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NEWSLETTER
VOL. 28
NO. 3/2010

A key technology for the future

IEA Energy Technology Perspectives 2010

Overview of the Scenarios

Buildings and Heat Pumps in ETP 2010

ETP 2010 from a regional perspective

IEA Heat Pump CENTRE
NEWSLETTER
Volume 28 - No. 3/2010

In this issue

Heat Pump Centre Newsletter, 3/2010

This issue gives an overview of the IEA's recent publication Energy Technology Perspectives 2010, with an emphasis on heat pumps. The ETP 2010 provides a thorough analysis of the world overall energy situation. Presenting two main scenarios, a clear message is that the world has to switch from the "Business as usual" Baseline scenario, and instead aim for the Blue Map scenario. Another clear message is that heat pumps will be able to make a significant difference in that shift.
This issue also contains a heat pump market report from Italy.

Enjoy your reading!

Johan Berg
Editor

COLOPHON

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Energy Technology Perspectives 2010: An Introduction

Dr Peter Taylor
Head of Energy Technology Policy Division
International Energy Agency

Throughout energy circles, the threat of climate change has held the spotlight in recent years. Meanwhile, two other concerns have re-emerged from the shadows. The financial crisis of 2008/09 has highlighted concerns that volatile oil prices and high energy prices can cripple economic growth at critical moments. Headlines from gas supply cuts to the Ukraine to hurricanes destroying oil rigs in the Gulf of Mexico showed that threats to energy security arise in many forms and unexpected places. For several years, the IEA has been presenting the case that an energy revolution, based on widespread deployment of low-carbon technologies, is needed to tackle the climate change challenge. Energy Technology Perspectives 2010 (ETP 2010) demonstrates that a low-carbon future is also a powerful tool for enhancing energy security and economic development.

Current energy and CO_2 trends run directly counter to the repeated warnings sent by the United Nations Intergovernmental Panel on Climate Change (IPCC), which concludes that reductions of at least 50% in global CO_2 emissions compared to 2000 levels will need to be achieved by 2050 to limit the long-term global average temperature rise to 2.0°C to 2.4°C. Recent studies suggest that climate change is occurring even faster than previously expected and that even the "50% by 2050" goal may be inadequate to prevent dangerous climate change.

ETP 2010 provides an IEA perspective on how low-carbon energy technologies can contribute to deep CO_2 emission reduction targets. Using a techno-economic approach that assesses costs and benefits, the book examines least-cost pathways for meeting energy policy goals while also proposing measures to overcome technical and policy barriers. Specifically, ETP 2010 examines the future fuel and technology options available for electricity generation and in the key end-use sectors of industry, buildings and transport. It sets out the technology transitions needed to move to a sustainable energy future, and provides a series of technology roadmaps to chart the path. Other new elements of ETP 2010 include chapters on financing, behavioural change, the diffusion of technologies from developed to emerging economies, and a discussion of the environmental impacts of key energy technologies. For the first time, this edition also includes detailed analysis of OECD Europe, the United States, China and India.

Ultimately, the scale of the challenge demands a global strategy, not least because globalisation makes major economies increasingly interdependent in terms of trade, investment and the spread of technology. Another striking development is that many of these efforts already reflect stronger engagement between government, industry and civil society. ETP 2010 highlights innovative policies and actions that warrant thoughtful consideration and broader application.

The IEAs Multilateral Technology Initiatives (MTIs), including the Heat Pump programme, can be an important part of the transition to a low-carbon energy system. The IEA team worked closely with many contributors from the MTIs, and enjoyed particularly beneficial co-operation with the Heat Pump Programme. ETP 2010 highlights the importance of heat pumps in achieving the goals of a more secure, low-carbon energy future and I am delighted that the Heat Pump Centre is highlighting the important messages of ETP 2010 in its September newsletter.

Heat Pumps in Energy Technology Perspectives 2010

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

There is no doubt that meeting stringent targets for GHG emission reductions worldwide will require significant changes in the ways we produce and use energy. Responsible for approximately 30 % of the energy consumption in OECD and Economies In Transition (EIT) countries, the building sector represents a strategic target for achieving the commitments of reducing GHG emissions. But any attempt to address this challenge must take into account the building context; in OECD and EIT countries, existing buildings will account for roughly 90 % of the total building stock in 2030 and space and water heating could, in the medium term, remain an important part of the energy loads. In developing countries and in hot and warm climates, we can anticipate increasing demands for air-conditioning, probably amplified by the increase in living standards and climate change.

Strategies are proposed for the building sector and concretised by the Net Zero[1] and Near Zero Energy concepts, probably more suitable for new buildings. Significant steps are required to meet NZE targets. After reducing the energy loads by improving building designs (e.g. improved envelopes and passive solar designs), it is essential to use integrated energy-efficient and renewable technologies to meet the remaining loads, thus minimising the size of on-site renewable energy systems and reducing their costs, which are presently too high in most cases. Existing buildings will benefit from technology developed under NZE initiatives.

Retrofit and integration with advanced systems will be the challenges. The most promising future options for space heating and cooling are offered by heat pump systems. As the only heating system that delivers more energy than it consumes, and with the capability of upgrading thermal energy, heat pumps represent a strategic option as the core of integrated heating and cooling systems and renewable energy sources

The adoption of heat pump technology has, until now, been limited by its high initial cost, lack of knowledge on its optimal integration with renewable energy systems and existing building systems, and poor performance of air source systems in cold climates. The context, however, has changed: heat pump seasonal performance under several operating conditions have improved significantly, and energy loads have been reduced in advanced building designs, in the past years. As a result, integrated heat pump and renewable energy systems have become increasingly attractive options for heating and cooling. Efforts to increase electricity decarbonisation will also support the impacts.

Heat pumps have been selected among the IEA portfolio as one of the end-use technologies that will play a major role in meeting the GHG emission reductions worldwide. The IEA Heat Pump Programme has actively participated in the development of the ETP 2010 document by providing sound technical and economic information on how heat pumps will be part of the strategy. The Heat Pump Programme is already committed to playing a major role in decreasing GHG emissions from the building sector.

[1] A net-zero energy building is defined as one that, in an average year, produces as much electrical plus thermal energy from renewable energy sources as it consumes

The 10th IEA Heat Pump Conference

Heat pumps-The Solution for a Low-Carbon World

Date: 16 May 2011 ~ 19 May 2011
Venue: Chinzan-so Tokyo, Japan

1. Registration:
   Online registration has started since Oct 1, 2010. We have 3 kinds of fee categories, general participants, students and accompanying persons.
   Technical and non-technical tours information, Accommodation booking have also been available.

2. Call for Exhibitions & Call for Sponsors have started.

3. Conference Program
- Monday 16 May 2011
  AM/PM Workshops

- Tuesday 17 May 2011
  AM: Opening plenary session
  PM: Two parallel Sessions including poster presentation
  EV: Welcome Reception

- Wednesday 18 May 2011
  AM: Two parallel Sessions including poster presentation
  PM: 8 Technical and 2 Non technical tours
  EV: Banquet

- Thursday 19 May 2011
  AM: Two parallel Sessions including poster presentation
  PM: Two parallel Sessions including poster presentation
  EV: Closing plenary session
  *Exhibition: from May 16 through 19.

Web: For more information, please log on to the Conference website at: http://www.hpc2011.org

Regional Coordinators
For information on papers and workshops, conference program, etc., please contact the Regional Coordinator for your area:
- Asia and Oceania: Mr. Makoto Tono, tono.makoto@hptcj.or.jp
- North and South America: Mr. Gerald Groff, ggroff2@twcny.rr.com
- Europe and Africa: Mrs. Monica Axell, monica.axell@sp.se

General

We welcome the United Kingdom as a member of HPP!

The Heat Pump Programme has the pleasure to welcome United Kingdom as a new member country in 2010. The British contracting party is DECC, Department of Energy & Climate Change, for and on behalf of the Government of the United Kingdom. The UK heat pump situation will be presented in a coming issue of the HPC Newsletter.
http://www.heatpumpcentre.org/en/aboutHPP/membership/Sidor/default.aspx

The UK National Heat Pump Awards 2011

The UK market for air-to-water and ground-to-water heat pumps is about to experience unprecedented growth as more and more customers see the energy-saving potential of this environmentally friendly technology. Now, the industry gets the opportunity to celebrate excellence with the launch of the UK's first National Heat Pump Awards. This award is the heat pump industry's unique opportunity to highlight and reward the best products, projects and professionals in what is set to be one of the UK's fastest growing industries.
http://www.national-heat-pump-awards.co.uk/default.aspx

BUILD UP - New web portal

The European Commission has launched the BUILD UP web portal as a tool for sharing information on reducing energy use of buildings. The BUILD UP initiative was established by the European Commission in 2009 to support EU Member States in implementing the Energy Performance of Buildings Directive (EPBD).
The BUILD UP web portal will enable anyone from home-owners to builders to look up and share best practice and information. At the same time, it will inform and update the market about the legislative framework. BUILD UP can be an extremely useful tool to improve building performance.

The BUILD UP web portal is intended to reap the benefits of Europe's collective intelligence on energy reduction in buildings for all relevant audiences. It will bring together new practitioners and professional associations, while motivating them to exchange best working practices and knowledge and to transfer tools and resources.
http://www.buildup.eu/

Daikin to develop zero-energy office

Daikin Europe is to construct a zero-energy office, utilising heat pumps, heat recovery ventilation and solar cells as part of its contribution to a major cross-border project to develop zero-energy building concepts.
http://www.acr-news.com/news/news.asp?id=2153&title=Daikin+to+develop+zero+energy+office

IKEA Leads Way for 'Big Box' Geothermal Installations

Swedish furniture retailer IKEA is working with the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) to install geothermal heat pumps in a 38 600 m2 store under construction outside Denver. The system, which is being installed under the store's parking garage, will use 130 boreholes of 140 mm diameter, 150 m deep. A liquid will loop through a piping system from the surface through the underground holes to provide heating or cooling as outside temperatures dictate. NREL says the project, to be completed in 2011, could become the benchmark for a standard for geothermal installations in other large-scale retail stores. It says it will provide performance data to researchers around the world to use for their models.
http://www.fastcompany.com/1684572/ikea-leads-way-for-retail-geothermal-installations

Smart fridges - helping to cool the planet?

Over 3000 power customers are to take part in a major "smart grid" trial throughout 2010, designed to assess the effectiveness of so-called smart fridge technology capable of cutting power use from fridge-freezers during periods of peak demand. The fridges are designed to automatically modify their power consumption in response to second-by-second changes in the balance between supply and demand on the grid.
http://www.businessgreen.com/business-green/news/2254341/npower-trial-smart-fridges

ASHRAE, NEMA Partner on Smart Grid Standard

Under a national Smart Grid effort, ASHRAE and the National Electrical Manufacturers Association (NEMA) are jointly developing a standard to provide a common basis for electrical energy consumers to describe, manage, and communicate electrical energy consumption and forecasts. ASHRAE hosted a kickoff meeting to begin work on the proposed standard on August 30-31 at its headquarters in Atlanta.
http://www.achrnews.com/Articles/Industry_News/BNP_GUID_9-5-2006_A_1000000000000903673

Towards smart energy grids

The first step towards a smart energy grid is underway, with new requirements calling for the integration of smart power meters in new residential constructions. With the help of "smart meters", household appliances such as dishwashers, washing machines, dryers, refrigerators and freezers can be controlled to switch on when power costs are low to help reduce overall energy costs. The energy economics law will require energy suppliers to offer such reduced energy prices after 2011. However, a study performed by Accenture shows that many consumers are not as well-informed as they could be in regards to the possibilities of improving energy efficiency and saving energy costs at home. "Even twelve years after deregulation of the German energy market, many consumers fail to see power as a product they are free to choose," says Stephan Werthschulte, general manager of the energy supply economics section of Accenture. "Now that we are on the verge of having smart grids, the energy sector is in the difficult position of switching to a new kind of product and informing consumers of this change."
Source: Energy-server Newsletter, issue 124

Results published from UK heat pump field trial

The Energy Saving Trust's heat pump field trial is the most wide-ranging monitoring exercise of domestic heat pump installations and customer feedback undertaken to date in the UK. The trial was launched in July 2008 to monitor the performance of 83 heat pumps installed in UK homes for a period of at least twelve months.
The field trial included a wide range of sites and types, including:

- Air and ground source heat pumps
- Installations in private and social housing
- Installations providing central heating/hot water and heating only
- Installations supported by UK grants programmes

The Energy Saving Trust identified participants from a selection of grant recipients and sites put forward by social housing providers, the energy suppliers and heat pump manufacturers. The field trial was undertaken to determine the key factors which affect the performance of domestic-scale heat pumps, including technical parameters (e.g. system sizing and installation) and customer feedback and behaviour. The findings illustrate that heat pump performance is highly dependent upon appropriate installation and integration with the building's existing heating system, as well as appropriate control by the customer.
http://www.energysavingtrust.org.uk/Generate-your-own-energy/Heat-pump-field-trial
Further comments at
http://www.hydrocarbons21.com/content/articles/2010-09-09-recommendations-from-the-uk-s-largest-heat-pump-trial.php

AHRI and HRAI Sign Mutual Cooperation Agreement

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) and the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) have signed a memorandum of understanding on mutual cooperation and assistance in providing services to their respective members, many of whom are common to both the U.S. and Canadian associations, said the organisations.

Specifically, AHRI and HRAI agreed to provide technical assistance to each other, on an as-available basis, in understanding and responding to legislative, regulatory, and code body proposals and activities regarding the safety, energy, and environmental aspects of building standards, product standards, or product installation requirements, whether such standards or requirements originate with a governmental or with a non-governmental entity.
http://www.achrnews.com/Articles/Breaking_News/BNP_GUID_9-5-2006_A_10000000000000905501

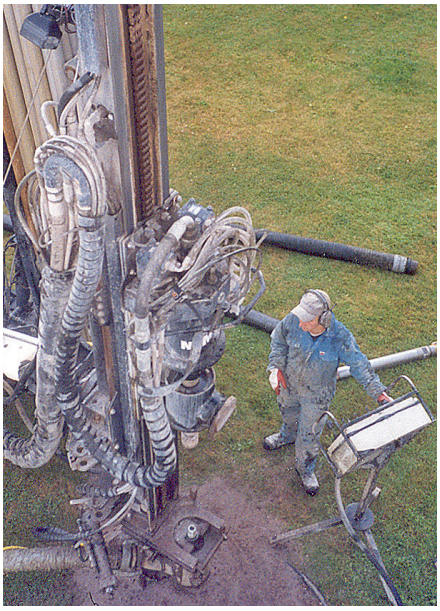
Energy savings must be tripled to reach climate goals: report

The EU could reach its goal of making energy savings of 20 % by 2020 simply by realising all cost-effective energy saving measures, according to a study commissioned by the European Climate Foundation and the Regulatory Assistance Project. In reality, however, EU policies are currently only delivering a third of the potential energy-saving measures, such as insulating buildings or using electric motors in industrial installations.
http://www.euractiv.com/en/energy-efficiency/energy-savings-must-be-tripled-reach-climate-goals-report-news-497812

Regions look to create global power base

Regional representatives from around the world this week outlined plans to create an 'R20' for global cooperation on climate and energy reform during a high-level energy congress in Canada. The original 'R20' declaration – the 'R' stands for 'Regions' - was made at last year's global climate summit in Copenhagen, following an initiative by California Governor Arnold Schwarzenegger at the 'Global Summit on Climate Change', held in Los Angeles in September 2009.
The basic premise is to help willing and selected regions to design and implement their Climate Change and Energy Regional Packages. As well as bringing together leading regions with pre-existing devolved legislative power, the R20 will seek to develop the capacities of a limited number of interested sub-national governments from developing and emerging countries.
http://www.euractiv.com/en/energy-efficiency/regions-look-create-global-power-base-news-497902

Position paper on Induced Seismicity in Geothermal projects



The German Geothermal Association (GtV), has published a position paper, concluding that Geothermal installations have until now never caused hazardous earthquakes causing structural damage or putting human life at risk. In Germany, only minor cases of damage have been reported, and have until now not even been proven in court. Geothermal projects come within the remit of the Mining Act, which states that care must be taken that no personal harm occurs and that traffic or general infrastructure is not damaged and no damage is caused to public property.
http://www.egec.org/
(See News, 05.07.2010)

Policy

EU Legislation: Energy labelling and Energy performance of Buildings Directive published

The Official Journal (OJ) of the European Union has published two directives with relevance for the future of heat pumps. Both of these directives are now in force.
http://www.ehpa.org/news/article/european-legislation-energy-labelling-and-energy-performance-of-buildings-directive-published-in-oj/

Issue L53 of the Journal publishes the final version of:
•Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the Indication by Labelling and Standard Product Information of the Consumption of Energy and Other Resources by Energy-Related Products. The new language-neutral label provides three additional classes (A+, A++ and A+++) on top of the existing A grade. The label is designed to indicate and promote energy-efficient products.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0001:0012:EN:PDF
•Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the Energy Performance of Buildings.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

DOE Tightens Heating Equipment Efficiency Requirements

The U.S. Department of Energy (DOE) has finalised more stringent efficiency requirements for residential water heaters and other appliances. DOE announced on April 1 that large electric water heaters (55 gallons [208 litres] or more) will need to use 47 % less energy than currently mandated, and large gas water heaters will need to use 30 % less. In addition to water heaters, DOE issued new efficiency requirements for pool heaters and direct-heating equipment such as gas fireplaces. According to DOE, these appliances collectively account for about 18 % of residential energy use. The new water heater requirements will come into effect in 2015. The other appliance regulations will apply to products manufactured in 2013 and later.
http://www.energy.gov/news/8816.htm

EU's next energy savings plan to focus on buildings

Buildings will be at the centre of the EU's new energy savings plan, which the European Commission plans to present by the end of the year, the EU Energy Commissioner has said. Commissioner Günther Oettinger told journalists after an informal meeting of European energy ministers on 7th September that he would bring out the much delayed new Energy Efficiency Action Plan this year. To achieve the action plan's objective of making energy savings of 20 % by 2020, the EU will first have to agree on what every member state and every sector must contribute towards the goal, Oettinger said. The debate on 7th September already touched upon some sectors with high potential for

energy savings, and ministers agreed buildings would be the most important contributor, he added.
http://www.euractiv.com/en/energy-efficiency/eus-next-energy-savings-plan-focus-buildings-news-497609

European commission proposes phasing out coal subsidies

According to the European Commission, Europe's unprofitable coal mines will have to be shut down within the next four years, before state subsidies are halted. A proposal has been presented for a new regulation that would allow member states to grant operating aid to coal mines only if they present plans to close by 15 October 2014.

