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ACCELERATING THE EFFICIENT ELECTRIFICATION OF HEATING BUILDINGS

The decarbonisation of buildings is key for the EU to achieve its climate goals

Buildings are responsible for almost 40% of total energy consumption in the EU and for over one third of the total greenhouse gas emissions (GHG). Indeed, the EU's '*Fit for 55' package*', which targets a 55% net reduction of GHG by 2030 and climate neutrality by 2050 – identifies buildings as having huge potential for emissions reduction.[1]

The role of heat pumps

The two main levers for reducing emissions in the buildings sector are (i) reducing energy demand (improving thermal efficiency) and (ii) decarbonising heat production. This article focuses on the latter. There are a range of options to decarbonise heat production, for example district heating, solar thermal, hydrogen boilers or heat pumps, all of which are likely to play a role in the vast challenge to decarbonise buildings. In this article, we investigate the different barriers that European consumers have to face when deciding to change their current home heating option to heat pumps.

To start with: *what is a heat pump*? Simply put, it works like refrigerator in reverse: it captures the ambient heat in the ground, water or air outside a property and transfers it inside. Heat pumps are efficient: while performance can depend on the precise heat pump technology as well as weather conditions, heat pumps typically provide 3-6 units of heat output for each unit of energy input (i.e. an efficiency of over 300%). By contrast, gas condensing boilers are typically have an efficiency of around 95%.

Three key barriers

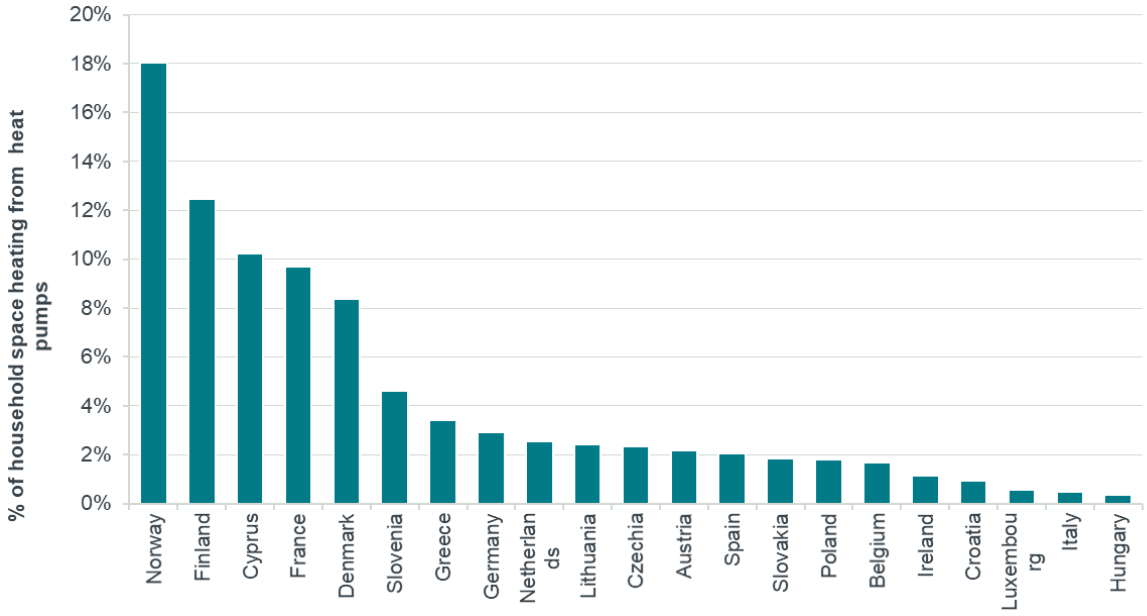
Despite their advantages, heat pump adoption is still in a nascent stage. There has been significant growth in recent years for certain countries in Europe: recent statistics show that yearly heat pump sales to households in Europe increased by 34% in 2021, and 38% in 2022.[2] The most rapid sales increases are found in emerging heat pump markets such as Belgium, Czech Republic and Poland. In these countries the heat pump market roughly doubled in a single year from 2020 to 2021. However, this growth rate is from a low baseline level. In Figure 1 below we observe that in most European countries, heat pumps are still not widely adopted. Take the Netherlands or Germany as examples: in these two countries heat pumps serve less than 2% of household heating needs. In contrast, gas boilers in those countries account for

[1] Fit for 55 (July 2022) is the EU's recent set of proposals to revise and update EU legislation, with aim to provide a "coherent and balanced framework for reaching the EU's climate objectives". Further details are here https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/ (last accessed on 28/02/2023). We also note that EU have proposed the *Energy Performance of Buildings Directive* (EPBD), setting out specific measures for achieving net-zero emissions in building stock.

