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CRUX ALLIANCE

A policy toolkit for global mass heat pump deployment

Version 2.0

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Regulatory Assistance Project (RAP)®
Rue de la Science 23
B – 1040 Brussels
Belgium

+32 2 789 3012
info@raponline.org

raponline.org
linkedin.com/company/the-regulatory-assistance-project
@regassistproj.bsky.social

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Authors

Regulatory Assistance Project

Dr Richard Lowes (lead author)
Duncan Gibb
Dr Jan Rosenow
Louise Sunderland
Samuel Thomas

Agora Energiewende

Andreas Graf
Steffen Verheyen

CLASP

Lina Kelpsaite
Matt Malinowski
Alexia Ross

Global Buildings Performance Network

Dr Peter Graham
Rehema Kabare
Mugure Njendu

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Pengfei Xie, RAP

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Rafael Martinez Gordon, International Energy Agency

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Nora Steurer, United Nations Environment Programme

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Figures

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Prologue

In November 2022, we — a partnership of international organisations, all with expertise on heat pumps — published our *Policy Toolkit for Global Mass Heat Pump Deployment*. This toolkit provided a framework, the first of its kind, to guide policymakers around the world on how to support heat pumps — the critical technology for cleaning up the heating and hot water used in buildings.

We launched our toolkit at COP27 in Egypt at the peak of the gas price crisis in Europe. Since then, heat pump markets have grown around the world — although this growth has not been even, and the pace of growth is not fast enough to meet international goals. Gas prices have remained stubbornly high across much of the world; 2023 was the warmest year on record,[1] and 2024 may be even warmer, having recorded the hottest day in recent history.[2]

Through reducing emissions and reducing the use of fossil fuels for heating, and by pairing well with increasingly cost-effective renewable electricity, heat pumps are more important than ever — but the transition to clean heating needs to be accelerated.

Version 2.0 of our toolkit builds on a further two years of research and engagement on heat pumps with governments, installers and individuals around the world. The fundamental structure of the toolkit is the same, and our Greek temple metaphor remains. But as we have worked on heat pumps around the world we have discovered nuance and complexity driven by cultural factors, climate factors and technical factors.

We use Version 2.0 to introduce technical variety and case studies to our toolkit, deepening our understanding. Nevertheless, we highlight the fact that — while there may be specific policy needs in certain jurisdictions — the fundamental policy requirements are the same everywhere. Energy pricing needs to reflect externalities and deliver relatively low heat pump running costs; building owners may need financial support to fit heat pumps; and regulation will be needed to shape markets to drive the technology outcomes planned by policymakers. These fundamentals need to be coordinated by governments, and this needs to happen in an equitable way to ensure a smooth and timely transition towards clean heating.

Dr Richard Lowes
LEAD AUTHOR

1 The Copernicus Programme. (2024, 9 January). *Copernicus: 2023 is the hottest year on record, with global temperatures close to the 1.5°C limit* [Press release]. https://climate.copernicus.eu/copernicus-2023-hottest-year-record

2 The Copernicus Programme. (2024, July). *New record daily global average temperature reached in July 2024*. https://climate.copernicus.eu/new-record-daily-global-average-temperature-reached-july-2024

Executive summary

Introduction

Heat pumps, devices which use electricity to extract heat from the environment, are widely seen as a critical technology for clean energy systems. Future energy scenarios developed by international bodies such as the International Energy Agency and the Intergovernmental Panel on Climate Change, as well as numerous national governments, point to heat pumps as being the most important technology to decarbonise heating, most of which is currently provided by fossil fuels. Some jurisdictions, in particular in Europe, have even gone a step further by setting explicit heat pump deployment targets to help encourage their uptake.

Heat pumps are relatively simple appliances. They share similar components to refrigerators and air conditioners and effectively move an external source of heat to where it is needed, such as in buildings for heating or the production of hot water. Their key value is systemic efficiency; for each unit of electricity consumed to operate them, electricity which is increasingly clean, they produce multiple units of usable heat. Because of this, they require much less energy input for a similar heating outcome compared to combustion technologies, making them naturally cleaner and generally cost-effective to run.

Despite their cold climates, heat pumps hold a dominant market position in several Nordic countries (Norway, Sweden, Finland), where — in part because of previous energy price crises — they have been actively supported to efficiently provide heating and support the transition from fossil fuels. Outside of these Nordic countries, heat pumps typically make up a relatively small share of heating equipment sales relative to fossil fuel technologies, although markets are shifting. For global energy and climate goals to be achieved, heat pumps must rapidly become a dominant hot water and space heating technology worldwide.

About this toolkit

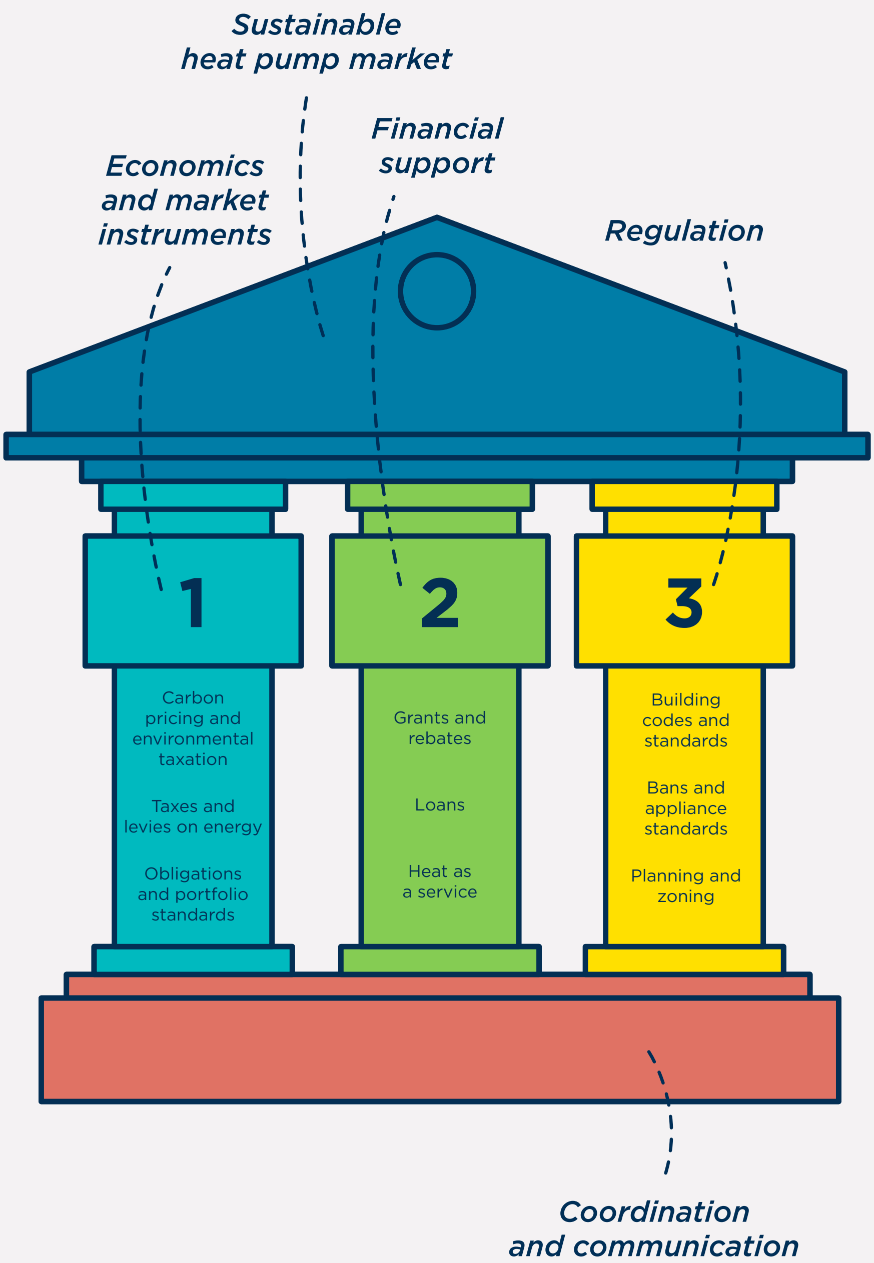
The aim of this toolkit is to equip policymakers and associated interests with a suite of policy and regulatory tools that can be used to promote heat pumps. It has been researched and written by a global team of experts from The Regulatory Assistance Project, Agora Energiewende, CLASP and the Global Buildings Performance Network.

The structure of the toolkit is loosely based on that of a Greek temple, with foundations and pillars, supporting a rapidly growing heat pump market. The temple image below is clickable and will take readers to relevant sections of the toolkit. Clicking on the video logo will take readers to short videos which give an overview of each element of the toolkit. Together, these videos make up a short series which complements this document.

The main focus of the toolkit is on heat pumps used by households for heating in buildings. However, some of the wider applications — for example in commercial buildings, industry and district heating, as well as for cooling — are also explored in the report.

Overview

This toolkit is not a review of every heat pump support policy in existence, but a synthesis of policy approaches to heat pump deployment and a guide to designing the best packages of policies. Our review highlights that single policies on their own are unlikely to drive heat pump deployment at the levels required by global decarbonisation goals, and therefore heat pump policy packages need to be implemented. The graphic below forms a basis for the toolkit structure, but a complete policy package needs to consider foundational elements and must also take account of each pillar. In the toolkit, we provide details of, examples of, potential issues with, and solutions to the various policy elements we discuss.



Clickable links in the above image will take readers to the relevant section of the paper and provide further detail on each of the policy elements, which we briefly describe below.

However, before going into the detail of the toolkit, we urge all policymakers and interested parties to consider the importance of equity and fairness in the transition to clean heat. While benefits for households and building owners may be great, the transition will require significant capital investment in heat pumps themselves and also in making buildings and heating systems suitable for their use. Efforts should be made to ensure that capital costs are affordable for all households, that switching to a heat pump leads to lower energy costs compared to fossil fuel alternatives, and that sufficient and suitable advice and support is made available to undertake the technology switch.

Foundational elements of this toolkit recognise the need for coordination and communication around heat pump policy efforts and strategies. Beyond the need to provide coordinated packages of policies, policymakers must also consider communication and engagement with citizens on the need for and details of the heat transition. The community of installers also needs to be prepared through communication and training. Finally, actors in the wider energy system, such as electricity distribution operators and energy suppliers, must be coordinated to provide a smooth and efficient journey for consumers.

Pillar 1 considers economic and market-based instruments. These instruments are fundamentally associated with balancing the economics of buying and operating heating appliances towards clean options, such as heat pumps, so that their lifetime costs are cheaper than fossil-based alternatives. We provide detail on three key economic and market elements: carbon and environmental taxation; taxes and levies on energy bills; and heat market mechanisms that change market conditions through obligations and portfolio standards on market actors, such as heating appliance manufacturers or energy retailers.

Pillar 2 considers financial support. Within this pillar, we identify three key elements of financial support for heat pumps: grants and tax rebates to provide subsidies to building owners; loans to provide additional capital support, if appropriate; and heat-as-a-service packages, financing models which eliminate the requirement for building owners to fully finance heat pumps up-front.

Pillar 3 considers regulations and standards. These are the rules and requirements that shape markets. We consider building codes and standards, appliance standards, and heat planning and zoning.

To build an effective heat pump policy package, policymakers must consider foundational elements as well as each of the pillars. And even within each pillar, combinations of elements may be appropriate.

While designing and delivering coordinated policy packages for heat pumps may be a complex task, it is a requirement of a rapid transition towards clean heating. The benefits of achieving the transition to clean heating are undoubtedly significant: primary energy demand can be reduced, air and climate emissions from heating eliminated, and reliance on fossil fuels phased out. We hope this toolkit provides some clarity for policymakers on how to achieve these goals.

1 Introduction

Governments around the world are recognising the value of heat pumps in replacing fossil fuel-based heating to reduce carbon emissions, air pollutants and exposure to fossil fuel markets.

This policy toolkit is a foundational guide for policymakers and advocates interested in learning how to achieve rapid and successful heat pump deployment. Experts in energy policy and markets, appliance regulation and sustainable buildings have contributed to its development. It starts by providing information on how heat pumps work and why they are important (Section 2), and the expected role of heat pumps in the future (Section 3).

Policymakers often favour technology-agnostic approaches. However, the required speed of energy system decarbonisation under global agreements and the fact that heat pumps have been repeatedly identified as a key clean heating solution which can be immediately scaled imply the need for targeted policy support. Clean and available alternative heating technologies are also limited.

Many countries offer targeted heat pump support. Some, particularly some Nordic countries, now have well-established heat pump markets. Considering historical best practice and using a review of global support policies for heat pumps, this toolkit provides policymakers with the best available guidance on how to design packages of policies which can drive rapid and sustainable heat pump deployment.

In Section 4, we consider a necessary focus on equity in delivering any heating transformation. In Section 5, we introduce our policy toolkit, the structure of which emphasises the need for foundational governance support alongside three policy pillars of 1) energy economics/market reform, 2) targeted financial support, and 3) regulation.

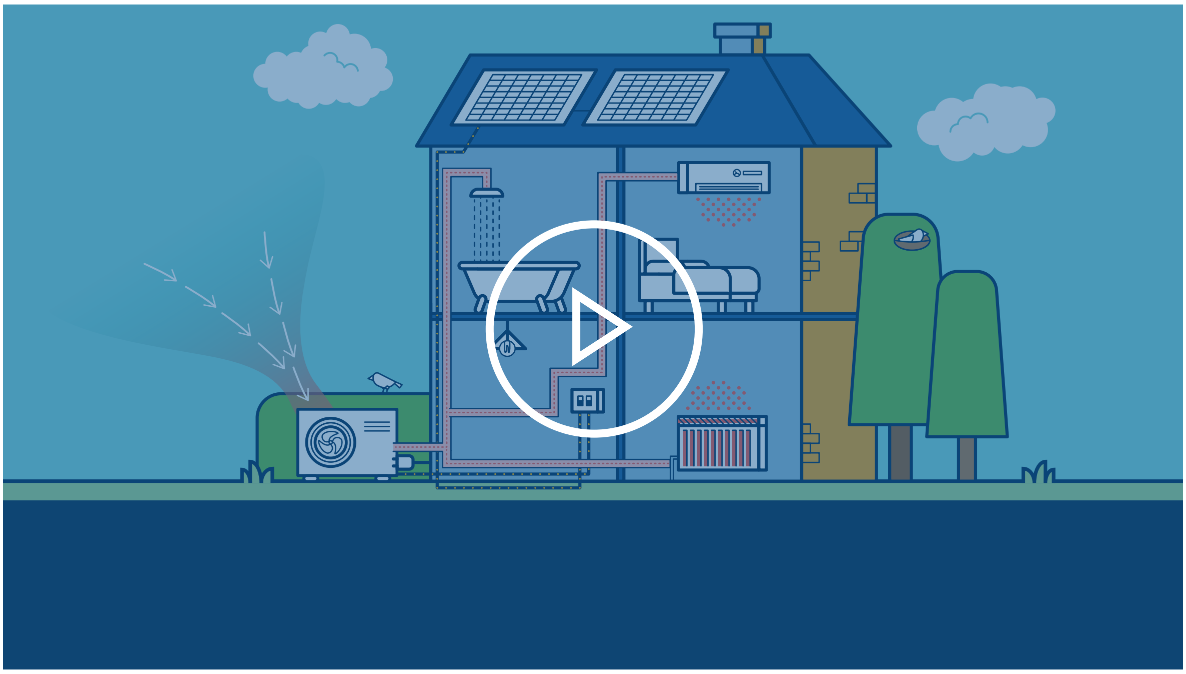
Often, countries have attempted to support heat pump markets using one single policy instrument, typically a subsidy programme. Our toolkit structure demonstrates the need for coordinated packages of policy which go beyond single instruments. Sections 6, 7, 8 and 9 expand on various elements of the toolkit, providing examples of these policy approaches, the benefits and potential issues associated with them, and key decisions policymakers may need to consider.

In Section 10, we introduce a number of country case studies — policy reviews based on our toolkit model, a new feature for version 2 of our toolkit. The toolkit is briefly summarised in Section 11, recognising that this area of policy and technology is rapidly innovating.

2 Heat pumps and their benefits

Heat pumps are a critical clean energy technology. This section considers how these devices work and why they are so important in a future energy system. A short video overview of this section can be accessed by clicking on the figure below.

Figure 1. A house with an air-source heat pump



Note: Click for a link to section summary video.

2.1 What are heat pumps?

Heat pumps are highly efficient appliances that extract ambient, renewable heat from the environment and deliver space and water heating in buildings or provide heat for industrial processes.

All types of heat pump use a vapour compression cycle to move ambient heat from cold (a lower-temperature source, such as the outside air) to hot (a higher-temperature application, such as a living room). As heat naturally flows in the opposite direction, from hot to cold, an external source of energy, usually electricity, is needed to power the devices.

Heat pumps use similar components to refrigerators and are very similar to air conditioning units. Indeed, reversible heat pumps provide both heating and cooling and are widely used in various building types. Such reversible units are better suited to heating systems which use blown air and ducting as the heating medium (common in the United States), rather than wet central heating systems that distribute heat using hot water through pipes and radiators (common in Europe). We expand on this topic in the upcoming box 'Air-blown or wet distribution systems'.

Heat pumps tap into heat from three main sources: ambient air, the ground, or water. Air-source heat pumps, whose external units resemble those used for the air-conditioning units ubiquitous in some parts of the world, extract heat from the outside air and convert it into useful hot indoor air or water. Ground-source heat pumps take heat from the earth using systems of pipes or deep boreholes. Less common water-source heat pumps can harness heat from water sources, such as the sea, rivers and lakes. Heat pumps can also tap into sources of heat that would otherwise be wasted, such as that in sewers and wastewater, thus increasing overall energy efficiency as the heat source is already at a higher temperature.

Left: Air-source heat pumps in situ (image courtesy of Joe Smyth). Right: A Slinky-style ground-source heat pump ground array (image courtesy of David Brooke). Images reprinted with permission.

