements for marking

of domestic hot water units compressors for space heating and/or cooling

EN 15879-1: Testing and rating of direct exchange ground coupled heat pumps with electrically driven - Part 1: Direct exchange-to-water heat pumps

CEN ISO/TS 16491: Guidelines for the evaluation of uncertainty of measurement in air conditioner and heat pump cooling and heating capacity tests

List of ISO standards on heat pump performance rating

ISO 5151: Non-ducted air conditioners and heat pumps -- Testing and rating for performance

ISO 13253: Ducted air-conditioners and air-to-air heat pumps -- Testing and rating for performance

ISO 15042: Multiple split-system air-conditioners and air-to-air heat pumps -- Testing and rating for performance

ISO 13256-1: Water-source heat pumps -- Testing and rating for performance -- Part 1: Water-to-air and brine-to-air heat pumps

ISO 13256-2: Water-source heat pumps -- Testing and rating for performance -- Part 2: Water-to-water and brine-to-water heat pumps

ISO 16358-1: Air-cooled air conditioners and air-to-air heat pumps -- Testing and calculating methods for seasonal performance factors -- Part 1: Cooling seasonal performance factor

ISO 16358-2: Air-cooled air conditioners and air-to-air heat pumps -- Testing and calculating methods for seasonal performance factors -- Part 2: Heating seasonal performance factor

ISO 16358-3: Air-cooled air conditioners and air-to-air heat pumps -- Testing and calculating methods for seasonal performance factors -- Part 3: Annual performance factor

Natural Solutions for Developing Countries

A new guide on low-GWP technologies for developing countries has been published by Shecco, in collaboration with the United Nations Industrial Development Organization (UNIDO). The guide is a worldwide market research, and shares relevant experiences in the refrigeration, air-conditioning and foam sectors in which low-GWP technologies are employed. The guide identifies and describes barriers and good practices in the uptake of natural substances from over 50 case studies and the outcome survey from more than 200 stakeholders from different developing countries.

The guide is free for download: http://publications.shecco.com/publications/view/16

Source: IIR Newsletter, No. 57, January 2014

ASHRAE Refrigeration Commissioning Guide for Commercial and Industrial Systems

Sixty percent of energy use in supermarkets is attributed to refrigeration, and studies have shown commissioning could result in 7 to 25 percent energy savings. A new guide from ASHRAE outlines a commissioning process that would result in substantial savings.

"Refrigeration Commissioning Guide for Commercial and Industrial Systems" provides user-friendly, how-to guidance for commissioning of custom-engineered refrigeration systems in commercial and industrial facilities. The book is available for free download at http://www.ashrae.org/freeRefCxGuidance

ANSI/ASHRAE Standard 206-2013 "Method of Test for Rating of Multi-Purpose Heat Pumps for Residential Space Conditioning and Water Heating"

ANSI/ASHRAE Standard 206 was developed to provide a uniform method of testing for rating the performance of multi-purpose heat pumps (combined appliances) which perform space conditioning and water heating in residential applications. The heat pumps may also provide additional functions, such as ventilation and/or dehumidification.

The standard provides a single comprehensive procedure for all existing and anticipated multi-purpose heat pumps, covering six different basic systems: single capacity air-source, dual capacity air-source, variable capacity air-source, single capacity liquid-source, dual capacity liquid-source, and variable capacity liquid-source.

The combined appliances may operate in up to 7 modes: 1) space conditioning only; 2) dedicated water heating; 3) dehumidification + space conditioning; 4) dehumidification; 5) space conditioning + water heating; 6) dehumidification + space conditioning + water heating; and 7) dehumidification + water heating.

The standard specifies the test equipment for performing such tests, the data required and the calculations to be used.