The new regulation is to set up a transition regime as the current coal regulation expires at the end of the year. The new rules would allow the hard coal industry to receive closure aid, but would no longer be granted aid for investment or accessing coal reserves. The aim of the regulation is to bring to an end decades of repeatedly extended subsidy schemes to maintain uncompetitive mines, instead directing state aid towards paying for the social and environmental consequences of closures.
http://www.euractiv.com/en/energy/commission-proposes-phasing-out-coal-subsidies-news-496532?utm_source=EurActiv+Newsletter&utm_campaign=8f80aa58ae-my_google_analytics_key&utm_medium=email

California Adopts Nation's First Statewide Green Building Standard

The California Building Standards Commission has unanimously adopted the first-in-the-nation mandatory Green Building Standards Code, called CALGreen. The program, which takes effect on January 1, 2011, will require all new buildings in the state to be more energy-efficient and environmentally responsible. California Governor Arnold Schwarzenegger said the action lays the foundation for the move to greener buildings, constructed with environmentally advanced building practices that reduce energy use, decrease waste, and conserve resources.

CALGreen will require mandatory inspections of energy systems (such as furnaces, heat pumps, air conditioners, and other mechanical equipment) for non-residential buildings with more than 10 000 square feet of floor space, to ensure that the energy systems are working at their maximum capacity and according to their design efficiencies. It also requires that every new building constructed in California must reduce water consumption by 20 %, divert 50 % of construction waste from landfills, and install materials that emit low amounts of indoor pollutants. In addition, separate water meters are required for non-residential buildings' indoor and outdoor water use, with a requirement for moisture-sensing irrigation systems for larger landscape projects.
http://apps1.eere.energy.gov/news/news_detail.cfm/news_id=15771

Working Fluids

AREA seeks ban on split sales to unqualified persons

AREA, the European Contractors Association, is pressing for the 3 kg limit in the F-gas Regulations to be reduced, and to make it an offence to sell precharged systems to unqualified persons. These are amongst a number of changes suggested by AREA in a comprehensive response to Oeko-Recherche, the organisation responsible for carrying out the current review of the F-gas Regulations.
http://www.acr-news.com/news/news.asp?id=2161

HFC phase-down talks to continue in November

Despite opposition from several developing countries, including China, South Africa, India and Brazil, proposals to add a phase-down of HFC refrigerants to the Montreal Protocol will now be discussed at the next meeting in Uganda this November.
http://www.acr-news.com/news/news.asp?id=2154&title=HFC+phase-down+talks+to+continue+in+November+++

Honeywell's low-temperature refrigerant receives ASHRAE designation

Honeywell's R22 replacement for commercial supermarket refrigeration, Genetron Performax LT, has received the official ASHRAE designation of R407F. A blend of R32, R125 and R134a, it is preferred at low temperatures to R407A due to its higher capacity. It also has the lowest GWP of all commonly used blends, including R404A and R407A.
http://www.acr-news.com/news/news.asp?id=2211&title=Honeywell%27s+LT+refrigerant+receives+ASHRAE+designation

German Automotive Industry Supports 1234yf

German car manufacturers are reported to have given their backing to the new refrigerant HFO-1234yf, thus paving the way for worldwide acceptance of the gas as a replacement for R134a in car air conditioning systems.
The decision, which has come under stern criticism from German environmental groups (although the Environmental Investigation Agency is positive), is said to have been made in May and represents a marked U-turn on their previous support for CO_2. While other car manufacturing countries had given tacit support for the new HFO, German manufacturers maintained their preference for CO_2 as the preferred replacement for R134a once it is banned in new models of cars in Europe from January 2011.
http://www.ejarn.jp/Type_news_inside.asp?id=13450&classid=10

http://www.acr-news.com/news/news.asp?id=2177&title=Green+backing+for+1234yf

A-Gas calls for ban on refrigerant sales via internet auction sites

Refrigerant producer A-Gas (UK) is calling for a ban on the sale of refrigerants on internet auction sites. The company is concerned that buyers may not have the necessary specialist knowledge in the safe handling of refrigerants and points out that the contents of any cylinder being sold on auction sites cannot be guaranteed to be genuine.
http://www.acr-news.com/news/news.asp?id=2163&title=A%2DGas+calls+for+ban+on+refrigerant+sales+via+internet+auction+sites

Hydrocarbon refrigerant gets US thumbs-up

A hydrocarbon refrigerant blend has been approved for use in the US. Approval of HCR188C1 - a blend of ethane, propane, butane and isobutane - by the US Environmental Protection Agency paves the way for the sale of a hydrocarbon refrigerant in the USA for the first time. The US has previously shunned the use of hydrocarbons in refrigeration and air conditioning systems on safety grounds, but earlier this year the EPA announced that it proposed allowing the use of hydrocarbons in new household refrigerator and freezer equipment, as well as new stand-alone commercial refrigeration units.
http://www.acr-news.com/news/news.asp?id=2173&title=Hydrocarbon+refrigerant+gets+US+thumbs%2Dups

Japan's Imperial Innovation Prize for CO_2 heat pump system

Much interest by the competing companies, and appraisal by peers, secured Denso's patent of a CO_2 heat pump hot water system (Eco-Cute) an exceptionally high patent score as well as Japan's Imperial Innovation Prize.
http://www.r744.com/articles/2010-07-08-imperial-innovation-prize-for-co2-heat-pump-system.php

Expansion-compression unit to exploit the potential of transcritical CO_2

The first transcritical CO_2 system with an integrated expansion-compression unit has been put into operation in a Swiss wholesale market under the direction of Frigo-Consulting AG. The work-extracting expansion in this innovative technology is expected to lead to energy savings of 10-15 % per year.
http://www.r744.com/articles/2010-06-15-expansion-compression-unit-to-exploit-the-potential-of-transcritical-co2.php

Methyl chloride makes an illegal comeback in Korea

Methyl chloride, the toxic and flammable chemical once used as a refrigerant until superseded by fluorocarbons in 1929, has reappeared in car air conditioning systems in Korea.
http://www.acr-news.com/news/news.asp?id=2193&title=Methyl+chloride+makes+an+illegal+comeback+in+Korea

Technology

New air conditioning process said to use 50 % to 90 % less energy

The U.S. Department of Energy's (DOE's) National Renewable Energy Laboratory (NREL) has announced that it has invented a new air conditioning process with the potential of using 50 % to 90 % less energy than today's top-of-the-line units. The DEVap, which stands for Desiccant-enhanced EVaporative air conditioner, uses membrane technology to combine the efficiency of evaporative cooling and the drying potential of liquid desiccant salt solutions.
http://www.nrel.gov/overview/pdfs/47566.pdf

Embraco claims oil-less compressor breakthrough

Embraco has announced the development of a new oil-less linear compressor design - compatible with both R134a and R600a - for domestic refrigeration, which it says will be more efficient and more compact than current units.
http://www.acr-news.com/news/news.asp?id=2231&title=Embraco+claims+oil%2Dless+compressor+breakthrough

A Star CO_2 heat pump is born

Star Refrigeration has launched a CO_2 heat pump for commercial applications that generates hot and chilled water simultaneously.
http://www.acr-news.com/news/news.asp?id=2196&title=A+Star+CO2+heat+pump+is+born

Markets

Japanese heat pump market forecast: Energy efficiency on the move

Market research company Fuji Keizai has analysed the Japanese heat pump market for applications in Eco Cute water heaters and air-conditioners, and published a forecast for the market development over the next ten years.
http://www.r744.com/articles/2010-08-25-japanese-heat-pump-market-forecast-energy-efficiency-on-the-move.php

Heat pump numbers rise as economy improves

Economic recovery has been more U-shaped than V-shaped, but the HVAC industry is slowly turning upward, as evidenced in a recent rise in some equipment sales numbers reported by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI). This growth, coupled with energy efficiency and economic concerns, is generating innovative technology and fresh approaches to residential and commercial heat pump applications.
http://www.e-first.co.uk/Heat-Pump-Numbers-on-the-Rise-as-Economy-Continues-to-Improve-nw81.html

Carrier and Daikin report summer successes

The world's top two air conditioning companies continue to battle it out for the Number 1 spot, with both reporting recent successes.
http://www.acr-news.com/news/news.asp?id=2205&title=Carrier+and+Daikin+report+summer+successes

EPA, DOE take steps to strengthen testing and enforcement of Energy Star

The U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) have outlined a series of steps to further strengthen the trusted Energy Star program. This action comes at a critical time for American consumers, many of whom struggle to keep up with their monthly energy bills. In addition to third-party testing already underway, EPA and DOE have launched a new two-step process to expand testing of Energy Star qualified products.
http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/f721f69419064539852576eb0065e109!OpenDocument

Road map gives directions to lower emissions

Those in food retailing who find themselves lost when it comes to deciding which refrigeration route to take to reduce their carbon emissions would do well to download a copy of the Refrigeration Road Map (from the Carbon Trust's website). The Road Map has been produced in partnership with the Institute of Refrigeration and the British Refrigeration Association, and looks at the various options available and prioritises them in terms of carbon-saving potential, relative cost and commercial maturity.
http://www.acr-news.com/news/news.asp?id=2168

Photo: IVT Värmepumpar, Sweden

Danish homeowners highly satisfied with heat pumps

98 % of Danish homeowners who have installed a heat pump were satisfied with their heat pump equipment, their installation and the heating cost savings they realised, according to a report by the Danish Energy Agency on the Danish experience with heat pumps and the barriers to a wider uptake of the technology in the country.
http://www.hydrocarbons21.com/content/articles/2010-09-14-danish-homeowners-highly-satisfied-with-heat-pumps-.php

Heat pump applications in Italy

Carmine Casale, Italy

This report considers the heat pump sector's present difficulties and the reasons for them apart from the general economic situation. The absence of clear signs of recovery is also pointed out. The article describes the growth of heat pump applications in Italy over the last five years, with a forecast for 2010. The various applications are described separately in order to highlight the differences between them. The report concludes with a note on absorption heat pumps.

Introduction

Italy should be an ideal market for heat pump applications due to its climate conditions. According to Meteostat, the Italian climate varies from A (average) in the north to W (warmer) in central and southern Italy: these are climates where heat pumps offer the best performance even for air-to-air types. Nonetheless sales or, more correctly, effective use of heat pumps have not been particularly good.

At present, the global economic crisis has severely and adversely affected the sales of heat pumps, despite their appeal of energy savings and resulting financial savings. However, other factors act against the use of heat pumps in Italy for pure heating, as further described below. Absorption heat pumps are dealt with separately.

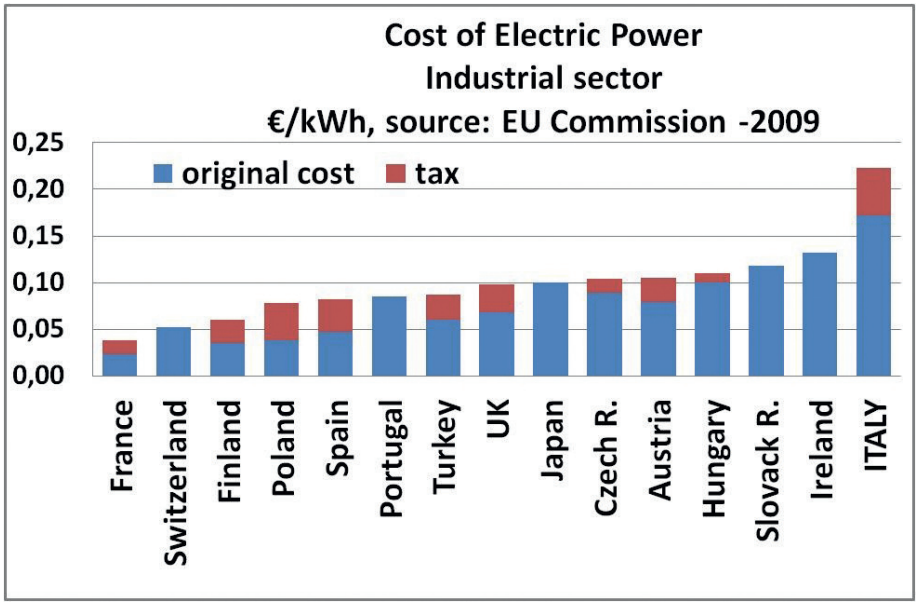


Figure 1 – Cost of electricity in the industrial sector.

No relief to the crisis yet in sight

There is no question that the heat pump market is suffering from a severe crisis, the main cause of which is the sharp decline in the building sector.

Construction of large buildings for the commercial or tertiary (institutional, government, hospitals) sectors has been depressed for the last three or four years, due to a fairly low rate of public and private investment. There is indeed some activity in the refurbishment of government buildings, but this is not as extensive

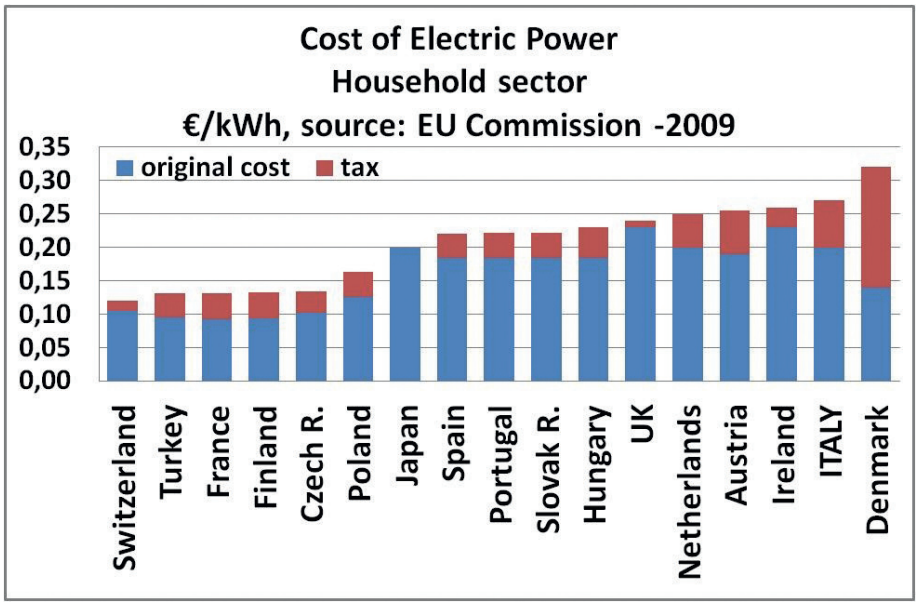


Figure 2 - Cost of electricity in the domestic sector.

as it should be (or as is discussed), and in many cases is proceeding at only a very slow rate.

The domestic sector is a little more active, due to the extent of refurbishment in both small and medium-sized buildings. Most applications are for single-family dwellings or apartment buildings. However, this sector is affected by other factors which aggravate the situation. First, the lack of continuity of government incentives (in force today, but with no assurance that they will still be available next year). Second, the relative decrease in the price of oil, which makes owners and users reluctant - or at any rate, undecided – to grasp the real advantage of heating system replacement or updating. The ROI (return on investment) in this case is very low, with an unacceptably long payback time. In addition to these factors, a further important restraint on domestic heat pump applications (which also adversely affects ROI) comes from the very high cost of electricity as shown in Figures 1-2.

Italy, on the other hand, is a country where the demand for summer cooling is generally high, and so the universal preference is for reversible heat pumps. This demand further reduces the spread of heat pumps, as the government and the power utilities are concerned about the high increase in the demand for electricity during the summer.

The importance of EER (or SEER) for reversible heat pump is well known, and is a factor to be taken into consideration in addition to COP (or SCOP).

As a matter of fact, the government has enforced very tight restrictions. The following table shows the conditions that must be fulfilled if a heat pump application is to be eligible for incentives.

Thus, in order to stay within the limits, equipment designers have to optimise both COP and EER. This has become an important issue for the following two main reasons.