[2] (https://www.carbonbrief.org/guest-post-how-the-energy-crisis-is-boosting-heat-pumps-in-europe/ last consulted on 11/04).

45% of heating needs. Other forms of fossil fuel heating – such as using oil or coal– typically make up the rest of the heating mix.

Figure 1 Only a minority of household heating needs in Europe is served by heat pumps today



Source: Eurostat

In this article, we outline three main barriers to the uptake of heat pumps: high running costs, high upfront costs and supply chain issues. We focus particularly on the first barrier, and discuss possible policy solutions to address this, and hence drive heat pump uptake.

Figure 2 There are three main barriers to a household getting a heat pump

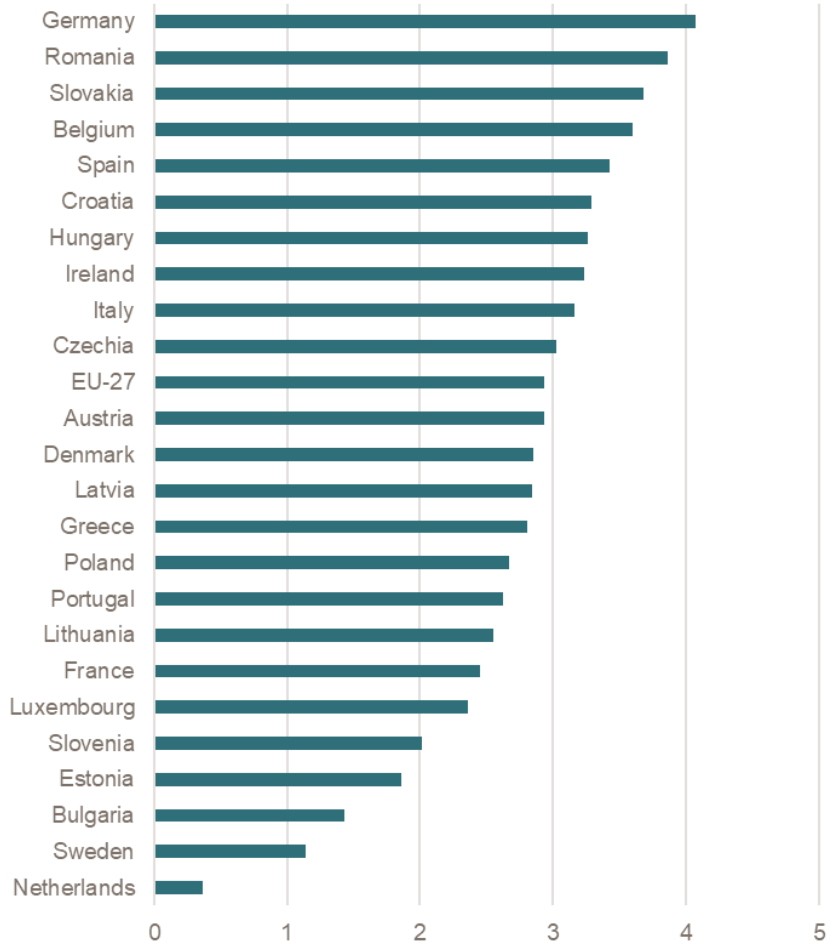
Source: Frontier internal

An affordability challenge

In some situations, energy market price distortions mean that heat pumps have higher running costs than fossil-fuel based alternative technologies. Assuming a heat pump consumed a third of the energy required to fuel a typical gas boiler, electricity prices would need to be no higher than three times the price of gas for a customer to see lower heating bills, should they switch their gas boiler for a heat pump.

However, as we see in Figure 3 below, in several countries (for example, Germany, Belgium and Spain), retail electricity prices are more than three times higher than those of gas. This picture is based on data in the first half of 2022 and so may partly be affected by consumer relief measures adopted in the energy price crisis, though the broad picture has remained stable in recent years.

Figure 3 Across Europe, electricity prices range from 0.4 to 4.2 times greater than those of gas



Source: Eurostat

Note: Gas and electricity prices are based on first semester of 2022. It includes all levies and taxes and is based on a medium range of consumption (between 20 GJ < Consumption < 200 GJ for gas and 2 500 kWh < Consumption < 5 000 kWh for electricity)

This relative cost difference partly reflects a difference in underlying cost (the price of electricity partly reflects the cost of producing electricity using gas, which involves a conversion loss). However, a large part of the wedge is driven by taxes and levies that are applied predominantly to electricity consumption, and which primarily serve to recover costs of public spending (as opposed to reflecting an underlying cost to society of electricity use). In contrast, gas or oil consumption faces little or no taxation (and is not currently, in contrast to electricity, subject to an EU-wide carbon price reflecting the costs to society of greenhouse gas emissions). This distorts the playing field between heating technologies.

