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Zooming in on…

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Removing social and economic barriers to decarbonising heating

Background

Decarbonising residential heating has become a major issue of public debate. With the Russian invasion in Ukraine, it has become clear that switching away from fossil fuels for heating will be not only about **reducing emissions but also about enhancing Europe's energy security**. Thus, plans to phase out the installation of new fossil fuel boilers are now being discussed on the national and the European level.

When it comes to climate-neutral options for heating, heat pumps will be a key technology, as they are a solution for both decarbonising on-site heating and district heating. However, especially regarding their role in on-site heating, there is a **high uncertainty among consumers** concerning the potential costs and benefits. Therefore, this briefing will first explore the functioning of heat pumps and their role in climate-neutral heating. It then discusses the main social and economic barriers to decarbonising heating and how to overcome them.

Since the buildings sector is responsible for 35% of the EU's energy-related emissions, its decarbonisation will be essential for the EU to achieve its climate targets. However, Europe is still largely dependent on fossil fuels for residential heating. Heat pumps offer a way to decarbonise heating. Rather than burning fuel, heat pumps extract heat from ambient air or the ground and transfer it into the heating system. By inverting this circuit and if technically equipped**, heat pumps can also be used for cooling** buildings, thereby providing an energy-efficient alternative to air conditioning. By using this so-called thermal energy, heat pumps are highly efficient, as they only need an electricity input of 20–30% of the total energy output. **Therefore they are three to five times more efficient than gas boilers**.

Today in Europe, heat pumps are most commonly used for the on-site heating of single-family homes. However, using them for on-site heating in multi-family homes is also possible. Moreover, **large-scale heat pumps offer a potential solution for decarbonising industrial heat and district heating**. For industrial heat, heat pumps already constitute a competitive option for applications up to 100°C such as the paper or the food processing industry. For district heating, waste heat – for example, from data centres and geothermal heat – could be used to power heating networks. Consequently, decarbonising the EU building sector will encompass both accelerating the deployment of small-scale heat pumps for residential on-site heating and the deployment of large-scale heat pumps for district heating and industrial heat.

For example, a study by Agora Energiewende shows that a capacity of **80 million heat pumps in the EU by 2040** could lead to a **nearly complete phase-out of using fossil gas in the buildings sector** in the same year. Concerning the overall share of on-site heat pumps in residential heating, a McKinsey report argues that for cutting building emissions, the share of heat pumps in residential heating in the EU would need to rise **from 2.5% in 2020 to 40% in 2050**.

Heat pumps and renewable district heating as the major options

In addition, renewable district heating will be another option to decarbonise residential heating. The McKinsey study expects the share of district heating in residential heating in the EU to rise **from 13% in 2020 to 33% in 2050**. Thus, **heat pumps and renewable district heating will be the main options for renewable residential heating in Europe**. Concerning district heating, this implies that existing heating networks need to be decarbonised, as a share of around 70% is still powered by fossil fuels. Moreover, new heating networks powered by renewable energy sources need to be built rapidly.

Regarding the availability of district heating, large differences exist between the member states. District heating is highly popular in some member states such as Denmark, reaching a share in residential heating higher than 50%. In other member states such as Spain and Belgium, however, heating networks do not exist. So the potential of renewable district heating is probably higher in the former countries, as building up heating networks is both timely and costly. Generally, building up new district heating networks is more likely to be a competitive solution for climate-neutral heating in urban areas, as building up new networks in rural areas will be more costly. However, forecasts concerning the competitiveness of renewable district heating are still highly uncertain. Regarding Austria, a study by Fallahnejad et al. calculates potential shares of district heating in total residential heating as lying between 13% and over 50%. Their scenarios up until 2050 depend on several factors such as the connection rate of households in areas with heating networks. Other analyses conclude that a share of 50% for district heating might also be possible for the EU as a whole.

For economic and ecological reasons, decarbonising heating via **green hydrogen or biomass will not constitute major alternatives either**. Concerning hydrogen, more than half of the energy is lost in the production process. As heat pumps collect most of their energy from ambient heat, calculations show that **using hydrogen for heating consumes six times as much energy compared to using heat pumps**. Thus, according to a whole range of research, hydrogen should not play a major role in climate-neutral heating as it could lead to rising energy bills for households. Green hydrogen will not be sufficiently available for heating and it will be primarily needed in sectors like the steel industry where technically hydrogen constitutes the only way to decarbonise. The potential for using biomass in large-scale climate-neutral heating is limited as well. Biomass resources constitute land sinks, absorbing CO2 emissions, and are thus important for the fight against climate change. Consequently, biomass for heating should stay limited. In addition and from an environmental perspective, using biomass in other areas of decarbonisation such as building materials might be more efficient than using it for heating.

