Heat Pumps

INSIGHTS FOR POLICY MAKERS

Based on thermodynamic refrigeration cycles, heat pumps use a process fluid and electricity to extract thermal energy from a low-temperature source and provide heat to a higher temperature sink (and refrigeration of the heat source). Heat sources (in heating applications) or sinks (in cooling applications) include outdoor/indoor air, river/lake/sea water, ground heat and waste heat. Common applications for heat pumps are air-conditioning, refrigeration and space heating in both residential and commercial buildings. Other applications include hot water supply in commercial buildings, cold storage warehouses and process heat and steam for industrial applications.

Heat pumps are very energy efficient devices. They can provide three to six units of useful thermal energy for each unit of energy consumed. In comparison, traditional combustion-based heating systems only provide less than one unit of thermal energy for each unit of energy consumed. An important performance indicator for heat pumps is the co-efficient of performance (COP), which is the ratio of the energy output to the energy input. The smaller the temperature difference between the heat source and the sink, the higher the COP. Today's best heat pumps can offer COP values between six and seven and high reliability under a wide range of operating conditions. In particular, significant advances have been achieved for air-source heat pumps (ASHPs), which are mostly used for air conditioning. Some ASHP models can provide indoor space heating even with outdoor air temperatures as low as -25°C, while keeping COP values greater than one. These technical advances have significantly enlarged the range of applications. With capacities between 1kW and 10 MW, current heat pumps can provide heating and cooling to single houses or to entire districts . In industrial applications, they can be used at temperatures from below -100°C to above 100°C. Although efficiency has been improved by a factor of 2.5 over the past decades, an additional increase of 20-50% is expected between now and 2030.

The economics and market penetration of heat pumps have significantly improved. However, their contribution to space and water heating is still relatively modest except for some OECD countries. Space heating/cooling and hot water supply account for roughly half of the global energy consumption in buildings, with a fast-growing demand in emerging economies, most of this demand being met by the combustion of fossil fuels. Therefore, the highly efficient heat pumps have a key role to play in reducing CO2 emissions in the residential, commercial and industrial sectors. Furthermore, because heat pumps mostly use the renewable sources of heat and sinks (apart from the electricity used to run the process), they can be regarded as renewable technologies that contribute significantly to the penetration of renewable energy.

Heat pumps are considered as a renewable energy technology in the European Union (EU), where they are expected to account for between 5% and 20% of the EU's renewable energy target for 2020. Several other countries (e.g. the United States, the United Kingdom, Australia and Japan) grant tax reductions, subsidies or other benefits to facilitate the use of heat pumps. In many other countries however, heat pumps are not considered as renewable technologies and receive no incentives or subsidies. In addition, because significant differences exist in national standards and regulations to measure heat pump performance, their contribution to the penetration of renewable energy is not well captured in today's energy statistics. To support heat pump deployment, national standards should be harmonised, consumers should be fully informed of the efficiency of heat pumps, and the investment costs of heat pumps (compared to traditional combustion devices) should be reduced. Therefore, continued support to R&D and policy measures are essential to improve competitiveness and market penetration of heat pumps, thus exploiting their large potential to supply efficient and clean energy services.

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