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REGULATORY ASSISTANCE PROJECT

Taking the burn out of heating for low-income households

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Summary

Evidence shows that the most affordable clean heating solutions for households across Europe in the next decades will be an efficient heat pump or connection to a clean district heating system, coupled with home energy efficiency. Before the current energy price crisis, this future in which clean heating options also have the lowest cost had not arrived. Due to both higher upfront investment costs and a large gap between fossil fuel and electricity prices, switching to clean heating before the crisis was often more expensive than staying with fossil fuels.

The energy price crisis – which has seen the price of fossil gas multiply many times in a matter of months and the prices of other fossil heating fuels follow suit – has closed the gap between the cost of heating with a heat pump and heating with fossil fuels. Based on the economic assessment set out in this paper, many of those who could switch to clean heat now would. Yet, while the economics of switching to clean heat have improved in 2022, the affordability of all forms of heating has declined. Low-income households are now even further away from being able to afford clean heating: The risk that they will remain reliant on fossil fuels is clearer now than ever.

Low-income and energy-poor households are most exposed to the impacts of the current price crisis. They tend to live in the worst-performing homes that cost the most to heat. These households are the least able to absorb the extra costs of rising bills into household budgets or to cover costs with savings. To protect low-income households from the ongoing price volatility of fossil fuels, switching to the clean alternatives that will be the most affordable solutions in the future should be prioritised.

From our assessment of the economics of switching from fossil fuel heating to a heat pump for low-income households, we identify what actions are needed on several fronts to address both the upfront and running costs of clean technologies.[1] Currently, only nine Member States provide a suitable level of subsidy for low-income households, and many of these programmes have design flaws that limit access. Governments have historically subsidised fossil fuel technologies for low-income households and provided bill subsidies directed to the dominant fossil fuel heating. To reverse this historic trend and liberate as a priority the most vulnerable in society from reliance on fossil fuels, governments must act fast.

The risk of remaining reliant on fossil fuels for low-income households is clearer now than ever.

The rapid shift to clean heating for low-income households must be coupled with guarantees of affordability. To inform the next generation of clean heat programmes, we identify a number of innovative initiatives that aim to deliver these benefits. We conclude with the following recommendations:

[1] The authors would like to acknowledge and express their appreciation to the following people who provided helpful insights into drafts of this paper: Clotilde Clark-Foulquier, FEANTSA; Monica Vidal and Eva Brardinelli, Climate Action Network (CAN) Europe; Jozefien Vanbecelaere, European Heat Pump Association; Adeline Rochet, E3G; Davide Sabbadin, European Environmental Bureau (EEB); Sabrina Iannazzone, European Anti-Poverty Network (EAPN); Laia Segura, Friends of the Earth Europe (FoEE); and Richard Lowes, Marion Santini, Dominic Scott, Sophie Yule-Bennett and Samuel Thomas from RAP. Graphic design by Tim Newcomb and Noble Studio Ltd. Deborah Bynum provided editorial assistance.

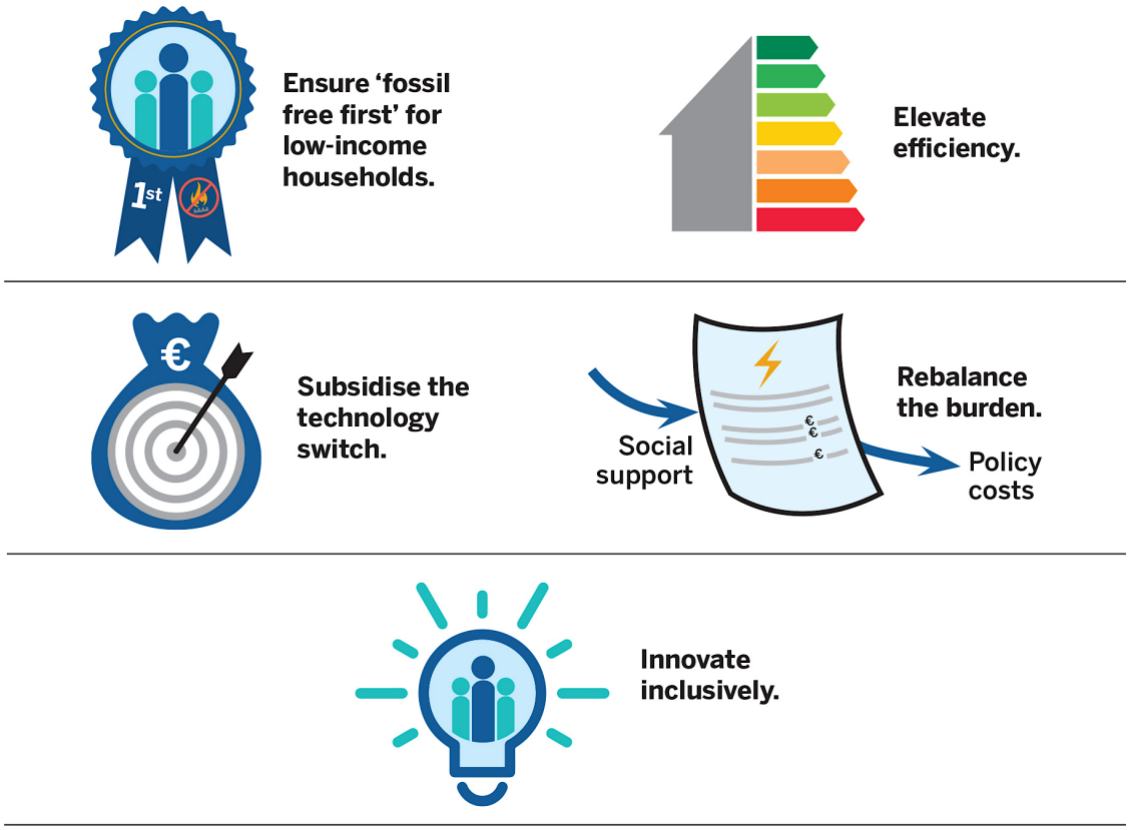
Ensure 'fossil free first' for low-income households: Prioritise clean heat with energy efficiency for low-income households and design policies with affordability and the specific needs of these households in mind in national heat and buildings decarbonisation strategies.

Elevate efficiency: Member States should prioritise energy efficiency for low-income households switching to clean heat. Improved energy efficiency of the building envelope helps to reduce heating needs, can ensure heating is efficient, and provides protection from price fluctuations. Beyond reducing bills, energy efficiency opens the door to a range of benefits from using energy more flexibly to providing services to the electricity system.

Subsidise the technology switch: Every Member State should make available subsidies of up to 100% of the costs of switching to clean heating, ringfenced for low-income households.

Rebalance burden: Member States should explore and implement options to transfer policy costs like taxes and levies *away* from electricity bills and transfer support to pay heating bills *to* electricity bills when customers switch.

Innovate inclusively: Focus EU and Member State research and innovation funding, as well as industry initiatives, on innovations that open up access to the benefits of the energy transition for low-income households.



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Introduction

The current gas price crisis, during which the wholesale price of gas in Europe has increased tenfold in two years,[2] clearly demonstrates that reliance on fossil fuels threatens energy security and affordability. No group in society is more at risk from this threat than the lowest-income households and communities. Low-income households disproportionately live in the worst-performing homes that use more energy to heat.[3] Those who rely on fossil fuels to heat the space and water in their homes are the most exposed to the price risks, on top of the well-established health risks associated with burning these fuels at home.[4]

Programmes to support low-income and energy-poor households to reduce their energy bills and protect themselves from the health problems caused by cold homes have focused on improving the energy efficiency of the homes and replacing inefficient heating with more efficient heating – mostly fossil-fuelled systems. It is now clear, however, that while energy efficiency remains the number one priority for energy poverty alleviation, locking low-income households into continued fossil fuel use by installing new fossil heating technologies is a very short-sighted choice.

Providing subsidies for fossil fuel heating sends all the wrong signals. It indicates to households that this is an efficient and wise investment, despite the risk of that investment locking them into long-term exposure to volatile fossil fuel prices and the rising costs of the gas system.[5] It creates a fleet of stranded assets that will need to be replaced, with further subsidy, to reach decarbonisation goals. It also tells gas system operators that they need to continue to pour money into infrastructure to serve customers who invest in fossil fuel heating.[6] As better-off neighbours move to cleaner fuels, the cost of gas infrastructure will fall on a smaller number of grid-connected households that may not have the means to switch away. Remaining reliant on the gas grid exposes households to the cost of investment in hydrogen blending and even the potential to be offered very high-cost hydrogen as a heating fuel in place of gas.[7] This signal for continued investment in the gas system runs counter to both carbon reduction targets and sustainable paths to support low-income households.[8]

European and national policymakers are waking up to the need to swiftly decarbonise heating in our homes – for which Europe is still reliant on fossil fuels for over three-quarters of heat supply.[9] The proposal for the recast of the Energy Performance

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[2] Trading Economics. (n.d). *Natural gas EU Dutch TTF price*. https://tradingeconomics.com/commodity/eu-natural-gas

[3] Sunderland, L., Jahn, A., Hogan, M., Rosenow, J., & Cowart, R. (2020). *Equity in the energy transition: Who pays and who benefits?* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/equity-in-energy-transition-who-pays-who-benefits/

[4] Kambli, N. & Hanoteaux, R. (2022). *The link between gas and health: a rapid review.* E3G. https://www.e3g.org/publications/the-link-between-gas-and-health-a-rapid-review/

[5] Sunderland, L. (2020, 15 July). Getting off gas: Future risks for low-income households. *Foresight Climate & Energy*. https://www.raponline.org/blog/getting-off-gas-future-risks-for-energy-poor-households/

[6] Anderson, M., Rosenow, J., Bürger, V., & Braungardt, S. (2022). *Fossil gas infrastructure first, energy efficiency never?* https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2022/3-policy-finance-and-governance/

[7] Rosenow, J. (2022a). Is heating homes with hydrogen all but a pipe dream? An evidence review. *Joule.* https://doi.org/10.1016/j.joule.2022.08.015

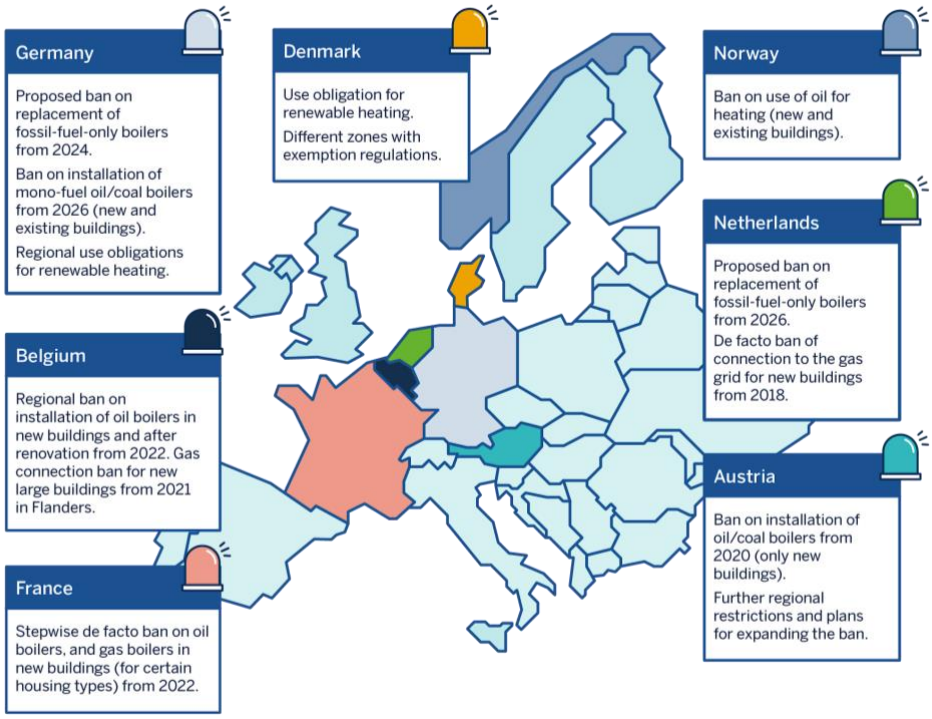
[8] Anderson, M., Rosenow, J., & Cowart, R. (2022). *The clash with gas: Should it stay or should it go?* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/clash-with-gas-should-it-stay-or-should-it-go/

[9] In 2017, 83% of EU space heating capacity was fossil-fuel fired (66% gas, 15% oil, 2% coal). Bagheri, M., Mandel, T., Fleiter, T., et al. (2022). *Renewable space heating under the revised Renewable Energy Directive: Description of the heat supply sectors of EU Member States space heating market summary 2017*. Publications Office of the European Union. https://data.europa.eu/doi/10.2833/256437

of Buildings Directive sets out that Member States should put in place policies to decarbonise heating and cooling by 2040 and aims to end the subsidy of fossil gas boilers from 2027.[10] Moving faster, an increasing number of countries, as shown in Figure 1, are introducing or strengthening bans on fossil fuel boilers, extending regulations from oil and coal to gas. A smaller number of countries are also ending subsidies for fossil fuel heating sooner.[11]

The rapid shift to clean heating[12] for low-income households must be coupled with guarantees of affordability. This report aims to set out the necessary steps. First, we analyse the clean heating options to identify the most suitable technologies. Next, we compare the costs of buying and running a fossil fuel boiler with those of a heat pump. Then we explore the provisions necessary to ensure that the shift to zero emissions heating also reduces bills or increases thermal comfort for low-income households, and we review the current practices and innovative approaches in Member States. Finally, we conclude with recommendations to change national policy frameworks.