While the amount of renewable heat which can be harnessed from the environment is vast and waste heat is available too, the temperature tends to be too low for immediate use. Once the environmental or waste heat is absorbed by a working fluid (refrigerant) — a substance which moves between a liquid and gaseous state — a compressor upgrades the heat to a useful temperature.

The relative efficiency of this process depends on the difference in temperature between the heat source and the intended output temperature, as well as on the technical characteristics of the heat pump. To produce higher output temperatures heat pumps need to work harder, and will therefore perform less efficiently in such situations. As such, an important difference between heat pumps and combustion-based heating technologies is that with heat pumps, the full heating system needs to be carefully designed to allow lower output temperatures to be used.

2.2 The benefits of heat pumps

Heat pumps are an extremely efficient way of providing heating and have multiple benefits compared to other heating technologies:[3]

Heat pumps can operate with (nearly) zero emissions

The ambient energy harnessed by the device is already renewable and, when powered by increasingly cheap, clean electricity, heat pumps can replace fossil fuels and provide (nearly) zero-emissions heat.

Heat pumps are the most energy-efficient technology available and can substantially reduce primary energy consumption

They produce three to five times more useful energy than they consume by extracting useful heat from the environment.[4] They can also use waste heat as an ambient heat source. Harnessing these 'free' resources can help to substantially reduce demand for fossil fuels, even in cases where the electricity driving the heat pumps is largely produced with fossil fuels.

Heat pumps are cost-efficient

Due to the energy savings that heat pumps provide, they can achieve running costs similar to or better than fossil fuel heating. Multiple national and international analyses show them as the critical, cost-effective technology for decarbonising heat.

Heat pumps can play an important role in cooling

Reversible heat pumps can produce heating and cooling in a single appliance.

Heat pumps can help to decarbonise heating networks and industrial processes

Large heat pumps can play a central role in providing low-carbon heating and cooling to district heating networks and low- to medium-temperature process heat to key industries such as food and beverages, paper and the chemicals sector.

Heat pumps can enable the use of more clean electricity

As well as increasing the demand for clean electricity, flexibly operating heat pumps can enable the cost-effective integration of variable renewable power sources, such as solar and wind.

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3 Lowes, R., Rosenow, J., Scott, D., Sunderland, L., Thomas, S., Graf, A. *et al.* (2022, March). *The perfect fit: Shaping the Fit for 55 package to drive a climate-compatible heat pump market.* Regulatory Assistance Project, Agora Energiewende, CLASP & GBPN. https://www.raponline.org/knowledge-center/the-perfect-fit-shaping-the-fit-for- 55-package-to-drive-a-climate-compatible-heat-pump-market/

4 Coefficient of performance (COP) is the ratio of useful heat output to electricity input. Seasonal COPs (SCOPs) refer to the seasonal or average performance. COP is analogous to the device's efficiency.

Air-blown or wet distribution systems

The heat from heat pumps is typically distributed around buildings by either hot water through pipes and then emitted via radiators and underfloor heating (wet systems), or is distributed by hot refrigerant through pipes and then warms the air directly with warm air being blown around a building (air-blown or forced air). Underfloor heating is not a requirement for any form of heat pumps.

In air-blown systems the air may be warmed centrally with warm air then ducted around the house, or the air may be warmed in a single room. Different types of heat pumps, for example ground or air source, can use either type of distribution system.

The presence of wet or air-blown systems varies geographically, and is often due to cultural and historical rather than technical reasons. In the United Kingdom and most of northern continental Europe, wet systems are widely used. In the United States, newer homes typically have air-blown systems rather than wet.[5] In most Nordic countries, air-blown systems are the most typical.[6]

A radiator and associated pipework in a wet central heating system. Image from Shutterstock.

5 U.S. Department of Energy. (n.d). *Heat Distribution Systems.* https://www.energy.gov/energysaver/heat-distribution-systems

6 Rosenow, J. (2023, 2 October). How heat pumps became a Nordic success story. *Carbon Brief.* https://www.carbonbrief.org/guest-post-how-heat-pumps-became-a-nordic-success-story/

Air-blown heat pumps can be relatively cheap to install, particularly if they are small capacity with a single internal unit (a system known as a mini-split), but they can offer a complete solution for large and/or multi-family dwellings (though these are more expensive). Air-blown systems typically don't provide hot water, so a separate solution (or an additional hot water heat pump) may be needed. Air-blown systems do offer one significant advantage over wet systems in that they can often be used for cooling as well as heating — that is, they are reversible. Demand for cooling is expected to grow as the global climate warms. Air-blown systems may also be better at quickly heating rooms and buildings which are infrequently occupied. Wet systems typically can only offer limited cooling, if any, owing to condensation risks; they can however typically produce hot water.

In work for policymakers in the UK, where cooling demand is small but growing, RAP pointed out that in addition to support for wet heat pump systems, government could offer support for air-blown systems — but this support would needed to be carefully managed, owing to the heterogeneity of air-to-air heat pumps and the fact that they can be much cheaper to install than air-to-water systems.[7] Air-to-air systems may also be very useful for small dwellings and flats, as RAP work for the Greater London Authority has shown (upcoming). In warmer countries, air-to-air heat pumps may have the most value, potentially offering a strong market pull towards heat pumps for people who want cooling which can be delivered from the same device as heating, as demonstrated by RAP's work in Spain.[8]

An air-to-air heat pump in a home. Image courtesy of CLASP.

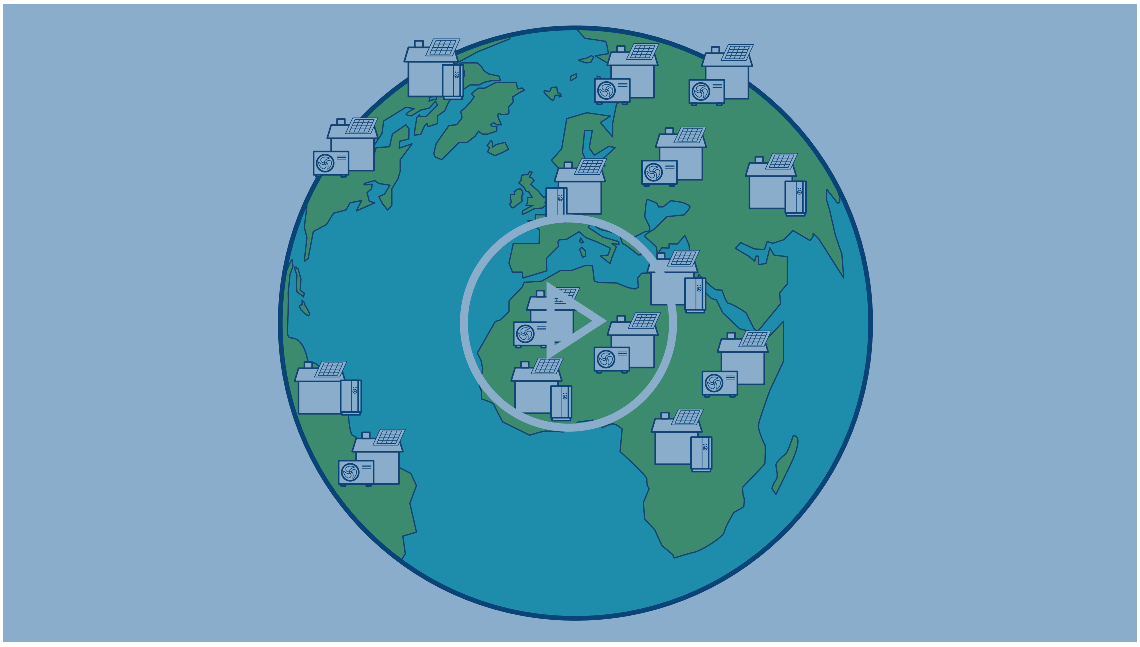
7 Lowes, R. (2023, November). *Blowing hot and cold: Reflecting the potential value of air-to-air heat pumps in UK energy policy.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/blowing-hot-and-cold-reflecting-the-potential-value-of-air-to-air-heat-pumps-in-uk-energy-policy/

8 Gibb, D. and Lowes, R. (2024, September). *Heat pumps for Spain: Reforming Spanish energy policy to support the transition to clean heating.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/heat-pumps-for-spain-reforming-spanish-energy-policy-to-support-the-transition-to-clean-heating/

3 The role of heat pumps in a clean energy system

Heat pumps have been repeatedly identified as a key alternative to heating with fossil fuels. Adopting them will help countries achieve goals relating to climate change mitigation and sustainable development, and reduce exposure to fossil fuels. This section explains the scale and pace needed for heat pump deployment and considers what factors have led to early progress in certain countries. A short video summarising this section can be accessed by clicking on the image below.

Figure 2. Heat pumps are expected to be a vital clean-heating technology around the world



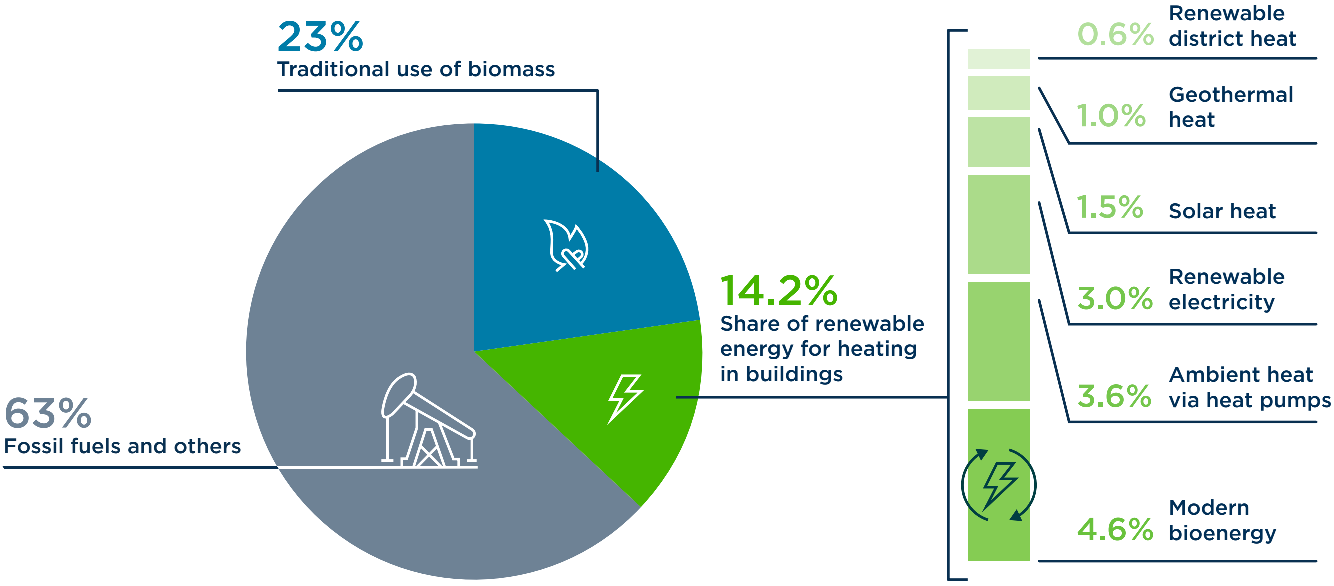
Note: Click for a link to section summary video.

Overall, heating and cooling currently make up around half of global final energy demand. This is roughly equally divided between energy consumption in industrial processes on the one hand, and residential and commercial buildings on the other.[9]

9 Irena, IEA and REN21. (2020, November). *Renewable Energy Policies in a Time of Transition: Heating and Cooling.* https://www.irena.org/Publications/2020/Nov/Renewable-Energy-Policies-in-a-Time-of-Transition-Heating-and-Cooling

In buildings, space and water heating accounted for 4.2 Gt CO_2 annually (11% of global energy-related emissions) in 2022, comprising 2.4 Gt CO_2 in direct emissions from fossil fuel consumption and 1.7 Gt CO2 in indirect emissions from the production of electricity and heat used in buildings.[10] As shown in Figure 3, fossil fuels still make up 63% of global energy-use for buildings-related heating.[11]

Figure 3. Energy consumption for heating in buildings, by source, 2021



Source: REN21. (2023). *Renewables 2023 Global Status Report: Buildings in Focus.*

To achieve a decarbonised energy system, gas, coal and oil heating must be completely phased out. In locations with exposure to increasingly volatile fossil fuel imports, such as Europe, energy security concerns have added extra impetus to plans to decarbonise heating and shift away from fossil fuels.

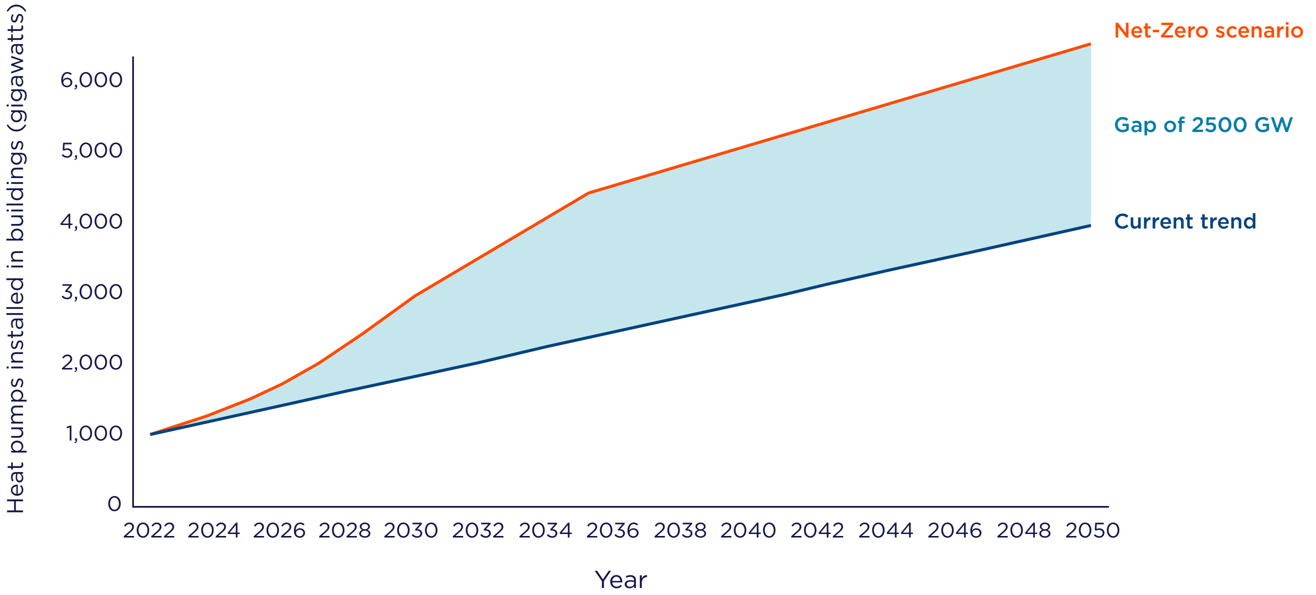
The International Energy Agency (IEA) sees the global installation of heat pumps tripling from around 1,000 GW in 2022 to 3,000 GW in 2030, more than doubling again to 6,500 GW in 2050. This pace until 2030 corresponds to a compound growth rate of around 15% per year. However, in recent years heat pumps installation numbers have grown at around 11% per year, well below the rate needed, resulting in an anticipated gap of 2,500 GW by 2050, shown in Figure 4.[12] If this gap grows it will become increasingly difficult to close, demonstrating the need for early action.

10 IEA. (n.d.). *Heating*. https://www.iea.org/energy-system/buildings/heating

11 REN21. (2023a). *Renewables 2023 Global Status Report: Buildings in Focus.* https://www.ren21.net/gsr-2023/modules/energy_demand/01_buildings_in_focus/

12 IEA. (2023, September). *Space heating. Net Zero Roadmap.* https://www.iea.org/reports/space-heating

Figure 4. Heat pumps are expected to be a vital clean-heating technology around the world, but a deployment gap remains



RAP figure based on: IEA. (2023, September). *Space heating. Net Zero Roadmap.*

While heat pumps are widely available and have been a common technology for heating and cooling for decades, they represent only a small share of the global heating market. In 2021, heat pumps accounted for around 10% of global heating equipment sales, compared to a 45% market share for fossil fuel equipment.[13] Similarly, the IEA estimates that heat pumps met around 12% of global space heating needs in buildings in 2022, with more than 1,000 GW of capacity in operation for space (and/or water) heating.[14]

Multiple analyses at international, national, regional and local levels have pointed to the importance of heat pumps in clean energy systems. As shown below in Figure 5, the IEA's *Net Zero Emissions by 2050* (NZE) scenario, aligned with limiting global temperature rises to 1.5°C, sees a combination of energy efficiency and electrification as key to eliminating emissions from buildings. In this scenario, heat pumps become the dominant global heating technology by 2030, with continued expansion of their share up to 2050.[15] Figure 5 shows that while global floor area grows significantly by 2050,[16] the energy demand for heating (and cooling) can be limited by energy efficiency retrofits and the rollout of heat pumps in existing buildings, alongside ensuring that new buildings are zero carbon with clean heating systems, like heat pumps, from the outset.