The procedures in this standard may be used as a basis for establishing efficiency ratings for such equipment and for estimating annual energy consumption.

http://www.ashrae.org/206

Events

2014

3-4 April
4th Annual CIBSE ASHRAE Technical Symposium
Dublin, Ireland
https://www.ashrae.org/membership--conferences/conferences/ashrae-endorsed-events/2014/cibse-ashrae-technical-symposium

7-8 April
High Performance Buildings Conference
San Francisco, USA
http://www.hpbmagazine.org/hpb2014

24-25 April
Efficient, High Performance Buildings for Developing Economies
Manila, Philippines
https://www.ashrae.org/membership--conferences/conferences/ashrae-conferences/efficient-high-performance-buildings-for-developing-economies

8-10 May
11th International HVAC+R Technology Symposium
Istanbul, Turkey
http://www.ttmd.org.tr/sempozyum2014/eng/

12-16 May
11th International Energy Agency Heat Pump Conference
Montreal, Canada
http://www.iea-hpc2014.org/

14-16 May
10th International Geothermal Conference
Freiburg, Germany
http://www.geothermiekonferenz.de/en/igc-2014-homepage

18-21 May
7th Asian Conference on Refrigeration and Air Conditioning
Jeju Island, Korea
http://www.acra2014.org/

20 May
7th EHPA European Heat Pump Forum
Berlin, Germany
http://forum.ehpa.org/about/

20-21 May
2014 Energy Efficiency Global Forum
Washington, D.C., USA
http://eeglobalforum.org/

23-25 June
3rd IIR Conference on Sustainability and the Cold Chain
London, UK
http://www.ior.org.uk/iccc2014

28 June – 2 July
ASHRAE Annual Conference
Seattle, USA
http://ashraem.confex.com/ashraem/s14/cfp.cgi

14-17 July
Purdue Conference: 22nd International Compressor Engineering Conference
West Lafayette, Indiana, USA
https://engineering.purdue.edu/Herrick/Events/2014Conf

14-17 July
Purdue Conference: 15th International Refrigeration and Air Conditioning Conference
West Lafayette, Indiana, USA
https://engineering.purdue.edu/Herrick/Events/2014Conf

14-17 July
Purdue Conference: 3rd International High Performance Buildings Conference
West Lafayette, Indiana, USA
https://engineering.purdue.edu/Herrick/Events/2014Conf

31 August - 2 September
11th IIR-Gustav Lorentzen Conference on Natural Refrigerants - GL2014
Hangzhou, China
http://www.gl2014.org/en/index.asp

10-12 September
Building Simulation Conference
Atlanta, USA
https://www.ashrae.org/news/2013/ashrae-ibpsa-usa-building-simulation-conference-announced

14-16 October
Chillventa
Nuremberg, Germany
http://www.chillventa.de/en/

15-16 October
IGSHPA Technical Conference and Expo
Baltimore, USA
http://www.igshpa.okstate.edu/conf/

19-20 November
GeoEner 2014
Madrid, Spain
http://www.geoener.es/pages/geoener-english.html

20-21 November
The International Symposium on New Refrigerants and Environmental Technology 2014
Kobe, Japan
http://www.jraia.or.jp/english/symposium/

2015

24-28 January
ASHRAE Winter Conference
Chicago, USA
http://ashraem.confex.com/ashraem/w15/cfp.cgi

24-27 February
Climatizacion
Madrid, Spain
http://www.ifema.es/ferias/climatizacion/default_i.html

10-14 March
ISH
Frankfurt, Germany
http://ish.messefrankfurt.com/frankfurt/en/aussteller/willkommen.html

16-18 April
6th IIR Ammonia and CO2 Refrigeration Conference
Ohrid, Republic of Macedonia
http://www.r744.com/events/view/615

19-24 April
World Geothermal Congress
Melbourne, Australia
http://wgc2015.com.au/venue.php

27 June - 1 July
ASHRAE Annual Conference
Atlanta, USA
https://www.ashrae.org/membership--conferences/conferences

16-22 August
ICR 2015 – The 24th IIR International Congress of Refrigeration
Yokohama, Japan
http://www.icr2015.org/

In the next Issue

Highlights from research

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International Energy Agency

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

IEA Heat Pump Programme

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

Vision

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

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

Mission

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

IEA Heat Pump Centre

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

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