Table 1 – Lower limits of COP and EER for heat pumps eligible for incentives. Source: Italian DM 7/4/2008

	Heating mode			Cooling mode		
Heat pump type	t outdoor	t indoor	COP	t outdoor	t indoor	EER
	° C	° C		° C	° C	
air-air	Air temp: inlet db 7 wb 6	Air: temp: inlet db 20 wb 15	3.9	Air temp: inlet db 35 wb 24	Air temp: inlet db 27 wb 19	3.4
air-water	Air temp: inlet db 7 wb 6	Water temp: inlet 30 outlet 35	4.1	Air temp: inlet db 35 wb 24	Water temp: inlet 23 outlet 18	3.8
brine-air	Brine temp: inlet 0	Air temp: inlet db 20 wb 15	4.3	Brine temp: inlet 30 outlet 35	Air temp: inlet db 27 wb 19	4.4
brine-water	Brine temp: inlet 0	Water temp: inlet 30 outlet 35	4.3	Brine temp: inlet 30 outlet 35	Water temp: inlet 23 outlet 18	4.4
water-air	Water temp: inlet 15 outlet 12	Air temp: inlet db 20 wb 15	4.7	Water temp: inlet 30 outlet 35	Air temp: inlet db 27 wb 19	4.4
water-water	Water temp: inlet 10	Water temp: inlet 30 outlet 35	5.1	Water temp: Inlet 30 outlet 35	Water temp: inlet 23 outlet 18	5.1

Up to now, the performance of water chillers and direct-expansion air conditioning equipment (mainly rooftop units) has been optimised for the cooling mode even if the unit was a reversible heat pump. COP was less important. Now, with the real possibility of utilising reversible heat pumps for full heating operation, but which the government tends to limit due to its fear of increasing electric power consumption during warm seasons, the designer of reversible heat pumps has to optimise both COP and EER as much as possible, which is not really easy to accomplish simultaneously.

In addition, a substantial push for the application of heat pumps comes from recent European Directives, such as the revision of the Energy Performance of Buildings Directive (EPBD; important for the household sector – no lower limit for dwelling area), and particularly Renewable Energy Sources Directive (RES Directive), which is becoming mandatory for ambient temperature control and environmental care. Also the Ecodesign Requirements for Energy-Related Products (ErP) Directive and other labelling regulations play a favourable role for heat pumps. System sustainability can only be reached by complying with all those regulations and recommendations.
It has been widely recognized that heat pumps contribute to reducing the need for fossil-based energy on which we have to rely, at least for the time being.

Heat pump (compression) adoption in Italy

When discussing the present state of heat pump take-up in Italy, some graphs may be clearer than words.

Figure 3 shows the market share of reversible A-A heat pumps in Italy: they represent over 95 % of total split system installations. However the effective utilization of A-A heat pumps for full heating operation in winter time is very limited, almost negligible. We have also to take into account that each heat pump of this type will heat one room only and not the entire dwelling. So when we speak of 100 000 heat pumps in full operation during the winter, not more than 20 000 or 25 000 three-room dwellings have that type of heating. The rest of these heat pumps are used only on a few cold days when central heating or some other kind of heating system is not in operation. Variable Refrigerant Flow (VRF) installations, which have been included in the diagram, are still very limited.

The weighted average heating capacity for this type of heat pump in Italy is 3.2 kW_{th}.

The situation for reversible rooftop type heat pumps is much better and at present very encouraging in terms of their use for heating mode operation. Although the crisis has badly hit this type of heat pump, which was mostly used for commercial centres, supermarkets, multi-screen movie theatres etc., their use in winter is well over 85 %.

The weighted average is 52 kW_{th} per unit in heating mode.

One of the major applications is that of water chillers for hydronic systems. In general, air-cooled chillers are the preferred system in Italy. The percentage of reversible heat pumps is over 40 %, and this technology is used for full heating in winter, often utilising a single water network and diffusers (generally fan coils). There are also systems with all-air distribution: in such cases the heat pump also serves a central Air Handling Unit (AHU).

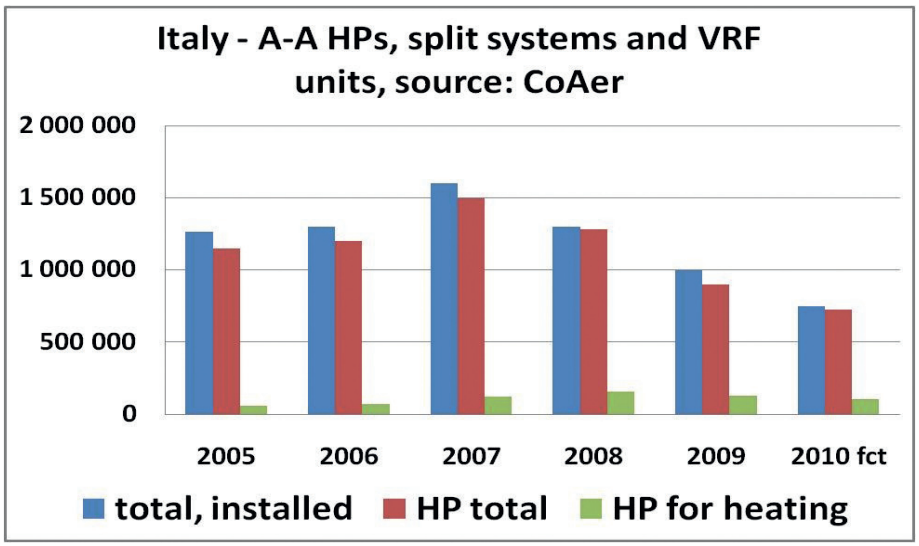


Figure 3 – Air-to-air reversible heat pumps, small capacity split systems

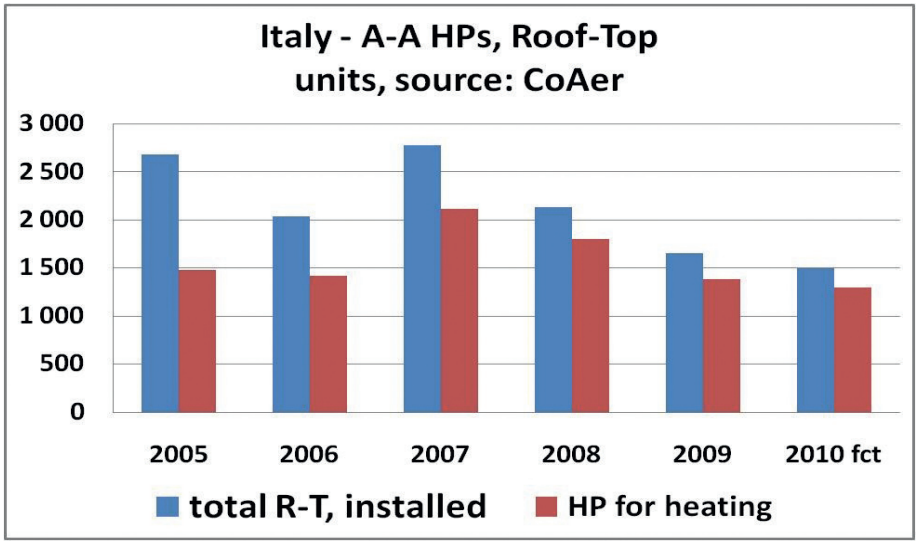


Figure 4 – Air-to-air reversible heat pumps, rooftop type

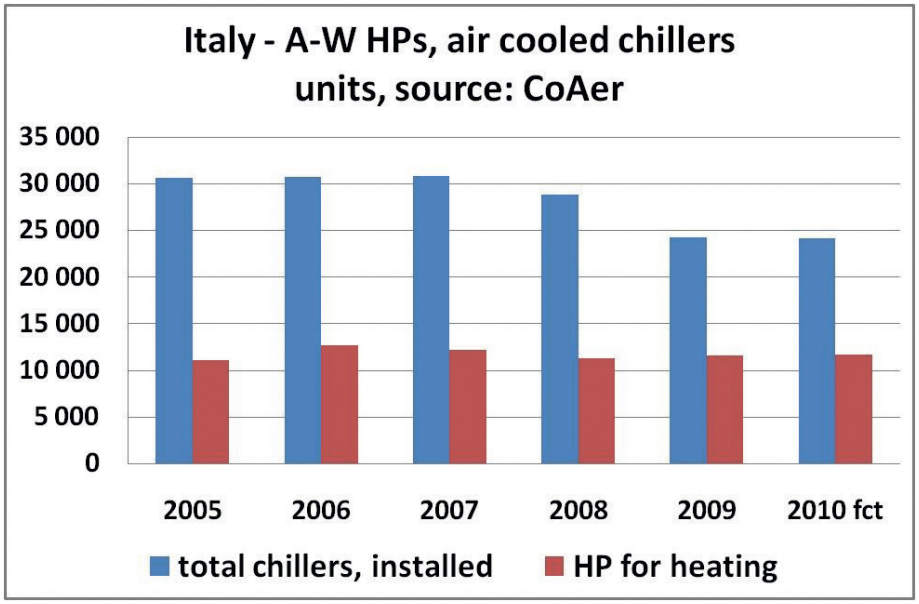


Figure 5 – Air-to-water and water-to-water reversible heat pumps, water chillers

With the water-sourced chillers, it is possible to reach COPs and SEER of great interest, especially on high-capacity units. Calculation of average performance is easier and more reliable for water chillers, as sales statistics are made on the basis of seven capacity sizes. The weighted average is 75 kWth per unit.

58 large units have been installed in district heating plants.

No statistics are available for ground source heat pumps, GSHP. Sales of GSHPs in 2009 totalled 1071 units (647 < 20 kWth and 424 > 20 kWth) of both horizontal and vertical types. The vertical type is the preferred one, as it requires little surface area for the collector excavations.

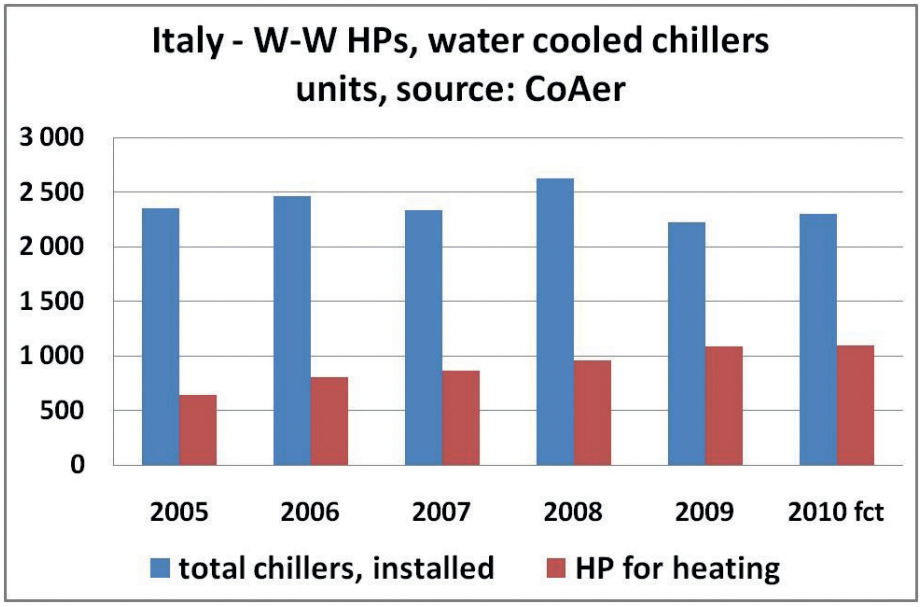


Figure 6 – Air-to-water and water-to-water reversible heat pumps, water chillers

Absorption heat pumps

Collection of installation data for this type of heat pump started only recently in Italy (as well as EU-EHPA), and so a full report of the general situation cannot be given.
In Italy a specific trade association includes the manufacturers (or importers) of "gas-fired" heat pumps, which is the type of absorption process commonly used. Although there is no manufacturer of high-capacity absorption heat pumps (whose application is relatively low), one important manufacturer designs and produces "gas-fired" heat pumps for "heating". These heat pumps are of the modular type, and cover from approximately 30 kWth and up. Heating heat pumps of this type have been well received, as witnessed by sales quantities. In 2009 this manufacturer, with a leading position internationally, sold over 4000 units and exported about 1000 units to Germany. This market trend is very positive.

Heat pumps versus boilers

A vast debate between experts involved concerns the convenience of using heat pumps as a unique source of heating and cooling in buildings. Serious and in-depth calculations (which we cannot discuss in this article) have demonstrated that a single system is much more convenient than the use of a boiler (even of the condensing type) for winter, plus a water chiller for summer. In addition, an advantage of heat pumps over boilers is that heat pumps are available for capacities from 2 kWth up to any value, theoretically with no upper limit.

Conclusion

There is no doubt that heat pumps are one of the best available technologies for reducing energy consumption and greenhouse gas emissions. A couple of factors against their wider take-up are the high cost of the technology itself and of electricity: both are problems that can be overcome.
Another difficulty comes from the fear of an increase in total electric power demand due to their use in summer. A simple calculation has demonstrated the opposite: that the use of heat pumps for year-round heating and cooling supply is a sustainable system because it in fact reduces the total primary energy demand. In addition, at least 50 % of heat pump output comes from renewable resources.

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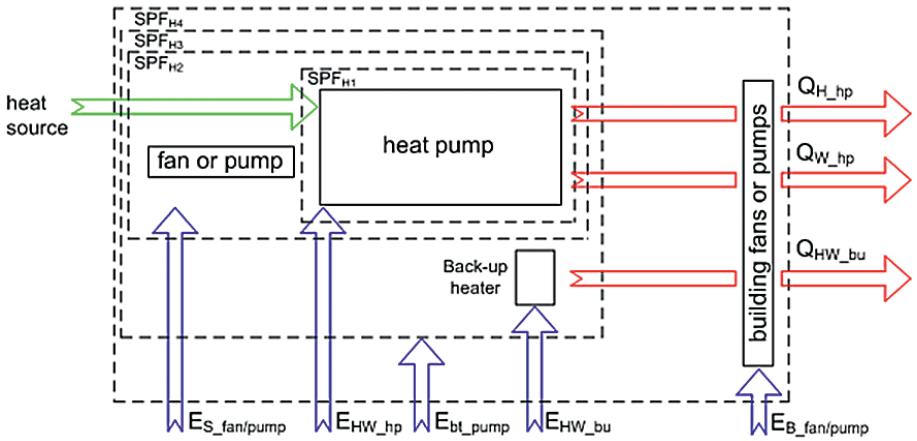
Annexes, planned

New IEA Annex: A common method for testing and rating of residential HP and AC annual/seasonal performance



To achieve an excellent working heat pump system, the right type of heat pump must be chosen and installed with a matching heat distribution system. For this reason, it is important to have reliable information on both the heat pump itself, and how it is influenced by the surrounding system.

A common SPF method would be important for fair comparison between different types of heat pump systems as well as fair comparison with other competing technologies using fossil fuels. A common SPF method can then later be incorporated in different labelling, rating and certification schemes.

There is thus a need for an improved transparent and harmonised method for calculation of heat pump system SPF based on repeatability and reliable test data from laboratory measurements.

The objective of the Annex is therefore to

1) Establish common calculation methods for SPF using a generalised and transparent approach. The focus is on a fair comparison between different heat pump types, but also for comparison between different competing technologies, such as pellet boilers, gas boilers etcetera.

2) Establish comprehensive test methods based on further development of existing test standards will be evaluated. The test standards should include test conditions needed for the future SPF calculations.

A fair amount of work will also be put on ground level comparisons of tests and ways to evaluate products around the world.

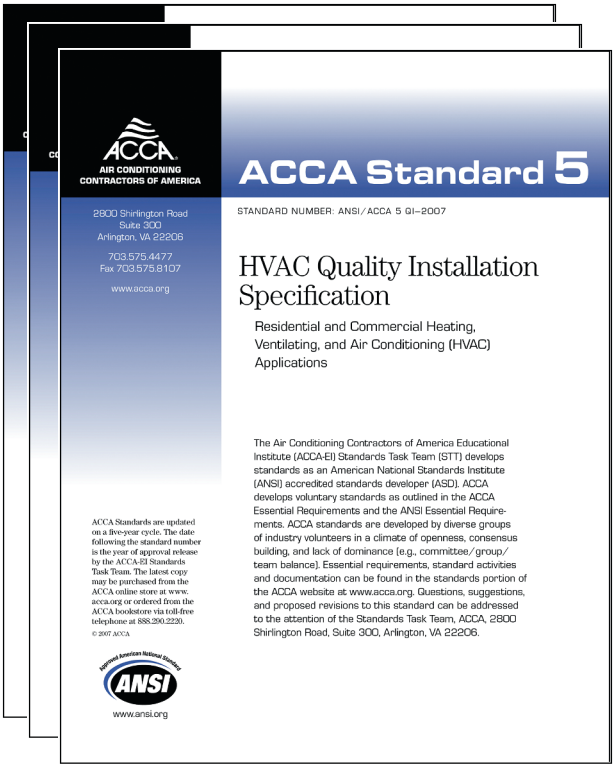
An initial meeting of interested parties was held on July 1, 2010 in Albuquerque, NM, USA. Representatives from Canada, France, Germany, South Korea, Sweden, and Switzerland attended in addition to the US hosts. Roger Nordman provided a presentation of the suggested work in the Annex. Each of the other country representatives that were interested in the Annex provided summary presentations discussing the issue from their perspectives.
France, Germany, Japan, Switzerland, the US and Sweden (OA), have committed to join the Annex so far. Austria, Finland, the Netherlands and South Korea have expressed interest and may join pending funding availability.

New IEA Annex: Quality Installation / Quality Maintenance Sensitivity Studies

(Avoiding Efficiency Degradation due to Poor Installations and Maintenance)

It is widely recognized that residential and commercial heat pump equipment suffers significant performance loss (i.e., capacity and efficiency) depending on how the components are sized, matched, installed, and subsequently field-maintained. The Annex will evaluate how installation/maintenance deficiencies cause heat pumps to perform inefficiently and waste considerable energy. Specifically to be investigated is the extent that small 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 a larger impact than others.

An initial meeting of interested parties was held on June 30, 2010 in Albuquerque, NM, USA. Representatives from Canada, France, Germany, South Korea, Sweden, and Switzerland attended in addition to the US hosts. Glenn Hourahan (Air Conditioning Contractors of America) and Piotr Domanski (US National Institute of Standards and Technology) provided overviews of the recent QI and QM standards and the proposed US sensitivity study project. Each of the other country representatives provided summary presentations discussing the issue from their perspectives. France, Sweden, the UK, and the US (OA) have committed to join the Annex so far. Canada, Germany, Japan, South Korea, and Switzerland have expressed interest and may join pending funding availability.