Figure 1. Fossil fuel heating restrictions in EU Member States and Norway



Adapted from Braungardt, S, et al. (2021). *Phase-out regulations for fossil fuel boilers at EU and national level*.

[10] The European Commission's REPowerEU Plan, Europe's response to the need to rapidly reduce reliance on Russian gas and accelerate the energy transition, proposes to bring forward the end date for subsidies for fossil fuel boilers from 2027 to 2025 and proposes a phase-out of the installation and replacement of fossil fuel boilers from 2029.

[11] For example, in 2022, both France and Germany announced an end to subsidies for gas boilers in their national subsidy programmes. De Clerq, G., (2022, 16 March) France ends gas heaters subsidies, boost heat pumps in bid to cut Russia reliance. *Reuters*. https://www.reuters.com/world/europe/france-ends-gas-heaters-subsidies-boosts-heat-pumps-bid-cut-russia-reliance-2022-03-16/; Bundeswirtschaftsministerium legt Reform der Gebäudeförderung vor – Fokus auf Sanierung und Vereinfachung der Anstragstellung durch klarere Zuständigkeiten [Federal Ministry for Economic Affairs and Climate Action presents reform of building subsidies – focus on renovation and simplifying application process through clearer responsibilities] [Press release]. https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2022/07/20220726-bundeswirtschaftsministerium-legt-reform-der-gebaeudefoerderung-vor.html

[12] This paper uses the term 'clean heating' to highlight the opportunities of low-carbon energy to decarbonise heating and reduce air pollution. A similar term is 'renewable heating,' that may include forms of solid biomass combustion that release local particulate matter with negative health impacts. 'Clean heating,' on the other hand, minimises local impacts and includes all types of low-carbon electricity.

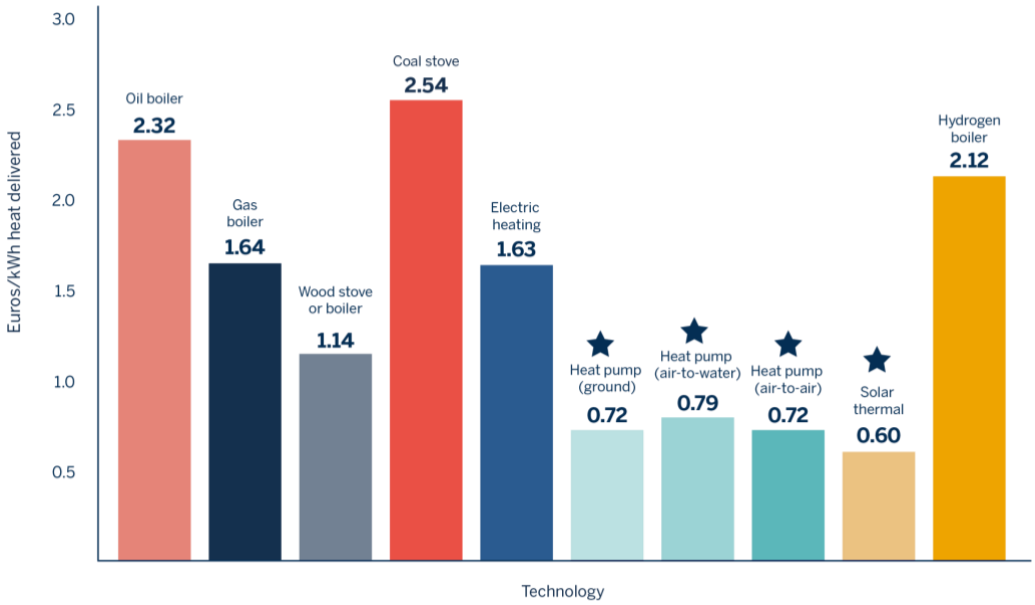
Which heating technologies are most suitable?

Clarity on the clean heat solutions suitable for each home type and location is vital to underpin an assessment of how low-income households can move away from fossil fuels while also reducing bills and achieving adequate levels of thermal comfort.

Consensus is forming that the main heating decarbonisation solutions for homes are good thermal efficiency of the building envelope combined with a heat pump or connection to a clean district heating system.[13] A study published in February 2022 by Element Energy[14] for the European consumer organisation BEUC calculated the cost in 2040 of four low-carbon heating options for four different home types, in four countries — Spain, Italy, Czechia and Poland. It found that electric heat pumps provided heat at the lowest consumer cost, including both capital expenditure and running cost, in both individual heating systems and in serving district heat networks.

A further 2022 study, based on analysis by Cambridge Econometrics, also found that in the next decade, 2030-2040, heat pumps and solar thermal will be the most cost-effective heating solutions, even compared to incumbent fossil options. Figure 2 compares the 10 technologies.[15, 16]

Figure 2. Total cost of owning and running different heating technologies, 2030-2040



Source: European Climate Foundation and the European Alliance to Save Energy, 2022.

[13] The term district heating is used in this paper to include shared systems serving multiple buildings in a geographical area and one building with multiple units.

[14] Element Energy. (2022). *The Consumer Costs of Decarbonised Heat. A report for BEUC.* https://www.beuc.eu/sites/default/files/publications/beuc-x-2021-111_consumer_cost_of_heat_decarbonisation_-_report.pdf

[15] European Climate Foundation (ECF) and the European Alliance to Save Energy (EU-ASE). (2022). *Building Europe's net-zero future: Why the transition to energy-efficient and electrified buildings strengthens Europe's economy.* Based on analysis by Cambridge Econometrics. https://europeanclimate.org/resources/renovating-and-and-electrifying-buildings-strengthens-europes-economy-and-energy-security/

[16] Electric heating directly converts electricity into heat. Heat pumps use electricity to harness energy from an ambient source (air, ground or water) and deliver it to water in pipes or radiators or through warm air. Solar thermal uses solar radiation to heat water. Hydrogen boilers could combust green hydrogen to heat space or water.

Individual and district-level heat pumps use electricity to produce heat and can do so very efficiently, which is partly why they are assessed as cost-effective in these studies. Electricity, however, is not yet fully decarbonised. To achieve full decarbonisation in 2050, scenarios predict the electricity system needs to be decarbonised by around 2035.[17] Adding new electric demand, or 'electric loads,' to the power system from heat pumps must therefore be accommodated while avoiding the need for new fossil fuel generation and without increasing the carbon content of electricity. Key to ensuring that all of the heat provided by heat pumps is clean is to recognise the value of the flexibility of these new electrified heat loads. This means enabling that electricity demand to be shifted to times of the day when renewable energy is abundant.[18] Energy efficiency, heat storage, smart controls and building-level renewable generation all contribute to the flexibility of electrified heating loads. They can provide householders access to the significant benefits of financial rewards and a resilient home in the event of an outage or extreme weather event.[19]

For a small number of homes where the specific home type or location conditions make it necessary, the alternative solutions of direct electric heating or biomass may be suitable. Direct electric heating may be an option in very well insulated apartments with low heat demand, where for example external appearance or wall area make an individual heat pump undesirable.

Biomass for heating accounted for 81% of Europe's renewable heating and cooling target in 2018. This share is pushed higher by the fact that the EU's Renewable Energy Directive incentivises the inefficient use of biomass over more efficient electric heat.[20] In a very small number of rural homes that need high-temperature heating due to limited cost-effective insulation options, biomass heating may be considered — but only where locally sourced, sustainable fuel is available.[21] Given the risks to public health of increasing carbon emissions,[22] the negative biodiversity impacts from using unsustainable biomass and the competition from other harder-to-decarbonise sectors for this resource, the use of biomass in domestic heating should be limited.[23]

The investment needs, and who manages these investments, are different for households switching from one individual heating technology to another compared to those switching from an individual heating system to a district system. Households heating with an individual system face the high upfront costs of switching systems and, without government subsidy, bear those costs privately. They must also calculate whether the running costs are higher or lower than the previous system. For

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[17] Rosslowe, C. (2021). *Zero-carbon power.* Ember. https://ember-climate.org/insights/research/zero-carbon-power/

[18] Rosenow, J., & Lowes, R. (2020). *Heating without the hot air: Principles for smart heat electrification.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/heating-without-hot-air-principles-smart-heat-electrification/

[19] Yule-Bennett, S. & Sunderland, L. (2022). *The Joy of Flex: Embracing household demand-side flexibility as a power system resource for Europe*. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/joy-flex-embracing-household-demand-side-flexibility-power-system-resource-europe/

[20] Gibb, D., Thomas, S., & Rosenow, J. (2022). *Metrics matter: Efficient renewable heating and cooling in the Renewable Energy Directive.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/metrics-matter-efficient-renewable-heating-cooling-renewable-energy-directive

[21] Thomas, S., Scott, D. & Rosenow, J. (2021). *Making renewable heating 'fit for 55'.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/making-renewable-heating-fit-for-55/

[22] Holland, M. (2018). *Covered in smoke: why burning biomass threatens European health.* Fern. https://www.fern.org/publications-insight/covered-in-smoke-why-burning-biomass-threatens-european-health-160/

[23] Toleikyte, A., & Carlsson, J. (2021). *Assessment of heating and cooling related chapters of the national energy and climate plans (NECPs).* Publications Office of the European Union. https://publications.jrc.ec.europa.eu/repository/handle/JRC124024

households connecting to a district heating system, the upfront costs of connection are lower and can be partially rolled into the cost of heat provision. The economics are, therefore, quite different for households connecting to district heating, as are governance and consumer protection considerations, particularly as district heat is a natural monopoly. For these reasons (further outlined in Annex 1), and to keep a manageable focus, this paper focusses solely on the shift to individual heating system solutions.

Having established that electric heat pumps and district heating, in combination where possible with solar, are expected to be the most cost-effective primary clean heat solutions for households in the future, this paper sets out how to ensure these options are affordable for low-income households.

What will it cost households to switch?

In this analysis, we consider the financial cost of the switch to clean heat, particularly for low-income households. The analysis does not consider the non-financial costs associated with time, disruption, lack of trust, risk of adopting a new technology, and so on. Some of these costs or barriers are addressed by the examples later in the paper.

Any analysis of the costs of switching to clean heat solutions must consider the real-world circumstances in different countries and the experience of households. We have therefore nuanced our analysis in a number of ways:

- Current predominant heating fuel

  Although fossil fuel systems continue to dominate residential heating in nearly all Member States, different countries have different levels of reliance on individual fuels. Some countries are highly dependent on fossil gas (e.g., Belgium, Germany, the Netherlands), while others continue to rely on heating oil (e.g., Ireland) or coal (e.g., Poland). The analysis presented below compares the costs of different heat solutions for gas-, oil- and coal-dependent typologies, with example countries for each.

- Underheating and energy rationing

  An understanding of the unique constraints faced by the lowest-earning members of society is essential to an assessment of the economics of switching heating sources. Low-income households often underheat their homes, meaning calculations of heating expenditure with their current heating system may be underestimated. To save energy costs, these households may use around 20% less energy for heating than the average household in their country.[24] This affects an assessment of the economics of switching, as a 'boost' to reach adequate heating levels and thus higher thermal comfort must also be considered. We illustrate the reduced heating costs associated with rationing energy with the existing system, whereas the aim is to achieve full thermal comfort with the renewable system.

[24] For UK households, the difference between the modelled energy need spend and the actual average energy spend is greatest for low-income households. Those in the lowest income decile underspent by 33%, with the 2nd and 3rd income deciles underspending by 18% and 17% respectively. Department of Energy and Climate Change. (2014). *Annual energy poverty statistics report, 2014.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/319280/Fuel_Poverty_Report_Final.pdf

- Access to subsidies for upfront costs

  Subsidies available in Member States are often not suitable for or not accessed by low-income households, as is covered in the following chapter. No existing subsidies for either fossil heating systems or heat pumps have been included, in order to provide a less distorted and arguably more real-world economic analysis. Some very-low-income households that do not have access to boiler subsidies may replace a broken boiler with a used one. Due to the lack of available data, we have not attempted to calculate this cost comparison.

To demonstrate the challenge of switching from a fossil fuel system to a clean heat alternative, while also reducing bills and increasing thermal comfort, we present an analysis of the total cost of ownership of an air-to-water heat pump against prevailing fossil fuel heating systems.

The running cost of heating is reliant on both the price paid by households for the heating fuels and the efficiency of the heating system. An efficient, minimum-standard air-source heat pump converts one unit of electricity into around three units of heat, when installed correctly in a building with an adequately efficient building envelope. A modern, efficient fossil fuel boiler converts one unit into only around 0.93-0.95 units of heat (see Annex 2). The heat pump is therefore at least three times more efficient than the fossil boiler. Heating costs will, in turn, be lower by heating with a heat pump when electricity is less than three times the cost of the comparable fossil fuel.

A heat pump is at least three times more efficient than a fossil boiler.