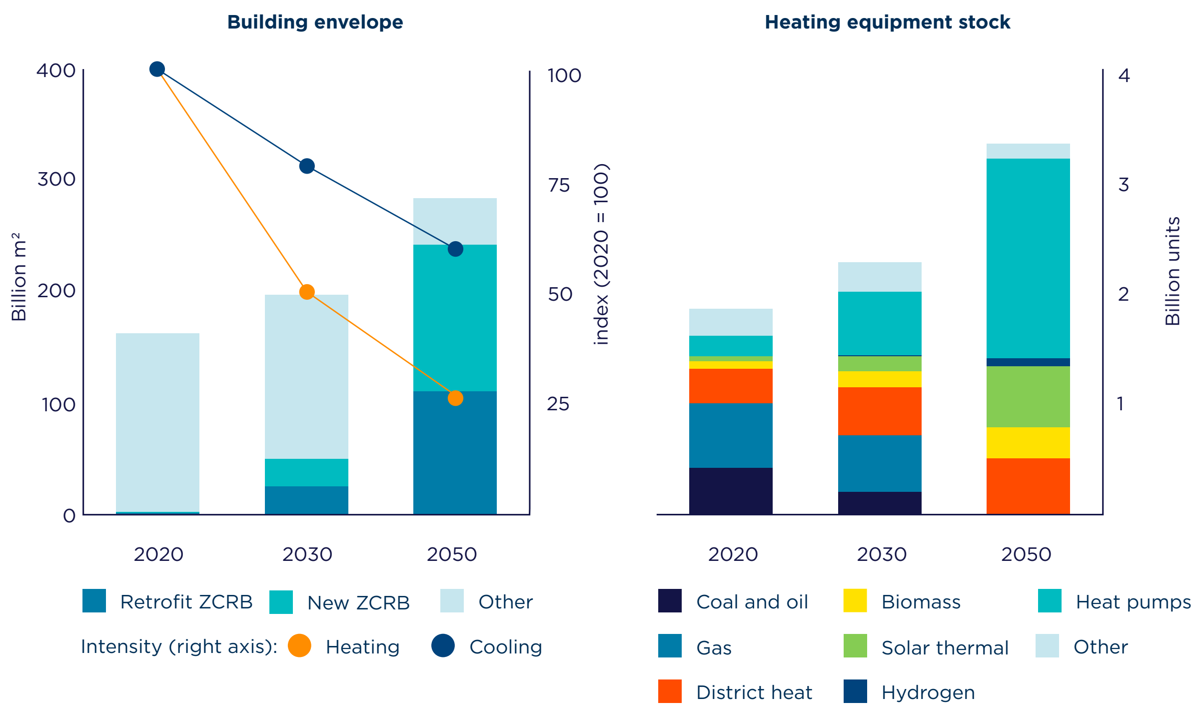
13 Ren21. (2023b). Heatpumps. In: *Renewables 2023 Global Status Report.* https://www.ren21.net/gsr-2023/modules/energy_supply/02_market_developments/03_heatpumps/

14 IEA, 2023.

15 IEA. (2021, May). *Net Zero by 2050: A Roadmap for the Global Energy Sector.* https://www.iea.org/reports/net-zero-by-2050

16 IEA, 2021.

Figure 5. Global building and heating equipment stock by type; and useful space-heating and cooling-demand intensity changes in the NZE report



Source: IEA. (2021, May). *Net Zero by 2050: A Roadmap for the Global Energy Sector.* Note: 'ZCRB' is zero carbon ready buildings; some district heating will be based around large heat pumps.

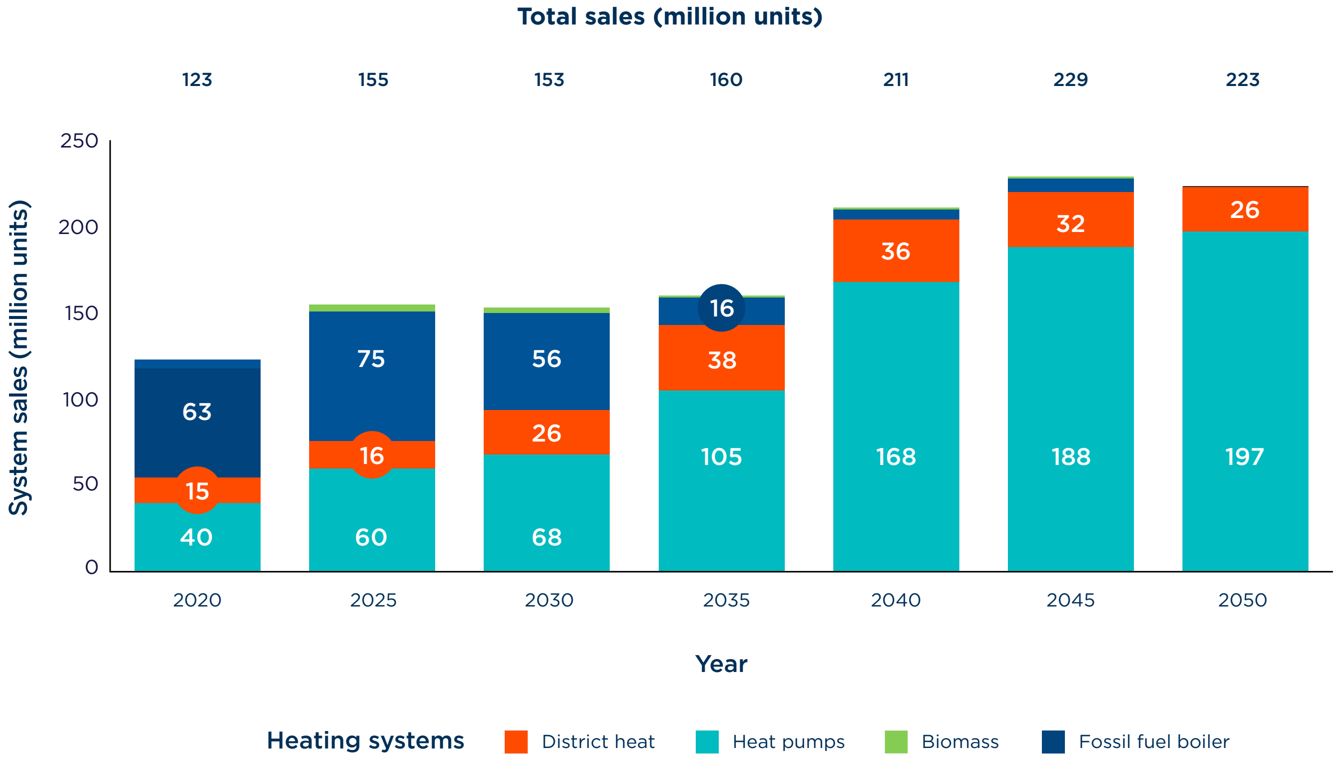
The IEA's pathway requires rapid increases in heat-pump deployment over the coming decade. The share of space heating demand met by heat pumps will need to increase from the current level of 12% globally in 2022 to 25% in 2030 and 55% in 2050. As a result, the capacity of heat pumps installed in buildings will also need to rise from 1,000 GW in 2022 to 3,000 GW in 2030 and 6,500 GW in 2050.This requires global installations of heat pumps to surge from 1.5 million units per month to 5 million per month by 2030.[17]

A similar trajectory for heat pumps is shown in analysis by consultancy McKinsey & Company (Figure 6).[18] Under this trajectory, by 2030, heat pump sales increase by 70% from 2020 levels to become the dominant heating appliance type sold.

17 IEA, 2021.

18 McKinsey Global Institute. (2022). *The net-zero transition: What it would cost, what it could bring.* https://www.mckinsey.com/capabilities/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring

Figure 6. Global heating system sales under net-zero transition scenario



Source: McKinsey Global Institute. (2022, January). *The net-zero transition: What it would cost, what it could bring.*

Despite the importance of heat pumps, the IEA classifies their global status in terms of international energy and climate goals as 'more efforts needed'.[19] As we have shown already in Figure 4, while heat pump installations are increasing,[20] a step change is needed for deployment rates to be aligned with those in the IEA's NZE scenario.

Heat pumps come in many shapes and sizes, and the box below explains how large heat pumps, beyond a single building scale, are also expected to help with building and industrial decarbonisation.

19 Delmastro, 2022b.

20 Rosenow, J., Gibb, D., Nowak, T. and Lowes, R. (2022a, September). Heating up the global heat pump market. *Nature Energy 7,* 901–904. https://doi.org/10.1038/s41560-022-01104-8

Large-scale heat pumps

Next to residential heating, heat pumps also offer efficient pathways towards decarbonizing district heating and industrial process heat. With coal and fossil gas being the primary fuels in the global energy mix for both district heating[21] and industry,[22] large-scale heat pumps constitute one of the main levers for decreasing emissions in these sectors. Large-scale heat pumps apply the same thermodynamic principle as heat pumps used for residential heating. However, they are much bigger in their heating capacities and dimensions. Furthermore, more options are available regarding potential heat sources including air, near surface and deep geothermal energy, waste heat from industry, sewage treatment plants and data centers, the sea and rivers.[23]

Large-scale heat pumps have the potential to provide heat for district heating and a large share of industrial heat demand. For example, a study on Germany has shown that heat pumps could entirely cover the heat demand below 200 degrees — that covers the entire heating demand needed for buildings as well as a large part of industrial process heat. For industry, large-scale heat pumps could be especially important for sectors such as food, paper, or textiles, where a large part of the process heat demand is below 200 degrees[24] as well as the chemicals sector.

Currently, the role of large-scale heat pumps remains marginal with large projects only starting to take off in most countries. Notable exceptions are Norway and Sweden where large-scale heat pumps already hold a 13% and 8% share, respectively, of the respective national energy mix for district heating.

Internal image of Bristol Castle Park heat pump. Image courtesy of Star Renewables.

21 IEA. (2022a). *District heating.* https://www.iea.org/energy-system/buildings/district-heating.

22 IEA. (2022b). *Industry.* https://www.iea.org/energy-system/industry.

23 Ahrendts, F., Drechsler, B., Hendricks, J., Küpper, J., Lang, S., Peil, T., Scholz, D., et al. (2023, December): *The roll-out of large-scale heat pumps in Germany. Strategies for the market ramp-up in district heating and industry.* Agora Energiewende and Fraunhofer IEG. https://www.agora-energiewende.org/publications/the-roll-out-of-large-scale-heat-pumps-in-germany.

24 Münnich, P., Metz, J., Hauser, P., Kohn, A., Mühlpointner, T. (2022, November): *Power-2-Heat: Gas savings and emissions reduction in industry.* Agora Industry and FutureCamp. https://www.agora-industry.org/publications/power-2-heat-1.

The capacity of large-scale heat pumps in current projects typically reach up to 20 MW per heat pump in both district heating and industry. The largest heat pump project in the world is in Hammarbyverket, Sweden. The installation has multiple units with 225MW thermal capacity. However, even larger capacities are planned for some future projects. For example a project in Hamburg (Germany) is planning to use two river-source heat pumps with a combined capacity of 230 MW.[25]

Key barriers to the deployment of large-scale heat pumps are similar to those for the residential heat pump market with high investment costs and unfavorable energy price ratios often representing key economic barriers to their roll-out. As a response, some national governments have started support schemes covering investment costs, or even operational expenditures in the case of the Netherlands and Germany.

Integration of large-scale heat pumps with an increasing renewable electricity system through flexible use constitutes an important lever for the cost-effective roll-out of large-scale heat pumps; they can significantly contribute to electricity system flexibility when combined with thermal storage and incentivized to provide system-friendly operation via dynamic pricing.

Queen's Quay 5.2MW water source heat pump, Glasgow, Scotland. Image courtesy of Star Renewables.

25 City of Hamburg. (2022, 17 June). *Energie aus Bille und Elbe durch Flusswärmepumpen* [Press release]. https://www.hamburg.de/politik-und-verwaltung/behoerden/bukea/aktuelles/pressemeldungen/2022-06-17-bukea-energiepark-tiefstack-kohleausstieg-233720.

Government policies and regulation undoubtedly have a role in driving the global heat pump market, as evidenced by countries which have already successfully deployed heat pumps at scale. As such, before getting into the detail of the toolkit, historical experiences of successful heat pump deployment are briefly considered in the box below. The toolkit is, however, built on a much wider base of heat pump policy experience.

3.1 Learning from countries with significant heat pump deployment

Some of the Nordic countries — specifically Norway, Sweden and Finland — have been successful in deploying heat pump policy strategies and have the highest heat-pump penetrations globally. However, achieving this transition required a range of policy reforms and supporting measures.

Previous rapid heating transitions have relied on carefully managed policies and governance.[26] Policy stability has also been key for continued market growth. Studies[27] of the policy frameworks in Norway, Sweden and Denmark indicate that packages of policies are needed to deliver heat pumps, rather than single measures. Such packages should include:

- Measures to support consumer confidence, including cross-sector heat pump associations, promotional campaigns and message boards where users can share advice and experience.
- A direct focus on skills and consumer awareness, including technical standards and skills.
- Financial support and economic measures that include grants, tax breaks and carbon taxes, when renewable alternatives are available, accessible and affordable.
- A role for regulation of appliances, fossil fuel appliance sale end-dates, and shared pathways/visions.

An air source heat pump during a cold spell. Courtesy of IMS Heat Pumps.

26 Sovacool, B. and Martiskainen, M. (2020, April). Hot transformations: Governing rapid and deep household heating transitions in China, Denmark, Finland and the United Kingdom. *Energy Policy 139,* 111330. https://doi.org/10.1016/j.enpol.2020.111330.

27 Hanna, R., Parrish, B. and Gross, R. (2016, May). *UKERC Technology and Policy Assessment — Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply.* UKERC. https://ukerc.ac.uk/publications/best-practice-in-heat-decarbonisation-policy-a-review-of-the-international-experience-of-policies-to-promote-the-uptake-of-low-carbon-heat-supply/

4 An equitable toolkit

Ensuring an equitable transition to clean energy should be an overarching strategic concern for policymakers.[28] Such a transition can protect those with the lowest incomes, who are spending the greatest share of their incomes on energy and who are most likely to be struggling to pay for energy.

Heating and cooling are essential to human health and wellbeing, and it is vital that these services are accessible and affordable to everyone. Heat pumps, as the most efficient technologies for providing active heating and cooling, and therefore with some of the lowest running costs, will play a key role in delivering clean energy affordably.

Policies can be designed to specifically alleviate energy cost concerns and ensure access to clean energy. Principles of equity are laced throughout this toolkit. However, the key equity issues associated with heat pumps — which are capital and running costs, and access — are discussed below. It is also important for policymakers to recognise that those on lower incomes are more likely to live in multi-family buildings; specific heat pump policy and regulatory reform is likely to be required to drive heat pump uptake in such buildings.

Equitably designed heating transition policy has the potential to accelerate the deployment of heat pumps, encouraging individuals to act.

Image from Shutterstock.

28 Carley, S. and Konisky, D.M. (2020, June). The justice and equity implications of the clean energy transition. *Nature Energy 5*, 569–577. https://doi.org/10.1038/s41560-020-0641-6

4.1 Affordability

Overall, ensuring that heat pumps are affordable is key for an equitable, and therefore timely, heat transition.

Although in many jurisdictions heating using fossil fuels, particularly gas and unsustainable biomass, has been cheaper to date, there is growing evidence that remaining reliant on combustion technologies poses risks beyond climate change. For example, the fossil fuel price crisis in Europe earlier this decade illustrated the volatility of international fossil fuel prices and supply.

Proper accounting of the external and environmental costs increases the price of carbon-intensive fuels. Furthermore, as national transitions away from fossil fuels progress, the costs of the infrastructure, in particular gas grids, are shared between fewer users and over shorter lifetimes, meaning costs may rise for consumers.[29] Therefore, there are risks if heating transitions are not fully inclusive and do not prioritise the needs of marginalised and lower-income communities.

Heat pump affordability for all is vital. Affordability consists of two elements: upfront costs and running costs.

Managing upfront costs

Heat pumps and additional building decarbonisation efforts, such as fabric efficiency, generally require relatively large upfront investments that provide long-term benefits and gradual paybacks.

The cost of a first-time switch to a heat pump from a fossil fuel-based heating system in an existing building will nearly always be more than the cost of a like-for-like replacement of an existing system.[30] Many of these additional costs are to prepare the heating system itself; they may include:

- The heat pump unit and its controller
- A new hot-water cylinder (tank)/instant hot water source or standalone hot-water heat pump, if needed
- Drilling of boreholes, digging of trenches and laying of pipes for ground- or water-source heat pumps
- Electrical system upgrades
- Higher-output radiators, or other internal units suitable for lower-temperature heat pump heating
- Pipework or ductwork upgrades which may be required for lower-flow temperatures or refrigerant
- Removal of gas connection or gas/fuel tanks
- 'Making good' and decorating following installation works

Cost-effective energy efficiency upgrades may also help maximise heat-pump performance and reduce running costs, but these may also carry significant upfront costs. Fabric efficiency measures and costs associated with heating system upgrades, however, are one-time costs, and the benefits continue for the lifetimes of the devices and the efficiency measures in place.

Decarbonising heating therefore requires a policy focus on equitably providing funding and finance where it is needed and in an appropriate and accessible form. This could include 100% funding for the lowest-income households. Funding programmes also need to be designed with inclusive access or priority access for target groups in mind. This can include sustainable long-term budgets, pre-financing, streamlined

29 Example of gas grid issues: Rosenow, J., Lowes, R. and Kemfert, C. (2024, July). *The elephant in the room: How do we regulate gas transportation infrastructure as gas demand declines?* One Earth. https://doi.org/10.1016/j.oneear.2024.05.022

30 Lowes et al., 2022.

application and administrative processes, and integration with technical support and advice.[31]

Managing ongoing costs

The main ongoing cost for heat pumps is the electricity they use. The energy demands of heat pumps, typically around one unit of electricity for three units of heat, means they are extremely efficient and require much less input energy than combustion technologies.

While heat pumps consume less input energy, electricity is nearly always more expensive than fossil fuels on an energy basis (e.g. per kWh or BTU). Although running costs for heat pumps can be similar to or even lower than fossil fuel systems, this isn't always the case, and the pricing issue requires careful consideration by policymakers.[32] Over time, heat pump running costs are expected to become lower than alternatives as the cost of renewable electricity falls.[33]

To encourage the uptake of heat pumps, governments should ensure that a switch will result in lower energy bills or higher levels of comfort for similar cost, particularly for lower-income households. While this issue is considered later in the toolkit from a heat-pump deployment perspective, the central role of equity in the heating transition brings to light some strategies to manage ongoing costs.

The first strategy to ensure lower energy bills after switching to clean heating is to reduce the overall heating demand of a building. In Ireland, heat pump grants are subject to strict minimum energy efficiency building requirements. This policy is intended to protect energy users,[34] and generous energy efficiency grants are offered alongside support for installing a heat pump.[35] Policy support for energy efficiency measures should be available, and low-income householders — who disproportionately live in homes with poorer energy efficiency — should be provided with greater support for fabric energy efficiency measures. The ability of the home to hold heat or stay cool for longer can also unlock the potential to choose times of the day when electricity is cheaper, and to turn the heat pump up or down to benefit from these prices (see Section 7.3) as a further strategy to reduce running costs.