Ongoing Annexes

Bold text indicates Operating Agent. * Participation not finally confirmed, ** Participant of IEA IETS

Annex 31 Advanced modelling and tools for analysis of energy use in supermarkets.	31	CA, DE, **SE,** UK**,** US
Annex 32 Economical heating and cooling systems for low-energy houses.	32	CA, **CH**, DE, NL, SE, US, JP, AT, NO
Annex 34 Thermally Driven Heat Pumps for Heating and Cooling	34	AT, **DE**, NL, US
Annex 35 Application of Industrial Heat Pumps (together with Task XIII of "Industrial Energy-Related Technologies and Systems" (IEA IETS))	35	AT*, CA, DK*,**, FR, **DE**, JP, NL*, KR, SE*, CH*

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

Energy Technology Perspectives 2010: An Overview of the Scenarios

Peter Taylor, IEA, France

The previous edition of Energy Technology Perspectives (ETP), published in summer 2008, called for an energy technology revolution to tackle the undesirable consequences of our current patterns of energy supply and use. Current energy and CO_2 trends run directly counter to the repeated warnings sent by the United Nations Intergovernmental Panel on Climate Change (IPCC). But how do we shift to a more sustainable energy future? ETP 2010 explores what this future might look like through detailed scenario analysis that highlights the key technologies, by sector and region, as well as examining issues such as financing, R&D and deployment needs, policy issues, behavioural aspects and environmental co-impacts.

Introduction

In order for policy makers to be able to arrive at informed decisions about energy and climate change policy they require detailed, robust analysis of the technology options available and their potential to meet energy efficiency, security and climate change policy goals. Energy Technology Perspectives 2010 (ETP 2010) builds on the analysis in ETP 2006 and ETP 2008 to provide this kind of information.

The core framework in which technologies are analysed and policy options explored remains the scenario analysis, although ETP 2010's focus is arguably more on implementation and providing policy makers with more detailed regional and technology policy messages than previous editions. ETP 2010 analyses and compares various scenarios using a MARKAL-based bottom-up modelling approach[1]. The approach isn't to forecast what will happen, but rather to demonstrate the many opportunities to create a more secure and sustainable energy future.

Additional detailed analysis has been undertaken for China, India, OECD Europe and the United States. For ETP 2010, the IEA Secretariat co-operated with a number of modelling groups with national and/or regional models. The insights from their models, which are based on the same approach as the ETP model, were used to refine the analysis.

[1]The ETP model belongs to the MARKAL family of bottom-up modelling tools (see www.etsap.org), although it is supplemented by detailed end-use models for industry, transport and buildings which have been implemented in excel.

The Baseline and BLUE Map Scenarios

The ETP 2010 Baseline scenario follows the Reference scenario outlined in the World Energy Outlook 2009 to 2030, extending it to 2050. It assumes no new energy and climate policies. This is used as a Reference scenario, against which the potential impact of actions to further reduce CO_2 emissions can be assessed. In contrast, the BLUE Map scenario (with several variants) is target-oriented: it sets the goal of halving global energy-related CO_2 emissions by 2050 (compared to 2005 levels) and examines the least-cost means of achieving that goal through the deployment of existing and new low-carbon technologies.

The BLUE scenarios explore what needs to be done to meet ambitious emission reduction goals and other policy objectives. The scenarios are internally consistent analyses, based on a set of optimistic but plausible technology assumptions, which enable an assessment of the least-cost pathways that may be available to meet these goals. The BLUE scenarios can help policy makers identify technology portfolios and policy strategies that may help deliver the outcomes they are seeking. The scenarios are also used by the IEA as the basis for technology roadmaps.

Table 1 presents some of the key results from the scenario analysis and compares the Baseline scenario to the BLUE Map scenario. It is clear that aggressive policy action to deploy low-carbon technologies will result in a dramatically different energy future. Low-carbon energy technologies deployed in the BLUE Map scenario lead to a more sustainable energy future, with CO_2 emissions reduced by 50% compared to today's level in 2050. The BLUE scenarios also enhance energy security (e.g. by reducing dependence on fossil fuels) and bring other benefits that contribute to economic development (e.g. improved health due to lower air pollution).

The increased uptake of cleaner and more efficient energy technologies envisaged in the BLUE scenarios will need to be driven by:

- Increased support for the R&D of energy technologies that face technical challenges and need to reduce costs before they become commercially viable;
- Demonstration programmes for energy technologies that need to prove they can work on a commercial scale under relevant operating conditions;

Table 1: Energy and emission trends under the Baseline and BLUE Map scenarios: 2050 compared to 2007

Baseline scenario	BLUE Map scenario
Energy-related CO_2 emissions roughly double	Energy-related CO_2 emissions reduced by 50%
Primary energy use rises by 83%; carbon intensity increases by 10%	Primary energy use is more than one-quarter lower; carbon intensity falls by 64%
Liquid fuel demand rises by 57% requiring significant use of unconventional oil and synthetic fuels; primary coal demand increases by 138%; gas demand is 85% higher	Liquid fuel demand falls by 4% and biofuels meet 20% of total; coal demand drops by 36%; natural gas falls by 12%; biomass becomes the dominant primary energy carrier
CO_2 emissions from power generation more than double; CO_2 intensity of power generation declines slightly to 459 g/kWh	CO_2 emissions from power generation are cut by 76%; its CO_2 intensity falls to 67 g/kWh
Fossil fuels supply more than two-thirds of power generation; the share of renewable energy increases slightly to 20%	Renewables account for 48% of power generation; nuclear provides 23% and plants equipped with CCS 17%
Carbon capture and storage (CCS) is not commercially deployed	CCS is used to capture 9.4 Gt of CO_2 from plants in power generation (55%), industry (21%) and fuel transformation (24%)
CO_2 emissions in the buildings sector, including those associated with electricity use, nearly double	CO_2 emissions in buildings are reduced by two-thirds through low-carbon electricity, energy efficiency and the switch to low- and zero-carbon technologies (solar heating and cooling, heat pumps and CHP)
Almost 80% of light-duty vehicles (LDVs) sales rely on conventional gasoline or diesel technology; petroleum products meet more than 90% of transport energy demand	Around 78% of LDVs sales are plug-in hybrid, electric or fuel-cell vehicles; the share of petroleum products in final transport demand falls to 50%
CO_2 emissions in industry grow by almost half, as industrial production increases	CO_2 emissions fall by 27% mainly due to energy efficiency, fuel switching, recycling, energy recovery and CCS
Total investment in energy supply and use totals USD 270 trillion	Investment in low-carbon energy technologies is USD 46 trillion (17%) more than in Baseline; cumulative fuel savings are USD 112 trillion higher than in Baseline
Non-OECD countries are responsible for almost 90% of growth in energy demand and account for nearly three-quarters of global CO_2 emissions	Non-OECD countries achieve CO_2 emissions reduction of around 30% compared to 2007; OECD countries account for less than one-quarter of global CO_2 emissions, having reduced emissions by 70% to 80% below 2007 levels

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

- Deployment programmes for energy technologies that are not yet cost-competitive but whose costs could be reduced through learning-by-doing;
- CO_2 reduction incentives to encourage the adoption of low-carbon technologies. Such incentives could take a number of forms – such as regulation, pricing, tax breaks, voluntary programmes, subsidies or trading schemes. The ETP2010 BLUE scenarios assume that policies and measures are put in place that lead to the adoption of low-carbon technologies with a cost of up to USD 175 (USD 2008) per tonne of CO_2 saved in 2050;
- Policy instruments to overcome other commercialisation barriers that are not primarily economic. These include enabling standards and other regulations, third-party financing schemes, labelling schemes, information campaigns, etc.

Energy and CO_2 Emission Trends

From 1990 to 2000, CO_2 emissions increased by an average of 1.1% a year. From 2000 to 2007, emissions growth accelerated to 3% a year, despite the increased focus on climate change. In the Baseline scenario, CO_2 emissions increase from 29 Gt in 2007 to 40 Gt by 2030 and reach 57 Gt in 2050, i.e. almost double that in 2007 (Figure 1). For the period from 2007 to 2050, this is an average increase of 1.6% a year. Nearly all the growth in global CO_2 emissions in the Baseline scenario comes from outside the OECD. Emissions from non-OECD countries grow from 15 Gt CO_2 in 2007 to 42 Gt CO_2 in 2050.

In the Baseline scenario, primary energy use rises by 83% between 2007 and 2050 and the carbon intensity of primary energy increases by 10%. This is despite continued technical energy efficiency gains and structural change.

Box One: Marginal and Average Abatement Costs

Based on assumptions that are optimistic, but not unreasonable, about the progress of key technologies, the BLUE Map scenario requires deployment of all technologies involving costs of up to USD 175 per tonne of CO_2 saved when fully commercialised. This is the marginal cost of achieving the BLUE Map scenario in 2050. However, there exist a wide-range of energy efficiency options and low- and zero-carbon technologies that achieve CO_2 savings at low or sometimes negative costs. These options are, generally, taken up first and account for significant portion of the total CO_2 emissions reductions in the BLUE Map scenario. The average cost of CO_2 abatement is therefore lower than the marginal cost.

In the BLUE Map scenario, CO_2 emissions in 2050 are reduced to 14 Gt, around half the level emitted in 2005. This means emissions are 43 Gt lower in 2050 than the 57 Gt projected in the Baseline scenario. Achieving these CO_2 emissions reductions will require the development and deployment of a wide range of energy efficient and low-carbon technologies across every sector of the economy (Figure 2). End-use efficiency improvements in the use of fuels and electricity, and power sector measures dominate the short- and medium-term emissions reductions. But to achieve the deeper emission cuts needed by 2050, these measures will need to be supplemented by the widespread introduction of new technologies such as electric vehicles (EVs) and CCS between 2030 and 2050. Crucially for heat pumps, the BLUE Map scenario requires the virtual decarbonisation of the power sector by 2050 in all world regions, significantly boosting the CO_2 reductions possible from heat pumps.

The results of the BLUE Map scenario show that 2005 emission levels can be halved by 2050 by exploiting technology options with marginal costs of up to USD 175/t CO_2 saved (see Box). If technologies were not to emerge at the rate or at the cost assumed, the levels of emission reduction needed could only be achieved at a higher cost per tonne of CO_2 saved.

The Buildings Sector, CO_2 Abatement and the Role of Heat Pumps

The BLUE Map scenario shows the part that the buildings sector can play in securing a more sustainable energy future. In this scenario, CO_2 emissions are 83% lower than in the Baseline scenario in 2050. Most of this saving comes from the decarbonisation of the electricity used in the sector (6.8 Gt CO_2), from energy efficiency and from the switch to low- and zero-carbon technologies (5.8 Gt CO_2).

The implementation of currently available low-cost energy efficiency options is essential to achieve cost-effective CO_2 emissions reductions in the short run. These include highly efficient heat pumps for heating and cooling, solar thermal space and water heating, and combined heat and power (CHP) systems, eventually perhaps with hydrogen fuel cells.

Heat pumps play a central role in the BLUE Map scenario, along with efforts to improve building shells, as space heating represents as much as a third of global energy consumption in the residential sector. Crucially, given the dominant role of non-OECD countries in demand growth to 2050, heat pumps can play a role in reducing energy demand growth for cooling if a shift to the most efficient air conditioning systems occurs. Although heat pumps are often a cost- effective abatement option today, further improvements in their performance and cost reductions are needed to ensure their use in less ideal applications or where energy prices are low.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

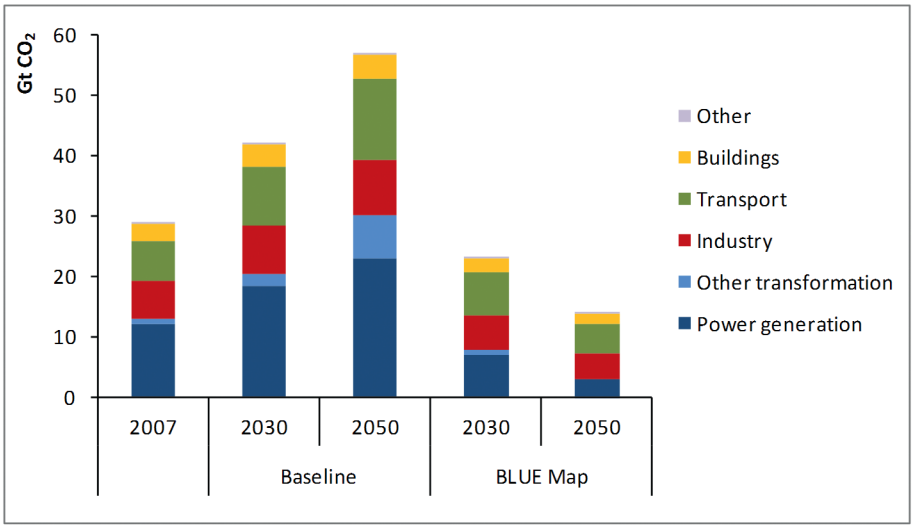


Figure 1: Global CO_2 emissions in the Baseline and BLUE Map scenarios

Key point: The BLUE Map scenario implies deep emission cuts across all sectors.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

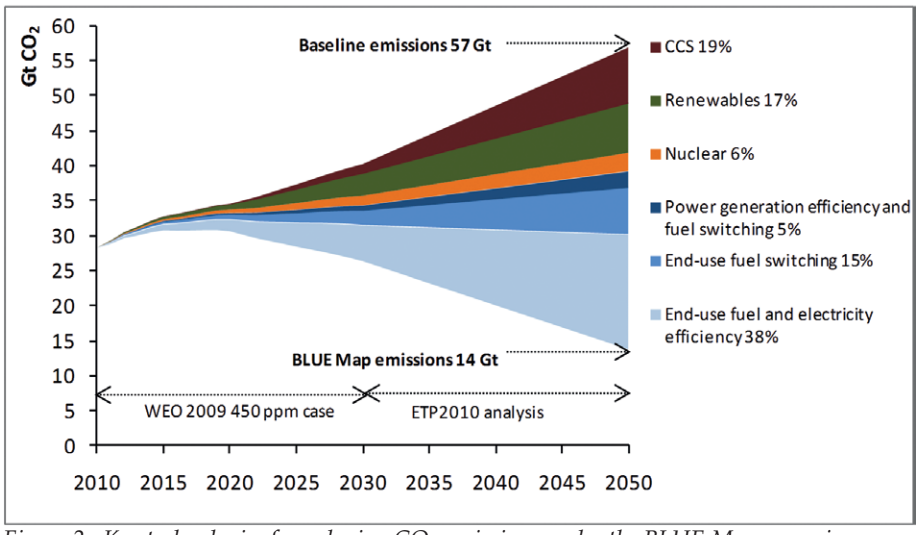


Figure 2: Key technologies for reducing CO_2 emissions under the BLUE Map scenario

Key point: A wide range of technologies will be necessary to reduce energy-related CO2 emissions substantially.

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Buildings and Heat Pumps in Energy Technology Perspectives 2010

Michael Taylor, IEA, France

The buildings sector has an important role to play in the BLUE Map scenario's overall goal of a 50% reduction in CO_2 emissions by 2050. Energy efficiency options are available in the buildings sector that can reduce energy consumption and CO_2 emissions from lighting, appliances and heating and cooling equipment rapidly and at often at low cost. The end-uses of space heating and cooling dominate energy consumption in OECD buildings, while cooling will be a major source of energy demand growth in developing countries. Heat pumps are a particularly important abatement option and are a key part of the solution for buildings in the BLUE Map scenario.

Energy and CO_2 Emissions from Buildings in the Baseline Scenario

In the Baseline scenario, global final energy demand in buildings increases by 60% between 2007 and 2050. Carbon dioxide (CO_2) emissions from the sector, including those associated with electricity use, nearly double from 8.1 gigatonnes (Gt) of CO_2 to 15.2 Gt CO_2. This is driven by a 67% increase in the number of households, a near tripling of the service building area, higher ownership rates for existing energy-consuming devices, and increasing demand for new types of energy services.

Total energy demand in the buildings sector increases from 2 759 Mtoe in 2007 to 4 407 Mtoe in 2050 in the Baseline scenario (Figure 1).[1] The residential sector accounts for 59% of this growth and the service sector for around 41%. The service sector grows the most rapidly at 1.5% a year between 2007 and 2050, with the residential sector growing by 1.0% per year. As a result, the service sector's share of energy consumption increases from 30% in 2007 to 34% in 2050, and that of the residential sector declines from 70% to 66%.

[1] In line with the treatment in the World Energy Outlook, the service sector total includes the projections for "non-specified (other)".

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

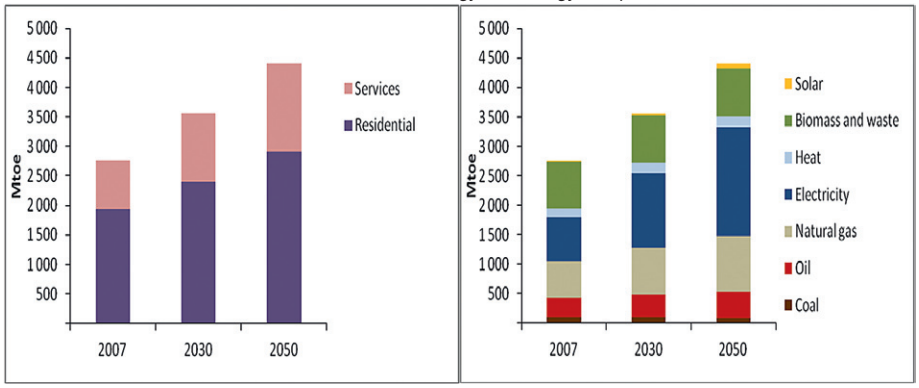

Figure 1: Buildings sector energy consumption in the Baseline scenario by sector and by energy commodity

Key point: The share of buildings sector energy consumption accounted for by electricity increases by 2050.