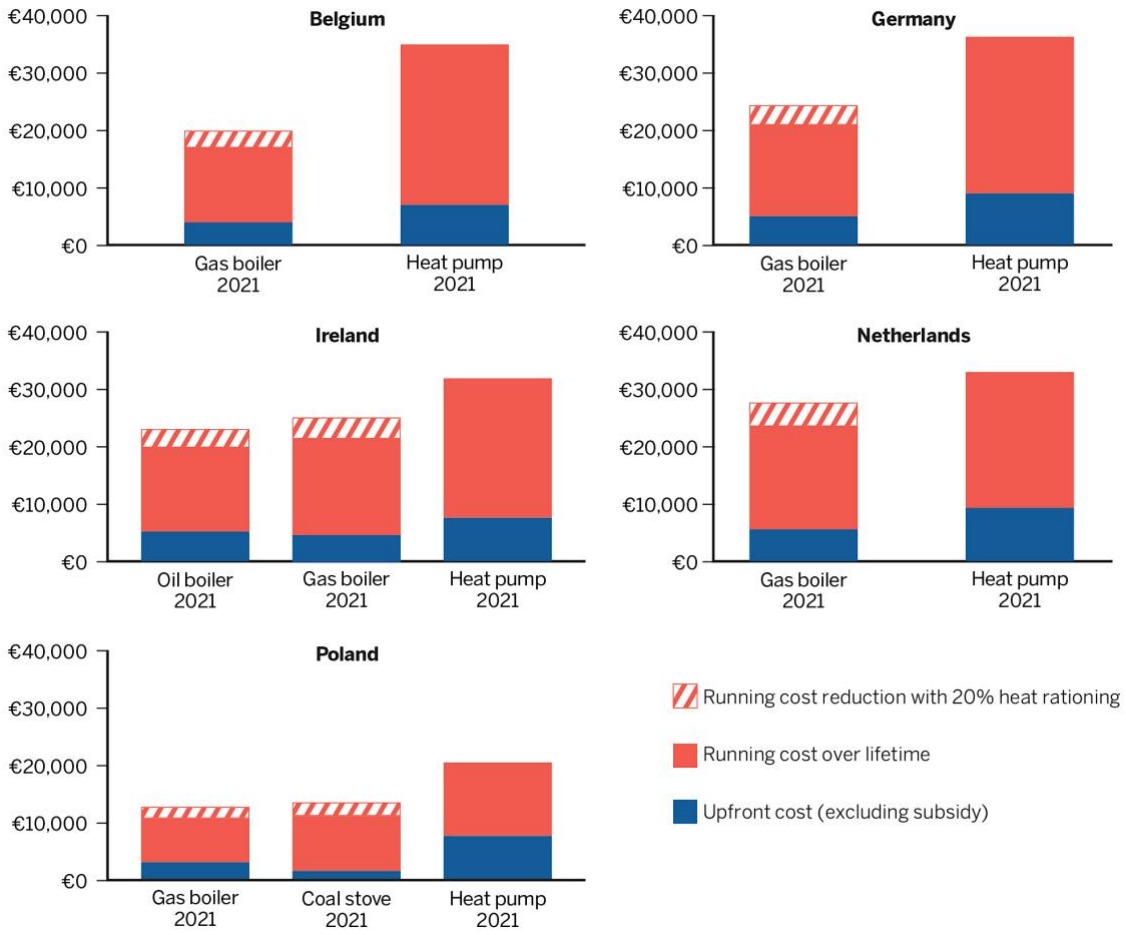
Energy prices for electricity and fossil fuels included in the analysis are average prices from the first half of 2021 and prices from July and August 2022 (see Annex 2). The prices in 2021 act as a past economic baseline, while 2022 prices highlight the current economic realities during the energy crisis. We did not attempt to predict future energy prices. It is important to note that heat pumps reduce price exposure to highly volatile fossil fuel markets. Households are shielded in two ways: First, electricity price increases are lower than those of fossil fuels, as shown in Figure 4; and second, the heat pump's efficiency reduces the overall exposure to rising prices.

Costs for low-income households in 2021

We first carried out a comparison based on energy prices in the first half of 2021, before fossil fuel and electricity prices skyrocketed in Europe. It is important to look at the pre-crisis picture as a starting point because it shows the costs at a time when many households already found heating their homes unaffordable and when energy poverty in Europe was already affecting millions of households.

Even though heat pumps will be an affordable clean heat solution in the future, Figure 3 shows that, in 2021 — when subsidies are excluded — a heat pump was more expensive to operate than a fossil fuel system in all typology countries we assessed. Not only were the capital costs more expensive, but operating costs were higher too.

Figure 3. Total cost of ownership comparison, based on energy prices in first half of 2021



Notes: Running costs include energy costs and maintenance. The lifetime of each technology has been set at 18 years to simplify the comparison of running costs. The analysis uses a heat pump coefficient of performance of 3.1, fossil gas boiler efficiency of 95%, oil boiler efficiency of 93% and coal stove efficiency of 75%. Assumptions and data sources are in Annex 2.

Based on the picture in the first half of 2021, low-income households would need significant support to cover the additional upfront cost of a heat pump *and* to reduce the cost of heating. Even if running costs were lower for heating with an electric heat pump, it cannot be assumed that future running cost savings can be banked against higher upfront costs. This is because low-income households may not have access to savings, subsidies or finance to cover the initial expenses.

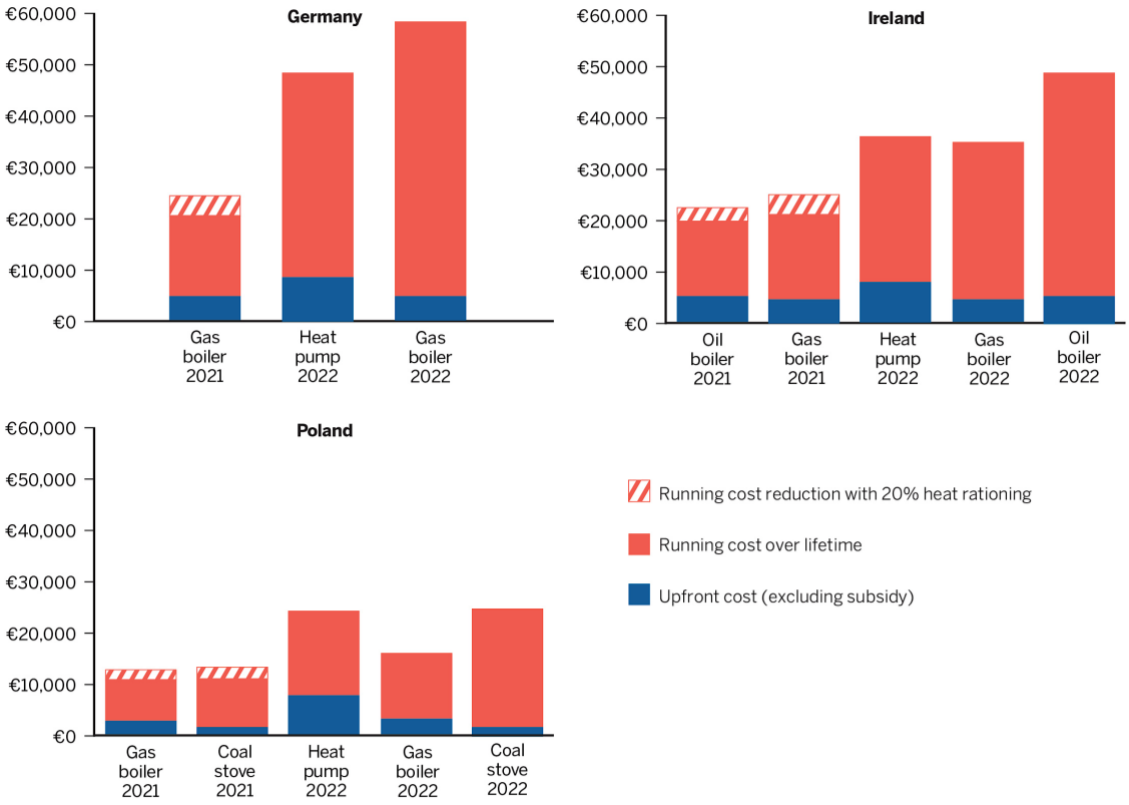
Costs for low-income households in 2022

Since late 2021 gas prices have skyrocketed, which has impacted wholesale and retail electricity prices in turn. The prices of heating oil and coal in Europe have likewise risen following the Russian invasion of Ukraine, though not to the same extent. The gas price rise has increased the price of gas more than that of electricity for households in most European countries (see Annex 4). As a result, the gap has narrowed between the running costs of a heat pump compared to a fossil fuel boiler. In some countries, the total cost of ownership of a heat pump is now lower than a fossil fuel boiler. Although this may appear to improve the economics of switching from a fossil fuel boiler to a heat pump, for low-income households the price rises have only made all forms of heating less affordable.

Figure 4 shows the estimated impact of the electricity and heating fuel price rise in three European countries that rely on fossil gas (Germany), heating oil (Ireland) and coal (Poland). In Germany and Ireland, dramatic increases in energy prices have made heat pump economics more favourable. Heating with a heat pump in 2022 is cheaper than with a gas boiler in Germany and with an oil boiler in Ireland. In Poland, the high upfront cost of a heat pump is not compensated for by an advantage in running costs.

As heating has become more expensive in general, current energy prices have made the *economics* of switching to a heat pump better with respect to other heating solutions, but the *affordability* has worsened in all countries. So, the economics have become better 'relatively' but worse 'absolutely.'

Figure 4. Total cost of ownership comparison, based on energy prices in 2022



Note: Running costs include energy costs and maintenance. Lifetime of all technologies has been set at 18 years to simplify the comparison of running costs. The analysis uses a heat pump coefficient of performance of 3.1, gas boiler efficiency of 95%, oil boiler efficiency of 93% and coal boiler efficiency of 75%. Assumptions and data sources are in Annex 2.

The current energy price crisis makes it clear that low-income households must be supported to protect themselves from the price volatility of fossil fuels. Switching to the clean alternatives that will be the most affordable solutions in the future is a priority. The crisis has not, however, made clean heating more accessible. To enable a low-income household to switch to clean heating, as well as reduce bills and improve thermal comfort, support is needed both to lower the cost of heating and to subsidise the upfront cost of the new heating system. We explore the numerous existing strategies to reduce heating costs in the next sections of this paper.

Strategies to reduce the cost of clean heat

The analysis above clearly shows that for low-income households to be able to benefit from affordable zero-emissions heating, they will need support with upfront costs and safeguards for running costs.

Reducing upfront costs

The upfront investment for switching to a heat pump can be between 50% and 100% more expensive than replacing one fossil system with another.[25] For first-time installations, when new radiators or pipework may be needed, it could cost even more. Subsidy levels must therefore be very high to enable low-income households to select the more expensive technology. For very-low-income households who struggle to fund a replacement fossil heating system, full subsidy for heat pump installation is needed.

A recent study on the impact of banning fossil fuel heating technologies in Europe summarised the subsidy schemes for zero-emissions heating across the Member States.[26] It found that 25 of 27 countries had some form of subsidy for renewable heating, although at least ten of these countries also subsidise fossil heating. Subsidy programmes and tax incentives designed for the general public are usually, however, insufficient for and inaccessible to low-income households.

We undertook a simple assessment of these national programmes to find those that offer sufficient levels of funding for low-income households. We identified programmes that either offered higher rates of subsidy based on household income or offered a very high subsidy level of 70% or more. We found that programmes in only nine of 27 countries offered funding that met these criteria: Austria, Belgium (Wallonia and Brussels regions), France, Greece, Italy, Ireland, Poland, Portugal and Slovenia. Table 1 outlines the programmes in these countries, and Annex 3 summarises the key design features of these programmes as well as those that offer over 50% of the cost of the single heating measure or of the renovation package.

For low-income households to be able to benefit from affordable zero-emissions heating, they will need support for upfront costs and safeguards for running costs.

This is likely to be an overestimation of the level of support truly reaching low-income households in EU countries. In addition to the subsidy level, other design features can ensure access for low-income households and successful outcomes. These include:

- **Availability of funds before payment for work is due, or direct payment from subsidy scheme to installer.** When funds are paid only after the invoice

[25] Based on the data used in our assessments, summarised in Annex 2.

[26] Braungardt, S., Bürger, V., & Stein, V. (2022). *Impact of a ban of fossil heating technologies on NECPs and national energy dependency.* A report by Oeko-Institut e.V. by Coolproducts. https://www.coolproducts.eu/wp-content/uploads/2022/07/Coolproducts-gas-boiler-ban-2022-_11-July-22.pdf

for works is settled by the customer, households who do not have the money to cover the initial costs are excluded. The U.S. Inflation Reduction Act is a recent example that offers point-of-sale rebates for qualifying low-income households.[27] The Italian 'Superbonus' scheme summarised in the box below also allows the installer to claim the tax credit directly.

