

Breakthrough for heat pumps – Practical options for an efficient heat transition in existing buildings

Executive Summary

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Mandatory RES shares in heating systems as a key policy measure for the market ramp-up of heat pumps

For the building sector to become climate-neutral, a heat transition is needed. The heat transition comprises three key areas of action: Renovating existing buildings to make them more energy-efficient, phasing out oil and gas boilers, and expanding and decarbonising heating networks. Progress in these fields of action will simultaneously reduce the need for fossil energy imports and thus make an important contribution to greater energy sovereignty in Germany.

One technology plays a key role, the heat pump. In the future, it is expected to replace many of the oil and gas boilers currently in operation - unless a heating network is already in operation on site. Numerous studies, including the "Big 5" German climate neutrality studies, highlight the need for a steep market ramp-up of heat pumps to achieve climate targets. Around six million heat pumps need to be installed by 2030 according to the "Climate-neutral Germany 2045" scenario (AEW et al. 2021). This requires, however, that the pace of expansion is significantly accelerated. The existing funding instruments alone will not be able to unleash the necessary momentum: accompanying regulatory measures are needed.

In March 2022, the German government decided that new heating systems must be operated with at least 65 per cent renewable energies from 1 January 2024. The so-called "65 per cent requirement" applies to new buildings as well as heating systems in existing buildings. The rule thus excludes pure oil- and gas-fired systems.

This new requirement can provide the necessary tailwind for the heat pump roll-out. However, it must be designed in a consistent and ambitious manner. First, the 65 per cent requirement must be enshrined in law now so that market players have the necessary planning certainty and, if possible, no new gas boilers are installed that then have to be decommissioned before the end of their service life. Second, exemptions must be severely limited and targeted, because heat pumps can already be used efficiently in most buildings today. Third, regulations must reflect existing resource scarcity and thus severely limit the installation of heating systems that rely on biomass or hydrogen.

If the regulation is implemented with such consistency, homeowners will make their investment decisions in favour of climate-friendly heating technologies in the future. At the same time, market players such as equipment manufacturers, tradespeople, energy suppliers and the housing industry will be provided with a reliable framework. This will enable them to invest in new production methods and business models - and thus unlock further economic benefits.

The 65 per cent requirement is in line with the impetus at EU level: the European Green Deal sets the course for complete decarbonisation by 2050; and the RePowerEU plan published in May 2022 specifically envisages the installation of ten million heat pumps within the next five years. In addition, some European countries have implemented further regulations to limit the use of fossil fuels, for example by banning the installation or use of oil and gas boilers, setting CO₂ limits for individual systems, or introducing obligations for using renewable heat.

Market ramp-up lags behind required momentum

To date, around one million heat pumps have been installed in Germany. Another five million heat pumps must therefore be added to achieve the climate targets by 2030. This corresponds to an average addition of 500,000 heat pumps per year. By way of comparison, around 154,000 new heat pumps were installed in Germany in 2021. Although very good subsidies are in place, homeowners still installed almost five times as many gas boilers as heat pumps in 2021.

Although the market share of heat pumps has increased significantly in the last two years, Germany performs poorly in a European comparison. In the pioneering countries of Norway and Finland, for example, more than ten times as many heat pumps were installed per 1,000 households in 2021 than in Germany. In Sweden, the market share of heat pumps is at around 90 per cent. In countries like the Netherlands, where heat supply is traditionally based on natural gas, the heat pump market has also developed successfully in recent years - the reasons for this include a favourable price ratio between electricity and natural gas, advanced municipal heat planning, and ambitious targets for phasing out the use of natural gas for heat supply.

Application in existing buildings

Current field tests show that heat pumps produce space heating and hot water also very efficiently in existing buildings. The efficiency of a heat pump (annual performance factor) depends in particular on the temperature level of a building's heating system. Many existing buildings manage with a temperature level that allows the efficient operation of a heat pump. This also applies to buildings heated by "conventional" radiators. However, it is important that the heat pump is carefully planned, installed and adjusted. In many cases, the temperature level can also be reduced to the necessary level by simple measures such as installing new windows or replacing individual "critical" radiators.

To date, heat pumps have been installed mainly in one- and two-family houses. The 65 per cent requirement significantly expands the application range of heat pumps. Heat pumps will establish themselves in building segments where they have previously only been used in isolated cases. These include, above all, multi-family houses, where installation is a complex but mostly solvable task. Challenges exist, for example, in tapping the heat source. In the case of air-to-water heat pumps, if ground-level installation is not possible due to space constraints, the entire system can be installed on the roof of the building. With sewers, PV thermal solar systems (PVT), ice storage or cold local heat, other heat sources are available that have been little used to date. Another option is the cascaded arrangement with a first heating stage by an air/water heat pump on the building roof and a second heating stage (reheating) by heat pumps in the individual apartments. Such technologies, which have already been tried and tested, now need to be rolled out across the board and standardised.