Energy and CO_2 Emissions in the BLUE Map Scenario

The BLUE Map scenario presents different policy challenges depending on the country. The policy challenge facing OECD countries and the Economies In Transition (EITs) is very different from that facing developing countries. OECD countries, and EITs to a lesser extent, are characterised by a large stock of residential buildings that is not growing quickly and that will be retired only slowly. So most of the CO_2 reduction potential is in the current stock of buildings. OECD countries and EITs also have significant heating loads, as does China. In developing countries, buildings have much shorter life spans, commonly of 25 to 35 years. The rate of growth of the overall building stock is also very rapid. The priority for developing countries is, therefore, to address the energy consumption of new buildings, especially in respect of cooling loads, through building standards and codes.

In the BLUE Map scenario, energy consumption in the buildings sector is reduced by around one-third of the Baseline scenario level in 2050 (Figure 2). Energy consumption in 2050 is only 5% higher than in 2007,

despite an increase in households of 67% and in service sector floor area of 195% over that time. The energy consumption of fossil fuels declines significantly, as well as that of traditional biomass. The residential sector accounts for 65% of the buildings sector's energy savings from the Baseline scenario in 2050.

In the Baseline scenario, the buildings sector emits 15.2 Gt CO_2 in 2050, an 87% increase over 2007 levels. The BLUE Map scenario reduces CO_2 emissions from the buildings sector by 12.6 Gt CO_2 from the Baseline scenario level in 2050, with 6.8 Gt CO_2 of this reduction being attributable to the decarbonisation of the electricity and heat sectors. As a result, buildings sector CO_2 emissions are 83% lower than the Baseline level in 2050. This reduces the direct and indirect CO_2 emissions attributable to the buildings sector to 2.6 Gt CO_2 in 2050, one-third of the 2007 level.

The BLUE Map scenario is based on the large-scale deployment of a number of technology options for the buildings sector, including:

- Tighter building standards and codes for new residential and commercial buildings. Regulatory standards for new residential buildings in cold climates are tightened progressively to between 15 and 30 kWh/m2/year for heating purposes[2], with little or no increase in cooling load. In hot climates, cooling loads are reduced by around one-third. For commercial buildings, standards are introduced which halve consumption for heating and cooling compared to 2007. This will enable the downsizing of heating and cooling equipment.
- Large-scale refurbishment of residential buildings in the OECD. Around 60% of today's residential dwellings in the OECD which will still be standing in 2050 will need to be refurbished to a low-energy standard (approximately 50 kWh/m2/year), which also enables the downsizing of heating equipment dwellings. This represents the refurbishment of around 210 million residential dwellings in the OECD between 2010 and 2050.
- Highly efficient heating, cooling and ventilation systems. Heating systems need to be both efficient and cost-effective. The coefficient of performance (COP)[3] of installed cooling systems doubles from today's level.
- Improved lighting efficiency. Notwithstanding recent improvements, many driven by policy changes, there remains considerable potential to reduce lighting demand worldwide through the use of the most efficient options.
- Improved appliance efficiency. Appliance standards are assumed to shift rapidly to least life-cycle cost levels, and to the current BAT (Best Available Technology) levels by 2030.
- The widespread deployment of CO_2-free technologies, including:
  - o Heat pumps for space and water heating. This occurs predominant-

[2] This is the useful energy demand. The actual energy consumption is a function of the fuel mix and the efficiency of the technology used.

[3] The COP of a heat pump is the ratio of useful energy output (heat or cold) to energy input (typically electricity).

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

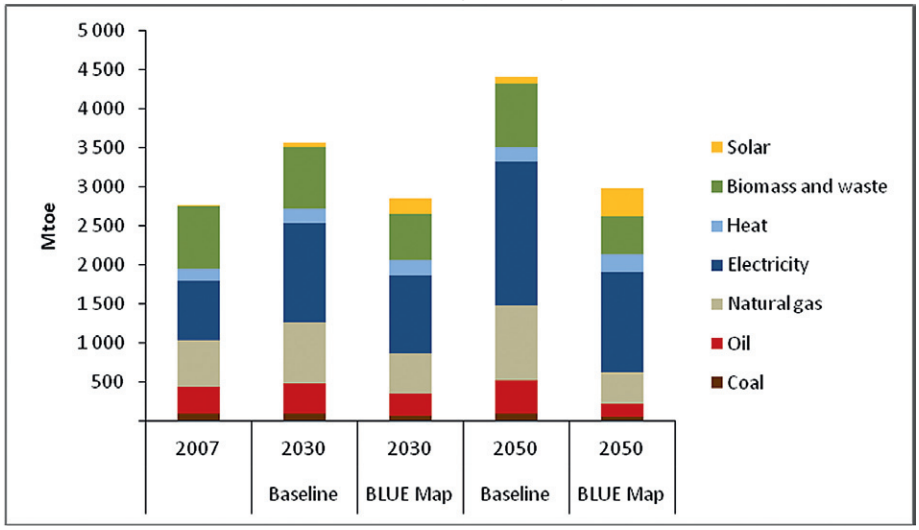

Figure 2: Buildings sector energy consumption by fuel and by scenario

Key point: Energy consumption in the buildings sector is 5% higher in 2050 than in 2007 in the BLUE Map scenario.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

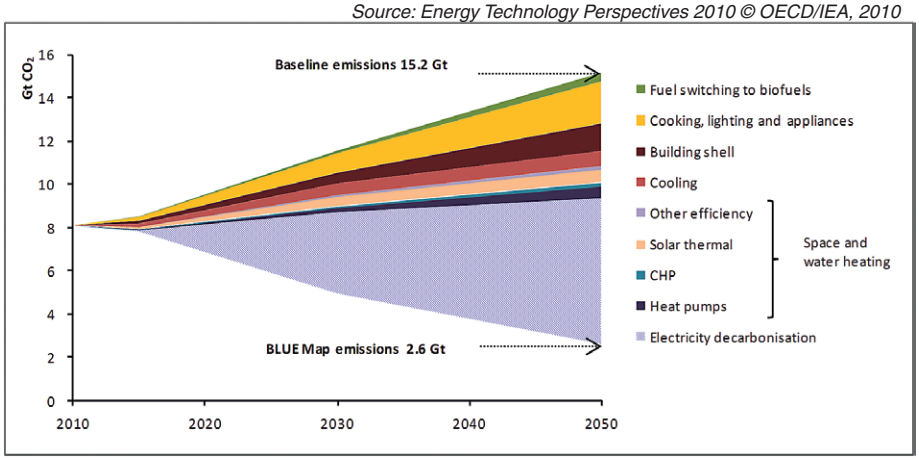

Figure 3: Contribution of CO_2 emissions reduction options

Key point: All end-uses contribute significantly to reducing CO2 emissions in the buildings sector in the BLUE Map scenario.

ly in OECD countries, and depends on the relative economics of different abatement options.

- Solar thermal for space and water heating. Often cost-effective today, further cost reductions for systems and the likely availability of low-cost, compact thermal energy storage systems in the near future help increase deployment, especially in OECD countries.
- Micro- and mini-CHP for space and water heating, and electricity generation. CHP can be an effective abatement option where power generation is CO_2-intensive. In the BLUE Map scenario in the buildings sector, all CHP deployed after 2030 is CO_2-free.

The CO_2 emissions savings that need to be delivered by the buildings sector in the BLUE Map scenario can only be achieved by undertaking all of these measures. Early improvements in the thermal envelope of buildings and other building shell improvements account for 22% of the total savings of 5.8 Gt CO_2 attributable to the buildings sector in 2050 (Figure 3) and enable the downsizing of heating and cooling equipment. Lighting and appliances, given the importance of electrical end-use growth and energy efficiency improvements in non-OECD countries, account for 32% of the total reduction.

The increased deployment of heat pumps for space and water heating, as well as the deployment of more efficient heat pumps for cooling account for 23% of the savings. Solar thermal systems for space and water heating account for around 12% of the savings. CHP plays a small but important role in reducing CO_2 emissions, as well as assisting in the balancing of the renewables-dominated electricity system in the BLUE Map scenario.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

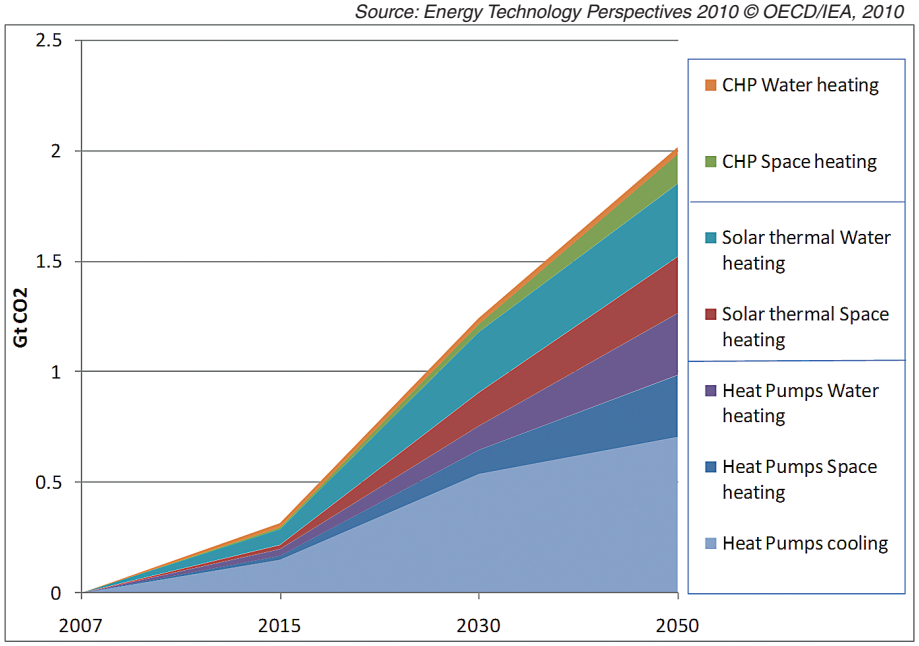

Figure 4: CO2 emissions reductions in buildings from heating and cooling systems in the BLUE Map scenario (reduction below the Baseline)

Key point: Heat pumps play a critical role in reducing CO2 emissions from heating and cooling equipment in the buildings sector

Heat Pumps in Buildings in the BLUE Map Scenario

The potential energy and CO_2 savings from the wider use of heat pumps are substantial, given their high efficiency and relatively low market penetration for space and water heating. The efficiency of today's BAT for air-conditioners is considerably higher than average installed efficiencies, offering further scope for CO_2 emission savings. When combined with thermal storage, to enable load to be shifted out of peak periods, heat pumps could also help reduce the costs in the BLUE Map scenario of integrating a high share of intermittent renewables into the grid.

The heating and cooling technology solutions that will allow the buildings sector to shift to a more sustainable energy and environmental future contribute 2 Gt CO_2 of the total savings. The increased deployment of heat pumps for space and water heating, as well as the deployment of more efficient heat pumps for cooling account for 63% of the heating and cooling technology savings.

The deployment of today's heat pumps systems will give way in the BLUE Map scenarios over time to integrated systems providing space heating, water heating and cooling, and hybrid heat pumps systems (i.e. combined with solar thermal systems) for improved efficiency. Although heat pumps are often competitive today, the large-scale global deployment of heat pumps for heating and higher efficiency air-conditioning devices will require additional R&D, demonstration programmes and support policies to help transform the market for heating and cooling.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

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IEA Energy Technology Perspectives 2010 just Launched

Shogo Tokura, International Heat Pump & Thermal Storage Technology Center of Japan, Japan

IEA has just launched the new edition of Energy Technology Perspectives (ETP) showing how new technologies will be important for halving global CO_2 emissions by 2050. Key Message by ETP 2010 indicated that biggest contribution to CO_2 emission reduction will be brought by combination of energy efficiency and lower-carbon electric power. ETP 2010 clearly said World-wide promotion of heat pumps is the KEY. Also, the characteristics of heat pumps as a highly efficient technology using renewable energy sources was acknowledged in ETP 2010 for the first time. ETP has significant potential for formulating government policy, not only in OECD countries, such as Japan, but also in non-OECD countries.

ETP2010 Launched

The International Energy Agency (IEA) has just launched a new edition of Energy Technology Perspectives (ETP). The study presents updated scenarios from the present to 2050 that show how new technologies will be most important in key sectors and in different regions of the world for achieving the goal of halving global CO_2 emissions by 2050.

ETP 2010 was presented at the New Energy and Industrial Technology Development Organization (NEDO) on August 4, 2010 in Tokyo by Mr. Tanaka, Executive Director of IEA. The audience welcomed the new IEA publication as valuable input to Japan's New Growth Strategy, which focuses on various low-carbon technologies as a source of future growth.

Mr. Tanaka also attended the APEC Growth Strategy High-Level Round Table meeting held in Beppu, Japan, on 7-8 August, chaired by Mr. Naoshima, Minister of Economy, Trade and Industry. The aim of the Round Table is to advance the formulation of the APEC Growth Strategy – an initiative agreed on last year by APEC leaders, who committed to put in place a "comprehensive long-term growth strategy for the Asia-Pacific region" during 2010.
Mr. Tanaka contributed to the discussion of Sustainable Growth by delivering a presentation on the ETP Blue Map scenario, energy intensity improvements in APEC countries and possible policy actions, including the phase-out of fossil fuel subsidies, standard-setting to facilitate market transformation, and RD&D.

In 2005 at Gleneagles, G8 asked IEA for advice on future scenario and strategy. In response to this request, ETP 2008 was launched. ETP 2010 discusses three categories of end-use sectors - building, industry, and transportation - based on a number of scenario analyses (countermeasure/ reduction volume/ cost), the role of technology development necessary for short and mid-term perspectives, and a road map for core technology.

Heat pumps were taken up widely as a key and major technology for CO_2 emission reduction, mainly for the building sector.

Consolidated efforts have been made in the process of developing the ETP 2010 together with IEA, the IEA Heat Pump Programme, the European Heat Pump Association and the Heat Pump & Thermal Storage Technology Center of Japan.

Policy Support

In Japan, METI announced that a new road map will be developed in 2010, for further promotion of innovative energy technology development, taking into consideration Japan's advantage in technology and messages from international agencies, i.e. IEA's ETP 2010. "Cool Earth - Innovative Energy Technology Plan" was announced, and similar scenarios have been adopted.

Each country should consider basing its energy policy on any speciality of the country, and should also look at consistency of common world interest. In this context, ETP 2010 is a very important publication for suggesting common understandings among countries, in order to assist energy policy-making for each country.

Deployed and encouraged by Government support, Japan's Top Runner Programme has been introduced in ETP 2010, and has helped to achieve impressive improvements in COPs. The COP of heat pump air conditioners in Japan increased from around 4.3 in 1997 to around 6.6 in 2008.

BLUE Map Scenario

Without new policies, fossil fuels will continue to provide most of the world's energy needs, with energy-related CO_2 emissions almost doubling to 57 Gigatonnes (Gt) by 2050.
In contrast, the ETP2010 BLUE Map scenario charts a least-cost path for halving global energy-related CO_2 emissions by 2050 (compared to 2005 levels), consistent with a long-term temperature rise of 2 ° to 3 °C.

Scenarios and strategies to 2050

A global energy technology revolution is essential if the challenges of energy security and climate change, as well as the growing energy needs of the developing world, are to be met. This was the key message of the 2008 edition of the ETP. To guide this process, a first attempt on 17 energy technology road maps was outlined.Heat Pump was identified as one of 17 key technologies.

Improved efficiency is fundamental for all modes.

In the BLUE Map scenario, the electricity sector is virtually decarbonised. This enables the buildings and transport sectors to reduce CO_2 emissions by additional electrification. As a result, the share of electricity in final consumption rises to 27 % in 2050 as low-carbon electricity increasingly substitutes for fossil fuels. In the buildings sector, heat pumps play an increasing role.

"Key Message" of ETP 2010

The following three points were raised as key messages of ETP 2010.

- It is possible to reduce CO_2 emission reduction to half by 2050, utilizing existing and new technology in the energy field.
- The biggest contribution to CO_2 emission reduction will be by energy efficiency improvement and by lower-carbon electric power.
- World-wide promotion of heat pumps and electric vehicles is the KEY.

These key messages will be applied to energy policy and promoted widely to Japanese citizens.

Energy efficiency - the "fuel" of the future

Heat Pump and Electric vehicles; Two Major Key EE Technologies

Increased energy efficiency will become the most important "fuel" of the future. Low-cost options for reducing actual consumption - many of which are already available - offer the greatest potential for cutting CO_2 emissions over the period to 2050.

ETP 2010 strongly pointed out that decarbonised electricity supply offers substantial opportunities to reduce CO_2 emissions in end-use sectors through increased electrification, through the introduction of electric vehicles, and efficient electric heat pumps.