- **Longevity of funding.** Long-term consistent funding is also key to provide households with access to support when they need it. If budgets are time-limited, with gaps in provision, it affects low-income households more than other consumer groups. Low-income households, for example, are more likely to change a heating system at breakdown rather than make investments before they are necessary. It is important to note that some of the subsidies identified are short-term, emergency response programmes introduced either as part of Covid-19 recovery plans (e.g., Italy's Superbonus) or as part of emergency plans to address the current energy price crisis (Ireland). If these programmes are not sustained long term, their ability to support low-income households will be hampered.
- **Absence of competing subsidies for fossil fuel systems.** Whether the subsidy is dedicated to renewable heating only or may cover the cost of fossil fuel heating is important. If the percentage subsidy offered for a fossil system is similar to that for renewable heat, it can give a false incentive to low-income households to choose a fossil heating system. Due to the lower cost of a fossil system, when offered the same percentage subsidy, the household contribution needed for the fossil system is lower and therefore more affordable. Five of the schemes that offer suitable funding levels also fund fossil fuel systems.
- **Dedicated budgets for low-income households.** Dedicated, ringfenced budgets for low-income households guarantee that these households will benefit. If the budget is finite, funds are very often taken up by households with higher incomes. We found only two programmes with dedicated budgets.
- **Administrative burden and support to access the scheme.** Even if the subsidy levels are appropriate, schemes with a bureaucratic application process often do not benefit low-income households adequately (see box on the Italian Superbonus). Subsidies tend to be allocated to higher-income neighbours who have better access to information and more available time, or dedicated budgets go unspent. France's new programme MaPrimeRénov' Sérénité attempts to address this by including support to apply and complete the renovation.

[27] Sweren, A. (2022, September 8). The Inflation Reduction Act 'pumps up' heat pumps. HVAC Solutions. https://www.hvac.com/resources/inflation-reduction-act-heat-pump-rebates /

Table 1. Design of national clean heat programmes offering 70% or more subsidy for low-income households

Country/ region	Subsidy level	Subsidises fossil fuel systems	Dedicated budget for low-income households	Budget time period
Austria	Up to 100%. Available to households in income deciles 1-3, with income eligibility adjusted for household size.	No	No	Ends in 2022
Brussels, Belgium	Up to 90%. Differentiated based on household income (three income bands).	Yes	No	To 2024
Wallonia, Belgium	Up to 70%. Differentiated based on household income (five income bands) and size.	No	No	Unknown
France	Up to 90%. One programme dedicated to low-income households, one offering differentiated subsidy levels based on income (four income bands) and household size.	No	Yes	Long-term
Greece	Up to 70%. Interest-free loan and subsidy combination, with variable rates of subsidy based on household income and number of children.	Yes	No	Rolls over
Ireland	Up to €6,500 for a heat pump. Not means tested. Fully funded energy upgrades for eligible households living in poorly performing homes.	No	Not for clean heat	Part of funding package to 2030
Italy	Subsidy of 110% of the total costs.	Yes	No	Ends in 2022
Poland	Up to 80%. Three subsidy levels based on income.	Yes	Yes	To 2027
Portugal	Subsidy up to 85% for a heat pump.	No	No	Ends in 2022
Slovenia	Up to 100% for low-income households.	Yes	No	Unknown

Based on Braungardt, S., Bürger, V., & Stein, V., 2022, with additional sources.
See Annex 3 for more details.

Italian Superbonus not reaching its potential to reach low-income households

The Ecobonus, Italy's most important energy efficiency mechanism, provides a tax deduction of 65% for projects aimed at reducing a building's energy consumption. In 2020, the Ecobonus was extended and upgraded: A new tax deduction of 110% of the cost was introduced for specific retrofit works, called Superbonus. The main objective of this new measure was to revitalise the construction industry, as well as to promote energy efficiency.

The Superbonus offers a deduction of 110% of the cost of energy efficiency measures. Eligible measures are divided into primary improvements (insulation and replacement of the heating equipment) and secondary improvements (including photovoltaic panels, double glazing, electric car chargers). To obtain the incentive, homeowners must install at least one primary work and the resulting improvements must increase the building's energy efficiency label by at least two levels. The deduction can be accessed as a tax relief or as a discount from the installer or supplier for the same amount. The supplier then recoups the amount in the form of a tax credit or transfer to a bank. By eliminating the upfront costs and being available to all citizens including those who do not pay tax, the mechanism could benefit low-income and energy-poor households and solve the landlord-tenant dilemma.[28]

Despite this design, monitoring data shows that households living in single-family homes have accessed the funding more than those living in multi-family dwellings, despite the high penetration of multi-family homes in Italy's stock. This supports monitoring data of long-running tax incentives which shows that more higher-income households enjoy the benefits.

The Superbonus has not been effective for low-income households because of the uncertainty created by its short timeframe and the complexity of the paperwork involved. This discourages low-income people in particular from taking the risk and starting the renovation process. It is further compounded by the fact that building contractors ask households to pay up front for the building energy efficiency assessment and evaluation of the potential improvement in the energy label.

The Superbonus has already exceeded its initial budget of €33 billion, and the cost-effectiveness of a scheme that reimburses all households more than the costs of the works must be questioned.

Summarised from: Andreolli, F. (2022). A critical assessment of the Italian Superbonus. In The Greens/EFA (2022)[29]

Reducing running costs

Ensuring that heating with electricity is affordable for low-income households and becomes the obvious choice over heating with fossil fuels requires efforts on two fronts. First, the relative cost of heating with a heat pump should be lower than heating with a boiler running on the cheapest alternative fossil fuel. As shown in Figure 3, this was not the case prior to the gas price crisis. Second, the overall cost of heating must be affordable and as stable as possible.

[28] The landlord/tenant dilemma, also called the split incentive, occurs when the landlord controls investments in the building but has little incentive to invest in energy efficiency because the energy savings that result from the investment are enjoyed by the tenant.

[29] Sunderland, L., & Segura, L. (Guest Eds.). (2022). *Energy poverty handbook.* The Greens/EFA in the European Parliament. http://extranet.greens-efa.eu/public/media/file/1/7858

Before the energy price crisis, the average price differential between gas, usually the cheapest fossil fuel for heating, and electricity across Europe was 3.3,[30] meaning that heating with an efficient heat pump was not necessarily cheaper. The gas price crisis has raised the price of gas more than that of electricity for residential customers, reducing this differential for some of Europe's capital cities (as illustrated in Annex 4).[31]

Figure 4 shows how this price change has reduced the difference between the running costs of a fossil fuel boiler and a heat pump in 2022 when compared to 2021. If gas prices fall in the future,[32] then the 'benefit' of the current proximity between fossil fuel and electricity prices will be lost. Governments therefore have an opportunity to put in place measures now that aim to retain this proximity, while ensuring that wholesale price reductions are passed on to households.

It is critical to avoid adding to the cost of fossil fuel heating for those who are already unable to afford sufficient heat and cannot elect to switch to a heat pump.

Pre-crisis, part of the reason for higher electricity prices when compared to gas was higher taxes, network costs and levies that pass on policy costs to consumers on electricity bills.[33] In 2021, only around one-third of the final price of electricity accounted for the energy used, compared to around half in a gas bill.[34] Independent of the wholesale price of gas or electricity, these taxes, network charges and levies can be adjusted to reduce the burden on electricity bills.

The current proposals for revision of the Energy Tax Directive[35] would be a step in the right direction of reducing the tax burden on electricity and ensuring that the energy content and environmental impact of fuels is reflected in taxation. Under the proposals, electricity would always have the lowest rate, whereas fossil fuels and unsustainable biomass would both have higher rates. Ahead of the Directive negotiations, some countries have already begun an adjustment. For example:

- In the Netherlands, a tax reduction is applied to each electricity connection or meter. As part of a package of measures to encourage the switch to electric heating, the tax reduction is justified on the basis that tax should not be paid on the part of energy consumption that can be considered a basic need.[36] The tax rebate for each

[30] Electricity to fossil gas price ratio in 2020 (residential sector). See Rosenow, J. (2021, 3 March). Unlocking electrification through rebalancing levies and taxes. *Euractiv.* https://www.euractiv.com/section/electricity/opinion/unlocking-electrification-through-rebalancing-levies-and-taxes/

[31] Annex 4 is an illustration of the price difference between gas and electricity in 2021 and 2022 for residential customers based on Member State capital cities and is therefore not directly comparable to the energy price data used in Figures 1 and 2.

[32] Gas prices are currently predicted to fall post 2023 but to more than double previous levels. See Dutch TTF natural gas futures. https://www.theice.com/products/27996665/Dutch-TTF-Gas-Futures/data?marketId=5360399

[33] Figure 2 in Rosenow, J. et al, 2022.

[34] Agency for the Cooperation of Energy Regulators and Council of European Energy Regulators (ACER/CEER). (2022). *Market monitoring report.* https://www.acer.europa.eu/electricity/market-monitoring-report

[35] European Commission. (2021b). Proposal for a Council Directive restructuring the Union framework for the taxation of energy products and electricity (recast). https://ec.europa.eu/info/sites/default/files/revision_of_the_energy_tax_directive_0.pdf

[36] Rijksoverheid [Government of the Netherlands]. (n.d.) Milieubelastingen [Environmental taxes]. https://www.rijksoverheid.nl/onderwerpen/milieubelastingen/energiebelasting

electricity connection is €681.63 in 2022.[37] The Netherlands has also increased its energy tax on fossil gas, while lowering it on electricity.[38]

- In Denmark, a more targeted measure reduces the tax paid on the electricity assessed to be used for heating.[39] Average Danish electricity use above 4,000 kWh per year is deemed to be associated with heating with electricity, with consumption below that level deemed to be for all other electrical uses.[40] Electricity use above 4,000 kWh per year benefits from a reduced tax rate of 0.8 øre/kWh (approximately 0.1 €/kWh) in 2021 from a previous level of 15.5 øre/kWh (2.08 €/kWh).[41]
- In Germany, the renewable energy surcharge, which added 0.37 €/kWh to the cost of electricity, has been removed from bills. The surcharge served to finance the expansion of solar, wind, biomass and hydropower plants, the cost of which is now covered by general taxation.[42]
- In Germany and Austria, discounted network tariffs are available for flexible loads or those that may be interrupted by the distribution system operator, including heat pumps.[43]

Very often these measures are part of a package designed to rebalance fossil fuel and electricity prices, shifting the tax or levy burden to the more polluting fuel. In these packages, measures to reduce the final price of electricity are coupled with measures to increase the cost of fossil fuels. This is the case in the Dutch and Danish examples above. Aligning the prices of different energy options with their environmental impact can internalise the true cost of fossil pollution and, at a time of 'normal' prices, can provide a useful price signal to households who are able to switch away from fossil use.[44] It is critical to avoid adding to the cost of fossil fuel heating for those who are already unable to afford sufficient heat and cannot elect to switch to a heat pump. The exception would be if the reduction in the electricity bill, for all other uses besides heat, offsets any cost increase for heating.

Governments looking to reduce the non-energy elements of the electricity bill without adding a burden to fossil fuel heating bills for low-income households can achieve this by:

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[37] Tax authority of the Netherlands. (2022). Tables of rates for environmental taxes. https://www.belastingdienst.nl/wps/wcm/connect/bldcontentnl/belastingdienst/zakelijk/overige_belastingen/belastingen_op_milieugrondslag/tarieven_milieubelastingen/tabellen_tarieven_milieubelastingen?projectid=6750bae7%2D383b%2D4c97%2Dbc7a%2D802790bd1110

[38] Rosenow, J. et al, 2022.

[39] The 2018 Danish Energy Agreement introduced a reduction of the tax on electricity used for heating. Danish Ministry of Climate Energy and Utilities. (2018, 29 June). *Energy Agreement of 29 June 2018*. https://en.kefm.dk/Media/C/5/Energy%20Agreement%202018%20a-webtilgængelig.pdf

[40] Footnote 1 in Danish Energy Agency. (2021). *Heat as a service: Evaluation of a Danish support scheme for dissemination of a new business concept for heat pumps.* https://ens.dk/sites/ens.dk/files/Globalcooperation/final_ens_heatpump_as_a_service_web.pdf

[41] Pedersen, S. V. (2021) *Denmark: Strategic Market Outlook*. International Energy Agency Technology Collaboration Programme on Heat Pumping Technologies. https://heatpumpingtechnologies.org/publications/denmark-strategic-market-outlook/

[42] Bundesregierung [German Federal Government]. (2022). *Stromkunden werden entlastet* [Burden on consumers relieved]. https://www.bundesregierung.de/breg-de/suche/eeg-umlage-faellt-weg-2011728

[43] Linz Netz. (n.d.). Interruptible Network Tariff Information. https://www.linznetz.at/media/linz_netz_website/netz_dokumente/informationen-unterbrechbarer-netztarif.pdf

[44] Rosenow, J. et al., 2022.

- Shifting levy costs from electricity bills to taxation, as per the German example.
- Protecting low-income households using fossil fuels for heating from increases in taxes by offering a reduced tax rate on heating fuels for eligible households.
- Redistributing revenues from carbon or windfall taxes in a timely and well-targeted way to fully offset the added cost for eligible households, as in Ireland and Germany.

Further measures, beyond the scope of what is possible through shifting taxes and levies, will be needed to make clean heat affordable for low-income households, particularly if energy prices remain high.

