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The Potential Impact of Heat Pumps on Energy Policy Concerns

Position paper from the Heat Pump Programme Implementing Agreement

www.heatpumpcentre.org

The Question

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.[1]

What is the role for heat pumps in meeting these goals? The Heat Pump Programme has produced a short non-technical communiqué ("How Heat Pumps can Help to Address Today's Key Energy Policy Concerns") that addresses the role of heat pumps in energy and environmental policy. This can be seen on the programme's website.

The Contribution of Heat Pumps to Energy and Environmental Goals

1. **Heat pumping technology could have a material impact on greenhouse gas emissions at a modest cost[2]**

Heat pumps should be seriously considered as part of any portfolio of technologies aimed at reducing greenhouse gas emissions, and of policies to support the deployment of these technologies.

Heat pumping technologies are already the dominant cooling technology. There exists a large energy and CO_2 savings potential globally, given that average efficiencies, both of installed heat pumps and of those currently on the market, are substantially lower than the best available. The potential savings in rapidly expanding developing countries are large. In OECD countries, their principal CO_2 emissions reduction potential lies in meeting a greater share of space and water heating, the most CO_2 intensive end uses.

In the IEA's BLUE Map scenario[2], heat pumps for heating and cooling account for 1.25 Gt of CO_2 savings in the buildings sector alone. However, in a 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, the savings could be as much as 2 Gt CO_2.

However, these figures could be higher still, given that

- Efficiencies can still be improved. Unlike boiler technology, current heat pumps are not operating near their theoretical limits of efficiency. Efficiency improvements are possible, albeit at increased cost.
- Market penetration could be higher. If heat pumps were to become the dominant technology in the way that fossil fuel technologies are today, then the savings could be even higher.
- Decarbonisation of the electricity sector will reduce CO_2 emissions from heat pumps to very low levels.

The cost of saving a tonne of carbon dioxide emissions through heat pumping technology varies between countries, as does the cost of other alternatives. However, heat pumps generally offer costs that are very favourable compared to CO_2 abatement in the transport sector or even industry, when deep cuts are considered. For heat pumps, the main determinants of abatement costs are the local climate (heating and cooling seasons), the CO_2 intensity of the electricity supply system, fuel costs, heat pump costs and efficiency; and the cost of incumbent heating systems. 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.

2. Heat pumps can reduce exposure to supply risk

The risk of interruption of energy supplies is partly political and partly related to supply infrastructure reliability. Heat pumps cannot directly influence these risks but, like other energy efficiency measures, their use reduces energy demand and therefore the scale of exposure to the risks. In so doing, it makes risk management easier.

Most heat pumps use electricity. Since electricity generation is not inherently fuel-specific, increased use of heat pumps increases the diversification in terms of primary energy sources. The use of heat pumps therefore fits well with strategic plans to shift to a more secure portfolio balance of fuels and technologies in the future.

3. Heat pumps can reduce infrastructure costs for energy supply networks

Developing countries often face significant challenges in meeting the growing demand for energy services from their citizens as incomes rise. A shift to highly efficient heat pump air conditioners would not only reduce overall electricity demand and the need for energy supply infrastructure, but also help to reduce peak loads. This would reduce the need and cost for expensive extensions and upgrades of the electricity system.

4. Policy options

The optimal choice of policy instruments depends on the exact nature of the energy and environmental problems being addressed, as well as local circumstances. However, to generalise, a robust policy package will need to rely on a portfolio of measures and technologies in order to reduce risks and costs.

If there is sufficient confidence in market mechanisms and the state of development of different technologies, policies can be "technology-blind" (carbon taxes would be an example). For many technologies - especially those related to buildings - the rate of implementation can be constrained by the stock turnover period. For heating systems, this is typically of the order of 10 to 20 years. Thus decisions by consumers or by policymakers have to be based on estimates (or alternative scenarios) of likely benefits over lengthy future periods, during which it is unlikely that current conditions (especially energy prices) will pertain. In this situation of spending now in order to achieve benefits in the somewhat distant future, it is unlikely that decision-makers will make the optimal choices.

Given the short planning horizon of most actors and the very different state of development of different technologies, the reality is therefore that the overall policy regime will need to be complemented by more tailored support packages for individual technologies, that can be phased out over time to allow each technology, once mature in a given market, to compete freely to meet the desired energy and environmental policy goals.

For policies that distinguish between technologies, different instruments are appropriate in different situations. The table below summarises some typical instruments for different classes of cost-effectiveness (for example in terms of lifetime cost per tonne of carbon dioxide emissions abated). Specifically, a distinction is made between cost-effectiveness to the end-user and cost-effectiveness to society (including the cost of externalities).

Typical policy instruments

Life cycle cost (LCC) or Net present value (NPV)

Better ←→ Worse

Cost-effective to user and to society	Cost-effective to society but not to user	Not currently cost-effective to society or user
Remove market barriers • provide information • overcome capital constraints (e.g. loans) • support development of market structure	**Incentives and regulatory requirements** • minimum carbon efficiency requirements • reflect external costs through taxation • subsidies or soft loans	**Support development (if potential appears worthwhile)** • R&D support • demonstration programmes

The choice of what instruments to include in policy packages depends not only on local circumstances, but also on the cost-effectiveness of the policy and the scale of the benefit likely to be achieved.

Generally, heat pumps fall into the first two columns of this table. Although they are sometimes cost-effective today, in many applications it is the societal benefits that make them attractive.

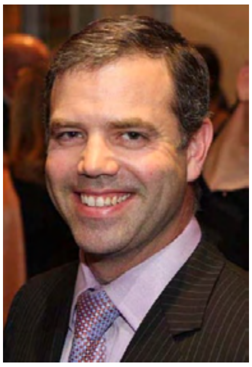
Despite the fact that heat pump technologies are mature in many applications and markets, further R&D is required to optimise systems in a wider range of applications, to continue to reduce costs and to improve performance. This reflects the general comment of the 2001 IPCC report that, for mitigation policy in general, "expanded R&D is needed … but implementation remains the major hurdle."

5. Implications for the IEA

One of the G8 requests to the IEA was for "advice on alternative energy scenarios and strategies aimed at a clean, clever and competitive energy future". We suggest that the approach outlined above can be part of the structure of the IEA's response.

In order to identify where different technologies fall in the matrix of instruments, costs and carbon benefits of each technology need to be assessed, along with the their potential scale of impact. We suggest that the Implementing Agreements – and especially those within the Building Coordination Group – can provide much of this through their collective knowledge and networks. We therefore suggest that the planning and financing of the IEA's response should include provision for work by the Implementing Agreements. Indeed, this would be completely in line with the commitment of the IEA energy ministers quoted above.

1. http://www.iea.org/journalists/ministerial2009/communique.pdf
2. IEA (2010), Energy Technology Perspectives: Scenarios and Strategies to 2050, IEA/OECD, Paris.



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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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