Building Sector - Biggest Potential for CO_2 emission reduction by heat pumps

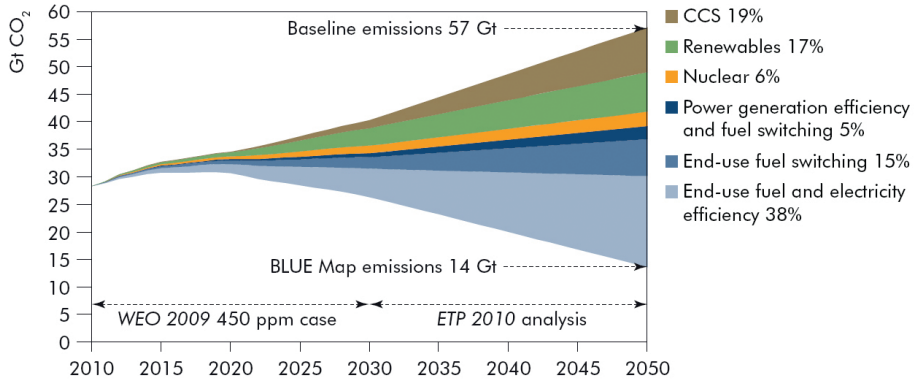
Direct emissions from buildings account for around 10 % of global CO_2 emissions. Including indirect emissions from the use of electricity in the sector increases this share to almost 30 %. A substantial CO_2 reduction in the area of cooling, heating and water heating can be expected by application of heat pumps.

It is important to utilise currently available low-cost energy efficiency improvement options, such as high-efficiency heat pumps for cooling and heating.

The increased deployment of heat pumps for space and water heating, as well as the deployment of more efficient heat pumps for cooling, account for 22 % of the CO_2 emission savings. Solar thermal systems for space and water heating account for around 12 % of the savings. CHP plays a small role in reducing CO_2 emissions.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

Figure 2.2 ▶ **Key technologies for reducing CO_2 emissions under the BLUE Map scenario**

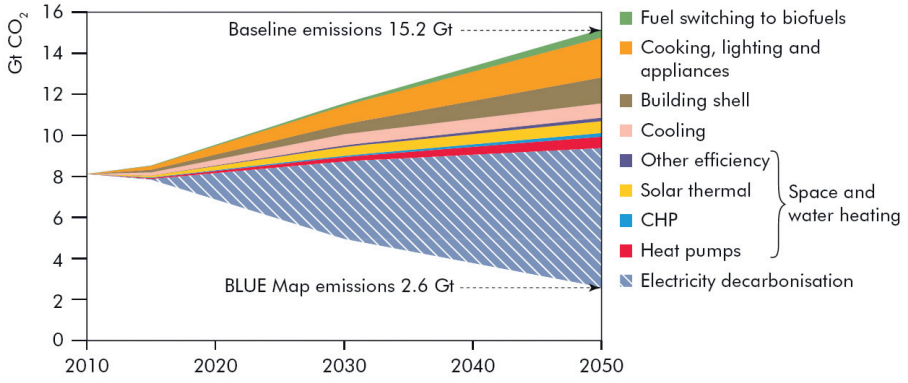


Key point

A wide range of technologies will be necessary to reduce energy-related CO_2 emissions substantially.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

Figure 6.16 ▶ **Contribution of CO_2 emissions reduction options**



Key point

Improvements in the building shell and energy savings in electrical end uses dominate total CO_2 reductions in the BLUE Map scenario.

In industry – Heat pumps can replace boilers

Besides building sector applications, there is significant potential for industrial use. Higher capacities and higher temperature of heat pumps have enabled them to replace boilers for industrial use.

Heat pump applications in industry

Heat pumps are already widely used in residential and other buildings. Recent technological advances that have improved efficiency, increased capacity and increased output temperatures, offer the opportunity to replace boilers with heat pumps in a range of industrial applications. Heat pumps supplying heat at temperatures over 100 °C are being commercialised.

Additional R&D could help to make this technology more suitable for wider adoption in industry. In the food and beverage sector, operating temperatures are often relatively low and therefore particularly appropriate to the use of heat pumps. An analysis of the CO_2 reductions from applying heat pumps with electric-drive compressors in the food and beverage industry in eleven countries has estimated that annual CO_2 emissions could be reduced by 40 million tonnes, equivalent to about 1.3 % of CO_2 emissions in the industrial sector in the eleven countries analysed.

Energy supplied by heat pumps = Renewable energy

In discussions among the IEA Heat Pump Programme, the European Heat Pump Association and the Heat Pump & Thermal Storage Technology Center of Japan, together with IEA, the characteristics of heat pumps as a highly efficient technology using renewable energy sources was acknowledged in ETP 2010 for the first time.

The main environmental advantage of heat pumps results from the substitution of non-renewable energy by energy from a renewable source, namely from air (aerothermal), ground (geothermal), or water (hydrothermal). This relation has recently been documented by the European Commission and Parliament in its Directive on the Promotion of Use of Energy from Renewable Sources (2009/28/EC).

Energy from renewable sources means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas or biogas.

Barriers and R&D priorities

Heat pump technologies are proven and mature. But achieving the goals in the BLUE Map scenario will require a number of current market and non-economic barriers to be overcome, as well as additional R&D to improve overall system performance, particularly to extend their use to a wider range of applications and climates. For example, although there are many air-conditioning products on the market, users often lack an understanding of the most appropriate technology for a specific use. Some more efficient systems have high initial capital costs, although they may be cheaper to run on a lifetime basis. The installation and operation of more advanced systems can also be difficult, adding to costs. There has been a lack of good comparative information to help the consumer. Improvements in control systems have the potential to achieve additional savings by ensuring that coolers run only when necessary. Similarly, more efficient heating systems suffer from relatively high first costs, a lack of consumer awareness of the often lower life-cycle costs, and a lack of good comparative information and financing packages to help overcome these barriers.

The main R&D priorities for the future are:

- Components: More efficient components and systems for heating and cooling applications. Reduce costs and increase reliability and performance.
- Systems / applications: Optimise component integration and improve heat pump design and installations for specific applications.
- Control and operation: Develop intelligent control strategies to adapt operation to variable loads and optimise annual performance. Develop automatic fault detection and diagnostic tools.
- Integrated and hybrid systems: Develop integrated heat pump systems that combine multiple functions (e.g. space conditioning and water heating) and hybrid heat pump systems that are paired with other energy technologies (e.g. storage, solar thermal and other energy sources) in order to achieve very high levels of performance. Integrated systems, such as those that integrate solar thermal technologies and heat pumps, have significant potential and would result in very high-efficiency/low-carbon hybrid systems.

Conclusions

The ETP 2010 launched this year delivered several key messages on the importance of energy efficiency, particularly heat pump application.

ETP 2010 has significant potential for formulating government policy, not only in OECD countries, such as Japan, but also in non-OECD countries. (a few countries in Asia are still not OECD members.)

ETP 2010 clearly stated the following as key messages:

- It is possible to reduce CO_2 emission to half by 2050, utilising existing and new technology in the energy field.
- The biggest contribution to CO_2 emission reduction will be by improving the efficiency of energy use and through the use of lower-carbon electricity production.
- World-wide promotion of heat pumps and Electrical Vehicle-enabling synergy is the KEY.

Heat pumps have a great potential for reducing CO_2 emissions from the building sector. Greater use will also be made of them in industry.
Finally, heat pumps contribute a substantial amount of renewable energy.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

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Realizing a low-carbon society by heat pumps in China

Xu Wei, China Academy of Building Research, China

With the increase in the urbanization rate, the improvement of people's living standards, and the higher quality of the indoor environment, the use of heat pumps has been increasing for several years in China and will continue to do so for the foreseeable future. This paper describes the market, technical trends and related industry associations of heat pumps in China. Finally, the ETP 2010 description of China is provided.

Introduction

Since 1978, with the rapid economic growth, and particularly the rapid growth of industrialization and the service industry, China has been undergoing a period of rapid urbanization development. The national urbanization proportion has increased from 17.9 % in 1978 to 46 % in 2009, thus causing a massive population shift from rural to urban areas. Since the Reform and Opening Up, construction and related industries have achieved fast growth in parallel with the urbanization process, and have made an important contribution to national economic growth and societal development, improvement of urban and rural residential living conditions, and sustainable development of urban and rural environments.

By 2008, there were already 40 billion m^2 of floor space in buildings in China, and there will be a further 20 billion m^2 by 2020. Energy use in 2020 is forecast by the Chinese Academy of Engineering(CAE) to reach 3.5 billion tce[1] (tonnes coal equivalent). As heat pumps can provide heating, cooling and hot water requirements in the building sector, and as they are also considered as renewable energy in China, the government provides considerable support for their use.

[1] 1 tonne coal equivalent = 29.3 GJ = 0.70 toe (tonne oil equivalent).

Heat pump market trends

In China, more than 85 % of domestic air conditioning is provided by air/air heat pumps. Figure 1 shows the number of domestic air conditioning units increased from 30 per 100 families in 2001 to 110 per 100 families in 2009.

One reason is that, as the Chinese economy keeps on growing, more and more people want to improve their living conditions, with the result that the area that needs heating is extending to the south in China, while the area that needs cooling is extending to the north.
The second reason is that the national codes for different types of air conditioners and heat pumps are updated very quickly to increase their minimum COP requirements. In May 2010, the government published its latest performance requirements for higher COP of air conditioners and heat pumps, raising the minimum requirement from 2.6 to 3.2. The minimum requirement in 2010 is Level B (Mid level). The codes are:

- The minimum allowable values of energy efficiency and energy efficiency grades for unitary air conditioners,
- The minimum allowable values of energy efficiency and energy efficiency grades for room air conditioners,
- The minimum allowable values of energy efficiency and energy efficiency grades for variable-speed room air conditioners,

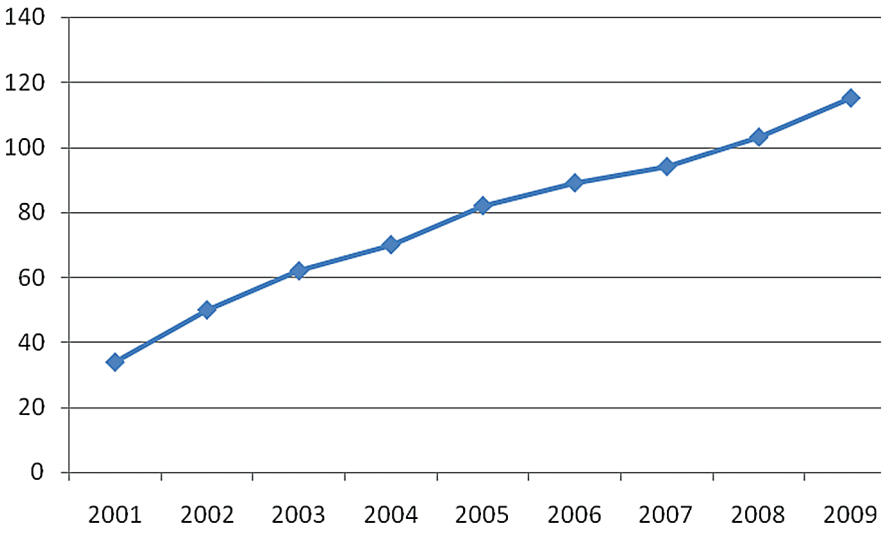

Figure 1. Number of domestic air conditioners per 100 families

- The minimum allowable values of IPLV (Integrated Part Load Value) and energy efficiency grades for multi-connected air conditioning (heat pump) units.

Figure 2 shows the air conditioner export numbers, increasing from 5.26 million in 2001 to 33 million in 2007. Due to the economic crisis, exports decreased in 2008 and 2009. Exports in 2010 are forecast to reach 30 million.

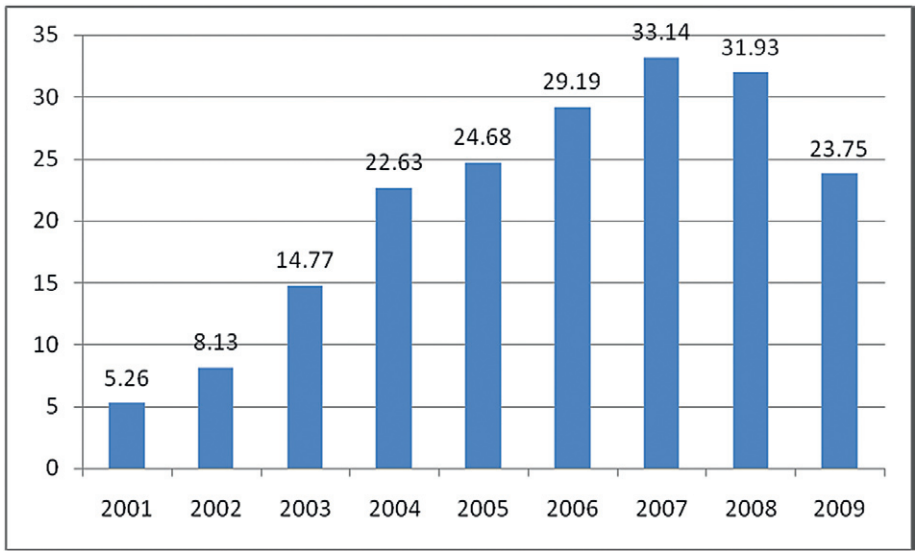

Figure 2 Air conditioner exports

The use of ground-source heat pumps (GSHP) has also grown rapidly in recent years, as shown in Figure 3. These systems are being promoted by the government in three stages. The first stage is the pilot project stage. The Ministry of Construction (now called the Ministry of Housing and Urban-Rural Development [MOHURD]) selected 369 pilot projects in all parts of the country, and provided a subsidy of USD 4.50-7.50 per square meter. The second stage is that of urban demonstration, which started in 2009 and is being implemented at present. The MOHURD selected 20 cities as pilot cities to demonstrate GSHP technology at city level, and the latest news this year is that 15 more cities have been added to the program in 2010. The next stage for GSHP utilization might be the mandatory stage, whereby buildings that could utilize renewable energy must do so.

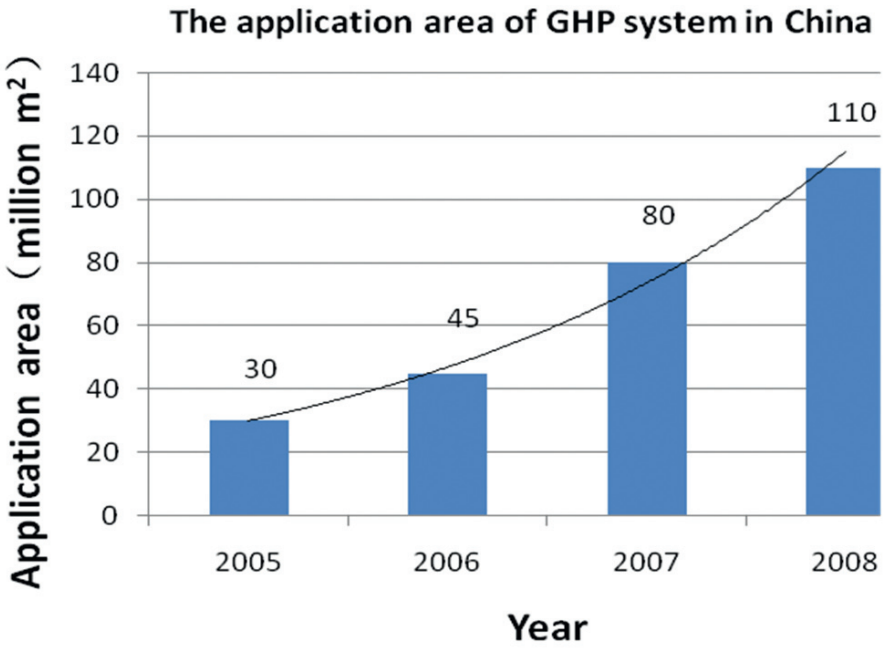

Figure 3. The application area of GSHP in China

In response to the country's initiative, several ministries, commissions and local authorities have formulated corresponding policies for energy conservation and building energy efficiency. Many cities have also provided special subsidies to encourage use of ground-source heat pump systems. For example, Beijing released the "Instruction Opinion about Development of Ground-Source Heat Pump Systems" and "Building energy-saving plan", both of which include the use of heat pumps and ground-source heat pumps. In Shenyang, local regulations require the use of GSHPs to provide heating in new buildings.

The Chinese state encourages the use of solar energy and geothermal energy in new and retrofit buildings. Geothermal energy is considered a renewable energy source under the Chinese Renewable Energy Act. Geothermal pilot projects receive special subsidies. The fast development of real estate construction, economic growth and increasing living standards mean that the market will definitely experience explosive growth in the next few years.

Technical trends of heat pumps

A market survey of what aspects were most important to domestic heat pump and air conditioner users found that COP, health, cooling/heating performance, price, installation and service, design, noise, and lifetime were the most important. This means that it can be expected that high-COP low-noise heat pumps with variable-frequency drive will grow more rapidly than other heat pumps.

For GSHP systems, system design is likely to require thermal response tests and a suitability analysis as standard, with solar energy or energy storage to meet the peak demand while the heat pumps meets the basic demand. In the future, ground-source heat pumps may also be used in other applications besides the building sector, such as in greenhouses.

Heat pump industry associations

China has two influential heat pump industry groups: the China Refrigeration and Air-Conditioning Industry Association, which focuses on the heat pump unit, and so domestic air conditioners, domestic heat pumps and large water/water and water/air heat pumps units are their main working areas, while the other is the China Committee of Ground-Source Heat Pumps, which concentrates on GSHP systems, in the form of large water/water and water/air heat pump units and their accessories.

China Refrigeration and Air-Conditioning Industry Association

The China Refrigeration and Air-Conditioning Industry Association (CRAA), founded in 1989, is a national non-profit industrial organization mainly representing refrigeration and air-conditioning manufacturers, together with research and design institutes and universities. Membership is voluntary. CRAA is a major voice for the whole industry, and works for members' mutual interests and benefits. CRAA is the manufacturers' link to government, and has provided members and the whole industry with varied and valuable services.