Finally, social tariffs are an important part of the policy landscape for ensuring energy affordability in many countries. They are not, however, a panacea for ensuring bills are manageable. Imperfect targeting and eligibility criteria and the lack of access by some eligible households when tariffs are not automatically applied mean that not all households that need support actually benefit.[45]

These tariffs may also need reform to support electrified heating. For example, tariffs that offer reduced unit rates on electricity use up to a usage or capacity cap, such as in Spain, may not provide adequate assistance to households with higher-than-average electricity consumption due to electrified heating. In addition, much of the tariff or price support designed to make heating affordable is in the form of subsidies for fossil fuel heating – for example, tariffs available on the gas bill or as a specific rebate associated with use of a fossil heating fuel. In cases where financial support is linked to a meter point, connection or use of a non-grid fossil fuel like oil, coal or bottled gas, it is crucial that households do not lose this benefit if they remove the gas connection or stop using the fossil fuel.

In conclusion, improving the *economics* of switching to a heat pump requires reform of the comparative price of electricity and fossil fuel alternatives. To ensure *affordability* for households facing energy poverty, this reform must be accompanied by further measures, like social tariffs, to bring down the cost of heating with electricity.

Ensuring affordability cannot rest, however, solely on the subsidisation of energy costs. Not only is continued subsidy an expensive option in the long term, it also misses the multiple benefits provided by structural measures. Energy efficiency, renewable energy and clean heat assets continue to pay dividends over time, providing better value for money than subsidies. These measures also offer multiple non-energy benefits in the form of health and wellbeing, future-proofing homes for the climate and extreme weather events to come, and contributing to meeting Europe's goal of a net-zero building stock.

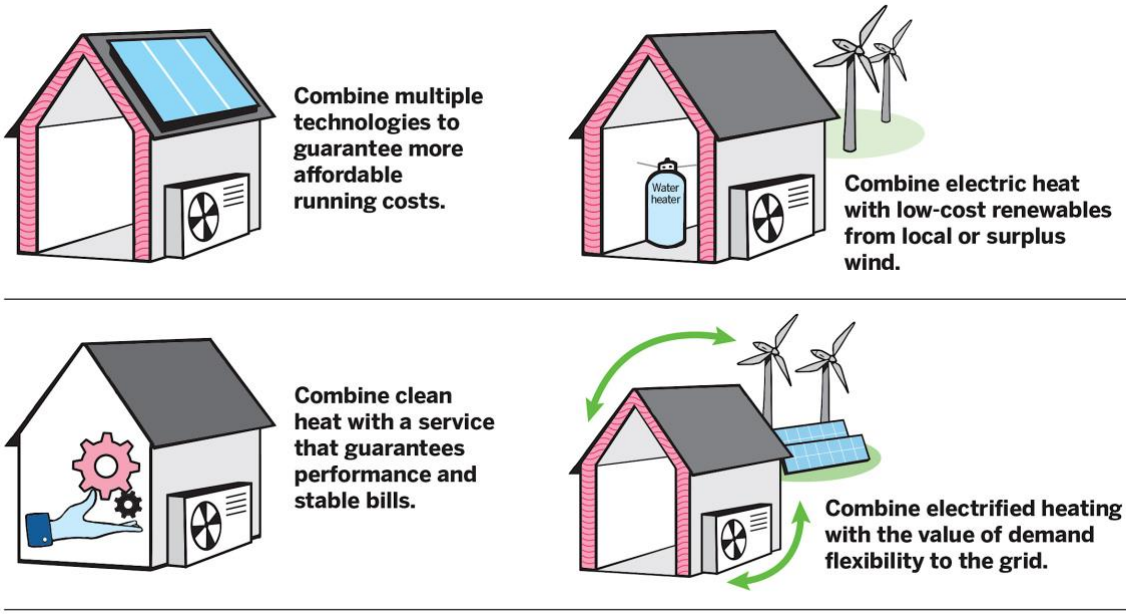
The next section of this report looks at some of the more innovative projects and programmes that are combining different technologies, services and tariffs to reduce heating costs and bring greater benefits and safeguards to low-income households switching to clean heating.

[45] Pye, S., Dobbins, A., Baffert, C., Brajković, J., Grgurev, I., De Miglio, R. & Deane, P. (2015). *Energy poverty and vulnerable consumers in the energy sector across the EU: analysis of policies and measures*. A report of the INSIGHT_E Project. https://ec.europa.eu/energy/sites/ener/files/documents/INSIGHT_E_Energy%20Poverty%20-%20Main%20Report_FINAL.pdf

Innovative strategies for affordability

A number of innovative combined strategies to safeguard affordability and deliver multiple benefits to households are emerging. The small-scale projects and initiatives identified in this section provide some inspiration for the next generation of clean heat and energy poverty alleviation programmes needed across Europe. The examples include strategies illustrated in Figure 5.

Figure 5. Combined strategies to safeguard affordability of clean heating



Combining multiple building-level technologies

Energy efficiency and clean heat: The perfect marriage

The first and foremost strategy to ensure affordability is to reduce overall need for heating through improved thermal efficiency of the home. Combining renewable heating with a full renovation of the home secures lower bills. Good thermal efficiency and appropriately sized heat emitters – pipes, radiators and underfloor heating – are also key to a well-performing heat pump.[46]

The framework of support in France is perhaps the best in Europe due to its funding for a full range of renovation measures, increasing levels of funding based on household income and size, and the ability to combine government subsidy with support from energy suppliers and preferential loans. The French framework is illustrated in Figure 6 in the box below and is described in Annex 3.

Availability of funding for multiple measures does not, however, guarantee that combinations of technologies are installed. Applications to the central French government subsidy, MaPrimeRénov', particularly for heating system replacements,

[46] Sunderland, L. (2022). *How much insulation is needed? A low-consumption, smart comfort standards for existing buildings*. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/how-much-insulation-needed-low-consumption-standard-for-existing-buildings/

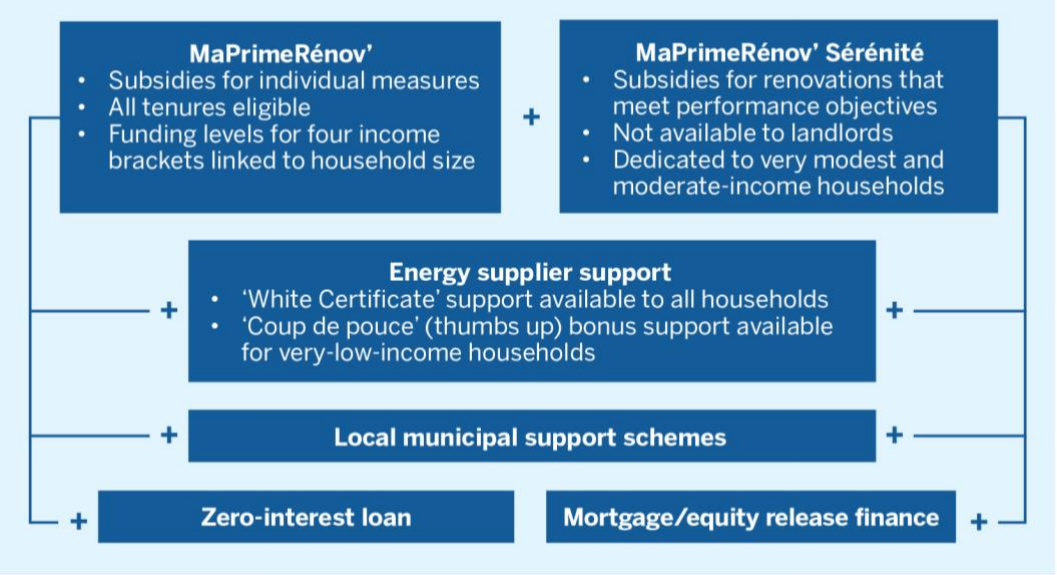
have predominantly (86%) been for single measures. Comprehensive renovations account for around 0.1% of applications.[47]

More innovative projects like the one-step renovation offered by EnergieSprong[48] aim to overcome this piecemeal approach and take existing homes to net-zero standard. EnergieSprong does this through a combination of prefabricated insulated panels for the external walls, insulated rooftops with solar panels, smart heating, and ventilation and cooling installations.

France's framework of support for renovation and clean heat for low-income households

France's framework of support centres around a comprehensive subsidy programme that offers low-income households higher levels of subsidy for individual measures. A new addition is a specific programme dedicated entirely to low-income households that focusses on achieving deeper renovations. Households accessing the second programme also receive support to define the project, apply for support and complete the works. Both can be combined with a range of other measures which can provide up to 90% of the renovation costs, complemented by finance.

Figure 6. France's framework of support



The energy cheque, which is France's bill support that can be used to fund renovation works, and a reduced VAT rate of 5.5% for renovation works also support this framework.

Source: Ademe (2022)[49]

Note: The French framework changes frequently, so this illustration may quickly become out of date.

[47] Rüdinger, A. (2022, April 8). Buildings Renovation: if Europe had started a decade ago it wouldn't have a Russian oil & gas problem. *Energy Monitor*. https://energypost.eu/buildings-renovation-if-europe-had-started-a-decade-ago-it-wouldnt-have-a-russian-oil-gas-problem/

[48] Energiesprong. (n.d.). Energiesprong explained. https://energiesprong.org/about/

[49] Ademe. (2022). *Renovation: Les aides financières en 2022* [Financial assistance in 2022]. https://librairie.ademe.fr/cadic/6684/guide-aides-financieres-habitat-2022.pdf

More than the sum of their parts

A broader technology mix is key to keeping the running costs of renewable heating to a minimum.[50] This is the conclusion of Warmworks, a joint venture partnership and managing agent for Scotland's national fuel poverty scheme.[51] To put this approach into practice, Warmworks launched projects in 2021 with Dumfries and Galloway Housing Partnership[52] and Angus Housing Association[53] to install a complementary group of technologies: air-source heat pumps, solar photovoltaics and batteries. The solar generates electricity to power the heat pump and the battery helps to make that electricity available when the sun has gone down. The aim is to convert the existing heating, which uses coal in the Dumfries and Galloway project, to renewable sources and make tenants' bills more manageable through a projected bill saving of 60%.[54]

These projects build on the success of a domestic battery storage project started in 2019, in which Warmworks, in partnership with Dumfries and Galloway Housing Partnership, installed batteries in homes in or at risk of fuel poverty and supported the tenants to shift to electricity tariffs that can optimise the use of the battery. These dynamic tariffs and clever use of the battery helped some tenants achieve a whole day's electricity use at the lower tariff rate. The batteries also provided security for individuals using medical devices who rely on electricity supply in the event of a power cut.[55]

Combining electric heat with local or surplus renewable generation

Waste not, want not

How can surplus renewable energy generation that would otherwise be wasted be used to reduce bills and alleviate energy poverty in Irish homes? This is the challenge that EnergyCloud,[56] a social enterprise supported by Irish utilities and the renewables industry, set out to solve.

EnergyCloud estimates that in Ireland €50 million worth of renewable energy generation potential is 'wasted' each year because it isn't matched with demand. The enterprise is exploring ways in which this wind and solar energy can be diverted to provide energy services in homes. Through a partnership with Clúid Housing, Ireland's largest social housing provider, EnergyCloud is currently using excess renewable generation to heat the water in hot water tanks of social housing tenants. The upfront investment of the household or housing organisation is minimised through existing

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[50] Warmworks. (2021). *Decarbonisation of Heat: what do we need for a successful transition?* https://www.warmworks.co.uk/2021/04/19/decarbonisation-of-heat-what-do-we-need-for-a-successful-transition/

[51] Energy Saving Trust. (n.d.). Warmer Homes Scotland in detail. https://www.homeenergyscotland.org/find-funding-grants-and-loans/warmer-homes-scotland/

[52] Warmworks. (n.d.). *Renewable heat project in Dumfries and Galloway*. https://www.warmworks.co.uk/our-work/renewable-heat-project-in-dumfries-and-galloway/

[53] Warmworks. (n.d.). *Renewable heat project with Angus Housing Association*. https://www.warmworks.co.uk/our-work/renewable-heat-project-with-angus-housing-association/

[54] Scottish Housing News. (2021, 14 October). *DGHP helps reduce energy bills for tenants*. https://www.scottishhousingnews.com/articles/dghp-helps-reduce-energy-bills-for-tenants

[55] Warmworks (2021, 24 August). *Domestic battery storage project in Dumfries and Galloway*. https://www.warmworks.co.uk/2021/08/24/domestic-battery-storage-project-in-dumfries-and-galloway/

[56] Energycloud. (n.d.). *About us*. https://www.energycloud.org/about/

heat storage capacity in the homes and a smart immersion heater switch that can be retrofitted to water tanks. Households benefit from free hot water top-ups when there is excess generation, which show as credits on their bill. A mobile phone app also alerts households when they have received a top-up, allowing them to adapt behaviours and avoid heating water at other times.

The social enterprise has been established with scale and replication in mind. In order to achieve this, EnergyCloud has engaged key stakeholders throughout the system on its board of directors: the technology provider, housing association, energy retailer, electricity network and renewable energy generation association.