Attractive operating costs, high investment costs

Heat pumps are much more climate-friendly than gas boilers and have lower operating costs. Even when the annual coefficient of performance is comparatively low, heat pumps are a much lower source of CO₂ emissions than gas boilers. In view of the goal stipulated in the amended German Renewable Energy Sources Act (EEG) of increasing the share of renewables in electricity generation to 80 per cent by 2030, the climate benefit will continue to increase very quickly. Operating costs are also much lower with heat pumps. Without subsidies, however, the investment costs for heat pumps are still significantly higher than those for a gas boiler. In conjunction with new production processes and shorter installation times, however, market players see an opportunity to reduce investment costs by up to 40 per cent.

So-called hybrid heat pumps, which usually consist of a combination of a heat pump and a gas or oil boiler, have in most cases neither an ecological nor an economic advantage over purely electric heat pump systems, at least in single-family houses.

Necessary adjustments to the heating market

The necessary market ramp-up of heat pumps requires fundamental adjustments at all levels of the heating market:

- Manufacturers must expand their production capacities or convert existing production lines to heat pumps. The degree of automation and thus industrialisation of the production process must be increased. In addition, individual components must be more standardised. The market needs standard solutions that are as fault-resistant and easy to install as possible.
- Companies in the sanitary, heating and air-conditioning trade must gear their portfolio to the sale, installation and maintenance of heat pumps. To do this, the companies need appropriate training for their employees. Heat pump manufacturers should also intensify their training programmes. Training should focus both on speed and quality of installation. There is a need to develop new qualification concepts and amended training curricula (including new attractive job profiles) and, if necessary, to shorten training periods. In addition, training significantly more women, rapidly integrating refugees into the labour market, admitting skilled workers from other sectors as well as more immigrants from abroad can increase the number of skilled workers.
- The heat pump ramp-up requires and offers the opportunity for the development of new products, service offerings, financing models and markets. Electricity distribution grids must be aligned with the additional loads and flexibility options associated with heat pumps. Grid fees should provide incentives to intelligently manage the interplay between local RES feed-in, flexible loads, and storage.

Need for political action

The market ramp-up of heat pumps requires strong political support. The core element is the 65 per cent requirement. It must allow for few exceptions only, take account of shortages (biomass) and availability (green hydrogen), and be cast into law immediately. Only with binding legislation will market players have the planning security they need to convert production processes and supply portfolios, adapt training activities, develop new business models and mobilise the necessary investments. In addition, the sooner the regulation is implemented, the smaller the gas boiler stock will be that has to be decommissioned before its average lifecycle expires.

It is also necessary to perpetuate and stabilise financial support to a wide array of target groups. In addition, subsidies must be targeted to areas where heat pumps have so far been installed in individual cases only, but which must be developed quickly as a result of the 65 per cent requirement (especially multi-family houses). Low-income building owners need targeted support. To ensure that the transformation is socially fair, legislators must also assess and, if necessary, adjust the framework for sharing costs between landlords and tenants.

A key to promoting the market ramp-up lies in the design of the energy price structure. The current energy crisis requires that competitive operating costs for heat pumps are safeguarded. Looking ahead to the post-crisis period, a steadily rising (ideally known) CO₂ price path is needed to improve competitive conditions for heat pumps and provide a reliable planning basis for investment decisions. With the abolition of the RES surcharge (also known as EEG surcharge), the operating costs of heat pumps have already been relieved. Further relief is planned (Energy Surcharge Act). It would also be conceivable to lower the electricity tax to the EU minimum tax rate.

The market ramp-up requires reinforcing measures to counter the shortage of skilled labour, in particular by establishing and expanding the respective training infrastructure. Even if the onus is more on market players, the establishment of this infrastructure should be accelerated by government funding, at least in the start-up phase. Another measure is to finance course fees and training time in order to create incentives to the labour force to make greater use of training opportunities. At the same time, training curricula should be updated to reflect the new focus on heat pumps. An information campaign anchored locally by multipliers should inform building owners and professionals about the new regulations and solutions.

In order to integrate heat pumps as efficiently as possible into the electricity distribution grid infrastructure and to exploit their flexibility potential, an appropriate incentive structure is needed, in particular through rapid implementation of a regulation for smart systems and accelerated digitisation of the distribution grids. In addition, remaining regulatory barriers to the installation of heat pumps or the development of heat sources should be removed. Last but not least, an active industrial policy should ensure that value chains for the production of heat pumps are secured in Europe.