China Committee of Ground-Source Heat Pumps

As ground-source heat pump systems grew rapidly in China, the industry found that high COPs alone were not enough to achieve the energy conservation goal: systems must also be well designed, constructed and commissioned, which led to formation of the China Committee of Ground-Source Heat Pumps in 2007. The objective is to unite the heat pump manufacturers, estate developers, system integrators, designers and the installers to make sure that every GSHP system can achieve its energy goal.

Final comments

There is no doubt that China has the world's largest heat pump market. With the improvement of living standards and the increasing rate of urbanization, the domestic heat pumps will continue to grow in the next 10-15 years. The GSHP system has been recognized as the preferred renewable energy source for the building sector. It is expected that, with government incentives and related policies, the total floor area for which ground-source heat pumps supply heating, cooling and hot water will be 5-8 times as large in 2020 as they are today.

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Article continues on the next page

ETP 2010, regarding China

The Chinese market and market trends have been described above. To set the background, the ETP 2010 description of China is provided in this box.

Since 1990, China's economy has grown fourfold, resulting in more than a doubling of energy use. Although substantial energy efficiency improvements have helped to limit growth in energy use, the increasing dominance of coal in the country's energy mix has meant that energy-related carbon dioxide (CO_2) emissions have grown more rapidly than energy consumption.

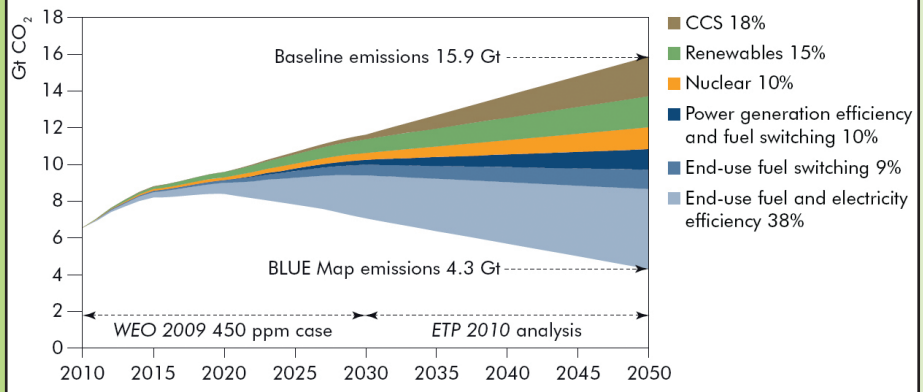
China's transition to a low-carbon energy system will require significant decarbonisation of the power sector (Figure 10.5). A mix of nuclear, more efficient coal technologies, carbon capture and storage (CCS), wind, solar and other renewable generation technologies will be needed.

Rapid growth in energy use is expected in the building sector, and urgent attention should be given to improving the energy efficiency of building envelopes, the use of more efficient heating and cooling systems (such as heat pumps), the use of solar thermal for space and water heating, and the use of more efficient lighting systems and appliances.

Space heating demand can be reduced through a mixture of building envelope improvements and heating system improvements (Figure 10.18). In zones with warm summers and relatively cold winters, highly efficient reversible air conditioners help to reduce the energy demand for space heating significantly while, in colder regions, ground-source heat pumps are also projected to play an important role.

Space and water heating, excluding building envelope measures, account for 20 % of the reduction in CO_2 emissions below the Baseline scenario in 2050 (Figure 10.19). The assumed continuous tightening of building codes and standards to a low-energy standard of around 50 kWh/m²/year for space heating results in accelerated savings in cold climate regions after 2030. Important contributions are also made from heat pumps, solar thermal, and CHP/district heating.

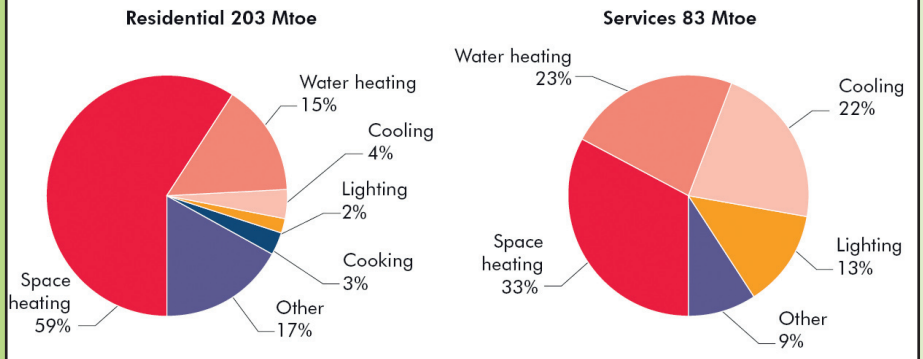
Figure 10.5 ▶ **Contributions to emissions reduction in China**



Key point

End-use efficiency savings and CCS are the largest contributors to emissions reduction in China; nuclear and renewables are also important. *Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010*

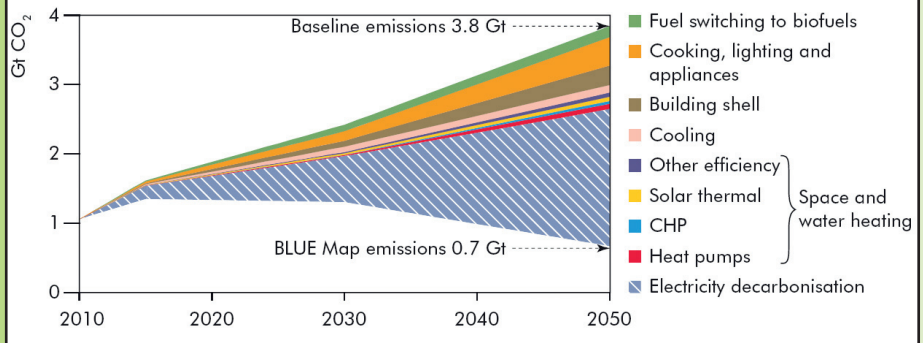
Figure 10.18 ▶ **Contribution to reductions in energy use in the BLUE Map scenario for China, 2050**



Key point

The largest potential for energy savings in the buildings sector comes from energy efficiency measures to reduce energy demand for space heating. *Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010*

Figure 10.19 ▶ **Contribution to reductions in CO_2 emissions in the building sector in the BLUE Map scenario, China**



Key point

A wide range of options are needed to limit growth in CO_2 emissions in the buildings sector.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

With extensive manufacturing capabilities, China's industry is well positioned to benefit from a global transition in the energy system, as this article has highlighted for heat pumps.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

The new IEA energy scenarios: immediate implementation required!

The EHPA view of the IEA's ETP 2010 report

Thomas Nowak, EHPA, Belgium

Many stakeholders from all parts of society recognise the need for a change in the way energy is produced and used. A change that requires concerted action from all parties on all levels - a change that is sometimes dubbed the next industrial revolution. It is becoming increasingly clear that it is time to establish the framework conditions for a future-orientated, reliable, and affordable energy supply, based on renewable energy sources. This future will mainly be based on three pillars:

1. Reduction in demand: The use of the most energy-efficient technologies and products, including those that provide a storage function for intermittent energy supply (wind, photovoltaic, solar thermal heat), thus making proper load balancing possible, and optimisation of buildings towards near-zero energy demand (or even plus-energy),
2. Decentralisation: An increasing number of decentralised plants for heating and electricity production by about 2050, using close to 100 % of renewable energy sources,
3. A smart electricity grid, balancing electricity supply and demand, as well as regional energy grids for heat and cold storage and distribution (these will probably differ considerably from today's district heating grids). Both grids will serve as energy sources and energy sinks for the consumer. They will require a much improved ICT infrastructure to better understand supply and demand patterns, to control energy flows and to administer the economic relationships between energy producers and users.

Heat pump technology has a considerable contribution potential to such an approach. It is energy-efficient, with major improvements of heat pump-based heat generator systems foreseen in the near future. It uses renewable energy for the production of heat (process heat and heating), cooling and hot water, and it can provide a balancing function for electricity and thermal grids.

These advantages are increasingly recognised: the European Union explicitly addresses heat pumps in all major pieces of legislation: the Directive on the Promotion of Use of Renewable Energy Sources (RES), the Energy Performance of Buildings Directive (EPBD) and the Framework Directive on Energy-Related Products (ErP) and its implementing measures, as well as in work intended to provide more comprehensive European Energy Statistics.

At the world level, the International Energy Agency comes to the conclusion that a simple Business As Usual (BAU) scenario is completely inadequate to tackle society's problems. The agency's Energy Technology Perspectives 2010 states clearly that BAU will lead to an approximate doubling of emissions, whereas a decisive switch towards a least life cycle cost development path is forecast to cut emissions in half by 2050 (in comparison with today's values and when compared to BAU). Heat pumps are part of the solution. They are recognised as a reliable, affordable, efficient technology using renewable energy sources.

The European Heat Pump Association welcomes the fact, that heat pumps are recognised in this document as a key end-use technology in the much required energy revolution. The report provides important messages to governments, industry and end users alike.

1. A sufficient number of technology solutions such as heat pumps exists today to achieve significant reductions in non-fossil fuel use for little or no extra cost, but they require a focus of attention to utilise their potential.
2. Governments should not only officially recognise this fact, but also become actively (and by all means in a consistent, transparent and predictable manner) involved in promoting their use via institutional and financial support. The IEA report is yet another that stresses the need for an immediate and substantial shift of investment towards RES technologies, if governments want to achieve their energy and climate protection targets for 2020/2030 and 2050. Pilot and demonstration installations and use of these technologies, in addition to support for market penetration, should be normal procedure in order to overcome end-users' reservations. Effort is also needed in training and certification of heat pump installers and education of other decision-makers, including the consumer. Requirements for certification and quality should be compatible throughout Europe. The cost of such activity must be considered an investment in the future.

3. Industry should focus on the cost reduction potential of products at all levels of the value chain. This will require thorough R&D with government support. The IEA report shows clearly that success in this field will increase market success.
4. End users are called upon to take a long-term view, focusing on the total cost of ownership instead of only on investment cost. Asking for quality units and qualified personnel is the key to receiving efficient systems. Appropriate qualification and certification systems already exist. Among them are the EHPA quality label for heat pumps, and the EUCERT program for training and certification of installers. Both are available in several European countries.

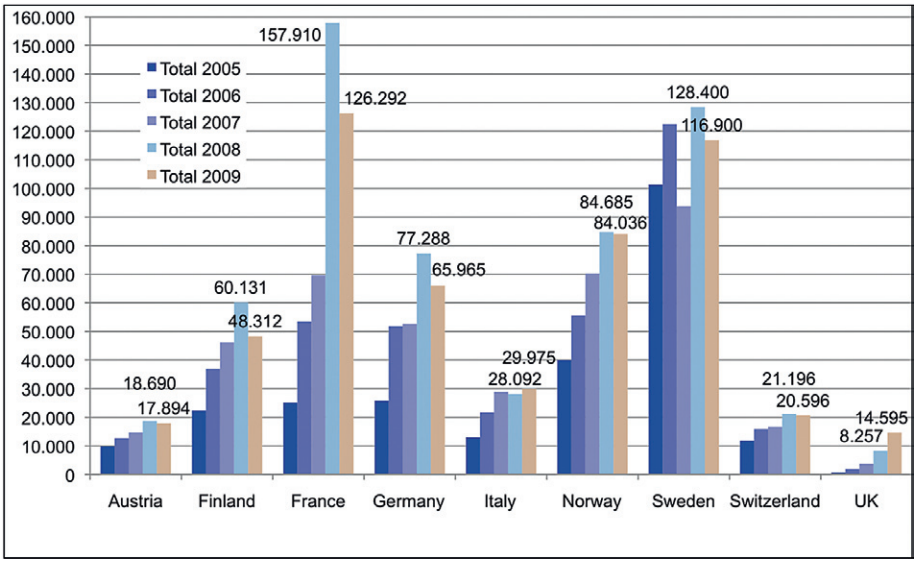


Figure 1: Heat pump units sold 2005-2009 per country (includes air-air heat pumps)*

EHPA has actively supported the IEA in compiling the report. It is convinced that the findings are relevant, and hopes that the recommendations will positively influence the market development of future energy technologies.

The heat pump market is following a long-term growth path. Heat pump sales from 2005 to 2009 in a selected number of indicator markets have been growing at 16 % on average, reaching a total of 524 565 units in 2009 (see Figure 1). The heat pumps installed in the nine countries analysed use approx. 6,82 TWh of RES, and save approx. 54 Mt of greenhouse gas emissions per year.

Even though the heat pump industry is affected by the difficult economic situation, the long-term trend is sound. However, a comparison between the total market for new houses and existing building stock shows that heat pump market share is still low. It is developing well in the segment of new houses, having passed the 30 % mark in many member states (with Sweden and Switzerland being rare examples at approx. 75 % and 95 % respectively). But the overall share in heating systems is still low, rarely exceeding 10 % in the majority of European markets. Interest in the use of heat pumps in industrial applications is growing, but is still small.

The IEA study shows in its BLUE heat pumps scenario that an early uptake of heat pumps will provide superior benefits towards the achievement of the targets set. Heat pumps would take a leading but not exclusive role towards a 100 % renewable Europe. The technology for the next energy revolution is here – it now needs the political will to make its potential reality throughout Europe.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

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ETP2010 – Huge potential for heat pumps!

Roger Nordman, Monica Axell, SP Technical Research Institute of Sweden, Sweden

This article comments on the results of the publication, and gives some guidance for future development for the heat pump community. It also gives an overview of the work contributed to the ETP from the IEA HPP. Finally, some ideas for further development of the technical basis for the ETP publication are given.

Introduction to ETP2010

The Energy Technology Perspectives was introduced in 2006 as a response to the G8 meeting request for alternative scenarios at the Gleneagles summit (2005). Tackling climate change and enhancing energy security requires a massive decarbonisation of the energy system leading to a new age of electrification. We need to break the historic link between CO_2 emissions and economic output; and do this not just for a few years, but from now on. ETP 2010 shows how this can be achieved. It identifies the technologies that we require and the policies that we will need in order to stimulate the necessary investment. Heat pumps are shown to be a very cost-effective means of reducing building-related emissions.

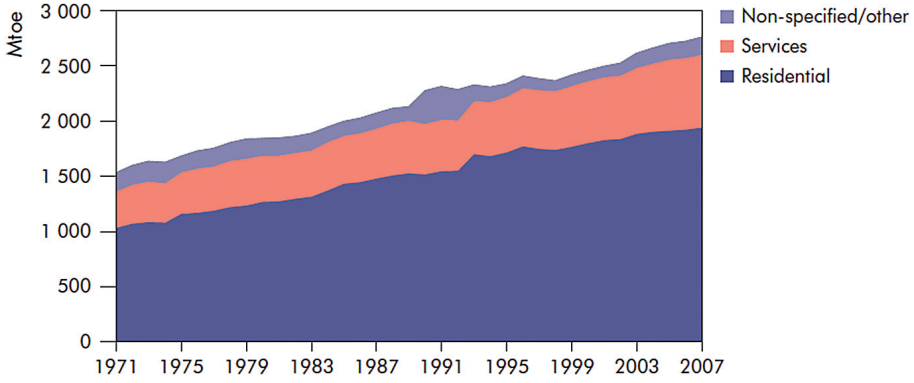
Buildings have large savings potential

Between 1971 and 2007, total energy consumption in the buildings sector grew by 1.6% a year from 1 535 million tonnes of oil equivalent (Mtoe[1]) to 2 759 Mtoe (Figure 1). Household sector CO_2 emissions were around 4.7 Gt CO_2 in 2007, while they were around 2.9 Gt CO_2 in the service sector. The world's population will increase by around 40% to 9.1 billion in 2050, mainly in Asia and Africa, which will lead to a large development of new buildings both in the domestic and commercial sector. Increased standard of living is a driver for increased thermal comfort in buildings, both regarding heating and air conditioning.

[1]Mtoe = 11630 GWh

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

Figure 6.4 ▶ Energy consumption of buildings by sector



Key point

The residential sector dominates total buildings sector energy consumption at a global level.

Figure 1. Energy use by building sectors.

Heat pumps have large potential in buildings

Heat pumps are unique in the sense that they can supply both heating, domestic hot water and cooling. As can be seen in Figure 2, about 63 % of the total savings (BLUE compared to Baseline) relate to heating, hot water production or cooling. The savings are calculated to be achieved by a mix of technologies, but only the market will tell how these savings will be divided between the different technologies. In the BLUE Heat Pumps scenario, which assumes a particularly successful (but not unreasonable) heat pump technology development, ultra-high efficiency heat pump air conditioners (COP of 9) for cooling and humidity control, and faster cost reductions for space and water heating applications are assumed. In the BLUE Heat Pumps variant, CO_2 emissions reductions are 7% higher than in the ordinary BLUE Map scenario. Heat pumps' share of the savings from space and water heating increases from 23% in the BLUE Map scenario to 40% in the BLUE Heat Pumps variant in 2050. In addition, highly efficient heat pumps for air-conditioning save an additional 155 Mt CO_2.

Already today, with available technology, heat pumps can contribute to decrease building energy consumption, e.g. up to 70% reduction in cold climates, such as Sweden. However,

there are still lots of possible potential, both regarding the heat pumping technology itself and considering the integration in buildings, smart grids, and even cities' energy systems.

As Figure 3 shows, most of the measures taken in the end-use efficiency "sector", where heat pumps belong, can be implemented with negative CO_2 marginal costs.

Table 1 shows that energy efficiency measures affecting heat pumps have a medium to large savings potential, but that they need urgent policy measures in the short to medium term. In the new build sector, this is achieved primarily by tightening building codes, which result in lowered space heating and cooling demands in many parts of the world. In the existing stock of buildings, some areas of the world now develop building codes that will be applied also in renovations. Because of the much more constrained situation in the renovation case, heat pumps may be a key driver for lowering the energy use. For instance, they can be applied without requiring too much space, whereas cross flow ventilation air heat exchange and improved insulation levels often leads to considerable interference with the building facade.