Skyrocketing sales and ambitious targets

In the light of skyrocketing gas prices, heat pump sales in Europe hit a new record in 2022 with three million units sold. Thus, sales doubled in comparison to 2019. However, large differences exist between the member states in terms of the popularity of heat pumps. Nordic countries are leading the race both in existing capacity and in the expansion of heat pumps. Due to favourable conditions for renewable energy, more than 60% of Norwegian households use heat pumps for residential heating. However, other countries are catching up to this position. For example, heat pump sales in Poland and the Czech Republic doubled last year in the wake of the war in Ukraine. This nearly put them on a level with France and Italy (the leading markets for heat pumps in Europe in absolute terms) when looking at heat pumps sold per 1000 households in 2022. Although experiencing a 53% increase in heat pump sales in 2022, **Germany is still lagging behind on heat pump sales,** not even reaching half the number of heat pump sales per 1000 households of Poland or the Czech Republic.

Concerning small-scale heat pumps for private households, the EU aims at installing an additional 30 million heat pumps by 2030 compared to 2020. In addition, many member states have also set ambitious targets for accelerating the roll-out of heat pumps. For example, Poland and Spain aim at increasing their heat pump capacity sixfold by 2030, while Germany is aiming to reach a capacity of 6 million heat pumps in 2030 by installing half a million heat pumps each year from 2025 onwards. Regarding renewable district heating, member states will need to increase the share of renewable energy in district heating by at least 1.1 percentage points per year by 2030 according to the Renewable Energy Directive (RED). However, some member states have set far more ambitious targets, with Germany aiming at achieving 50% renewable district heating in 2030 while Denmark intends to fully decarbonise district heating by 2030.

Heat Pumps: High upfront costs as a barrier for many households

Connecting a house to district heating is often even cheaper than installing a new gas boiler, provided that a heating network is available. However, installing an on-site heat pump is often still far more expensive than a gas boiler. These *upfront costs* are very likely to increase even more if the insulation of a building needs to be improved. This is necessary for poorly insulated buildings to ensure that a heat pump can be operated efficiently. While homeowners will have to cover these costs directly, tenants are likely to experience rent increases after a fossil fuel boiler has been replaced with a heat pump in their home. Furthermore, electricity costs linked to operating a heat pump constitute the main *operating costs* of heat pumps. While heat pumps are more expensive than fossil fuel boilers in terms of upfront costs, they are often less expensive in terms of operational costs due to their high energy efficiency. However, when comparing the relative operating costs of heat pumps and gas boilers via gas and electricity prices, there are considerable differences across EU member states. While this ratio is particularly favourable towards heat pumps in the Nordic member states, electricity is relatively expensive compared to gas in Germany, Italy, and Belgium. Thus, initial conditions for installing a heat pump are particularly unfavourable in these countries. Nevertheless, when comparing the total levelised costs which include upfront costs and operating costs over the

lifetime of a heating system, **heat pumps are already a cheaper option than gas boilers for many European countries** such as Germany, Italy, and the United Kingdom.

However, high upfront costs will represent a barrier to install a heat pump for low- and middle-income households. For example, in Germany and France**, installing an air-to-water heat pump is still three times as expensive compared to installing a gas boiler**. It also needs to be considered that homeowners with lower incomes tend to live in more poorly insulated dwellings. Consequently, they would also potentially face additional renovation costs when installing a heat pump.

The example of reducing upfront costs for low-income households when installing a heat pump also shows the limits of applying carbon pricing in the buildings sector, which will be included in the European Emissions Trading Scheme (ETS) from 2027 onwards. Proponents of carbon pricing in the buildings sector argue that increasing CO2 prices will incentivise households to install a heat pump by increasing the operational costs of fossil fuel boilers compared to heat pumps. However, as low-income households will not be able to afford the upfront costs of installing a heat pump, increasing CO2 prices without any targeted assistance for low-income households would only increase their energy bills, while only high-income households would be able to cut their energy bills by installing a heat pump.

Thus, all EU member states except Sweden and Romania have introduced measures to support households when installing a renewable heating system. However, some of these schemes also do subsidise installing fossil fuel boilers under certain conditions. Some member states also provide additional low-interest loans to households giving them the opportunity to finance the upfront costs over several years. When comparing the different support schemes among the member states, one needs to keep regional differences in mind. For example, there are considerable differences between the share of homeowners. While only 47% of the households are homeowners in Germany, this share rises to 87% in Poland.

