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

Position paper from the Heat Pump Programme Implementing Agreement

Heat pumping technologies[1] are a mature, widely deployed, and cost-effective energy efficiency option, with a significant role to play in portfolios of measures to address key energy policy concerns. The technical and market knowledge that resides within the International Energy Agency's Heat Pump Programme can help to develop applicable policies.

1. Key Concerns

The International Energy Agency (IEA), empowered by its member countries and energy ministers, has focused its work in three key strategic energy policy areas, as follows:

- **Energy security**: The promotion of diversity, efficiency and flexibility within all energy sectors
- **Environmental awareness**: Enhancing international knowledge of options for tackling climate change.
- **Economic development**: Ensuring the stable supply of affordable energy to IEA member countries. Promoting free markets for energy to foster economic growth. Working towards the elimination of energy poverty.

IEA energy ministers re-affirmed their commitment to reducing global energy-related CO_2 emissions from energy by 50 % compared to today's level by 2050 in their 2009 Ministerial Meeting. They also made strong statements about promoting energy efficiency and renewable energy, as well as the importance of accelerating the worldwide transition to low-carbon energy technologies.[2]

2. Scale of impact and costs

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

Heat pumping technologies are already the dominant cooling technology, but their main CO_2 emissions-reduction potential in OECD countries lies in providing a greater share of space and water heating. Many countries, particularly Switzerland and Sweden, already have significant markets for heat pumps in heating applications. However, their wider application could reduce global CO_2 emissions significantly. In the IEA's BLUE Map scenario, heat pumps for heating and cooling account for 1.25 Gt of CO_2 savings by 2050 in the buildings sector alone. An alternative scenario that sees heat pumps achieving early momentum to meet CO_2 reduction goals, and therefore achieving more rapid penetration than competing CO_2 reduction technologies, forecasts possible savings as large as 2 Gt CO_2.[3]

Savings could be even higher than this if heat pumps were to become the dominant space and water heating technology in buildings, while additional CO_2 reduction potential also exists in industry.

Savings in existing refrigeration and air-conditioning markets can be achieved very rapidly through the tightening of standards, bearing in mind that most countries are far from today's Best Available Technology (BAT) levels of efficiency. Very high efficiency air conditioners offer significant savings potential in developing countries, where electricity demand for cooling is growing rapidly, and would also help to reduce problems and costs associated with meeting peak load demand during the day. The savings in fossil fuel consumption vary, depending on the current and future fuel mix of power generation, but are significant.

As for other technologies, the life cycle cost of heat pumps varies with the country, application, relative capital and fuel costs. However, the savings offered by heat pumps can often be achieved at low, or sometimes even no, increase in costs on a life-cycle basis due to the very high efficiency of heat pumps. However, more commonly the savings are at the lower end of estimates of the social cost of emissions (USD 60 to 250 /t C [4]). This puts heat pumps on a par with good examples of wind or biomass installations, and often below the cost of solar energy. As the carbon intensity of electricity generation is reduced, the CO_2 savings from replacing fossil fuel combustion with electric heat pumps will increase, while greater deployment will help reduce costs, further improving the economics of carbon savings from heat pumps.

3 Relevance

3.1 Relevance: Supply Security

Heat pumping technology can improve the security of energy supplies by significantly reducing energy imports and providing greater fuel flexibility through the increased use of electricity (a multi-fuel energy carrier).

- Most OECD countries are net energy importers and are exposed to supply security risk from the interruption of supplies from natural disasters, geo-political tensions/events and political interference in energy markets.[5]
- Energy-efficiency improvements, such as heat pumps, reduce demand below what it would otherwise be, and thus reduce energy imports as well. As a result, risk management becomes more tractable.
- The use of electricity, which is the prime mover for most heat pumps,[6] allows a more diversified energy supply, because electricity can be generated from a wide range of fossil and renewable sources.

3.2 Relevance: Environmental impact

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

- The most pressing global environmental concern is climate change, although ozone depletion, air quality and visual and other amenity issues are also important.
- The use of heat pumps for space and water heating for buildings and industry usually emits less carbon than the direct use of fossil fuels for heating in OECD countries.[7]
- As electricity generation efficiency improves, and the generation mix contains a larger mix of renewables, the carbon savings from the use of heat pumps increases. Thus, there is synergy between heat pumping and lower-carbon electricity supply policies.[8]

3.3 Relevance: Developing economies

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

- Developing economies need to make large investments in energy supply and distribution infrastructure to meet the growing needs of households and industry. The provision of supply networks for gas and electricity to households has a particularly high cost.
- If highly efficient electric heat pumps provide space and water heating and cooling, then this reduces the incremental investment needed in energy networks, and will also help to reduce peak loads.[9]

4. Priorities for action

The IEA's Implementing Agreements, including the Heat Pump Programme, could identify and promote policy measures to encourage the appropriate uptake of heat pumping (and other energy efficiency) technologies within port-

folios of measures to address energy and environmental policy objectives. The Heat Pump Programme could work with the IEA Secretariat to help ensure that these opportunities and policies messages are widely distributed.