The second strategy is to ensure that heat pump running costs are always lower than those for fossil fuel heating. As of 2022, electricity in many countries is taxed more heavily than fossil fuels and often has various levies applied to it. Moving some or all of these taxes and levies away from electricity could lead to a more equitable outcome, in which heating with a heat pump reduces bills.[36] Combining heat pump deployment with other forms of local, low-cost renewable electricity — via, for example energy sharing, small-scale PV and storage — are further cost reduction strategies being explored.[37]

31 Sunderland, L. and Gibb, D. (2022, December). *Taking the burn out of heating for low-income households.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/taking-burn-out-of-heating-low-income-households/

32 For example, the annual cost of operating a heat pump in the Netherlands was estimated at 4% cheaper than a gas boiler following an increase and decrease in energy taxes on natural gas and electricity respectively. See Chapter 7 and the following source: Rosenow, J., Thomas, S., Gibb, D., Baetens, R., De Brouwer, A. and Cornillie, J. (2022b, July). *Levelling the playing field: Aligning heating energy taxes and levies in Europe with climate goals.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/aligning-heating-energy-taxes-levies-europe-climate-goals/

33 BEUC. (2021, November). *Goodbye gas: why your next boiler should be a heat pump.* https://www.beuc.eu/reports/goodbye-gas-why-your-next-boiler-should-be-heat-pump

34 Sustainable Energy Authority of Ireland (SEAI). (2024). *Technical Assessment Process for Heat Pump System Grants. Version 1.6.* https://www.seai.ie/publications/Technical_Advisor_Role.pdf

35 SEAI. (n.d.). *Insulation grants.* https://www.seai.ie/grants/home-energy-grants/insulation-grants/

36 Rosenow et al., 2022b.

37 Yule-Bennett, S. and Sunderland, L. (2024, January). *Flex-ability for all: Pursuing socially inclusive demand-side flexibility in Europe.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/flex-ability-for-all-pursuing-socially-inclusive-demand-side-flexibility-europe/

Finally, because the performance of heat pumps is so important for running costs, policy should attempt to ensure high levels of heat pump performance, something which can be achieved via appliance and installation standards and suitable advice to users. We discuss this issue in our upcoming sub-section on skills, in Chapter 7.

4.2 Accessibility and capacity building

Uptake of heat pumps in the Global North is fast on the rise, with evident benefits in space heating. In the Global South, use of heat pumps continues to grow for both space heating and water heating, but at a slower rate.[38]

While costs remain a key factor, other factors that impact the accessibility of heat pumps in the Global South include the need to import equipment and limited access to the necessary expertise for installation. It is important that national policymakers and international advocates consider these elements to ensure a wider deployment of heat pumps globally.

Consideration of enabling factors like import subsidies, support for local manufacturing, and training of local experts would address some of these issues.

An air source heat pump being installed. Courtesy Cotswold Energy Group.

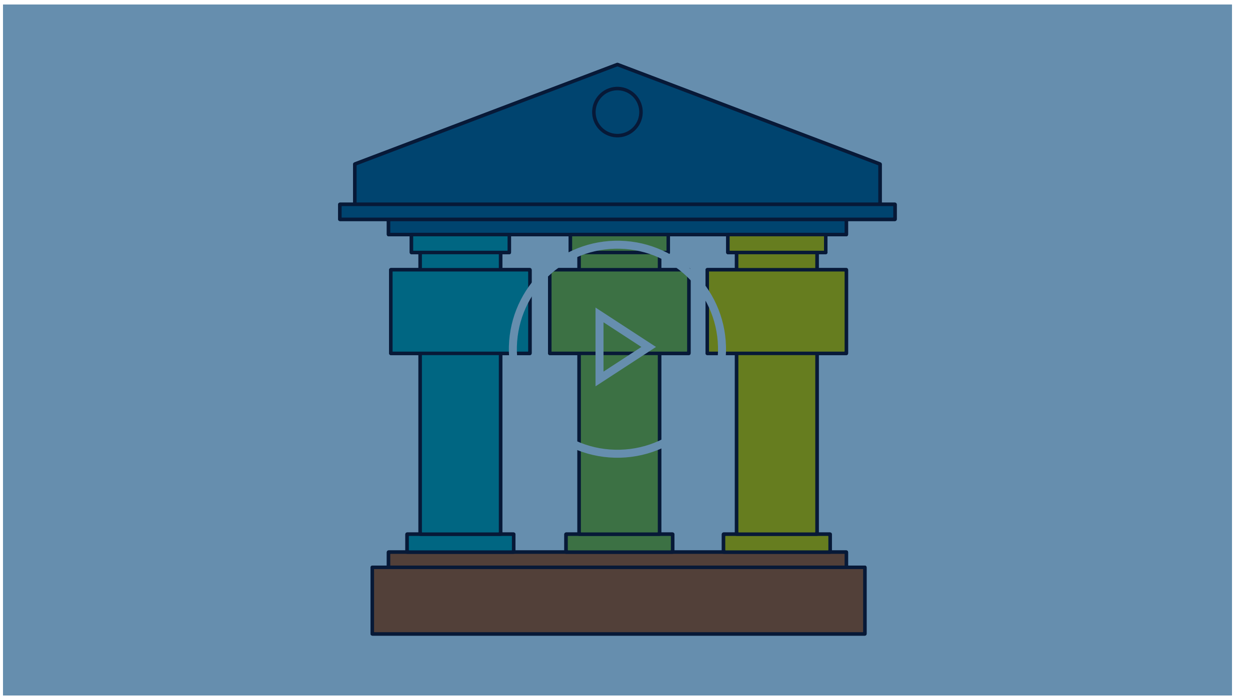
38 IEA. (2024a, July). *Heat pump sales by country or region, 2019-2023.*https://www.iea.org/data-and-statistics/charts/heat-pump-sales-by-country-or-region-2019-2023

5 Toolkit design

This document is primarily a toolkit to support policymakers looking to rapidly and sustainably deploy heat pumps in buildings. In the same way that there are many ways to build a new home, there are multiple policy tools to drive heat pump markets. For optimal and rapid deployment, different combinations of measures are needed to deliver strong and eventually self-sustaining markets.

We base our toolkit on one of the world's most iconic buildings: the Greek temple. The temple metaphor allows us to conceptualise an ideal heat pump policy framework. A video introduction to the toolkit can be found by clicking on this link or the image below:

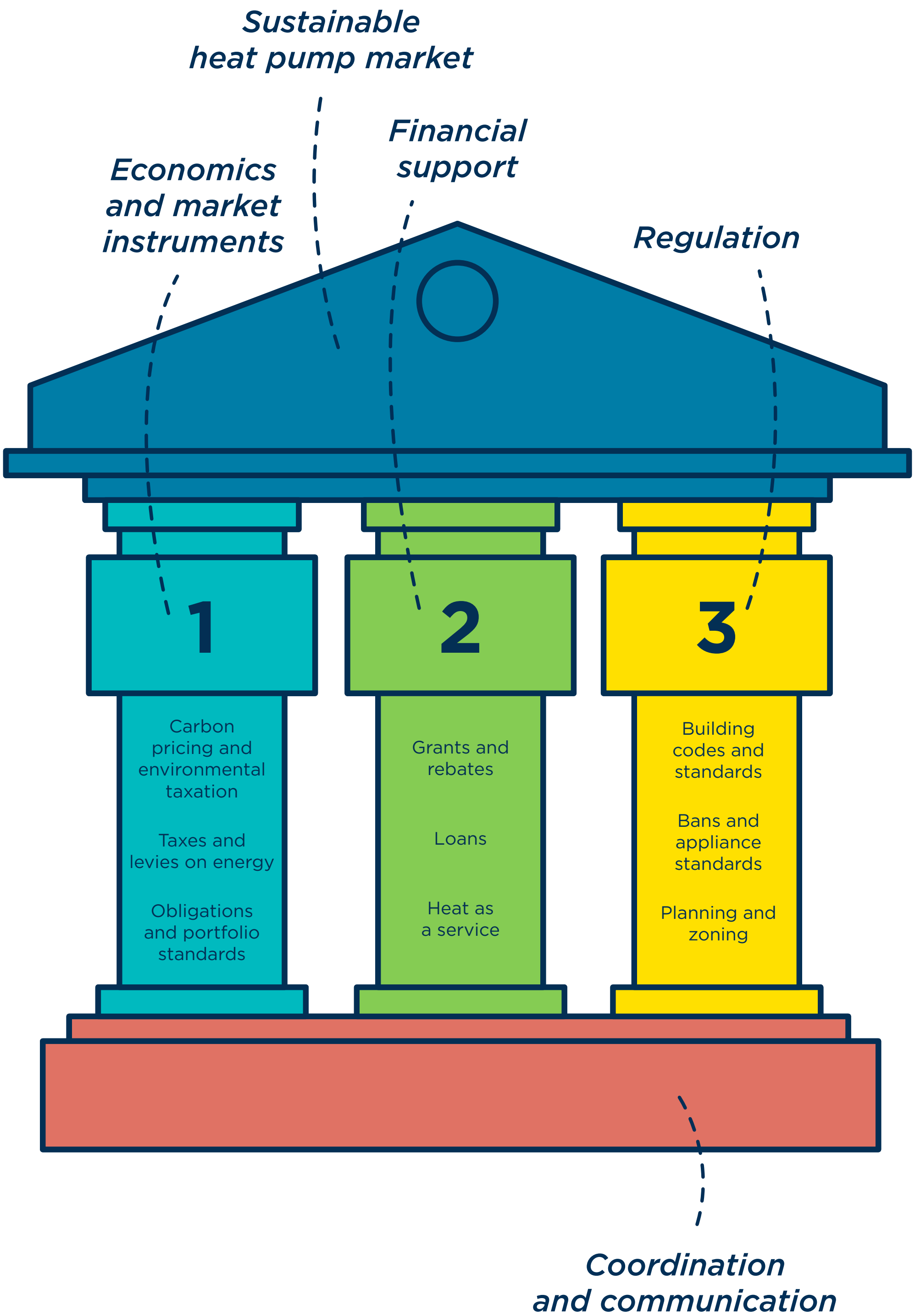
Figure 7. The role of government policy for heat pumps



The toolkit is composed of two main elements, as shown in Figure 8:

1. A strong foundation represents the communication and coordination needed to organise policy, regulation and stakeholders to govern a rapidly growing heat pump market.
2. Pillars are needed to hold up the temple roof — the heat pump market. The temple has three pillars, and they are all needed to support the heat pump market.

Figure 8. The Heat Pump Policy Toolkit framework



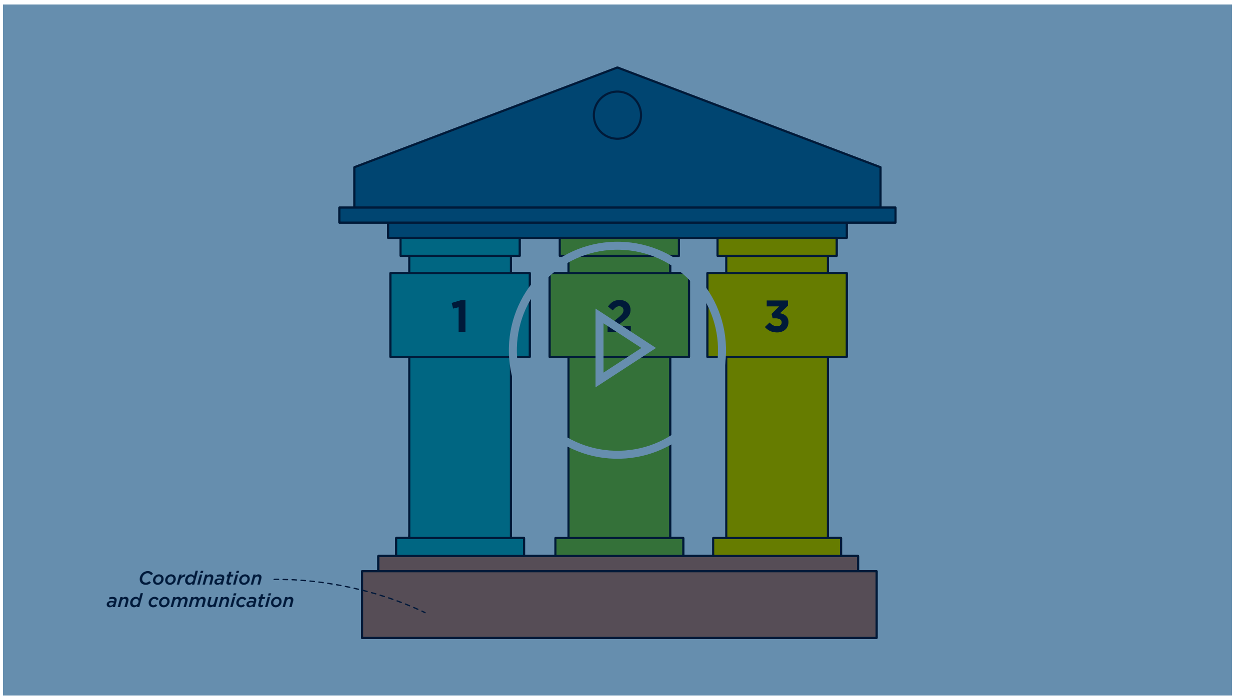
Each pillar represents a particular category of policy and contains various policy options. For a successful heat pump programme, strong foundations are required, as well as at least one element from each of the pillars. Ideally all elements of each pillar should be considered.

The remainder of this document provides details of each of the policy elements which have value for heat pump deployment. The document can be navigated by clicking on the relevant area of our temple, which also contains links to video overviews. The toolkit can also be read as a normal document.

6 Foundations: Coordination and communication

Deploying heat pumps at the required speed will not be achieved by the market alone, due to many overlapping barriers. Instead, a coordinated policy effort is needed to overcome the barriers and transform the market such that heat pumps can smoothly and cost-effectively replace fossil fuel heating. Figure 9 below provides a link to a video overview of this section.

Figure 9. Policy toolkit foundations



Note: Click for a link to section summary video.

High upfront equipment costs are one barrier, but others include the ubiquity of gas distribution networks, a lack of familiarity with heat pumps, consumer 'hassle factors,' and the complexity associated with multi-occupancy buildings. A single policy change will not address enough of the barriers to allow large-scale deployment.

Market transformation programmes have played an important role in accelerating the development and adoption of highly efficient technologies. They have been implemented by governments, international development agencies, utilities and even private companies, and have used a range of policies including research and development funding, incentives, bulk procurement, financing, information, and energy pricing.

The key is that the policies are coordinated. In China, for example, financial support was paired with regulation. A subsidy programme ran from 2009 through 2018 for variable-speed room air conditioners (which were reversible and so could alternatively be called mini-split heat pumps). Units that met China Energy Label's level 1 or 2 (highest level) received the subsidy. Partially due to this subsidy programme, the efficiency of air conditioners available in the Chinese market increased over this period, such that a revised efficiency standard could be adopted in 2020, locking in the efficiency gains and eliminating the need for continued subsidies.[39,40] An earlier market transformation involved the widespread deployment of solar-thermal water and space heating and included the coordination of industrial research with requirements at the local and national levels.

Further examples of successful coordination strategies can be found in many parts of the world. One review of successful heat pump deployments in Sweden and Switzerland found that 'The programmes in both countries should not be seen in terms of individual policy instruments but rather as strategic and coordinated programmes to re-ignite the market.' The programmes included voluntary labels, mandatory standards, and subsidies. In addition to those mechanisms on the demand side, the programmes strengthened the supply side ('manufacturers, retailers, driller and installation suppliers, research organizations, authorities, certifying bodies and test institutes') through research and development and shared learning.[41]

Several examples of policy mixes are included in Table 1.

An air source heat pump being installed. Courtesy Cotswold Energy Group.

39 Li, J., Yu, Y. and Zeng, S. (2016, February). *2014 Market Analysis of China Energy Efficient Products (MACEEP) (Version 1.1).* CLASP. https://storage.googleapis.com/clasp-siteattachments/2014_11_Market_Analysis_of_China_Energy_ Efficient_Appliances_2014_Final.pdf

40 IEA. (2020, updated 2024, July). *Minimum allowable values of the energy efficiency and energy efficiency grades for room air conditioner.* https://www.iea.org/policies/2395-gb21455-2013-the-minimum-allowable-values-of-the-energy-efficiency-and-energy-efficiency-grades-for-variable-speed-room-air-conditioners

41 Kiss, B., Neij, L. and Jakob, M. (2013, December). Heat pumps: A comparative assessment of innovation and diffusion policies in Sweden and Switzerland. *Energy Technology Innovation: Learning from Historical Successes and Failures.* Cambridge University Press.118-132 doi.org/10.1017/CBO9781139150880.013

Table 1. Policies included in countries' heat pump market transformation efforts

Country	Coordination	Communications	Training	Economic and market	Financial support	Regulations
China[42,43]	Inter-agency collaboration and intergov-ernmental collaboration	Public recognition of need by central government		Trials of heat pumps and a flexible resource for demand response	Subsidies	Minimum energy performance standard (MEPS)
Switzerland[44]	Conferences	Exhibitions	Installer training, driller quality label	CO2 tax on heating fuels	Subsidies	Non-renewabl e standard, labelling
Sweden[45,46]	Expert groups	Public demonstrations, information, and advice	Training of installers	Increased tax on oil, high carbon tax	Subsidies and loans	Labelling
Denmark[47]	Promotion	Advice from central government	Quality assurance for installers	Reduced taxation of electricity used for heating and a carbon tax	Subsidies	Electric resistance and oil ban
Finland[48,49]	Wide ranging recognition and support	Messaging boards to improve consumer confidence		Increased fossil fuel taxation	Subsidies, tax deductions	Building codes account for carbon intensity of heat

Beyond general coordination, the following toolkit subsections consider key foundational elements of heat pump deployment: citizen communication, communication with and coordination of the heating workforce, utility-level integration, and support for heat pump manufacturing.