A policy maker could work towards eliminating these distortions in two ways :

1. **Removing the taxes and levies applied to electricity**, as has been the case in Denmark and Germany, which comes with the disadvantage of a direct reduction in public funding sources (hence, an alternative may be preferable instead: spreading taxes across energy carriers, as has been done in the Netherlands).
2. **Imposing carbon taxes on consumption of fossil fuels** such as natural gas used in boilers; this has been implemented in Germany and Sweden. The EU new "emissions trading system 2", set up for fuel distribution for road transport and buildings, will also be helpful in this regard, ensuring that there are more consistent incentives across the EU to avoid the use of fossil fuels in heating.[3] An important caveat to these policies is that many households may be interested in replacing their existing gas boiler with a heat pump when the boiler comes to the end of its life (perhaps in 10, or 15 years), but until then, such taxation policies on gas will simply increase these households' energy bills but with limited effect on emissions.

An affordability and behavioural challenge

If policy adjustment can successfully address the running costs issues identified above, another financial issue remains: simply *purchasing* a heat pump requires a big up-front financial investment. Prices for heat pumps vary by type (e.g. air-source or geothermal heat pump), capacity and propriety, but on average, installing a heat pump can cost from € 9,000. If one compares this with the cost of installing a gas boiler – starting from around € 3,000 – heat pumps are clearly a relatively more expensive investment for a household.[4]

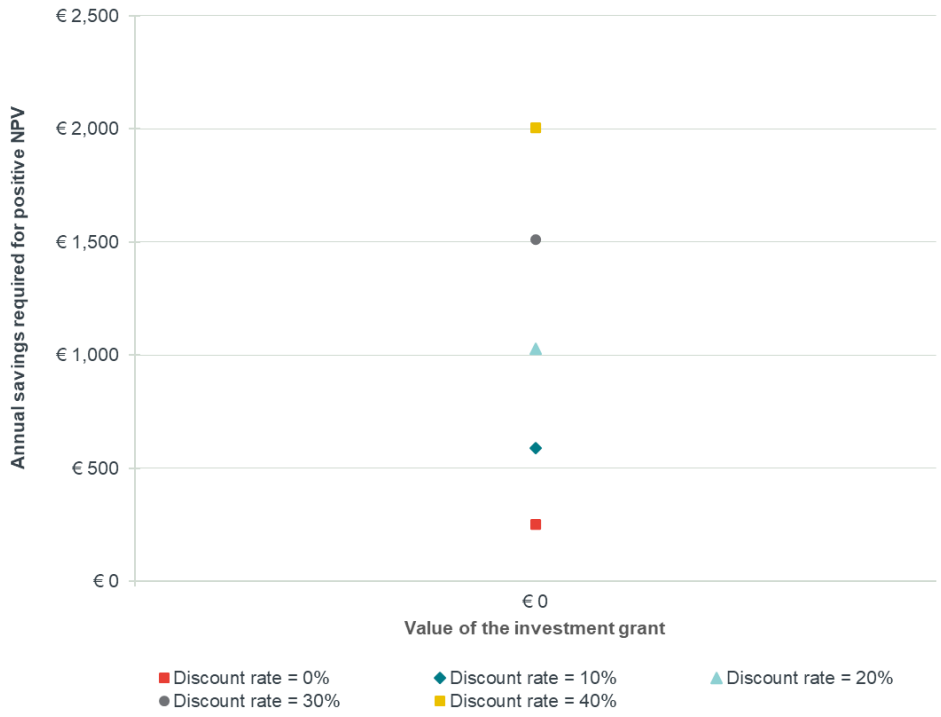
The trade-off between such high upfront costs and future running costs savings introduces a potential behavioural barrier to heat pump adoption: a household must estimate whether their *expected* future cost savings outweigh their incurred up-front cost today, involving therefore a consideration about the value today of cost savings in the future: the household's 'discount

[3] Information on the proposal can be found here: https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3542

[4] EU Heat Pumps: warnings against "one size fits all" policies. https://energypost.eu/eu-heat-pumps-warnings-against-one-size-fits-all-policies/ last opened 27/03/2023

rate'. As the figure below shows, higher discount rates drive higher required annual savings for an investment to 'break even': for example, a household with a 20% discount rate (i.e. for whom a pay-off in a year's time is valued 20% less than the same nominal pay-off received today) would need to expect savings of EUR 1000 per year in order to feel that spending EUR 5000 extra on a heat pump (up-front) relative to a gas boiler was worth it. Thus a household who has the capital to install a heat pump today may still not do so, if they do not expect future savings to compensate for their outlay today. Uncertainty regarding savings will tend to drive higher discount rates.