'Plots for Kilowatts'

Another initiative that aims to offer direct benefits to households from large-scale renewable energy generation is from Octopus Energy, one of the UK's largest energy suppliers. It is offering 'Plots for Kilowatts,'[57] whereby local communities can apply for an assessment of suitability for a local wind farm. Octopus' assessment matches willing communities with landowners and overlays data on local grid availability, wind speeds and environmental impact. In return, Octopus will offer electricity at a reduced price – up to 50% – to the participating communities. In the UK, energy poverty can be high in rural areas, where suitable land for turbines is most likely to be located. Rural homes tend to be less energy-efficient, and electrified heating or biomass are often the only clean heat solutions.[58] In addition to offering low-cost electricity, this approach also engages communities directly in the location of wind farms, reducing resistance to renewables development and rewarding communities for the impact of the energy infrastructure on them.

Combining heat and a service

Comfort, not kilowatts

A number of projects, programmes and commercial offerings are trialling and implementing heat-as-a-service, which guarantees households thermal comfort within pre-agreed parameters like temperature range, hours in the day and even specific heat preferences for rooms in the house. For a fixed price, the customer receives the comfort levels agreed no matter what the weather, with all the energy, servicing and maintenance costs included in the price.

A new central government programme in Denmark has many of the hallmarks of a heat-as-a-service scheme. It combines a fossil fuel boiler scrappage scheme with a service contract.[59] The energy supplier accesses the government scrappage subsidy and takes ownership of a heat pump, which it installs and maintains. The householder

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[57] Octopus Energy. (n.d.) *'Plots for Kilowatts': Octopus Energy invites landowners to host wind turbines to lower local energy bills* [Press release]. https://octopus.energy/press/plots-for-kilowatts-octopus-energy-invites-landowners-to-host-wind-turbines-to-lower-local-energy-bills/

[58] Department for Environment, Food and Rural Affairs. (2022). Fuel poverty in rural areas. https://www.gov.uk/government/statistics/fuel-energy-and-fuel-poverty-in-rural-areas/fuel-poverty-in-rural-areas

[59] Danish Energy Agency. (2022). Skrotningsordningen: Tilskud til varmepumper på abonnement [The scrappage scheme: Subsidy for heat pumps on subscription]. https://ens.dk/service/tilskuds-stoetteordninger/skrotningsordningen. This initiative is based on a pilot scheme exploring the viability of heat-as-a-service in the Danish market: Danish Energy Agency. (2021). *Heat as a service: evaluation of the Danish support scheme for dissemination of a new business concept for heat pumps.* https://ens.dk/sites/ens.dk/files/Globalcooperation/final_ens_heatpump_as_a_service_web.pdf

avoids the upfront cost of installation, maintenance and service, and pays an upfront fee, subscription fee and a price for heat.

In a different model, UK-based Brighton and Hove Community Energy Services Cooperative (BHESCo) finds that community energy cooperatives are well placed to offer cost-effective heat-as-a-service, given their lower project management costs, operating margins, cost of finance and heat price.[60] They also benefit from community engagement skills, technical competence and independence in contracting. BHESCo is working with rural villages in southeast England, which are predominantly reliant on oil or liquid petroleum gas for heating, often experiencing levels of energy poverty higher than the national average. The aim is to shift households to affordable, clean heat. The cooperative has developed a model that combines home energy efficiency improvements – aiming to improve properties to an Energy Performance Certificate label C – and heat pumps paid for by householders through a contractual price outlined in a heat supply agreement. The upfront investment is supported by a community share offer with an indicative return of 3%. Residents will switch from paying annually to fill their oil tanks to a monthly charge for the clean heat.[61]

Heat-as-a-service is a relatively undeveloped but promising offering that could remove much of the risk and uncertainty around the costs of heating for low-income households: service, maintenance or breakdown, performance and energy price.[62] Large upfront investments, unexpected costs for maintenance or repair, and fluctuating running costs are difficult to bear for low-income households,[63] so the stable payment plan offered by a heat-as-a-service contract may well be attractive.

As illustrated in our economic analysis, total lifetime costs may still not be affordable for low-income households, even when bundled so that future savings can offset higher upfront costs. Following the lead of the Danish model, heat-as-a-service offerings could internalise and rationalise the various supports available at national and local levels to reduce the monthly service payment. These include both upfront investment subsidies and fuel bill support. Energy bill subsidies are the dominant measure to help low-income households secure adequate, affordable energy services in Europe. The heat-as-a-service model, if integrating this subsidy into the service, could improve the long-term effectiveness of fuel bill support by funnelling payments into a mechanism that contributes to affordable bills and zero-emissions heating.

Combining heat with flexibility

Rewards, not risks: Benefits of demand-side flexibility

Using electricity at times of the day or night when it is cheaper is a well-established approach for managing heating bills for low-income households heating with electricity. Electricity tariffs that offer lower rates during the night, such as France's

[60] Curtis, D. (2021). *Why community energy offers a cost-effective solution to decarbonising heat in rural communities*. BHESCo. https://bhesco.co.uk/blog/community-energy-cost-effective-solution-decarbonising-heat-rural-communities

[61] BHESCo. *Innovative low carbon heating for Firle Village*. https://bhesco.co.uk/firle

[62] Pieterse, R. (2019). Defining Heat as a Service. Delta-EE. https://www.delta-ee.com/blog/defining-heat-as-a-service/

[63] National Energy Action. (2021). *Every home should be a warm and safe place: Fuel poverty monitor 2021.* https://www.nea.org.uk/wp-content/uploads/2021/11/0000_NEA_Fuel-Poverty-Report-and-Exec-Summary_v2.pdf

'Blue' and the UK's 'Economy 7,' have been in use in Europe since the 1960s.[64, 65] The cheaper electricity overnight is used to charge the heat storage device which then discharges through the day.

As the electricity system adapts to integrate higher levels of variable renewable resources like solar and wind, the most cost-effective path requires a more nuanced harmonising of supply with demand.[66] The dominant tool currently employed to incentivise customers to shift demand is a time-of-use or dynamic tariff that offers different prices at different times in line with grid conditions. These tariffs offer significant benefits in the form of lower prices to those who can move their energy demand to times of abundant renewable generation, but can also expose customers to high prices at times of high demand or lower renewable generation. The risk of high prices can outweigh the benefit of lower prices for households that are not able to bear fluctuations in cost. Relying only on tariffs to provide access for households to the benefits of cheaper electricity therefore risks shutting out lower-income households. This is a risk recognised by the Rural-Led Energy Transition[67] initiative of Ulster University and the Northern Ireland Housing Executive, which aims to reduce or eliminate the risk of low-income households being left behind in the transition to clean, smart, integrated energy systems.

> "*The declining costs of consumer-controlled flexible resources means that with new market arrangements, even moderately affluent households will be able to shift their energy consumption to off-peak/low-price periods and take advantage of cheap wind energy. This creates a risk that those who are unable to flex demand because they are not homeowners or have limited access to capital are disadvantaged."*

A number of pioneering projects are exploring a combination of improved technical capacity of households to use energy from different sources – both the grid and local small-scale renewables generation – at different times, with new services and offerings that are less risky than tariffs. The Rural-Led Energy Transition project is quantifying the system value that could be created by significant uptake of flexible electric heating in social housing in Northern Ireland. It will trial both innovative technology combinations, including smart controls, heat pumps and heat storage, and dynamic market arrangements to allow tenants to take advantage of cheap wholesale prices.

Elsewhere in the UK, social housing providers in Glasgow and London are combining existing storage heaters in their blocks of flats with smart charging technology to provide better comfort throughout the day, linked to the external temperatures and to allow access to cheaper tariffs.[68]

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[64] Pató, Z & Broc, J-S. (2020). *Report on international experiences with E1st.* Deliverable D2.2 of the ENEFIRST project, funded by the H2020 programme. Available at: http://enefirst.eu

[65] Fell, M.J. (2021). The history of heat-as-a-service for promoting domestic demand-side flexibility: Lessons from the case of Budget Warmth. *Journal of Energy History*. http://www.energyhistory.eu/en/special-issue/history-heat-service-promoting-domestic-demand-side-flexibility-lessons-case-budget

[66] Yule-Bennett & Sunderland, 2022.

[67] SPIRE 2 Storage platform for the integration of renewable energy. *RULET (Rural-Led Energy Transition)*. https://www.ulster.ac.uk/spire2/the-project/case-studies/rulet

[68] Connected Response. (n.d.). *Our projects*. https://connectedresponse.co.uk/projects/

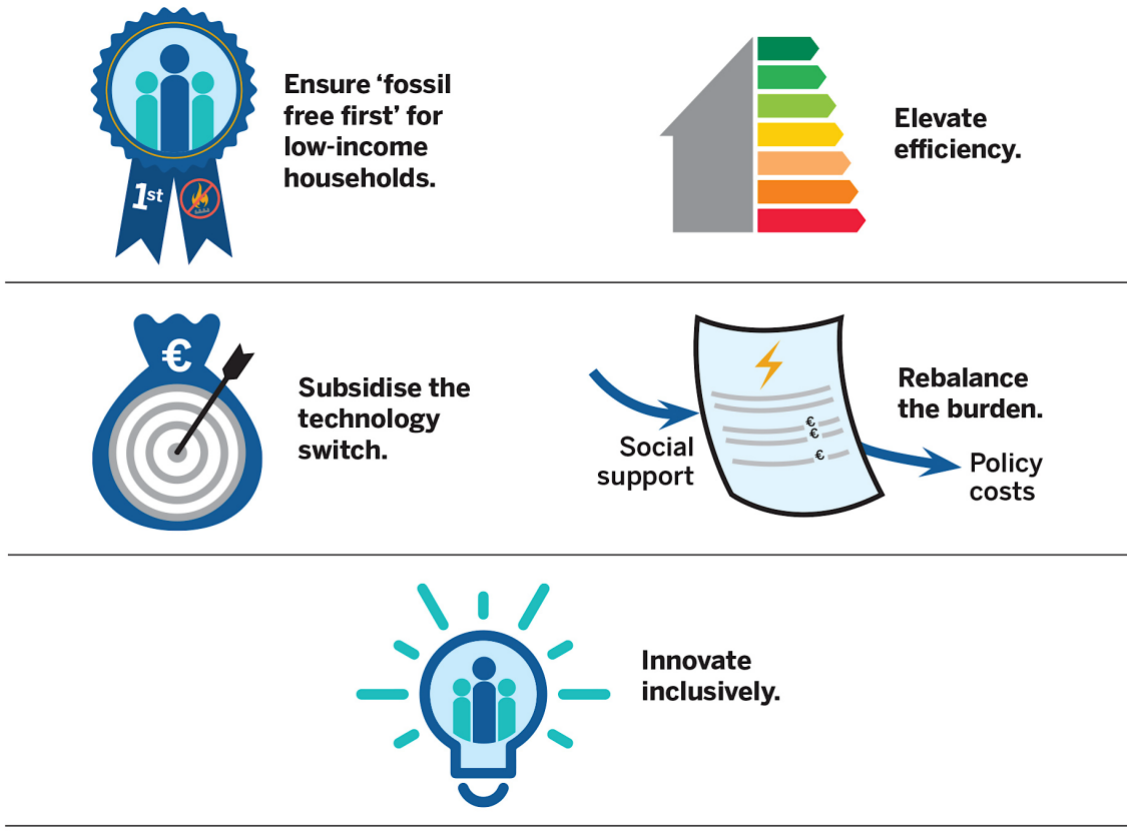
Finally, communities in Belgium, France, the UK, Germany and Spain are collaborating on the next generation of demand-side integration with the grid. The RESCoop VPP[69] project has created a community-based 'virtual power plant' which optimises the use of local renewable generation by matching local demand with local supply through monitoring and control systems. The system aggregates demand and supply to maximise the benefits of lower-cost local electricity generation.

Recommendations

We have reached the tipping point in Europe. We know that the future is clean heat delivered by a heat pump or through clean district heating, but until now fossil heating has been cheaper in many countries. The current energy price crisis has made all heating more expensive and has made the feared risk of fossil fuel price and supply volatility into a reality. Despite the fact that the currently sky-high prices may fall in future, they are not predicted to fall to pre-crisis levels. Therefore, the question of when the right time is to responsibly recommend that low-income households switch to clean heating is answered. The answer is now.

Swift and significant effort is needed on several fronts to ensure that low-income households can benefit from clean heat and at the same time lower bills. These recommendations are summarised in Figure 7.

Figure 7. Recommendations to ensure low-income households can switch to clean heat



[69] REScoopVPP. (n.d.). *What we do*. https://www.rescoopvpp.eu/about

Ensure 'fossil free first' for low-income households.

Prioritise clean heat with energy efficiency for low-income households and design policies with affordability and the specific needs of these households in mind in national heat and buildings decarbonisation strategies. Low-income households are most impacted by energy price volatility and most at risk of being locked into reliance on fossil fuels. Short- and medium-term measures to reduce reliance on fossil gas and accelerate the clean energy transition should therefore prioritise finite public funding and supply chain capacity for those most in need. This requires significant refocusing of clean heat support which, to date, has been designed to be available and accessible to higher-income households.

Elevate efficiency.