42 Li et al., 2016.

43 IEA, 2020, updated 2024.

44 Kiss et al., 2013.

45 Kiss et al., 2013.

46 Lopes, C. (2018, 4 October). *Heat pumps in Sweden: Factors behind the market developments* [Presentation]. Swedish Energy Agency. https://heatpumpingtechnologies.org/wp-content/uploads/2019/05/sead-poex-heat-pumps-in-sweden-carlos-lopes-2018-10-04-final.pptx

47 Hanna, R. (n.d.). *What works?: Systematic review of heat policy options relevant to the UK context* [Presentation]. Imperial College London & UKERC. https://iea.blob.core.windows.net/assets/imports/events/213/Hanna_ImperialCollege.pdf.

48 Hannon, M. J. (2015, October). Raising the temperature of the UK heat pump market: Learning lessons from Finland. *Energy Policy 85*, 369–375. https://doi.org/10.1016/j.enpol.2015.06.016

49 Rapid Transition Alliance. (2021, May). *The jump to pumps: how Finland found an answer to heating homes.* https://www.rapidtransition.org/stories/peer-to-peer-support-and-rapid-transitions-how-finland-found-an-answer-to-heating-homes/

6.1 Citizen communication

Financial and regulatory policies play an important role in accelerating technology development, but without a developed communication strategy these efforts will not reach their full potential. Robust consumer awareness and confidence efforts will be critical in successfully accelerating heat pump deployment in regional markets.

The following sections provide a range of communication activities proven through practice or research to be important in heat pump deployment efforts. The examples below draw on case studies and research into successful deployment of heat pumps, focusing firstly on government campaigns and then on more community-based communication efforts.

Government information campaigns

A common thread in some of the most developed heat pump markets in the world is a government that prioritises consumer awareness in its implementation and market transformation plans. Low consumer awareness and confidence form a barrier to the uptake of heat pumps.

In leading European countries, policies to promote heat pumps, implement information campaigns and increase technical standards have been successfully deployed in combination with subsidies. These efforts aim to improve and refine consumers' understanding and attitudes about transitioning their homes to heat pump technologies.

Sweden provides a prime case for the resourced development of robust consumer awareness and good policy. In the late 20th century, Sweden's government bolstered heat pump deployment efforts through a combination of well-funded R&D programmes, subsidies, trainings, loans and consumer information campaigns.[50] In 1993, as part of a procurement programme aiming to 'bridge the gap between buyers and manufacturers,' Sweden devoted 50% of its procurement budget to 'information activities, including information campaigns, brochures and articles.' The Swedish government's efforts bore fruit, with heat pump sales doubling between 1995 and 1996.[51]

The German government offers another example of strong communication capacity. In the mid-2000s, German utilities and energy agencies banded together to engage in a range of marketing activities in favour of consumer heat pump adoption that would transition the market from oil and gas to electricity. These efforts ranged from far-reaching radio advertisements to community-level engagement at trade fairs and town halls.[52,53] The collaboration is at least partially credited for sustained market growth in the years that followed.

Community-based information-sharing

Another effective path for communicating in favour of heat pump adoption is to engage consumers at the national or local levels. As highlighted above, campaign efforts in Germany sent government entities to interface with the public, which proved to be an effective tool; however, a different genre of efforts encourages inter-community dialogue.

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50 Kiss et al., 2013.

51 Kiss et al., 2013.

52 BEIS. (2017, November). *Annex: International comparisons of heating, cooling and heat decarbonisation policies.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/699675/050218_International_Comparisons_Final_Report_Annexes_CLEAN.pdf

53 Peran, A. (2021, 21 December). Building a UK heat pump market — Lessons from abroad. *Electrify Heat.* https://electrifyheat.uk/article/lessons-from-abroad/

In conjunction with their 1990s awareness campaign, Swiss policymakers brought installers and consumers together to bolster trust in the technology, share lessons learned, and prompt conversations with homeowners who were considering switching to heat pump heating.[54] Fostering a dialogue at the community level brings a personal touch to a technical and sometimes expensive activity where consumers may not feel empowered to make the most efficient choice.

In the German campaign discussed previously, the government developed a digital infrastructure for these important conversations. The utility RWE created a forum where consumers could access information and connect with local installers to facilitate purchase and installation.[55] Similarly, Finland provided consumers with platforms where users could share their experiences with the equipment, purchasing experience and installation process. This was critical in not only educating the public on the benefits of heat pump technologies but also in quelling anxieties about how the equipment would function in cold winter temperatures.[56]

In the UK, where the heat pump market is smaller, innovation charity NESTA has recently developed the 'visit a heat pump' scheme which allows people to find homeowners with heat pumps in the local area, and to arrange a visit.[57] The NESTA scheme is designed to provide confidence to households looking to switch.

An air-source heat pump outside a home. Image courtesy of CLASP.

6.2 Installer communication, training and certification/ verification

Since heat pumps are professionally installed and are typically purchased through the installer, installers are crucially important. Outreach from policymakers to installers takes three key forms: communication, training and certification.

First, communication helps installers learn about heat pump technologies, so that they are aware of new technologies, their capabilities and their uses, and can recommend them to customers. While this communication will be primarily provided by manufacturers, governments can also play a role by providing unbiased technical information, such as on sizing and selection for the local climate[58] or installation standards

54 Peran, 2021.

55 BEIS, 2017.

56 Sovacool and Martiskainen, 2020.

57 VisitAHeatPump.com (n.d.). *Visit a heat pump near you.* https://www.visitaheatpump.com

58 CanmetENERGY. (2020). *Air-source heat pump sizing and selection guide: Procedure for mechanical designers and renovation contractors.* Natural Resources of Canada. https://publications.gc.ca/site/eng/9.893837/publication.html

appropriate to the locally available equipment and building stock.[59,60,61]

An air-blower unit being fitted. Image courtesy of CLASP.

Second, to guarantee there are enough skilled engineers and to ensure customer satisfaction with heat pumps and avoid underperformance, governments should implement or support training programmes. For example, in the United States, typically more than a quarter of a ducted air-to-air heat pump's energy use is wasted due to flaws during installation.[62] Building up the workforce will require ambitious recruiting efforts and tax relief to increase the number of installers,[63] may take several years for them to gain the necessary experience,[64] and may also require the help of manufacturers to train installers.[65]

An example of the training gap can be seen in China. On the one hand, there were already 100 million ductless (split) air-to-air heat pumps in 2016 — basically air conditioners that can run in reverse, providing heating in the country's warmer regions.[66] This high penetration was enabled by relying on the matured installation system for air conditioners. On the other hand, the penetration of air-to-water systems is small, with installation challenges a major obstacle to growth. These problems stem from the system's complexity (refrigerant and water loops; mixture of manufacturer and generic components*) and the inapplicability of existing training: as many systems were originally developed in Europe training is expensive, in a different language, and inapplicable to Chinese building stock.*[67]

Third, installation quality can be supported through certification, where a third party validates installer skills, or verification, where a third party confirms the quality of the installation. The International Ground Source Heat Pump Association offers certification,[68] while the U.S. ENERGY STAR Verified Installation programme partners with an installer trade association to provide quality assurance using skills certification and installation verification through a smartphone app.[69]

59 National Energy Commission (China). (2021). *Design code for central heating system of air source heat pump (NB/T 10779).* https://www.chinesestandard.net/PDF/English.aspx/NBT10779-2021

60 National Energy Commission (China) (2020). *Specification for installation and acceptance of central heating system of air-source heat pump (NB/T 10416).* https://www.chinesestandard.net/Related.aspx/NBT10416-2020

61 Ministry of Housing and Urban-Rural Development (China). (2021). *Technical guideline for residential air-source heat pump cooling and heating system (RISN-TG039).* https://www.98tuji.com/108365.html

62 ENERGY STAR. (n.d.). *HVAC quality installation program: A new approach to residential HVAC efficiency and performance.* https://www.energystar.gov/ia/home_improvement/downloads/ESQI_factsheet.pdf?07d7-31fc

63 Norman, A. and O'Regan N. (2022, February). *Installing for time? New evidence on the attitudes of home heat installers towards decarbonisation and heat pumps.* Social Market Foundation. https://www.smf.co.uk/publications/installing-for-time/

64 Catapult Energy Systems. (2021). *Foresighting skills for net zero homes: A report for the Gatsby Charitable Foundation.* https://es.catapult.org.uk/news/skills-shortages-holding-back-home-decarbonisation/

65 Ground Source Heat Pump Association. (2020, November). *Written evidence submitted to the UK Parliament Environmental Audit Committee on Technological Innovations and Climate Change: Heat Pumps.* https://committees.parliament.uk/work/684/technological-innovations-and-climate-change-heat-pumps/publications/

66 Ministry of Housing and Urban-Rural Development (China). (2018, January). *China urban-rural construction statistics yearbook.* https://www.chinayearbooks.com/china-urban-rural-construction-statistical-yearbook-2016.html

67 China Heat Pump Association. (2022, 12 October). Interview with Hu Bo. CLASP.

68 International Ground Source Heat Pump Association. (n.d.). Training. https://igshpa.org/training/

69 Air Conditioning Contractors of America. (n.d.). *Existing homes program.* https://www.acca.org/qa/existing-homes

In the United Kingdom, accreditation of the heat pump installation by the Microgeneration Certification Scheme is required for the receipt of heat pump subsidy support.

However, top-down approaches such as centralised training, certification or verification can be counterproductive if there is no market for quality installation. In the above case of air-to-water heat pumps in China, for example, it is unclear whether the lack of training is the cause of a sluggish market or its result. As we discuss in the following box, policy certainty and long-term direction-setting may be as important, if not more so, for the development of skills, than specific government help with training.

A ground source heat pump being installed. Courtesy of Kensa Heat Pumps.

Boosting skills for quality heat pump installations

Former IT consultant Leah Robson founded Your Energy Your Way, a UK domestic heat pump installer which also fits solar and batteries, in 2018. She was bored of IT, and 'wanted to do something about climate change'. Your Energy Your Way, based in Ashford in the south of England, now employs 13 staff and has fitted 109 heat pumps alongside 112 sets of solar panels since 2021. It focuses on high-quality installations alongside upskilling staff.

Leah Robson (left) and the Your Energy Your Way team. Courtesy Leah Robson.

The continued support offered by the United Kingdom Renewable Heat Incentive policy, the subsequent Boiler Upgrade Scheme and 'putting out that figure for 600,000 heat pump installs [by 2028] really has made a difference' to growing the market, allowing Robson to grow the business and upskill her workforce. Simple policy administration, continuity of support, and a long-term funding outlook have been particularly important.

Funding for training is important but needs to be well administered: 'having the low carbon heating apprenticeship being launched from September' is a good move by the UK government but more may be needed. Free training courses have helped, but longer support is most useful, particularly as good training can take such a long time and funding support for SMEs would help with training.

Targeting a diverse workforce has allowed Your Energy Your Way to make the most of a wider pool of talent and to take on fitters including 'career switchers'. A diverse team also provides wider benefits for Your Energy Your Way in terms of customer service and broader life experiences.

Across the Atlantic, Alex Sloan is Vice President for Business Operations and Development at Electrify My Home, a heat pump installation business in California which also offers wider electrification services. The company of 17 staff first started fitting heat pumps because the gas furnaces on the market were oversized for any home which had received an efficiency retrofit — only heat pumps made sense. But heat pumps are increasingly well recognized for their clean energy value. The company also offers workforce training 'on our business model and how properly to install heat pumps and heat pump hot water heaters'.

'In addition to electrification, we focus on high performance,' says Sloan, noting the warm climate of California which can give great heat pump running costs and performance. One of the biggest drivers for heat pumps is 'the ultra-low NOX mandate in certain areas requiring special furnaces and water heaters riddled with warranty issues,' as well as the TECH Clean California Initiative which funds much of their training.

'In general the State stays away from particularly noting heat pumps in their policy,' but the executive order from California's governor with the goal of installing 6 million heat pumps, accelerated in some areas, is a strong market driver despite the challenges it brings. 'While rebates and incentives are helpful for encouraging heat pump uptake, contractors are challenged by the start/stop nature of programmes and the bulky administration required to participate,' Sloan adds.

Alex Sloan (bottom row, third from the left) and the Electrify My Home team. Courtesy Alex Sloan.

6.3 Utility integration and flexible use of heat pumps

Shifting how we heat buildings will have an impact on the wider electricity system. This will need to be planned for and coordinated to ensure that heat pumps provide maximum environmental and running cost benefits and enhance the reliability of energy systems.

Network regulation also needs to ensure that gaining an increased capacity electrical connection, if necessary, is straightforward; and that costs are not prohibitive for those disconnecting from the gas grid. Analysis in the United Kingdom has shown that there is huge variation in local network company customer service levels for those installing heat pumps,[70] and it may not always be straightforward to disconnect from the gas grid. Network regulators need to ensure good customer service, manageable costs, and standardisation when heat pumps are being installed.

To ensure that heat pumps reduce greenhouse gas emissions to the greatest extent possible, policymakers should coordinate heat pump deployment with improvements in their efficiency (e.g. through appliance standards) and reductions in grid emission factors (e.g. through utility policies).

The value of heat pumps can be enhanced through demand flexibility: the ability of heat pumps to avoid electricity consumption peaks, which results in lower emissions and costs, and makes use of renewable electricity when it is abundant. Additional fossil fuel generation typically powers peak periods, while the need to supply the peak periods drives infrastructure expansion and costs. Conversely, shifting demand to periods supplied by renewable generation (often off-peak), including building-level solar, encourages the use of renewables.[71] Flexible use of heat pumps can help to decrease curtailment of renewables and decrease the need for certain grid investments by shifting loads away from peak hours. For example, a study on the EU revealed that flexible operation of heat pumps had the potential to reduce household energy costs by up to EUR 71 billion by 2030, which translates into a cost reduction of 16 cents per kWh.[72]

From a technical perspective, combining heat pumps with thermal storage or other storage solutions such as home batteries or bi-directional electric vehicle (EV) charging enables households to shift their electricity demand to periods of higher renewable generation and lower electricity demand. Heat can be stored in hot water tanks or even bricks.[73] Importantly, better-insulated and tighter buildings can stay warm without heating and can simply have heating turned off at peak times. Rooftop PV and so-called home energy management systems (HEMs) can further enhance the flexibility of household demand by enabling electricity self-consumption and making it easier for consumers to adapt household demand to energy system needs.

Dynamic electricity pricing is a key approach to incentivise load shifting by households. In short, it charges consumers more during hours of high electricity demand or low renewables generation and less during hours of low electricity demand

70 Lowes, R. (2024, May). *Blowing a fuse: electricity distribution networks need to drive clean heating, currently they are often slowing it.* https://richardlowes.com/2024/05/31/blowing-a-fuse-electricity-distribution-networks-need-to-drive-clean-heating-currently-they-are-slowing-it/

71 Yule-Bennett, S. and Sunderland, L. (2022, June). *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/

72 DNV. (2022, October). *Demand-side flexibility: Quantification of benefits in the EU.* https://www.dnv.com/news/demand-side-flexibility-quantification-of-benefits-in-the-eu-232343/.

73 Steffes. (n.d.). *Comfort for the future with serenity.* https://www.steffes.com/ets/hq-serenity-eng/

or high renewables generation.
This way consumers are encouraged to shift their electricity use to off-peak and high renewables hours when electricity generation and power system costs are cheaper and greenhouse gas emissions lower. Heat pumps can be programmed or automated to
respond to these prices.

While many customers only have access to static tariffs, several dynamic electricity pricing models are emerging in different geographies, such as from Octopus Energy in the UK, an energy retailer which offers real-time tariffs as well as special heat pump tariffs that reduce electricity prices in three specific off-peak periods during the day. Generally, the availability of dynamic pricing depends on the regulatory environment and progress in rolling out smart meters. Data for the EU shows massive differences between different countries with regards to both dynamic tariff and smart meter availability,[74] although the EU has established a right to dynamic pricing in the latest revision of its electricity market design.

Dynamic pricing can considerably reduce energy purchase costs and thus improve the economic case for heat pumps,[75] though this is likely to depend on the national context.[76] To manage possible equity impacts of dynamic pricing, policies need to be designed to incentivise demand-shifting for households without affecting wellbeing.[77]

A building with a heat pump and solar PV. Image courtesy of Cotswold Energy.

74 ACER. (2023, September). *Energy retail and consumer protection. 2023 Market Monitoring Report.* https://www.acer.europa.eu/sites/default/files/documents/Publications/2023_MMR_Energy_Retail_Consumer_Protection.pdf.

75 Godron, P., Herrndorff, M., Müller, S., Schaber, K., Zackariat, M., Jooß, N., Köppl, S, et al. (2024, April). *The benefits of energy flexibility at home. Leveraging the use of electric vehicles, heat pumps and other forms of demand-side response at the household level.* Agora Energiewende and Forschungsstelle für Energiewirtschaft e. V. https://www.agora-energiewende.org/publications/the-benefits-of-energy-flexibility-at-home

76 Canning, A. (2024). *Assessment of consumer risks and benefits of heat pumps with and without dynamic price contract.* BEUC/LCP Delta. https://www.beuc.eu/news/dynamic-electricity-pricing-missing-piece-clean-heating-transition.

77 Yule-Bennett and Sunderland, 2024.

6.4 Supporting industry in upscaling heat pump manufacturing

Growing the heat pump market requires massive investment by manufacturers to scale up their capacities. This implies both building new heat pump factories as well as converting and expanding boiler factories into heat pump factories. Regarding both types of projects, policies need to provide investment certainty to manufacturers. Generally, ensuring sufficient future demand can be seen as the most important factor for reducing the investment risk of new heat pump manufacturing. Therefore, demand-side policies such as a clear commitment to phasing out fossil fuel boilers, rebalancing energy prices, and upfront subsidies indirectly support the heat pump industry.

Direct support for heat pump manufacturers can further contribute to reducing investment risks for new projects. This industrial policy can take the form of financial support through investment cost grants or low-interest loans and non-financial support through addressing regulatory barriers like permitting. Generally, maintaining employment and international competitiveness and resilience can be identified as the two objectives of industrial policy in the heat pump sector. Maintaining employment and competitiveness translates into defending the national heating industry against potential competitors from abroad, which might be a concern for certain governments given that other markets might be more advanced in the transition of the heating industry or able to respond more quickly. Moreover, ensuring resilience means that supporting the national industry also ensures access to heat pumps and key components even in the case of global supply disruptions.