Varying schemes among member states

One measure to support households buying a heat pump can be tax rebates allowing the households to deduct the costs of installing a heat pump from the amount of taxes they have to pay. The Italian Superbonus scheme serves as an example for such a scheme. It allows Italian households to deduct **90% of the costs of installing a heat pump** from their tax returns over five years. Initially, households could even deduct 110% of the costs after the introduction of the programme in 2020 before the new Italian government imposed cuts in the programme. The programme was not only designed to facilitate the deployment of heat pumps but also covers the costs up to 100,000 euros of insulating homes or installing cooling or charging points for electric vehicles. Thus, it generally aims at improving the energy efficiency of Italian buildings which are particularly poorly insulated compared to other European countries. For making the programme more accessible for low-income households, tax rebates can also be passed along to building contractors or banks, so that these households do not have to cover the costs before receiving the tax rebates afterwards. The programme has been praised for boosting the renovation of Italian buildings which are particularly old and thus often poorly insulated. However, it has also been criticised for opening up opportunities for fraud and not being sufficiently targeted at climate measures, as it also covers the installation of gas boilers.

Most of the member states offer direct grants for households installing a heat pump instead of a tax rebate. In Germany, up until now homeowners have been able to get a grant covering 25% to 40% of the costs when installing a heat pump. The amount of the grant depended on whether a fossil fuel boiler was being replaced and whether a climate-friendly refrigerant was used. From next year onwards, the German government plans to reform the scheme by introducing a basic grant of 30% of the costs for all households installing a heat pump. This grant can increase to up to 70% for low-income households.

One example of a country providing more targeted grants for installing a heat pump is **France**. The government programme "Ma Prime Rénov" divides French households into four different income groups, thereby determining the amount of aid they receive for installing a new heating system. Combined with other programmes, this amount can reach up to 8,000 euros for an air-water heat pump for low-income households, which can cover 50% to 100% of the upfront costs when installing an air-to-water heat pump in France according to the IEA. Additionally, all households are eligible for zero-interest loans when installing a heat pump.

Austria serves as another example of targeted grants for low-income households installing a heat pump. In addition to introducing a general support scheme covering up to 50% of the costs for installing a heat pump for all homeowners, the Austrian government also introduced the programme "Sauber Heizen für Alle" which specifically targets low-income households. Being only accessible to the 30% of Austrian households with the lowest incomes, the programme covers up to 100% of the costs of installing a renewable heating system. For installing heat pumps, this implies grants up to 22,000 euros. Most notably, grants for installing a heat pump are only accessible if a house cannot be connected to a renewable district heating network.

Poland has also introduced targeted grants for low-income households. While the basic grants for installing a heat pump account for 30% of the costs, this amount can increase to up to 90% for low-income households.

Next to upfront costs, operating costs of heat pumps are also crucial for the acceptance of heat pumps. Several measures can be introduced to lower the electricity prices relative to gas prices. For example, Denmark has cut electricity taxes for private households for the amount of electricity used to power a heat pump. Moreover, carbon pricing will make electricity comparatively cheaper, if a large share of electricity is generated by renewable energies. Lastly, flexible electricity tariffs can offer another way of lowering the operational costs of heat pumps.

Lack of information among consumers leads to insecurity

However, even when making a heat pump a financially attractive solution for all households, significant economic barriers still remain. First of all, there is a considerable **lack of accessible information** among consumers. This is particularly important as many of the purchases of new heating systems are distress purchases **when an old system breaks down**. Thus, households must be able to quickly identify the overall costs and benefits of installing a heat pump. **Independent energy audits** might be a key step in this process as they enable households to also identify the costs of potential renovations linked to installing a heat pump.

Many national support schemes also cover the costs of an energy audit. For example, the German government covers 80% of the costs associated with energy audits for private households. Another measure might be introducing so-called **one-stop-shops**. These private or public entities assist homeowners in renovating and decarbonising their homes. Ireland serves as an example of the successful implementation of one-stop-shops. Here, in addition to carrying out energy audits, these shops can also manage applications for government grants, contacting contractors, and assessing the results of the renovations.

The lack of information among homeowners is however also linked to **structural insecurities** concerning the decarbonisation of residential heating. For many homes, there is no clarity as to whether they will be connected to a climate-neutral heating network in the future or whether on-site heating will be necessary. Therefore, **heat plan strategies** such as in Denmark will be necessary on the local level to explore the potential of renewable district heating. Moreover, these strategies also need to encompass plans for the future of local gas grids as they might not be needed anymore in the future due to the roll-out of heat pumps and district heating. Consequently, parts of the gas grids might turn into stranded assets, entailing costs for grid operators and consumers. Decommissioning plans might be a necessary option. Meanwhile, electricity grids will need to be upgraded due to increased electricity demand for heat pumps. In addition, it will also be necessary to make energy demand more flexible in order to increase the stability of electricity networks. Here, installing thermal energy storage tanks might be one measure to make the electricity demand of heat pumps more flexible.