Member States should prioritise energy efficiency for low-income households switching to clean heat. Improved energy efficiency of the building envelope helps to reduce heating needs, can ensure heating is efficient, and provides protection from price fluctuations. Beyond reducing bills, energy efficiency opens the door to a range of benefits from using energy more flexibly and providing services to the electricity system.[70]

Minimum energy performance standards, as are proposed in the Energy Performance of Buildings Directive and are in place in several European countries,[71] are a key tool to ensure that homes are renovated to enable more efficient heat decarbonisation. These standards must be supported by adequate financial and practical assistance to ensure households can navigate the renovation process successfully. Member States and EU institutions introducing fossil fuel boiler phase-out policies must guarantee that homes of low-income people meet minimum efficiency standards before or in conjunction with the replacement of heating systems.

In addition to adequate thermal insulation to ensure the heating system can run at a low flow temperature and can heat the home with maximum efficiency,[72] the quality of installation, accompaniment and aftercare, maintenance, and other system performance guarantees are essential to ensure that the installed heating system performs efficiently. This is vital to safeguard affordability and to ensure that the switch achieves the predicted results and expected bills.

Subsidise the technology switch.

Every Member State should make available subsidies of up to 100% of the costs of switching to clean heating, ringfenced for low-income households. Dedicated budgets must be available long term. Subsidy levels should be varied by household income and size and, where relevant, combined with appropriate finance to cover any household contribution. It is important that access to programmes is simple. One-stop shops and advisory services with suitable levels of assistance for low-income and vulnerable

[70] Yule-Bennett & Sunderland, 2022.

[71] Sunderland, L & Santini, M. (2021). *Next steps for MEPS: Designing minimum energy performance standards for European buildings.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/next-steps-for-meps-designing-minimum-energy-performance-standards-for-european-buildings/

[72] Sunderland, 2022.

households are necessary to ease access to support and overcome non-financial barriers like unequal access to information and digital exclusion.

Programmes must no longer subsidise fossil fuel heating, as this perpetuates the cycle of dependence on fossil fuels and excludes low-income households from the benefits of transitioning to clean heat. The significant subsidies currently afforded to fossil fuel sectors should be redirected to support low-income households to decarbonise.

Programmes should not only fund heating measures but, as appropriate, should also support energy efficiency, heat storage, smart controls and small-scale renewable energy. Combinations of technologies can multiply the demand reduction, heating efficiency and demand-side flexibility benefits to households and provide more protection from price volatility.

Rebalance the burden.

Member States should explore and implement options to transfer policy costs like taxes and levies *away* from electricity bills and transfer support to pay heating bills *to* electricity bills when customers switch. Transferring taxes, levies and policy costs away from electricity bills can make heating with electricity more affordable. This should be done in a way that does not add to fossil fuel bills for low-income households that are still reliant on fossils for heating.

Social tariffs or heating subsidies designed to reduce the cost of fossil heating should be adapted to ensure the benefits are retained, as needed, when a household switches to efficient electric heating.

Innovate inclusively.

Focus EU and Member State research and innovation funding, as well as industry initiatives, on innovations that open up access to the benefits of the energy transition for low-income households. Developers of new services, tariffs and technology combinations in the heating sector should be incentivised to design with the needs of low-income households in mind. Innovation all too often focusses on the early-adopter sector of the market. There is significant potential in new offerings to address the specific challenges lower-income households face in decarbonising their homes affordably. This paper has illustrated a number of such innovations providing access to cheaper electricity, supporting households to offer the flexibility of their electricity use to the grid for reward, and providing services to guarantee stable, affordable heating bills.

Annex 1

District heat: Customer protection and affordability

For households connecting to district heating, the focus for affordability is predominantly on running costs, service charges and customer protection. District heating system ownership models, governance, business models and customer costs differ across Europe, as do the regulations within which they operate.[73] Customers of district heating do not always benefit from the same regulated protections as customers of other energy sources like electricity. This is exacerbated by the fact that district heating is a natural monopoly where customers have no ability to compare and select offers or prices from different suppliers.

The European consumer association BEUC has identified the following key issues for customer protection and affordability in district heating:[74]

- Lack of transparency in price structures and billing, and poor price control.
- Long-term contracts that consumers often cannot terminate.
- Inadequate consumer protections, for example, regarding disconnections.
- Lack of extrajudicial dispute-resolution mechanisms.
- Lack of transparency concerning energy sources, emissions and network losses.

Additional challenges for existing district heating systems to overcome in order to guarantee affordable heat provision include:

- Lack of adequate metering or control of heat to individual apartments.
- Inefficient systems and no competition impetus to drive the improvement.
- Different ownership and governance structures and for-profit or not-for-profit business models that result in more or less participation and control by customers.
- The need to finance significant investment to modernise and switch existing district heating systems from fossil fuels to low- or zero-emission sources, while keeping heat affordable.

For the expansion of new district heating systems, clear heat planning will be essential to ensure that new, efficient systems materialise. Ensuring that a district heating system is efficient requires connecting a sufficient penetration of homes and other heat users in the geographical area. Without clear zoning and safeguards to increase customer acceptance, district heating systems risk being inefficient and therefore more expensive for those who do connect.

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[73] European Commission, Directorate-General for Energy, Bacquet, A., Galindo Fernández, M., Oger, A., et al., District heating and cooling in the European Union : overview of markets and regulatory frameworks under the revised Renewable Energy Directive. Annexes 6 and 7: final version, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2833/96390

[74] BEUC. (2021). *How to make district heating fit for consumers. A BEUC position paper.* https://www.beuc.eu/sites/default/files/publications/beuc-x-2021-044_consumer_rights_district_heating.pdf

All of these risks to fair governance and affordable heat provision are amplified for low-income and vulnerable households. Low-income households have lower success levels in accessing redress when things go wrong,[75] placing more importance on getting things right. Low-income or vulnerable households are also less able to opt out of a district heating service, as they do not readily have the upfront investment needed to install an alternative individual heating system or, as tenants, do not have the decision-making rights. Similarly, limited housing choices mean households cannot choose to move away from the district heating area.[76]

BEUC has made recommendations on protections needed, many of which it wants to see enshrined in the Electricity Directive,[77] mirrored for district heating customers as outlined in the box below. There is clearly significant work to be done to put these into practice, to expand the best practices into district heating, and to explore the costs of updating and decarbonising existing district heating, but that is outside of the scope of this study.

Recommendations to guarantee adequate consumer rights and protections in district heating

"Minimum requirements for the district heating planning process will ensure that local authorities carefully plan new district heating networks and inter alia carry out public consultations, long-term cost-benefit analyses, develop consumer-centric tendering conditions, and grant opt-out possibilities for single family house and apartment buildings.

Tariffs, contracts and bills which are transparent, understandable and easy to compare: This includes a mirroring of Article 10, 18 and Annex I of the Electricity Directive. Transparency is particularly needed for price and tariff structures as the possibility to switch supplier does not currently exist in district heating. Comparability with other heating solutions should allow consumers to choose the right solution when they get the possibility to connect to district heating and allow regulators to detect abusive cases more easily.

Independent oversight by national regulatory authorities should become an efficient counterweight against a potentially detrimental natural monopoly. This includes mirroring Article 57, 58 and 59 of the Electricity Directive to establish price monitoring. In addition, price capping and benchmarking mechanisms will increase the competitiveness of district heating suppliers.

Safeguards and redress mechanisms to prevent and eliminate abusive practices: This includes the obligation to participate in alternative dispute resolution schemes, set up a single point of contact, allowing single family houses and apartment buildings the right to terminate a contract and modify the contracted 'heat load' (mirroring Article 10 and Articles 25, 26, 28 and 29 of the Electricity Directive as well as extending Article 24 §2 of the Renewable Energy Directive Article to energy efficiency improvements)."

Source: BEUC, 2021

[75] Creutzfeldt, N., Gill, C., Cornelis, M., & McPherson, R. (2022). *Access to justice for vulnerable and energy-poor customers. Just energy?* Bloomsbury.

[76] BEUC. (2021). *How to make district heating fit for consumers. A BEUC position paper.* https://www.beuc.eu/sites/default/files/publications/beuc-x-2021-044_consumer_rights_district_heating.pdf

[77] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast). *Official Journal of the European Union*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019L0944

Annex 2

Assumptions and data sources for total cost of ownership calculations

Energy demand

Residential space and water heating demand in 2019 was taken from the Eurostat database *Household final energy consumption disaggregated* and reflects the latest data available at the time of analysis.[78] The average space heating demand per country was then divided by the number of households per country to reach an average space and water heating demand per household.[79]

Device characteristics

Conversion efficiencies for each device are from Appendix X in the European Commission's Energy Efficiency Directive guidance note:[80]

- For heat pumps – the seasonal coefficient of performance of 3.1 is the minimum standard.
- For condensing gas boilers, we assumed an efficiency of 95% for the energy-efficient option.
- Conversion efficiencies for oil boilers (93%) are from the U.S. Department of Energy,[81] and for coal stoves (75%) they are from Cambridge Econometrics.[82]

Device lifetimes for each type of heating appliance can range from 18-25 years.[83] For simplicity of comparison, we set these values at 18 years.

Energy prices

Where possible, final electricity and fossil fuel prices include all taxes and levies, including carbon prices. Residential electricity and gas prices for the first half of 2021

[78] Eurostat. (2022). Disaggregated final energy consumption in households [Data set]. Accessed 1 September 2022. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_d_hhq

[79] Eurostat. (2022). Number of households by household composition, number of children and age of youngest child [Data set]. Accessed 14 July 2022. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfst_hhnhtych

[80] European Commission. (2019). Annex to Commission Recommendation on transposing the energy savings obligations under the Energy Efficiency Directive. https://eur-lex.europa.eu/eli/reco/2019/1658.

[81] United States Department of Energy. (2022). Furnaces and Boilers [Data set]. Accessed 12 August 2022. https://www.energy.gov/energysaver/furnaces-and-boilers

[82] Cambridge Econometrics. (2022). *Modelling the socioeconomic impacts of zero carbon housing in Europe.* European Climate Foundation. https://europeanclimate.org/wp-content/uploads/2022/03/modelling-the-socioeconomic-impact-of-zero-carbon-housing-in-europe-final-technical-report-march2022.pdf

[83] Cambridge Econometrics, 2022.

are taken from two Eurostat databases.[84] Prices in July and August 2022 are from CREG[85] and Electric Ireland,[86] as well as PGNiG and PGE for Poland.[87]

Heating oil prices in Ireland are from the European Union's *Weekly Oil Bulletin* (Bulletin 2038 for 22 February 2021 and Bulletin 2107 for 11 July 2022).[88]

Coal prices in Poland are from Statistics Poland for 2021.[89] Coal prices in Poland in 2022 are highly uncertain. This analysis has used a price of 2000 PLN/tonne.

Device upfront and maintenance costs

The upfront cost (equipment and installation) for heating devices can vary greatly between European countries and sources of data, and depending on whether the heating system is a replacement or a new build. In this study, upfront costs for new builds are based on Table A.1.1 in the Cambridge Econometrics study *Modelling the socioeconomic impact of zero carbon housing in Europe*.[90] Air-to-water heat pumps, condensing gas boilers and condensing oil boilers are assumed to be a standard 10 kW to determine both investment and maintenance costs. The upfront cost of a coal boiler in Poland was taken from recent average device prices[91] and the upfront cost of a heat pump was provided by PORT PC.

[84] Eurostat. (2022). Electricity prices for household consumers – bi-annual data [Data set]. Accessed 6 July 2022; Gas prices for household consumers – bi-annual data [Data set]. Accessed 6 July 2022, https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_202/default/table?lang=en

[85] CREG. (2022). Table de bord mensuel électricité et gaz naturel – Juillet 2022 [monthly electricity and natural gas dashboard – July 2022]. https://www.creg.be/sites/default/files/assets/Prices/Dashboard/tableaudebord202207.pdf

[86] Electric Ireland. (2022, 1 July). *Electric Ireland announces price change from August 1* [Press release]. https://www.electricireland.ie/news/article/electric-ireland-announces-price-change-from-august-1

[87] PGNiG. (2022). *Taryfa- cennik dla klientów indywidualnych oraz podmiotów objętych ochroną taryfową* [Tariff - price list for individual customers and entities covered by tariff protection]. Accessed 25 September 2022. https://pgnig.pl/dla-domu/taryfa-gazu; PGE. (2022). *Oferta taryfowa* [Tariff offer]. Accessed 25 September 2022 https://www.gkpge.pl/dla-domu/oferta/oferta-taryfowa

[88] European Commission, All weekly oil bulletins since 2009. https://ec.europa.eu/energy/observatory/reports/List-of-WOB.pdf.

[89] Statistics Poland. (2022). Communication on average annual retail price of 1000 kg of hard coal in 2021. https://stat.gov.pl/en/latest-statistical-news/communications-and-announcements/list-of-communiques-and-announcements/communication-on-average-annual-retail-price-of-1000-kg-of-hard-coal-in-2021,274,9.html

[90] Cambridge Econometrics, 2022.

[91] Czyste Ogrzewanie. (2021). *Zakup kotła na węgiel / drewno w 2022 roku* [Purchase of a coal/wood boiler in 2022]. https://czysteogrzewanie.pl/na-zakupach/zakup-kotla-na-wegiel-drewno-w-2022-roku/

Annex 3

Summary of clean heat subsidies at adequate levels for low-income households

Table 2 below identifies the subsidy schemes in EU Member States that offer higher rates of subsidy based on household income and those that offer a very high level of subsidy, 70% or more, for a single heating system measure. Schemes offering over 50% but less than 70% of the cost of a single measure or renovation package are marked in orange.