So far, heat pumps have been explicitly made a subject of industrial policy in the US and the EU. In other regions demand-side incentives are the prevailing policy instrument, although some countries are using the design of their incentive schemes to indirectly subsidise their national industries.

In the US, heat pumps are a key technology in the Inflation Reduction Act (IRA). Next to grants and tax rebates for consumers, the government also directly supports new manufacturing projects through the Advanced Energy Project Tax Credit, which can amount to up to 30% of investment costs. Moreover, heat pumps are one of the four key technologies in the Defense Production Act, which has so far allocated USD 169 million in subsidies to nine manufacturing projects.[78]

While the US has focused on supporting manufacturers financially, the EU's approach in the Net Zero Industry Act (NZIA)[79] aims mainly to address regulatory barriers. The NZIA sets an overall target of 40% domestic manufacturing by 2030 for key technologies including heat pumps. Concerning heat pumps, this target is not hugely challenging given that 79% of the EU's heat pump demand is currently supplied from within the EU. Regarding regulatory barriers, the NZIA establishes single points of contact for administrative procedures and reduces permitting time. Furthermore, the NZIA establishes a platform which advises companies on public and private financing options for their projects. However, the NZIA does not provide any new financing for manufacturing projects.

Meanwhile, in its Heat Pump Action Plan, the French government has put forward its own approach to an industrial policy on heat pumps.[80] Next to simplifying installation rules, upskilling installers and reorienting public procurement, this approach also comprises investment cost support for new manufacturing projects of between 20% and 45% of total costs, up to a total of EUR 200 million. This Action Plan has furthermore been linked to an annual manufacturing target of 1 million heat pumps by 2027, which embodies the ambition of the French government to produce heat pumps not only for domestic demand but also for export.

78 Rewiring America. (2023). *IRA factsheets.* https://www.rewiringamerica.org/ira-fact-sheets.

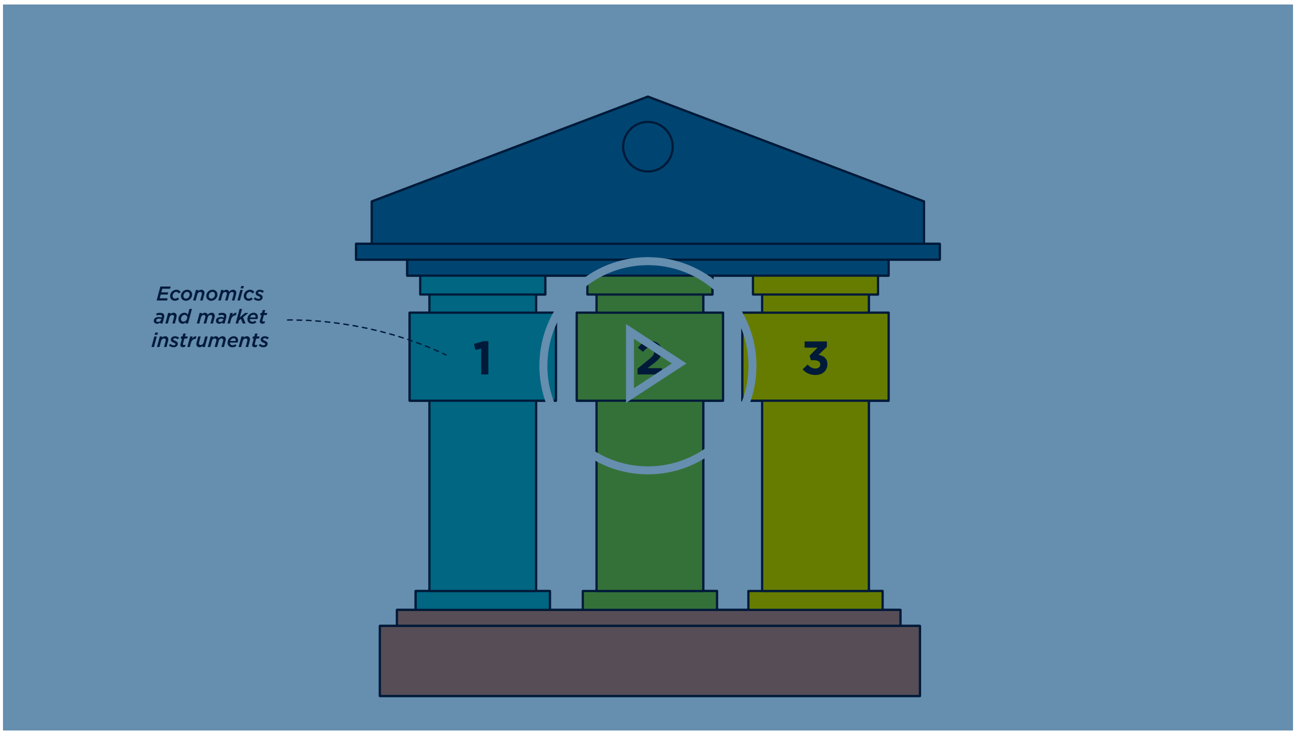
79 European Commission. (2024). *The Net-Zero Industry Act.* https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act_en

80 French Economic Ministry. (2024, April). *Un plan d'action pour produire un million de pompes à chaleur dès 2027.* https://www.economie.gouv.fr/actualites/plan-action-pompes-chaleur-2027

7 Pillar 1: Economic and market-based instruments

Heat pumps currently often cost more to install than fossil fuel heating systems, and running costs compared to fossil fuel heating are often similar but vary by country or region. Policymakers should ensure that there is a clear financial incentive for building owners to invest in heat pumps, an issue considered in this chapter and in the short video below.

Figure 10. Policy toolkit pillar 1



Note: Click for a link to section summary video.

Without a strong economic framework for both upfront heat pump costs and running costs, heat pump deployment is expected to be far slower than needed to reach net-zero emissions targets.[81]

The main running costs (associated with electricity used by the heat pump) will be determined by the cost of electricity, the efficiency of the heat pump, and the overall heat demand of the building. If fossil fuels such as oil, gas and coal are cheaper to use per unit of heat delivered, there is a disincentive for customers to switch to heat pumps. Even if the upfront heat pump costs can be reduced or subsidised, buildings and households that switch to a heat pump would see their running costs increase. It would also be a challenge to encourage the deployment of heat pumps through regulation if their operating costs were higher than existing fossil fuel systems.

There are several ways in which governments can change the economics of clean heating and incentivise people to adopt heat pumps. Subsections in this toolkit chapter consider

81 Rosenow et al., 2022a.

carbon pricing and environmental taxation, taxes and levies on energy, and obligations to develop markets. To shift the economics towards clean heating, combinations of such measures may be appropriate.

7.1 Carbon pricing and environmental taxation

Reflecting environmental costs in energy prices aligns the incentives facing energy users with environmental policy goals. This can support heat pump markets by making their operating costs relatively more attractive, and provide revenues to support building retrofits and heat pump financial support programmes, such as those discussed in Section 9. Such pricing reform can also support wider electrification.

How does it work?

Governments can tax environmental pollutants based on estimates of their environmental impacts. The most commonly taxed pollutant is carbon dioxide, but some countries also tax other emissions. An alternative to a tax is an emissions trading system (ETS), such as the EU ETS, in which the allowable quantity of emissions is set, with obligated parties required to hold allowances to cover their emissions. The ability to trade creates a market in which the marginal cost of reducing emissions should be revealed.

Examples

In the EU, carbon pricing is in place on directly combusted heating fuels (fossil gas, heating oil) in 10 Member States.[82] Denmark has a comprehensive approach, taxing carbon dioxide, nitrogen oxides and sulphur dioxide emissions.[83] In 2021, the European Commission proposed an EU-wide trading system for carbon emissions from the buildings and road transport sectors (ETS 2);[84] this is expected to come to full operation in 2027.[85] The Commission also proposed a reform of the Energy Taxation Directive that would ensure that electricity was always the least-taxed energy carrier, reflecting its lower environmental damage costs when compared with fossil fuels and biomass.[86] This tax reform has not yet been progressed, however.

Canada has a carbon tax that covers buildings, heating fuels and the power sector, with provinces able to set up their own schemes provided the rates are at least as high. The Canadian carbon tax is set to increase each year from 50 to 170 Canadian dollars by 2030,[87] although heating oil has been exempted from the coverage of this scheme owing to concerns over cost impacts.[88] South Korea has the world's most comprehensive emissions trading system, covering over 95% of carbon emissions, including those from heating fuels in large buildings.[89]

82 Sweden, Finland, France, Ireland, Denmark, Portugal, Luxembourg, Slovenia, Germany and Austria have instituted carbon taxes or ETSs covering heating fuels.

83 OECD. (n.d.). *Revenue from environmentally related taxes in Denmark.* https://www.oecd.org/tax/tax-policy/environmental-tax-profile-denmark.pdf

84 European Commission. (2021a, July). *Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757.* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0551

85 European Commission. (n.d.). *ETS2: buildings, road transport and additional sectors.* https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/ets2-buildings-road-transport-and-additional-sectors_en

86 European Commission. (2021b, July). *Revision of the Energy Taxation Directive (ETD): Questions and Answers.* https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3662

87 Government of Canada. (2023, June). *The federal carbon pollution pricing benchmark.* https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/carbon-pollution-pricing-federal-benchmark-information.html

88 Government of Canada. (2024a, April). *Fuel consumption levies in Canada.* https://natural-resources.canada.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel-prices/fuel-consumption-taxes-canada/18885

89 World Bank. (2022, May). *State and Trends of Carbon Pricing.* https://openknowledge.worldbank.org/handle/10986/37455

Carbon pricing instruments covering heating fuels are also in place in New Zealand and Switzerland, at the subnational level in Saitana, Japan, and in the emissions trading pilot in Beijing, China.[90] It is worth noting that most carbon pricing instruments currently cover electricity and not heating fuels,[91] making heat pump purchases relatively less attractive.

Key benefits

The key benefits relate to the alignment of end-user incentives with environmental policy goals and the potential to use revenues to fund environmental projects. Incorporating externalities into the prices of fossil fuels (and biomass, if applied to multiple pollutants) improves the 'total cost of ownership' of a heat pump, relative to a fossil fuel boiler. It also means that clean heat regulations could meet less resistance on the grounds of cost, and that heat pump subsidies could potentially be lower. Pricing support may be an important prerequisite for more intrusive regulation.

A tax provides more certainty and visibility for the price, while an ETS provides more certainty over the environmental outcomes, setting a limit on emissions. Both can create revenues that can be used to address equity concerns (see potential issues below), and overcome other barriers through complementary policy measures. The use of revenues to support energy efficiency and heat pump installations is particularly important for lower-income households.

Potential issues

Cap-and-trade regimes and energy taxation, whether for environmental purposes or not, can be regressive. Poorer households tend to spend a greater share of their disposable income on energy. These households are also less likely to be able to adapt to higher environmental taxes by investing in clean alternative technologies. This makes it essential that accompanying policy measures drive investment in decarbonisation among the most vulnerable households and compensate them financially during the period until their dwelling has been adequately renovated.

Political resistance to environmental taxation, such as the 'yellow vest' protests seen in France,[92] highlights the importance of communication and the careful consideration of the use of revenues. It may necessitate a significant proportion of revenues being redistributed to billpayers. This can be done by lowering other more economically inefficient taxes or through lump-sum transfers, thus reducing the scope for using the revenues to support decarbonisation projects. Virtually all Canadian carbon tax revenues are redistributed to consumers in provinces where the revenues are generated.[93]

Key decisions

- How should the public be engaged, given potential opposition to new tax measures?
- What should tax rates be and how should they change?
- How should revenues be allocated?
- When should measures be introduced (ideally when energy prices are coming down)?
- How should trading schemes be set up and who should be covered?

90 World Bank, 2022.

91 OECD. (2021, October). *Carbon Pricing in Times of COVID-19: What Has Changed in G20 Economies?* https://www.oecd.org/tax/tax-policy/carbon-pricing-in-times-of-covid-19-what-has-changed-in-g20-economies.htm

92 Mehleb, R., Kallis, G. and Zografos, C. (2021, September). A discourse analysis of yellow-vest resistance against carbon taxes. *Environmental Innovation and Societal Transitions 40:* 382-394. https://doi.org/10.1016/j.eist.2021.08.005

93 Government of Canada. (2024b, October). *How carbon pricing works.* https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution.html

7.2 Taxes and levies on energy

Beyond specific carbon and environmental pricing schemes, fiscal policy can improve or worsen the economics of heat pumps compared to fossil fuel appliances by rebalancing energy costs towards electrification. Taxes and levies on energy often make up a significant portion of electricity and gas prices — and, subsequently, households' energy bills. As well as delivering relatively cheaper running costs for heat pumps, these instruments can raise government revenue that can be directed towards energy transition projects.

How does it work?

By choosing in what proportion to set these fiscal instruments on electricity compared to fossil fuels, policymakers can encourage or discourage the use of heat pumps by influencing their running costs. To directly support heat pumps and wider electrification, governments can ensure that taxes and levies on electricity are minimised while increasing those on gas and oil.

Many countries apply energy levies and taxes that disadvantage electric heat pumps. As shown below in Figure 11,[94] in Europe, for example, these instruments applied to electricity can be five to ten times higher per unit of energy than those on natural gas.[95] In the United Kingdom, environmental levies account for around 23% of an electricity bill, while similar charges make up less than 2% of the gas bill.[96] Germany's Renewable Energy Surcharge (EEG) has historically accounted for up to 20% of household electricity bills.[97]

Bristol Castle Park Energy Centre Water Source Heat Pump. Courtesy Star Renewables.

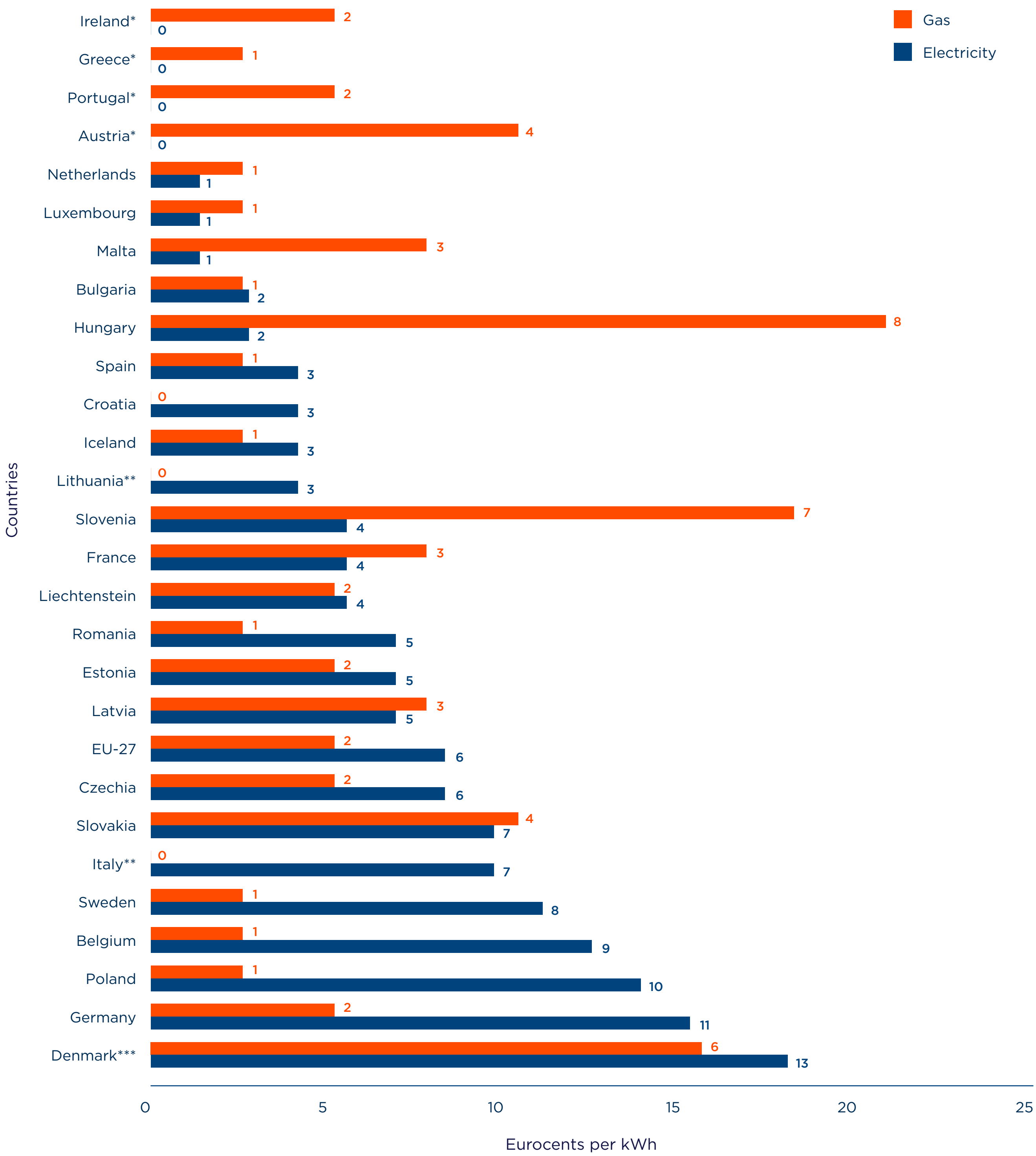
94 Rosenow et al., 2022b; Eurostat. (n.d.). *Electricity prices components for household consumers* and *Gas prices components for household consumers.* https://ec.europa.eu/eurostat/databrowser/explore/all/all_themes

95 Rosenow et al., 2022b.

96 Lowes, R., Rosenow, J. and Guertler, P. (2021). *Getting on track to net zero: A policy package for a heat pump mass market in the UK.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/getting-track-net-zero-policy-package-heat-pump-mass-market-uk/

97 Strompreisentwicklung. (2021). *Die entwicklung der strompreise 2021 im detail.* https://strom-report.de/strompreise/strompreisentwicklung/#strompreisentwicklung-2021; As of 1 July 2022, the EEG has been abolished from electricity bills; see Appunn, K. (2022, 30 June). Germany stops landmark mechanism that funded renewables expansion via power bills. *Clean Energy Wire.* https://www.cleanenergywire.org/news/germany-stops-landmark-mechanism-funded-renewables-expansion-power-bills