The IEA has expertise in assessing energy policies and identifying where they are successful, and has influence in encouraging governments to implement appropriate policies according to their specific needs. It has the ability to draw on the knowledge within the Heat Pump Programme of heat pump markets, products and technical options, and of experience with existing policies.[10]

We recommend that steps be taken to implement such collaborative studies

5. Some Options

At a macro-economic level, appropriate policies seem likely to include measures that pass environmental costs to end users, such as carbon trading or carbon taxes. Such measures would allow efficient markets to recognise the value of all energy-efficient technologies, including heat pumps.[11, 12]

However, markets are imperfect. The 2001 IPCC report[13] pointed out that, for mitigation technology in general, "expanded R&D is needed.....but implementation policies remain the major hurdle...". This is certainly true of heat pump applications, where a lack of awareness of heat pump technologies, their costs and energy-efficiency potential, as well as a lack of confidence in the technology, is inhibiting uptake. In addition, the supply and servicing infrastructure in most countries is immature and needs to be expanded. The fact that capital costs are sometimes higher than incumbent technologies, even when life-cycle costs are lower, also limits market growth. Policy measures to overcome these market hurdles are already employed in some countries, and include:

- establishment of accreditation schemes for installers and for equipment
- support for the establishment of properly constituted trade associations
- provision of objective information on performance
- deployment incentives, such as grants, tax rebates, etc.

At the same time as expanding the current market, further RD&D is needed, as there is scope for further technical development. Unlike fossil-fuelled heat generation, the current performance of most heat pumping systems still falls short of the levels that are theoretically and even practically possible. Likewise, although the ozone-depletion potential of refrigerants has been dramatically reduced, there is still scope to develop and apply ozone-neutral refrigerants and procedures to contain other refrigerants more securely. Much of this work is most efficiently carried out through international collaboration. This is the mainstream role of IEA Implementing Agreements.

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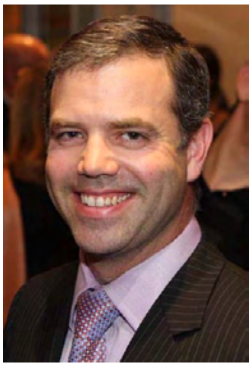
1. Heat pumping is a technology that (usually) uses electricity to either upgrade waste heat or renewable heat to useful temperatures, or to extract heat for refrigeration or other cooling applications.
2. http://www.iea.org/journalists/ministerial2009/communique.pdf
3. IEA (2010), Energy Technology Perspectives: Scenarios and Strategies to 2050, OECD/IEA, Paris.
4. UK Government Economic Service Working Paper 140, http://www.hm-treasury.gov.uk/d/SCC.pdf
5. The major risk management options relate to diversification of suppliers and supply routes, and to ensuring that suppliers and consumers have common interests in an uninterrupted supply.
6. Some application use gas, steam or waste heat
7. It is already more carbon-efficient to burn natural gas in a combined-cycle generation plant and then to use the electricity in a heat pump, than it is to use a gas boiler or furnace
8. The impacts noted above conservatively assume that the electricity generation fuel mix remains unchanged
9. High fixed costs and the consequent economies of scale mean that the additional costs incurred for higher capacity electricity distribution can be less than the cost of household gas supply system.
10. Similar opportunities exist for other energy-efficiency technologies.
11. This could be used to stabilise consumer prices, removing the uncertainty created by price volatility.
12. Current high fuel prices improve cost-effectiveness, but may not be sustained.
13. Climate Change 2001. Mitigation. Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. [available through Google books]



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IEA Heat Pump Centre

The IEA Heat Pump Programme is the foremost worldwide source of independent information and expertise on heat pump, refrigeration and air-conditioning systems for buildings, commerce and industry.

The IEA Heat Pump Centre is the central information activity of the IEA Heat Pump Programme. The Centre links people and organisations worldwide in support of heat pump technology and communicates through National Teams (NT) in the HPP member countries.

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