The analysis is based on the summary of zero-emissions heating subsidy schemes in EU Member States in Annex 2 of the 2022 study *Impact of a ban of fossil heating technologies on NECPs and national energy dependency*,[92] updated where relevant.

Table 2. National clean heat programmes offering high levels of subsidy for low-income households

Country/ region	Programme	Notes on suitability for low-income households
Austria	Sauber Heizen für Alle 2022 [Clean heating for all][93]	• Up to 100% of the total costs of replacing a fossil fuel heating system with connection to a district heating system, a wood boiler or a heat pump. • Available to households in lowest income deciles (1-3), with income eligibility adjusted for household size.[94] • Can be combined with local initiatives and with incentives for solar thermal. • For homeowners only, not available for multi-family buildings (more than two households). • Funding only guaranteed during 2022.
Brussels, Belgium	Renolution[95]	• Up to 90% of the cost of works, up to €4,750 for an air-source heat pump. • Subsidy level differentiated based on household income, three income bands. • Not solely dedicated to clean heat – can also fund replacement fossil fuel system.
Wallonia, Belgium	Primes Habitation [Household premiums][96]	• Different subsidy levels based on income and household size (five income groups). • Up to 70% of the cost can be covered, up to €6,000, for a heat pump. • Funds renewable heating system only, not fossil fuels.
Croatia	Energetska Obnova Obiteljskih Kuća [Programme for energy renovation of family houses][97]	• Provides subsidies for projects of 40%, 60% or 80%, based on location and priority. Up to 24,000 kn or €3,200 available for a renewable heating system. • Also funds fossil fuel heating with gas with the same maximum subsidy.

[92] Braungardt et al., 2022.

[93] Bundesministerium Umwelt, Energie, Mobilität, Innovation und Technologie [Federal Ministry for the Environment, Energy, Mobility, Innovation and Technology]. (n.d.). *Sauber Heizen für Alle 2022* [Clean heat for all 2022]. https://www.umweltfoerderung.at/index.php?id=856

[94] Land Oberösterreich. (n.d). *Sauber Heizen für Alle* [Clean heating for all]. https://www.land-oberoesterreich.gv.at/270992.htm

[95] Renolution. (n.d.). *Renolution! Ontdek hier hoe het Brussels Hoofdstedelijk Gewest u helpt bij uw renovatie* [Renovation! Discover here how the Brussels-Capital Region can help you with your renovation]. https://renolution.brussels/nl; Renolution. (n.d.). De renoluation van Brussel [The Renolution of Brussels]. https://renolution.brussels/nl/de-renolution-van-brussel

Country/ region	Programme	Notes on suitability for low-income households
Czechia	Nová zelená úsporám [New green savings programme][98]	• Subsidy covers up to 60% of the cost when combined with other subsidies for low-income households (but the highest funding level is associated with achieving a high standard of energy performance from the overall renovation, rather than a single measure). • Subsidy available for an air-source heat pump (without low-income uplift) is CZK 80,000 or €3,250.
France	MaPrimeRénov' MaPrimeRénov' Sérénité Coup de pouce [Thumbs up] white certificate uplift Zero-interest loan[99] Illustrated in box on page 21 (Note: France's framework changes frequently)	MaPrimeRénov' • Subsidies for energy audits, heating, insulation and other individual measures. • All tenures eligible. • Different funding levels for four income brackets, linked to household size. For example, €5,000 is available for an air-source heat pump, €11,000 for a ground-source heat pump and an automatic-feed wood boiler, €1,200 for connection to a district network for households in the lowest income bracket. • Additional bonuses of €1,500 for renovating a home that is F/G class to achieve at least an E class, and for taking a home to an A/B class. MaPrimeRénov' Sérénité • Only available for very modest income and moderate income (the lowest two of the four income brackets). • Renovations must achieve a primary energy reduction of 35% or EPC E. • Works capped at €30,000, with 50% funding limit for lowest income group. • Renovation funding is accompanied by support to define the renovation, apply for funds and deliver the renovation. Both programmes can be combined with energy supplier support via the white certificate scheme, which is available for all households but contains a 'coup de pouce' bonus for low-income households, which provides a minimum premium of €4,000 for an air-source heat pump for households in the lowest income bracket. Can also be combined with local municipal programmes and national zero-interest loans and equity release finance.
Greece	Πρόγραμμα «Εξοικονόμηση κατ΄ Οίκον II [Energy saving at home II programme][100]	• Interest-free loan and subsidy combination with variable rates of subsidy based on household income and number of children. • For those on very low incomes and with larger families, 70% of the cost is available in subsidy. • Available for both fossil and renewable heating.

[96] Wallonie énergie SPW. (n.d.) Primes Habitation (à partir du 1er juin 2019) [Housing premiums (from 1 June 2019)]. https://energie.wallonie.be/fr/primes-habitation-a-partir-du-1er-juin-2019.html?IDC=9792

[97] Environmental Protection and Energy Fund. (n.d.). Energetska Obnova Obiteljskih Kuca [Energy renovation of family homes]. https://www.fzoeu.hr/hr/energetska-obnova-obiteljskih-kuca/5963

[98] State environment fund of the Czech Republic. (n.d.). *New Green Savings Programme*. https://www.sfzp.cz/en/administered-programmes/new-green-savings-programme/

[99] Ademe. (2022). Renovation: Les aides financières en 2022. https://librairie.ademe.fr/cadic/6684/guide-aides-financieres-habitat-2022.pdf

[100] Greek Ministry of Environment & Energy. (n.d.). Πρόγραμμα «Εξοικονόμηση κατ΄ Οίκον II [Energy Saving at Home II programme]. https://exoikonomisi.ypen.gr/to-programma

Country/ region	Programme	Notes on suitability for low-income households
Ireland	Heat Pump System Grant[101]	• Up to €6,500 for a heat pump. • In addition to fully funded energy upgrades for eligible households (in receipt of welfare benefits, disabled people and households with young children), living in poorly performing homes.[102] • Part of dedicated funding package to 2030.[103]
Italy	Superbonus Ecobonus	• Subsidy of 110% of the total costs, between €15,000 and €30,000 for a heat pump, • Accessible through personal tax deduction or through a tradesperson's tax or bank. • Subsidy also available for fossil boilers. • Only confirmed funding until September 2022.
Italy	Ecobonus	• Tax deduction offering up to 65% of the cost of a heat pump with a ceiling of €30,000.
Poland	Clean Air Priority Programme Stop Smog[104]	• Programme that incentivises the replacement of highly polluting solid fuel heating sources with cleaner systems, and energy efficiency improvements in single-family homes. • Three differentiated subsidy levels based on income, offering up to 80% of costs of a package up to PLN 69,000 or €14,600. • For an air-to-water heat pump, a low-income household is eligible for 60% of the cost, up to PLN 18,000 (€3,800), or 90%, up to PLN 27,000 (€5,700) for lowest-income families. • Subsidy at similar percentage level available for gas and oil boilers. • Programme runs until 2027.
Portugal	Programa de Apoio Edifícios + Sustentáveis [More sustainable buildings][105]	• Government subsidy scheme for energy efficiency and renewable heating systems. • Offers high levels of potential subsidy, up to 85% for a heat pump (limit of €2,500). • Time-limited budget (to 2022).
Slovenia	Eko Sklad [Eco Fund subsidies and loans][106]	• Central government grant and soft loans scheme. • Offers up to 100% of the cost of individual measures for low-income households (compared to 20%-50% for other households). • Can fund various technologies, including fossil fuel boilers.

[101] Sustainable Energy Authority of Ireland. (n.d). *Heat Pump system grant*. https://www.seai.ie/grants/home-energy-grants/heat-pump-systems/

[102] Sustainable Energy Authority of Ireland. (n.d). *Fully funded energy upgrades*. https://www.seai.ie/grants/home-energy-grants/free-upgrades-for-eligible-homes/

[103] Sustainable Energy Authority of Ireland. (2022, 9 February). *Government launches the National Retrofitting Scheme* [Press release]. https://www.seai.ie/news-and-media/government-launches-the-n/

[104] Ministerstwo Klimatu i Srodowiska [Ministry of Climate and Environment]). (n.d). Rzadowy Program Smog Stop. https://czystepowietrze.gov.pl/stop-smog/ and Clean Air Programme https://czystepowietrze.gov.pl/czyste-powietrze/

[105] Fundo Ambiental [Environmental Fund]. (2021). 2ª FASE Programa de Apoio Edifícios + Sustentáveis [2nd phase support programmes buildings and sustainability]. https://www.fundoambiental.pt/apoios-prr/c13-eficiencia-energetica-em-edificios/01c13-i01-paes-ii.aspx

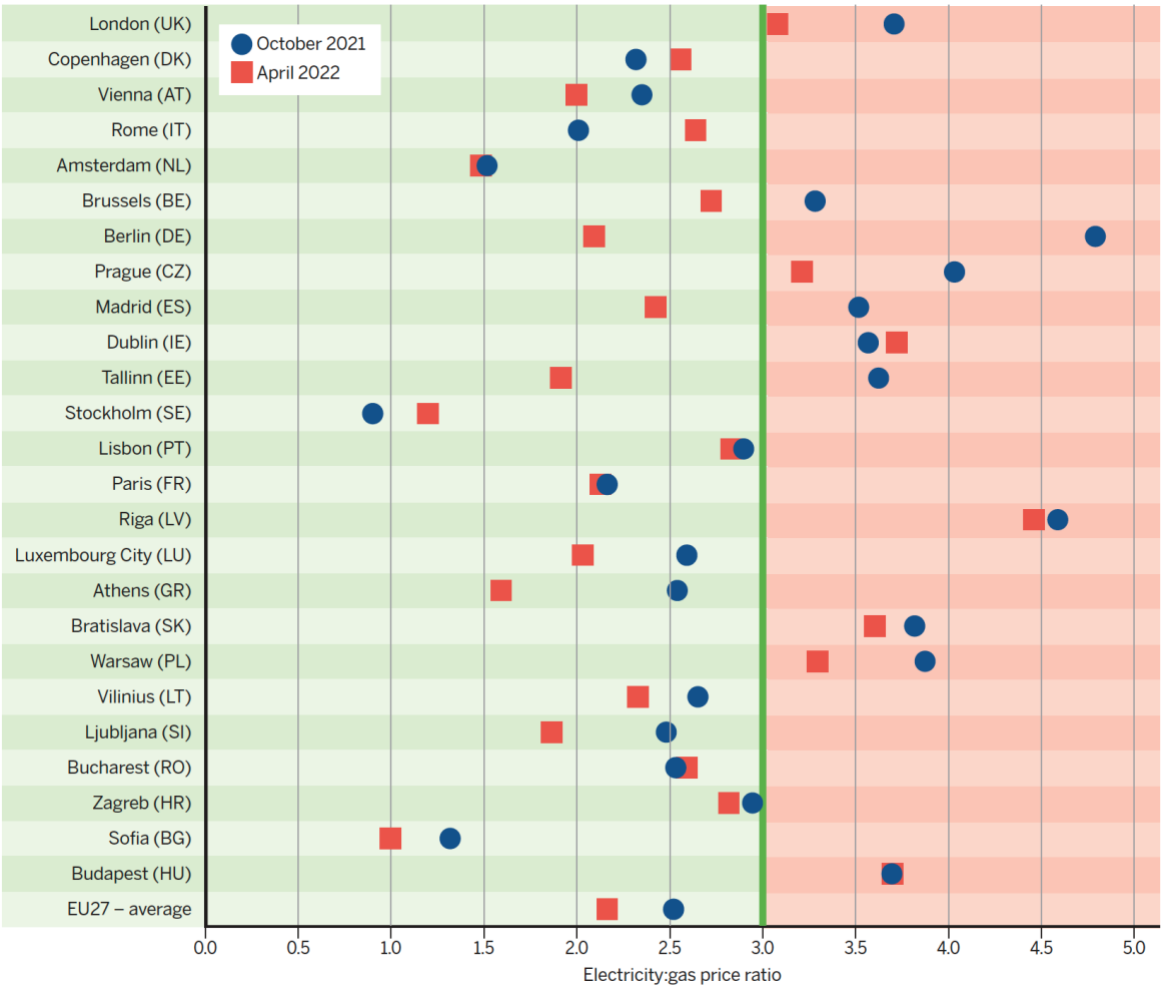
[106] Eko Sklad. (2022). Vlaganje vlog [application]. https://www.ekosklad.si

Annex 4

The difference between gas and electricity prices in EU capital cities

The chart below illustrates the relationship between electricity and gas prices in EU capital cities, plus London, in October 2021 and April 2022. The green line is the indicative price differential at which heating with a heat pump with a coefficient of performance of 3 becomes as cost-effective as heating with gas.

Figure 8. Gas and electricity price ratio in EU capital cities



Source: HEPI Household energy price index https://www.energypriceindex.com.
Figure based on design by Andreas Graf. https://public.flourish.studio/story/1619947/

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