Figure 11. Levies and taxes (excluding VAT) on residential gas and electricity (euro cents per kWh) in EU Member States (average in 2023)



** Ireland, Greece, Portugal and Austria provide rebates which are translated as a negative levy on the price of electricity.*

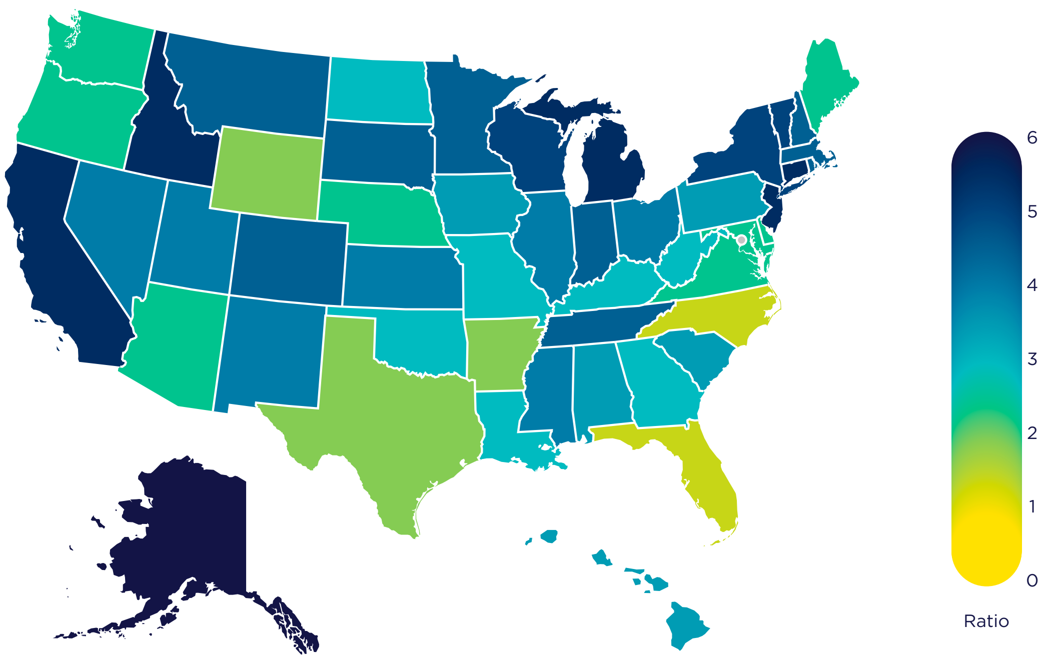
*** Italy and Lithuania provide rebates which are translated as a negative levy on the price of gas.*

**** Denmark applies the lowest possible tax rate to all residential electricity consumption above 4,000 kWh per year. The tax rate shown here would apply to electricity consumption up to 4,000 kWh.*

Source: Eurostat. (n.d.). *Electricity prices components for household consumers,* and *Gas prices components for household consumers.*

In the United States, the ratio of electricity to fossil gas averages 2.5:1 but varies greatly from state to state, from as low as 1.4:1 in Florida to around 3.4:1 in Michigan, Connecticut and New Jersey and nearly 5.5:1 in Alaska (as shown in Figure 12).[98] As such, there are significant variations in economic drivers for heat pumps even within the United States highlighting the need for often local energy market reform.

Figure 12. Ratio of residential electricity to natural gas prices (USD/kWh), 2023



Source: U.S. EIA. (n.d.). *Natural gas prices. Natural Gas, data for* 2023. US EIA. (n.d.). *U.S. Electricity Profile 2023. State Electricity Profiles.*

Benefits

Reducing electricity taxes and levies means that policymakers can reduce the total cost of ownership over the lifetime of a heat pump. At the same time, they can shift economic incentives away from fossil fuel appliances and towards heat pumps. Such changes via tax policy can be administratively simple. In addition, introducing heat pump electricity tariffs which lower or remove taxes and levies, or allowing energy suppliers to do so, can also lower the operating costs of heat pumps.

Examples

Since January 2021, electricity use for home heating in Denmark has been subject to the minimum allowable taxation rate under EU law, a decrease from EUR 120/MWh to EUR 1/MWh for consumption above a threshold of 4000 kWh/ year. This has cut the running costs of a heat pump in half. In its attempt to 'get off gas,' the Netherlands revised its energy taxation policy by raising taxes on natural gas while lowering them on electricity.

98 U.S. EIA. (n.d.[a]). *Natural gas prices.* https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_a.htm; U.S. EIA. (n.d.[b]). *U.S. Electricity Profile 2022.* https://www.eia.gov/electricity/state//

This dual revision greatly improved the economics of running a heat pump compared to a natural gas boiler.[99]

Ireland has a carbon tax on fuels, including those for heating. The government has set a long-term trajectory for the carbon price which is expected to reach EUR 100 per tonne of CO2 by 2030; revenues from the tax are hypothecated for green and climate initiatives.[100]

Potential issues

Unless carefully considered, rebalancing taxes and levies could increase energy costs for consumers living in poverty. Many low-income households heat their homes with fossil fuels and live in poorly insulated buildings, though it is worth noting that heat pumps may decrease costs for some households, such as those with resistive electric heating. Increasing taxes and levies on natural gas, although well-intentioned, could make fuels prohibitively expensive for struggling households. Even if switching to a heat pump would be more affordable due to the rebalancing, the cost savings will be experienced over the lifetime of the device rather than upfront, where low-income households may need the most urgent financial support. Tax and levy reforms need to be carefully managed and integrated with wider policy support for heat pumps.

Key decisions

- Does the energy taxation framework apply lower rates to gas or heating oil than electricity? What would be an appropriate way to rebalance these rates?
- If a reform is desirable, how can it be designed so that lowest-income households do not suffer from higher combined energy bills in the short term?
- What considerations are needed so that reforming levies does not encourage a disproportionate increase in electricity consumption and ensures electricity is used efficiently?

7.3 Obligations and portfolio standards

Markets for heat pumps can be created and scaled up using obligations and standards set on certain private or public parties: this could be a key tool for driving heat pump deployment to mass-market levels, in advance of fossil fuel phaseouts.

Energy efficiency obligation schemes obliging energy suppliers to deploy demand-side measures to increase efficiency are a well-established policy instrument in many parts of the world. Given that heat pumps considerably reduce energy demand in residential heating, several countries have included heat pump installations into their list of eligible actions.[101] By contrast, mechanisms explicitly for clean heating are a rather novel policy tool, with the leading examples only approved in recent years.

How does it work?

With such a policy, an organisation or company is compelled via regulation to meet a certain outcome. This outcome may or may not be solely related to heat pumps, but could drive a wider goal of removing emissions from heat or

99 Rosenow et al., 2022b.

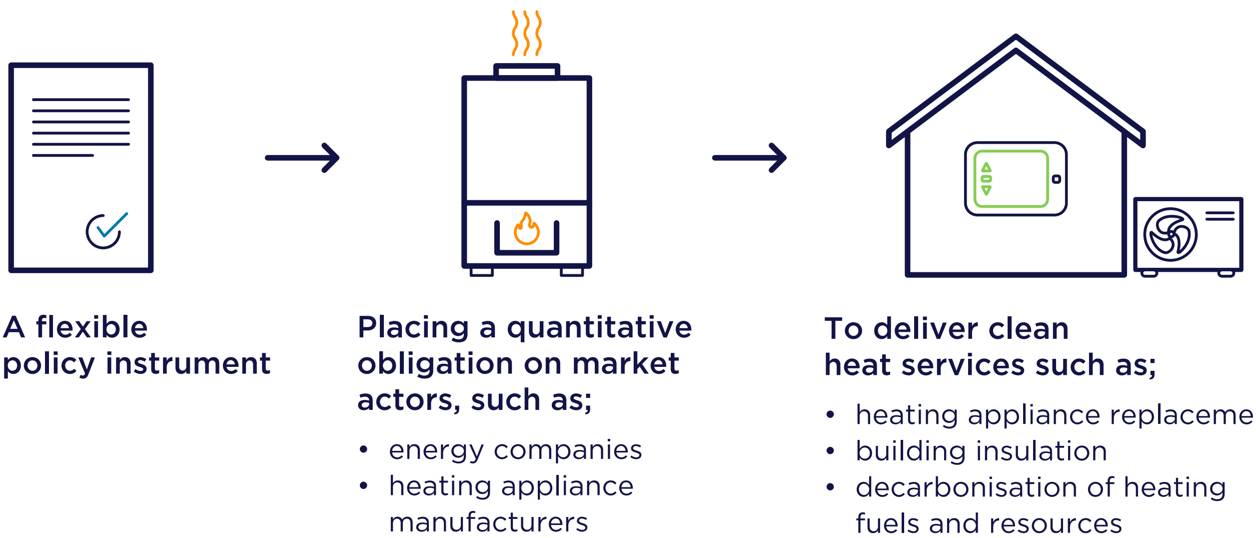
100 Tithe an Oireachtais. (2024, March). *Climate / Focus on the carbon tax.* https://www.oireachtas.ie/en/press-centre/news-and-features/20240326-climate-focus-on-the-carbon-tax/#:~:text=The%20Finance%20Act%202020%20has,per%20tonne%20of%20carbon%20dioxide.

101 Lees, E. and Bayer, E. (2016, February). *Toolkit for energy efficiency obligations* [Press release]. Regulatory Assistance Project. https://www.raponline.org/knowledge-center/toolkit-for-energy-efficiency-obligations/.

promoting renewable heat, or as part of a wider carbon commitment where heat pumps might be a key element in meeting the overall goal.

Similar to energy efficiency obligations, clean heating obligations can be put on energy suppliers or other market actors to ensure heat pump uptake among their customers. The core elements of clean heat standards are visualised in Figure 13.[102] Here, different types of energy companies — from energy importers and fossil fuel suppliers to network operators, electricity suppliers and DSOs — can be obligated. Obligating heating appliance manufacturers is an alternative approach, which could target manufacturers of all heating appliances or only manufacturers of fossil fuel boilers.

Figure 13. Elements of a clean heat standard



Source: Santini, M. et al. (2024, April): *Clean heat standards handbook.* Regulatory Assistance Project.

The level of the obligations can be set in line with climate ambition and heat pump targets or as part of these targets. To allow for flexibility, credit trading might be allowed between different market actors. Moreover, flexibilities to save credits for the next year (banking) or to borrow credits from the following year (borrowing), as well as thresholds for excluding small parties from obligations, are other design features which can enhance acceptability among obligated actors.[103]

Outside of buildings, mandates have also been introduced on vendors of vehicles to require a certain proportion of vehicle sales to be electric.[104]

102 Santini, M., Thomas, S., Lowes, R., Gibb, D., Cowart, R. and Rosenow, J. (2024, April). *Clean heat standards handbook.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/clean-heat-standards-handbook/

103 Santini, M. et al., 2024).

104 BC Gov News. (2020, July). *Province puts in place rules for 100% electric-vehicle sales by 2040.* https://news.gov.bc.ca/releases/2020EMPR0031-001416

Examples

The United Kingdom's proposed Clean Heat Market Mechanism is due to be launched in 2025.[105] This policy will place an obligation on manufacturers of fossil heating appliances to sell a minimum share of heat pumps (wet distribution systems only, see box) that is expected to increase over time to help reach the UK's heat pump targets. The obligation is expected to apply to the relative sales of these manufacturers of fossil fuel boilers (oil and gas) and must be fulfilled by submitting credits proving a sufficient number of verified installations of hydronic heat pumps by certified installers in existing buildings. Hydronic heat pump installations in the new-build sector are not planned to be eligible for credits to fulfil the obligation, on the basis that they are covered by a strict building standard for new construction. Non-compliant companies are expected to have to pay a fine for each missing heat pump credit. Various flexibilities are envisioned to allow manufacturers to meet the obligation more easily, including credit trading as well as banking and borrowing of credits.[106] Furthermore, additional complementary policies have been put in place that support manufacturers in meeting the obligation, such as the Boiler Upgrade Scheme grant of GBP 7,500 for households purchasing heat pumps.

In Colorado, U.S., a 2021 act (Bill 21-264) places an obligation on large gas distributors to develop plans for reducing their greenhouse gas emissions by 4% until 2025 and by 22% until 2030 (compared to 2015). Heat pump installations are among the eligible actions for delivering carbon savings.[107]

105 BEIS. (2022, May). *A market-based mechanism for low-carbon heat.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1074284/government-response-clean-heat-market-mechanism.pdf

106 BEIS. (2024, March). *Clean Heat Market Mechanism.* https://www.gov.uk/government/consultations/clean-heat-market-mechanism

107 State of Colorado. (2021, June). *Concerning the adoption of programs by gas utilities to reduce greenhouse gas emissions, and, in connection therewith, making an appropriation* [Legislation]. https://leg.colorado.gov/sites/default/files/2021a_264_signed.pdf

In Vermont, U.S., legislation for a Clean Heat Standard was enacted by the state legislature in 2023. From 2025, the Clean Heat Standard will require gas utilities and suppliers of other fuels to meet a certain proportion of their heat supplies from clean heat.[108] A range of energy efficiency measures including the installation of heat pumps will qualify for credit, while different actors such as installers will be able to trade their credit with the obligated parties. The bill will enter into effect in 2025 if the state legislature approves the final rules for implementation at the beginning of 2025.

Key benefits

Obligation-based policies are expected to lead to lower cost outcomes than using grants, because competitive pressure means obligated parties will attempt to find the lowest-cost solution. Such models are also expected to lead to innovation within the obligated companies which are actively supported to shift from fossil fuels to low-carbon technologies. Policy delivery risk and financing can also be partially shifted onto the private sector rather than government balance sheets.

Potential issues

While energy efficiency obligation schemes which have included heat pumps have been in existence for years, heat pump-specific obligations are currently in early development. The novelty of such schemes means that their performance is unclear in terms of the response from both market actors and building owners. There is a risk that low-income households and poorly insulated buildings might also not benefit from obligation schemes without sufficient complementary policies (e.g. support schemes), given the higher relative cost of realising heat pump projects in these cases.

108 Cowart, R. and Neme, C. (2021, December). *The Clean Heat Standard.* Energy Action Network. https://eanvt.org/project/chs-whitepaper/

The effect of obligation schemes strongly depends on the respective policy context. While obligations might reduce upfront costs for households when installing a heat pump, other barriers such as running costs, grid challenges or a shortage of skilled installers need to be addressed in parallel for compliant parties to meet their obligations. Therefore, obligation schemes are not silver bullets, as they can only be effective in a functioning policy mix.

Key decisions

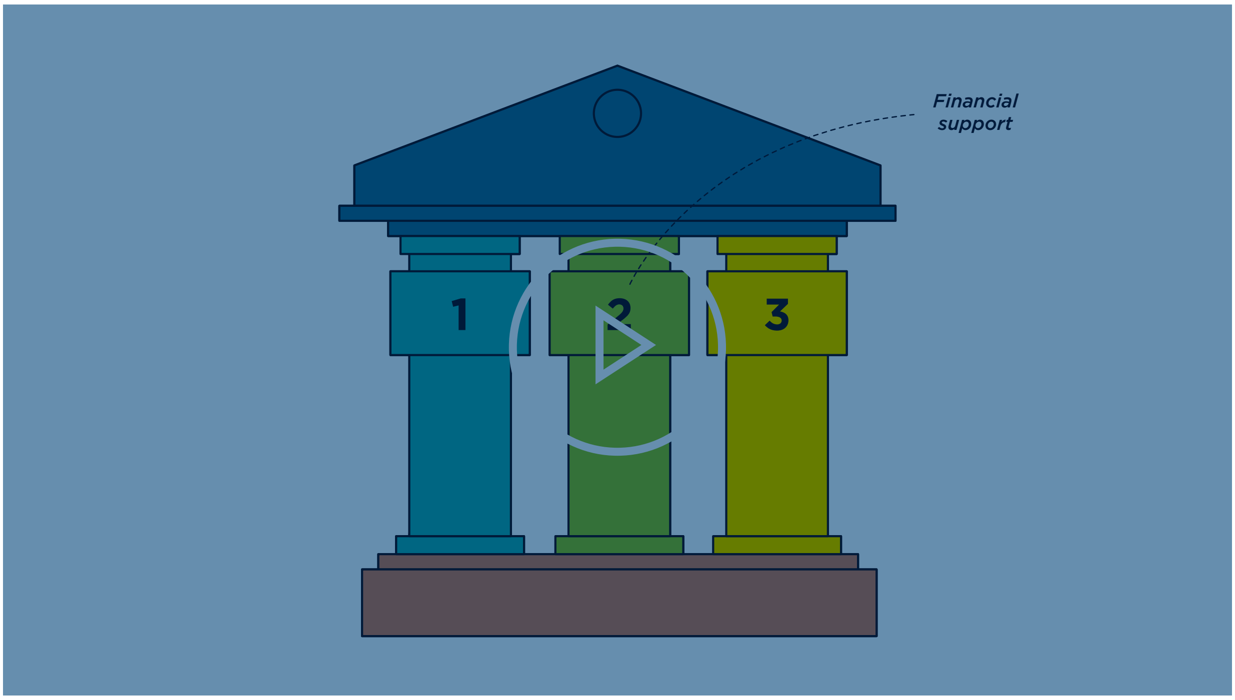
- Who is the obligated party?
- What will the target or outcome be, and what technologies will be supported?
- Is the scheme funded in an equitable manner, and does delivery support low-income households?

A trench for a ground source heat pump ground array. Courtesy of Danielsen_Photography/Shutterstock.

8 Pillar 2: Financial support

Providing financial support to building owners, our second policy pillar, is expanded on in this section and considered in the short video below.

Figure 14. Policy toolkit pillar 2



Note: Click for a link to section summary video.