Strong European companies, but availability for skilled installers as a bottleneck

Manufacturing and installing capacities are another important barrier when it comes to achieving the massive roll-out of heat pumps in Europe on time. According to a report by the European Commission, the **production capacity for heat pumps in Europe needs to more than double by 2030** to achieve the targets for the heat pump roll-out (30 million additional heat pumps by 2030) while maintaining the current share of domestic production, which is around 60%. This would create **28,000 additional jobs in heat pump manufacturing,** leading to an overall employment of 72,000 workers in the EU. Current investment announcements are in line with this target with investments of 5 billion euros through 2025 that have already been announced. Many of those investments are taking place in Poland, the Czech Republic, and Slovakia, which has already led to branding the region as a "*heat pump valley*".

While the market position of European companies is generally strong according to the analysis by the Commission, dependence on China might still be an issue regarding heat pumps. For some components such as semiconductors, there is still a dependence on non-European companies. Moreover, Chinese companies could also threaten the market position of European companies in future by offering cheaper alternatives benefiting from government subsidies. However, the Commission concludes that due to the technological lead of EU companies and the high share of the local content in the buildings sector, there is a small risk of the EU becoming dependent on imports from China compared to other products necessary for decarbonising the EU.

While the growth of manufacturing capacities is projected to be in line with the EU targets, expanding capacities for installing heat pumps might be a more difficult problem to solve. According to calculations by the IEA, **110,000 skilled heat pump installers will be needed in Europe by 2030, 70,000 more than in 2019**. Retraining workers from related occupations such as plumbers and electricians will therefore be crucial for expanding installation capacities, as many older workers from those occupations still lack the necessary qualifications. However, many regions in the EU already face a shortage of skilled workers in those occupations, so retraining workers will be very challenging.

The IEA further points out the importance of high skilled specialised installers for heat pumps to work properly, efficiently and securely. Thus, additional certification schemes need to be introduced, in addition to including corresponding skills into the curricula of related occupations. Otherwise, installers with no background on heat pumps might dissuade consumers from switching to heat pumps. Moreover, installers with close commercial ties to certain gas boiler manufacturers might be inclined to keep on installing their products. Subsidising training programmes for heat pump installers, assistance to SMEs to reconcile training and work, programmes to attract students to the heat pump sector, and offering good working conditions are other avenues to boost job take-up and participation in retraining programmes. **EU-wide certification schemes for heat pump installers** could facilitate the labour mobility of installers between the member states, increasing labour supply in regions with a particular shortage of skilled installers. Attention must be paid to brain drain, however.

A Heat Pump Action Plan for a just EU buildings transition

In light of these social and economic barriers, rapid action is necessary for the EU to achieve its targets for decarbonising the buildings sector. Thus, the EU plans to present a Heat Pump Action Plan by the end of the year. However, as the analysis has shown, **action will be necessary on the local and national level as well**. Moreover, assessing the potential of large-scale heat pumps for district heating needs to be included into the plan. Generally, the analysis of the major social and economic barriers to decarbonising heating revealed that there should be two political priorities for rolling out heat pumps.

Decarbonised heating needs to be an economically viable solution for all income groups. Thus, generous **grant schemes targeted at low-income households** are necessary. Otherwise, these households will not be able to install a heat pump even if it might be the only efficient solution for climate-neutral heating for this household. Moreover, the **support schemes also need to cover the costs of renovations** necessary for making a building ready for a heat pump, as especially low-income households tend to live in poorly insulated buildings. Furthermore, **additional regulations on rent increases** after renovations will be necessary to make sure that tenants will not be faced with rent increases that are not adequately offset by lower energy bills.

Moreover, households and suppliers need clarity about the future of heating. Consumers need easily accessible information to identify costs and benefits of each option for climate-neutral heating. Heat plan strategies by local authorities would further reduce consumers' insecurity about which option to choose. On the supply side, phase-out dates for installing

fossil fuel boilers could contribute to increasing installation capacities for heat pumps. Installers and workers from related occupations would thus be signalled to acquire the necessary qualifications and increasingly plan for the new technology.

A key element of a social-ecological transition

Thus, **grants targeted at low-income households and regulatory measures** will be necessary measures, in addition to CO2 prices, to achieve the decarbonisation of residential heating on time. If successful, this will massively contribute to reaching the targets for reducing emissions in the buildings sector and making Europe independent from fossil fuel imports. Furthermore, due to the efficiency of renewable heating systems, energy bills for private households will be reduced. Low-income households will benefit most as energy costs are the highest for them in relation to their income compared to other income groups. Consequently, if done properly, the decarbonisation of buildings has the **potential to become a key element of a social-ecological transition**.

Steffen Verheyen

Competence Centre for Climate and Social Justice