Figure 4 Expected annual financial saving required for customer to invest in heat pump, under different assumed customer discount rates



Source: *[Insert Source here]*

Note: *This graph assumes an additional heat pump cost compared to gas boiler of EUR 5k & 20 year lifetime*

Capital grants of sufficient size can solve both the up-front affordability issue, and simultaneously address this behavioural barrier.[5] Indeed, a number of EU countries have started to offer aid to help consumers with this high up-front cost. For example, the French government currently offers grants depending on the income and the type of heat pump: aid for geothermal heat pump grants € 11,000 for low income households and € 5,000 for average income households, and aid for water heat pump grants € 5,000 for low income households

[5] Note that for the policy-maker, an appreciation of the typical household discounts rates will be critical to determine the level of any grant needed to tip the balance for a household to opt to install a heat pump rather than a gas boiler.

and € 3,000 for average income households. In addition, France offers a zero-rate loan of up to € 50,000 (with a maximum repayment term of 20 years) for financing heat pump installations. Germany also offers loans with an annual interest rates from 1.8%, together with an option for a government subsidy of up to 50% of the value of the loan. In the UK, the Boiler Upgrade Scheme supports households installing heat pumps and biomass boilers with upfront capital grants of between £5000 and £6000, depending on the technology.[6]

For the policy-maker, an appreciation of both typical household capital savings and discounts rates would therefore be critical to determine the right level of any such grant scheme to catalyse heat pump installations. And an additional consideration before distributing such grants at all is that policy-makers may prefer to remain neutral in terms of the technologies they support for reducing buildings related emissions. However, naturally policies such as grants will lead to (possible unwelcome) distortions in household choices towards capex intensive technologies.

As an alternative to capital grants, Denmark has recently introduced a pilot scheme for an innovative approach: *heat as a service* (HaaS). The idea is to offer grants directly to *suppliers* for the installation of heat pump; the house *owner* pays a sign-on fee at the installation of the heat pump, a price for the heat supplied, and a monthly subscription fee.[7]

An additional set of challenges stem from the demand side: in addition to the possibility of high discount rates rendering future cost savings less powerful as a driver for a choice today, consumers may simply have little confidence in the 'new' technology and its ability to meet their needs. Or, they may fear the installation process, or any eventual aesthetic changes to their home after the installation. Such challenges may be at least partly addressed with supply-side policy options mentioned briefly below.

Overcoming supply side barriers

Policy to address the running costs and up-front investment costs may render a heat pump a financially interesting and viable option for households looking for a new heating or cooling system. However there may be more practical, supply-side problems: an inability to actually get a heat pump installed in the home. For instance: a lack of qualified engineers to install and / or service heat pumps in the area or indeed problems within the end to end supply chain of heat pumps to a particular country or region. Additionally, the relative ease of installing a heat pump depends on the type of home and space available.

6 https://www.ofgem.gov.uk/environmental-and-social-schemes/boiler-upgrade-scheme-bus (last accessed on 12/04/2023). This scheme has seen over 14,000 voucher applications since it opened on 23 May 2022 and has recently been extended to run until 2028 (for more statistics, see Department for Energy Security and Net Zero 2023 'Boiler Upgrade Scheme statistics', https://www.gov.uk/government/collections/boiler-upgrade-scheme-statistics).

7 Danish Energy Agency (2021) Heat as a service - Evaluation of a Danish support scheme for dissemination of a new business concept for heat pumps.

Policy-makers therefore also play an important role in setting up the right market conditions for the supply chain of heat pumps. For instance, policy focus might include smoothing and prioritising the customer experience to eliminate informational or logistical hurdles, facilitating partnerships between trusted brands to provide customers with joined-up offerings along the value chain or training installers. Our recent article summarises these and other key themes identified in a roundtable discussion on driving home energy efficiency in the UK earlier this year.

Conclusions

Accelerated deployment of heat pumps is likely to be a large of part of Europe's approach to decarbonising buildings as well as to reducing its reliance on gas imports, alongside other measures such as incentivising further low carbon heating options as well as higher thermal efficiency through better insulation. Addressing some of the key economic barriers of deploying heat pumps is an important foundation – but the behavioural and practical barriers that exist alongside also need addressing. Policymakers can help directly address some of these issues directly (e.g. through setting the right frameworks for energy taxation), but they can also support indirectly, by laying the foundations for improved trust between market players and the development of new business models to drive greater uptake.