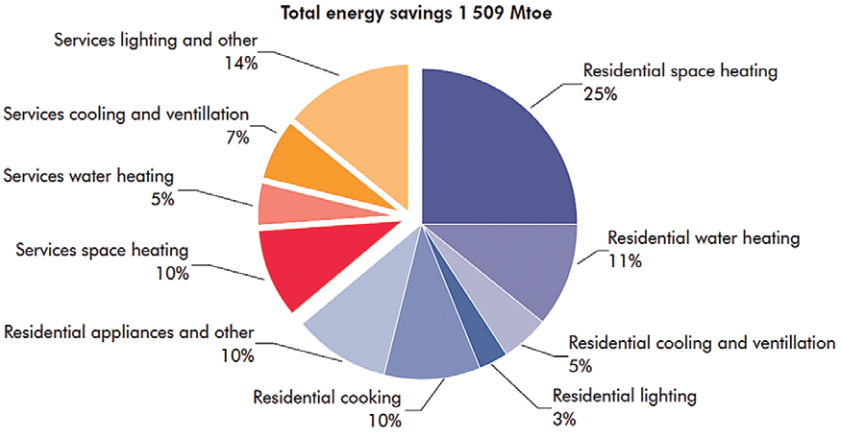
Lowering the use of domestic hot water can be achieved by high-efficiency equipment and also by changed user behavior. The amount that cannot be saved by more efficient goods and changed user behavior can be produced at very high efficiencies by using heat pumps. The Japanese Eco Cute heat pumps is one very good example of this (1).

Industry

Total final energy use by industry reached 3 015 million tonnes of oil equivalent (Mtoe) in 2007, representing almost a doubling of energy use since 1971 (see Figure 5.1 of ETP 2010). The five most energy-intensive sectors, namely iron and steel, cement, chemical and petrochemical, pulp and paper, and aluminium,

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

Figure 6.14 ▶ Buildings sector energy savings by sector and by end use, 2050



Key point

Two-thirds of the energy savings in the BLUE Map scenario come from the residential sector.

Figure 2. Building sector energy savings per end use.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

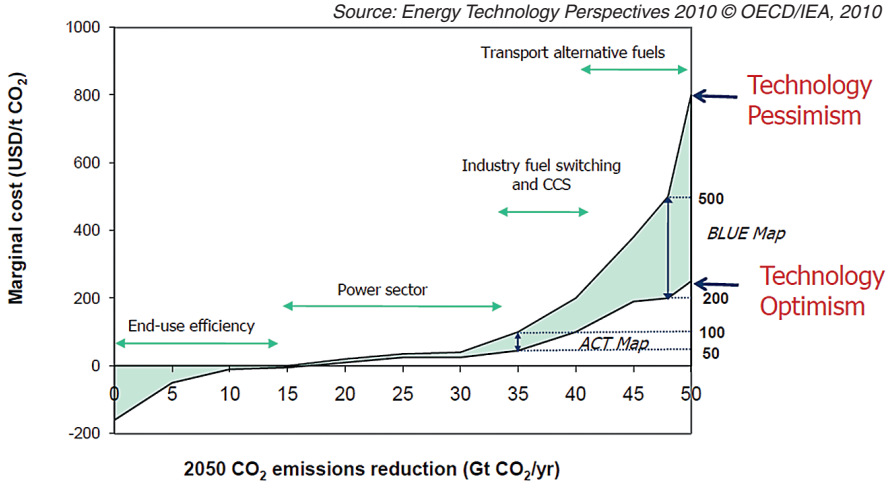


Figure 3. Marginal CO_2 abatement costs for different technologies (Source: Dr Peter Taylor Global Technology Perspectives and the Role of CHP/DHC in Global Warming Prevention, Sapporo, 4 July 2008)

Table 1. Priority policy actions for the BLUE scenario.

Table 6.1 ▶ Priority policy actions needed to deliver the outcomes in the BLUE Map scenario

	Overall savings potential	Policy urgency	Bulk of savings available
Energy efficiency			
Lighting	Medium	Average	Quickly
Appliances	Large	Average	Short- to medium-term
Water heating systems	Medium to large	Urgent	Short- to medium-term
Space heating systems	Medium to large	Urgent	Short- to medium-term
Cooling/ventilation systems	Medium to large	Urgent	Short- to medium-term
Cooking	Small	Average	Quickly
Fuel switching			
Water heating systems	Medium to large	Urgent/average	Short- to long-term
Space heating systems	Medium to large	Urgent/average	Short- to long-term
Cooking	Small	Average/urgent	Short- to medium-term
Building shell measures			
New residential buildings	Medium to large	Average/urgent	Medium- to long-term
Retrofit residential buildings	Large	Urgent	Medium- to long-term
New commercial buildings	Large	Urgent	Medium- to long-term
Retrofit commercial buildings	Medium to large	Average	Medium- to long-term

Note: Overall savings potential is relative to their contribution to total savings in the buildings sector. Where two policy urgency ratings are given, it is for OECD/non-OECD.

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

together accounted for two thirds of total industrial energy use and about 77% of total direct CO_2 emissions in industry. Work at the IEA is seeking to improve the quality of the underpinning data and to refine the methodologies used in calculating the savings potential in the industrial sector.

In the IEA HPP, work was undertaken in Annex 21. In addition to making an inventory of current users, each participating country conducted a market assessment using the Industrial Heat Pump Screening Program. This was specifically developed to determine how industrial heat pumps could be used in different applications. Estimates were made on the potential for using industrial heat pumps in over 35 different processes in the year 2010. The study indicated that industrial heat pumps could reduce the energy consumption for industrial process heating by 1300 to 3100 PJ per year worldwide, or 2-5% of the global energy demand for process heat in 2010.

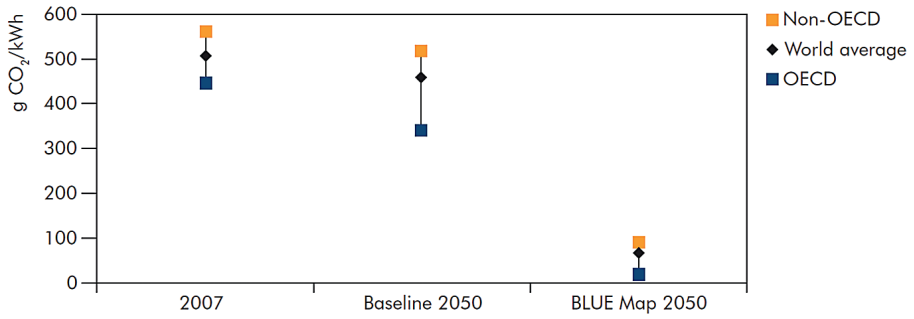
The applicability of heat pumps depends on the heat sink and source temperatures, and the associated temperature lift. Many refrigerants that could be used for high temperature applications were not good from an environmental point of view (ozone, GHG). Therefore the IEA HPP recently started a new Annex, Annex 35 (in cooperation with IEA IETS[2]), on industrial heat pumps. In this annex, one focus area will be to develop and apply high temperature (80 – 150°C) heat pumps. Another important area is to map the energy use versus temperature level, since this affects the potential for heat pumps in industrial applications. The results from this new Annex will be of great use also for the secretariat.

Heat pumps are a promising technology for industrial application and additional R&D is needed to allow for heat pump use at higher temperatures to enable wider adoption among industry sectors.

[2]http://www.iea-iets.org/

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

Figure 3.5 ▶ CO_2 intensity of electricity production by scenario



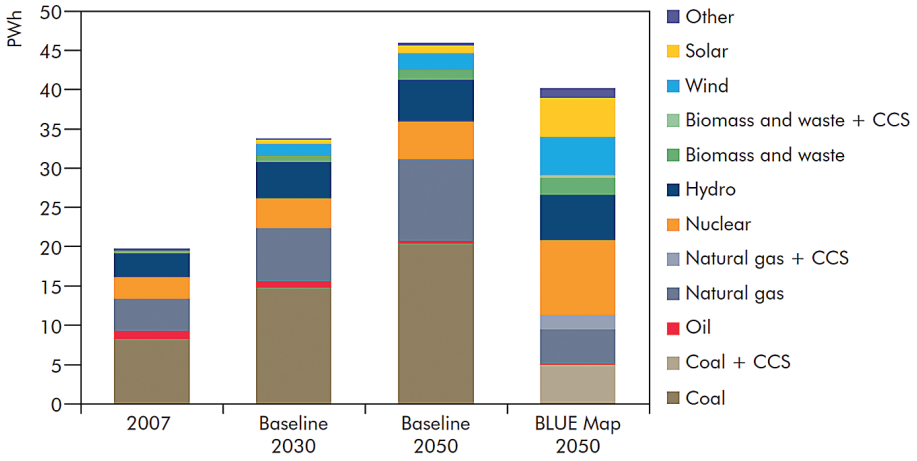
Key point

The power sector is virtually decarbonised by 2050 in the BLUE Map scenario.

Figure 4. Specific CO_2 emissions now and in the scenarios

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

Figure 3.4 ▶ Global electricity production by energy source and by scenario



Note: Other includes electricity generation from geothermal and ocean technologies.

Key point

There is a major shift from fossil fuels to low-carbon alternatives in the BLUE Map scenario.

Figure 5. Global electricity production by energy source and by scenario.

Heat pumps benefit from the development of other technologies

Introducing heat pumps for heating and hot water production in many cases (except when replacing direct electric) implies an externalization of internal emissions. This means that associated emissions from the use of the heat pump are moved from the building sector to the power generation sector.

With current specific CO_2 emissions in the power generation sector, different seasonal performance factor must be attained in different parts of the world in order to give a positive net CO_2 abatement.

The ETP concludes that a massive growth of renewable electricity generation is expected until 2050, which will lead to decarbonisation of the electricity grid. The main technologies in the generation sector will be solar PV, wind, nuclear, biomass CHP and CCS applied to coal and natural gas.

All of these technologies have their positive and negative effects, but as a whole, the renewable electricity production will be almost 100% in 2050 according to the ETP.

Heat pumps are the technology that benefits the most by this greening of the grid, since they act as multipliers of renewable energy.

Electricity as an energy carrier

An often unnoticed benefit of heat pumps is that infrastructure costs for society can be kept to a minimum if intelligent planning is done for the electricity grid. Since all buildings already have grid connection, securing reliable and stable grids minimizes extra costs for society. Electricity is also a flexible energy carrier with low distribution losses. By implementing smart grids, peak power problems on both the demand and the generation side could be lowered by the use of heat pumps that have the possibility to shift electricity to heat. Therefore, heat pumps can balance intermittent electricity generation such as solar PV and wind by moving a surplus of electricity into heat stored in the building.

HPP played a significant role in the development of the ETP2010

The IEA Heat Pump Programme (HPP) was first involved in the work with the ETP in the 2008 edition. Based on the experiences from that work, the executive committee of IEA HPP decided that involvement in the 2010 edition was of high importance. Consequently, members from many of the participating countries and the Heat Pump Centre have been present at the workshops held by the IEA. A truly massive effort has also been put into developing the text on heat pumps, a job that paid off twice, since lot of the material that couldn't fit into the ETP will appear in the forthcoming "Energy efficient buildings" roadmap publication from the IEA secretariat.

The Heat Pump Centre would like to thank all persons in the Heat Pump Programme, industry associations and industry that participated and gave input to this important publication.

Discussion

The ETP 2010 shows that heat pumps can play an important role in the transition of the energy system on the demand side. To some extent, heat pumps are underestimated in the ETP, since the application potential in, for example, industry is not so well understood. The work in the new IEA HPP Annex 35 will bring important knowledge to this sector.

Since the ETP 2008, the Heat Pump Centre has worked hard to improve the statistics for heat pumps, but we believe that there are still uncertainties in the statistics. During the work with this ETP, new ideas for improved statistics are being developed, and in the future, more detail may be obtained.

In parallel, the Eurostat in cooperation with industry and other stakeholders in Europe have developed a methodology to capture the share of renewable energy from heat pumps as stated in the RES directive (2). This model will also lead to better statistics.

For better background data as input to forthcoming ETP publications, the following should be further developed:

- Comprehensive market development data for heat pump in OECD and +5 countries,
- A common view on the seasonal/annual performance of heat pumps (including test conditions),
- Better cost and lifetime data for different types of heat pumps,
- An understanding of the potential for heat pumps in industry.

As an overall conclusion to the ETP, the following can be said:

- There is a need for an energy transition revolution,
- Heat pumps can play an important role in this aspect,
- It is now up to policy makers and industry to make the right decisions, and we cannot wait long to see the outcomes from such decisions.

References

1. Renewable energy and heat pumps in Japan, Sasaki, Masanobu, IEA HPC Newsletter No.N27.03/2009
2. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:01:EN:HTML

Source: Energy Technology Perspectives 2010 © OECD/IEA, 2010

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Energy Technology Perspectives 2010
This publication is the topic of the present Newsletter issue.
http://www.iea.org/W/bookshop/add.aspx?id=401

ASHRAE Handbook - Refrigeration
The diversity of refrigeration from ice rinks to refrigerant containment to freezing fruits and vegetables is covered in the latest Handbook volume from ASHRAE.
The 2010 ASHRAE Handbook – Refrigeration, covers the refrigeration equipment and systems for applications other than human comfort. It includes information on cooling, freezing, and storing food; industrial applications of refrigeration; and low-temperature refrigeration.
http://www.ashrae.org/pressroom/detail/17558

Geothermal Energy Systems: Exploration, Development, and Utilization.
(Ernst Huenges and Patrick Ledru, Eds.)
The book presents basic knowledge about geothermal technology for the utilization of geothermal resources. It helps to understand the basic geology needed for the utilization of geothermal energy and describes the methods to create access to geothermal reservoirs by drilling and the engineering of the reservoir. The book describes the technology available to make use of the earth's heat for direct use, power, and/or chilling, and gives the economic and environmental conditions limiting its utilization. Special emphasis is given to enhanced or engineered geothermal systems (EGS), which are based on concepts that bring a priori less productive reservoirs to an economic use. These concepts require the geothermal technology described here. The idea of EGS is not yet very old. Therefore, this book aims to provide a baseline of the technologies, taking into account the fact that due to a growing interest in EGS, a dynamic development may increase the specific knowledge to a large extent in the near future.
http://www.egec.org/index.html (See News 21.07.2010)
http://eu.wiley.com/WileyCDA/WileyTitle/productCd-3527408312.html

EU Energy Law : Volume V :The EU Energy Law & Policy Yearbook 2010
This yearbook provides sound knowledge of recent developments in the field of EU energy law and policy. The authors represent a wide variety of legal and political backgrounds and approaches to EU energy policy. They were given the mandate to critically examine current EU energy policy approaches in their respective area of expertise, and to explore the agenda of the new European Commission.

The yearbook covers the whole range of EU energy law and policy, from the 20-20-20 strategy and new initiatives for ensuring security of supply to the application of competition rules and the organization of an efficient technology policy. It provides practitioners and academics a clear and comprehensive guide in this field.
http://www.claeys-casteels.com/publications.php?pg=150

2010

13-15 October
Chillventa 2010
Nuremberg, Germany
http://www.chillventa.de

26-28 October
ICEBO 2010 - 10th International Conference for Enhanced Building Operations
Kuwait
http://www.icebo2010.org

26-28 October
AHR EXPO - Mexico
Mexico City, Mexico
http://www.ahrexpomexico.com/eng/

27-29 October
GREENEXPO - Alternative Energy 2010
Kyiv, Ukraine
http://www.greenexpo.kiev.ua/en/?pid=0

10-12 November
IAQ 2010: Airborne Infection Control - Ventilation, IAQ & Energy
Kuala Lumpur, Malaysia
http://www.ashrae.org/events/detail/90

15-16 November
CGC's 4th National GeoExchange Business & Policy Forum - 2010
Montreal, Canada
http://www.geo-exchange.ca/en/national_conference.php

17-18 November
geoENERGIA 2010
Trade fair for Shallow and Deep Geothermal Energy
Karlsruhe, Germany
http://www.geoenergia.de/infos/english.html

25-27 November
RENEXPO® Austria International trade fair
Salzburg, Austria
http://www.renexpo-austria.at/index.php?id=7&L=1

1-3 December
International Congress on Heating, Refrigerating & Air-Conditioning
Belgrade, Serbia
Contact: Branislav Todorovic at todorob @ eunet.rs

2-3 December
International Symposium on New Refrigerants and Environmental Technology
Kobe, Japan
http://www.jraia.or.jp/frameset_english.html

8-9 December
World Energy Engineering Congress
Washington, D.C., USA
http://www.energycongress.com

8-9 December
Geopower Europe
Paris, France
http://www.egec.org/index.html
[See "Events"]

13-15 December
8th International Conference on System Simulation in Buildings
Liege, Belgium
Organised in cooperation with IEA - ECBCS and ASHRAE
http://www.buildup.eu/events/2730

2011

21 January
European Conference on 'The Latest Technologies in Renewable Energy'
Edinburgh, UK
http://www.EUenergycentre.org/ukconference/edi11.pdf

29 January - 2 February
ASHRAE Winter Meeting
Las Vegas, USA
http://www.ashrae.org/events/page/2650

31 January - 2 February
International Air-Conditioning, Heating, Refrigerating Exposition (AHR Expo)
Las Vegas, USA
Co-sponsored by ASHRAE and ARI
http://www.ahrexpo.com

In the next Issue

Supermarket refrigeration

Volume 28 - No. 4/2010

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.

The IEA Heat Pump Centre is operated by

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