In most countries, the upfront cost of switching to a heat pump remains higher than many of the existing alternatives they need to replace.[109] This is in part because the capital cost of a heat pump unit is likely to be more than an equivalent furnace or boiler.[110] However, first-time heat pump installations are also likely to cost more than a boiler/furnace replacement due to potential additional work, such as upgrading the heat-emitter system, adding new ducts or installing a ductless system, carrying out any electric work, adding hot-water storage, and installing external components.

In less developed markets, technological and installation innovation is expected to drive heat pump costs down. However, in nearly all cases, the installation works associated with the initial switch from fossil fuel devices to heat pumps are

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

110 IEA. (2021, December). *Are renewable heating options cost-competitive with fossil fuels in the residential sector?* https://www.iea.org/articles/are-renewable-heating-options-cost-competitive-with-fossil-fuels-in-the-residential-sector

likely to cost more. Although many of these are one-time costs, a vital pillar of heat pump policy concerns financial support for building owners with capital costs. The varying affluence and characteristics of building owners means that different types and amounts of support are likely to be needed.

Multiple policy options to provide financial support are available and are described below. It's also worth considering that packages of financial measures, such as grants topped up with loans, may be valuable. Such packages could also support whole building plans which incorporate fabric energy efficiency work and heat pumps.

8.1 Grants and rebates

One of the simplest policy tools available is to provide building owners with capital to reduce the financial burden associated with a first-time switch to a heat pump. Lump-sum grants can be funded directly via government spending or levied on bills. Such policies can also provide financial support following the installation of a heat pump, including via tax rebates, but some schemes may require households to fund the entire system initially and claim money back, which may not be possible for many due to the significant upfront expense.

How does it work?

In dealing with the potential issue of higher upfront costs, these policies are designed to reduce the capital requirements for building owners associated with switching to or replacing heat pumps. Grants can be offered to building owners or paid directly to heat pump installation companies, with the latter option removing the cashflow burden for households but moving it to installers. Governments can also consider providing financial incentives to manufacturers and distributors which can reduce the costs and administrative burden. Payments could be made for each heat pump sold, potentially conditional on permanently converting the entire future

A domestic air-source heat pump. Image provided by Jonathan Atkinson, aka @lowwintersun.

supply of air conditioners to heat pumps.[111] To specifically address cashflow burdens among low-income households, governments can offer them higher subsidy rates. Grant schemes tend to be funded via government spending, but they could also be funded via utility bills. National tax systems can also be used to reduce upfront costs, with taxes on heat pumps and their installation being reduced compared to fossil fuel alternatives. The provision of grants and subsidies was an important element in forming the now well-developed Swedish and Swiss heat pump markets.[112]

Examples

Grant schemes for heat pumps exist around the world, although their design can vary significantly. In Japan, grants are offered for ground-source heat pumps with different types of support depending on the size of the installation.[113]

In the Netherlands, households are offered grants which are claimed following the installation, with the amount of support based on the capacity of the heat pump,[114] in a scheme which also supports hybrid systems.[115]

In Denmark, grants are offered post-installation, and the level of support is determined by the type of heat pump and the size of the building.[116]

In the UK, hybrid systems are not subsidised, and ground- and air-source heat pumps are eligible for grants of GBP 7,500,[117] a flat rate that exists for all house types and sizes. The grant is paid to the installer, thus reducing cashflow risk for households. The Canadian scheme is similar to the UK scheme, but grants are instead paid to households.[118] Grants for heat pumps in New Zealand of up to NZD 3,000 are available, although only for low-income households.[119]

Tax policies can have a similar impact by reducing upfront capital requirements. British Columbia, Canada, has recently increased the sales tax on fossil fuel combustion systems while removing it from heat pumps.[120] The UK government eliminated sales tax (VAT) from heat pumps in 2024, and maintains its provision of grants.[121]

111 Pantano, S., Malinowski, M., Gard-Murray, A. and Adams, N. (2021, May). *3H 'Hybrid Heat Homes' An Incentive Program to Electrify Space Heating and Reduce Energy Bills in American Home.* https://www.clasp.ngo/research/all/3h-hybrid-heat-homes-an-incentive-program-to-electrify-space-heating-and-reduce-energy-bills-in-american-homes/

112 Kiss et al., 2013.

113 Farabi-Asl, H., Chapman, A., Itaoka, K. and Noorollahi, Y. (2019, February). Ground source heat pump status and supportive energy policies in Japan. *Energy Procedia 158:* 3614-3619. https://doi.org/10.1016/j.egypro.2019.01.902

114 Rijksdienst voor Ondernemend Nederland. (2020, December). *ISDE: Warmtepomp woningeigenaren.* https://www.rvo.nl/subsidies-financiering/isde/woningeigenaren/warmtepomp

115 Where a heat pump is backed up by another heating system, such as a gas boiler. To ensure significant fossil fuel use reductions, care must be taken to ensure the backup is not used often.

116 Retsinformation. (2022, May). *Bekendtgørelse om tilskud til energibesparelser og energieffektiviseringer i bygninger til helårsbeboelse.* https://www.retsinformation.dk/eli/lta/2022/711

117 Ofgem. (n.d.). *Boiler upgrade scheme (BUS).* https://www.ofgem.gov.uk/environmental-and-social-schemes/boiler-upgrade-scheme-bus

118 Government of Canada. (2024c, June). *Eligible retrofits and grant amounts—space and water heating.* https://www.nrcan.gc.ca/energy-efficiency/homes/canada-greener-homes-grant/start-your-energy-efficient-retrofits/plan-document-and-complete-your-home-retrofits/eligible-grants-for-my-home-retrofit/23504#s5

119 Energy Efficiency & Conservation Authority. (n.d.). *Warmer Kiwi Homes programme.* https://www.eeca.govt.nz/co-funding/insulation-and-heater-grants/warmer-kiwi-homes-programme/

120 British Columbia Provincial Government. (2022, July). *Provincial Sales Tax on Fossil Fuel Combustion Systems and Heat Pumps.* https://www2.gov.bc.ca/assets/gov/taxes/sales-taxes/publications/notice-2022-003-provincial-sales-tax-on-fossil-fuel-combustion-systems-and-heat-pumps.pdf

121 Government of the United Kingdom. (2014, July; 2022, April). *Energy-saving materials and heating equipment (VAT Notice 708/6).* https://www.gov.uk/guidance/vat-on-energy-saving-materials-and-heating-equipment-notice-7086

Italy has taken the most radical tax approach to heat pumps (and other efficiency measures) by providing 'Superbonus' tax rebates of 110% of the installation cost (i.e. fully funded heat pumps with a small bonus), though this scheme was linked to the country's economic response to the Covid-19 pandemic. Under the scheme, installers claimed the rebate directly,[122] meaning that households saw no impact on their finances when switching to a heat pump. The programme has been credited with financing more than half a million heat pump installations in 2022. However, the programme did not seem to be financially sustainable or feasible in the long term, and was subject to fraudulent claims. After measures were put in place to curb subsidies, demand for heat pumps 'collapsed,' and the market saw a significant reduction in installations.[123] This scheme ended in 2023 when the new Italian government decided to lower the rates and to end the possibility of upfront payments.[124] The Italian policy highlights the need for sustainable and long-term policy design.

Key benefits

Grants and tax reductions can help overcome one of the key deployment challenges with heat pumps: first-time installation costs. Heat pump grants are simple for governments to administer and simple for consumers to understand. They have been, and will continue to be, central elements of successful heat pump deployment strategies around the world.

Potential issues

Grants and tax rebates can be unsubtle measures which lead to rapid and potentially unsustainable market responses. Following market booms, the withdrawal of heat pump subsidies in Swiss and Swedish markets led to a rapid fall in the number of installations.[125]

Key decisions

- What should the level of the grant be, and should it reduce over time?
- Who should be eligible for grants and to whom should they be paid?
- What types of heat pumps should receive grants, and should the level of grant vary by type?
- Should the level of grant be linked to income to provide more support to lower-income households?
- How can grant schemes be kept simple and transaction costs low?
- How should the grant scheme be funded?

122 Sunderland, L. and Segura, L., eds. (2022, September). *The Energy Poverty Handbook.* The Greens/EFA in the European Parliament. https://www.greens-efa.eu/files/assets/docs/greens_energypovertyhandbook_web__1___1_.pdf

123 Blackout News. (2023, 11 June). *Heat pumps in Italy: Subsidies exhausted, market collapses*. https://blackout-news.de/en/news/heat-pumps-in-italy-subsidies-exhausted-market-collapses

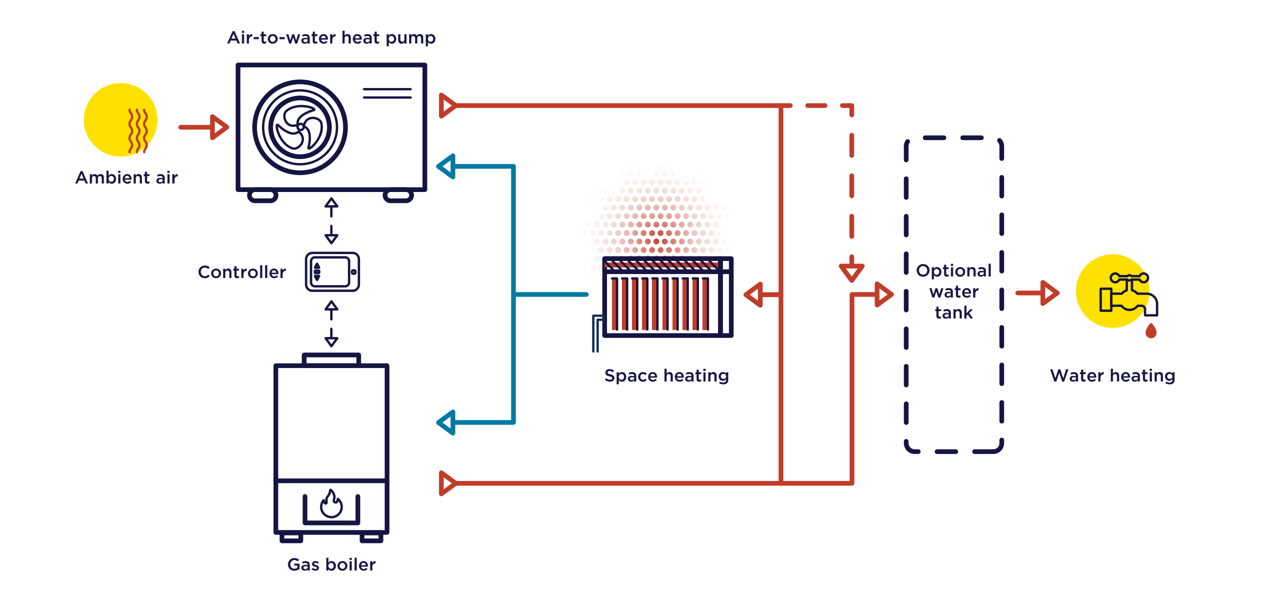
124 N26. (2023, March). *Italy's superbonus tax credit: Key changes in 2023.* https://n26.com/en-it/blog/superbonus-italy#no-more-credit-transfers-and-invoice-discounts-changes-to-the-2023-superbonus

125 Kiss et al., 2013.

Supporting hybrid heat pumps?

Hybrid heat pumps consist of a heat pump alongside another heating technology, typically a fossil fuel boiler. Hybrids are sometimes recommended if there are concerns around the ability of heat pumps to provide full heating at very low temperatures, or if a building has poor fabric efficiency and therefore a high heat demand. Hybrids may also allow a building owner to avoid the need for a hot water tank as heat pumps typically cannot produce domestic hot water instantaneously. A typical hybrid set-up combining a gas boiler and an air-source heat pump is shown below in Figure 15.[126]

Figure 15. Diagram of a hybrid heat pump system



Source: D. Gibb and R. Lowes. (2024, October). *One foot in the past: The role of hybrid heat pumps in Europe.*

Hybrid systems are likely to be unnecessary in most geographies and situations; they also require the financing and maintenance of two appliances and continued payment of any network/service fees. Hybrids will also not deliver full decarbonisation, and may mean further retrofitting in the future to remove the fossil fuel heating component.

Research by RAP has considered the potential for hybrid heat pumps in Europe and provided recommendations for policymakers considering their support. Overall, the RAP analysis suggests that if policymakers do choose to offer financial support for hybrids, this support should be:

- Targeted to specifically defined hybrids to ensure it offers value for money.
- Reflective of the value hybrids offer, without over-supporting them relative to full heat pump alternatives.
- Designed to ensure that the system delivers real emissions reductions.

126 D. Gibb and R. Lowes. (2024, October). *One foot in the past: The role of hybrid heat pumps in Europe.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/one-foot-in-past-role-hybrid-heat-pumps-europe/

8.2 Loans

Loans help reduce the upfront cost of heat pump installations by providing financing to a building owner which must be repaid over time.

How does it work?

Individuals may take out loans for heat pump installations like for any other home renovation. However, many jurisdictions have programmes geared specifically towards encouraging energy efficiency, which may be funded through government agencies, energy providers or even banks (sometimes called 'green banks'). These loans can be unsecured (no collateral) or secured (where the efficiency improvement is bundled into a home mortgage/credit package and the home is used as collateral, which may result in lower repayment amounts).[127]

In addition to loans and mortgages, there are other ways to finance efficiency improvements that are not associated with an individual, and are therefore not dependent on their creditworthiness, and may not require any money upfront, thus potentially increasing the number of installations. They are typically called on-bill and off-bill: on-bill is tied to the energy meter/account and repaid along with the energy bill, while off-bill is tied to the home and repaid through property taxes. Both automatically transfer to the next owner if the original owner moves out of the home, in effect mitigating some of the risk to the initial purchaser who may fear not getting their money back before moving.

127 Energy Sage. (2021, August). *Energy efficiency loans for homeowners.* https://www.energysage.com/energy-efficiency/financing/loans/

Examples

In Scotland[128] and Canada,[129] government loans are offered to households for energy efficiency work and heat pumps, and such loans can be combined with grants. Germany's state-owned KfW development bank also offers grant and loan combinations for household retrofits, including heat pumps.[130]

Another set of programmes growing in popularity in the United States are inclusive utility investments, also known under the trademark Pay As You Save (PAYS). Under these programmes, improvements are financed on-bill, and it is not the homeowner but the utility itself that is financing the investment. In effect, the utility is allowed to treat the efficiency improvement like other infrastructure, paying for it and recovering its cost (plus a profit) from customers through bills. This profit motive combined with the utility's low cost of capital and user-friendliness[131] has led to much better results compared to traditional loans (high total project amounts; ~80% customer offer acceptance compared to ~10% for loans; 0.1% default rate compared to 3—5% for loans).[132,133]

128 Home Energy Scotland. (n.d.). *Home Energy Scotland loan.* https://www.homeenergyscotland.org/find-funding-grants-and-loans/interest-free-loans/

129 Government of Canada, 2024c.

130 Bank aus Verantwortung. (n.d.). *Existing properties.* https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/

131 'This transforms the building upgrade process from one where customers coordinate contractors and pay for upgrades to one where they simply choose and receive building efficiency improvements.' Ferguson, J., Bickel, S., Lachman, H., Cillo, P. A. and Hummel, H. (2022). *Pay as you save system of inclusive utility investment for building efficiency upgrades: Reported and evaluated field experience in the United States* [Presentation]. ECEEE. https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2022/7-policies-and-programmes-for-better-buildings/pay-as-you-save-system-of-inclusive-utility-investment-for-building-efficiency-upgrades-reported-and-evaluated-field-experience-in-the-united-states/

132 Bickel, S. (2022, March 2). *Upgrade everyone* [Presentation].

133 OPALCO. (n.d.). *Are you ready to switch it up?: New measures added to OPALCO's on-bill financing program!* https://energysavings.opalco.com/switch-it-up-2/

This last issue is illustrated by two loan programmes in the US state of Connecticut. In one, residents can receive 0.99% annual interest rate financing up to 90% of the cost of a heat pump or other heating equipment (up to USD 15,000). The work is coordinated by a private financier and a vetted installer. Equipment must exceed current minimum efficiency standards, and the loan amount and payments are calculated based on anticipated energy cost savings. No credit check is required — electricity bill payment history is used instead.[134] In contrast, a public green bank also offers loans up to USD 40,000 to include heat pumps, more efficient fossil fuel systems, and other efficiency improvements such as insulation, air sealing, electric panel upgrades and building repairs, which are based on an audit and subject to a technical review. The interest rate is higher at 2.99% and a credit check is required.[135]

Key benefits

Since loans are repaid, the same funding can be used to fund additional installations in a revolving manner, allowing the programme to be self-sustaining or even profitable. This can increase the total number of heat pump installations given the same amount of funding. Loans can also be simple to administer.

Potential issues

Because loans are usually repaid with interest, which is an added cost of financing, they may not be as effective as subsidies at motivating rapid adoption. Government loans may reduce the cost of finance. Also, traditional loans (secured and unsecured) depend on borrower creditworthiness and are potentially risky to the borrower if their time horizon is uncertain, though on-bill and off-bill financing resolves many of those issues. In the case of loans and off-bill programmes secured using the home as collateral, there is the additional risk of the borrower losing their home if they default on the loan, which could be exacerbated by predatory lenders.[136] These programmes must therefore be carefully designed and implemented (e.g. using approved lenders and contractors, and subject to audits and technical review) to protect the customer.

Key decisions

- Should the loans come via government funding or through the private finance market? If the latter, how to incentivise the market?
- How to ensure the loans are providing benefit equitably and recipients are protected?
- What costs should the loans cover?

8.3 Heat as a service

Business model innovations can improve the economics of heat pumps for consumers and tackle the issue of upfront capital requirements. In heat-as-a-service (HaaS) propositions, instead of delivering a fuel (e.g. electricity or natural gas), energy providers supply a 'heating service.'[137] This commercial offer can range from appliance leasing to guaranteeing a constant temperature outcome within a building. In turn, customers typically pay a monthly subscription fee, avoiding the need for a large capital expense to swap out their heating appliance for a heat pump.

134 Capital for Change. (n.d.). *What is the Energize CT Heat Loan Program?* https://ctheatloan.com/about

135 CT Green Bank. (n.d.). *Heat pumps provide savings and comfort.* https://www.ctgreenbank.com/programs/smarte-heat-pump/

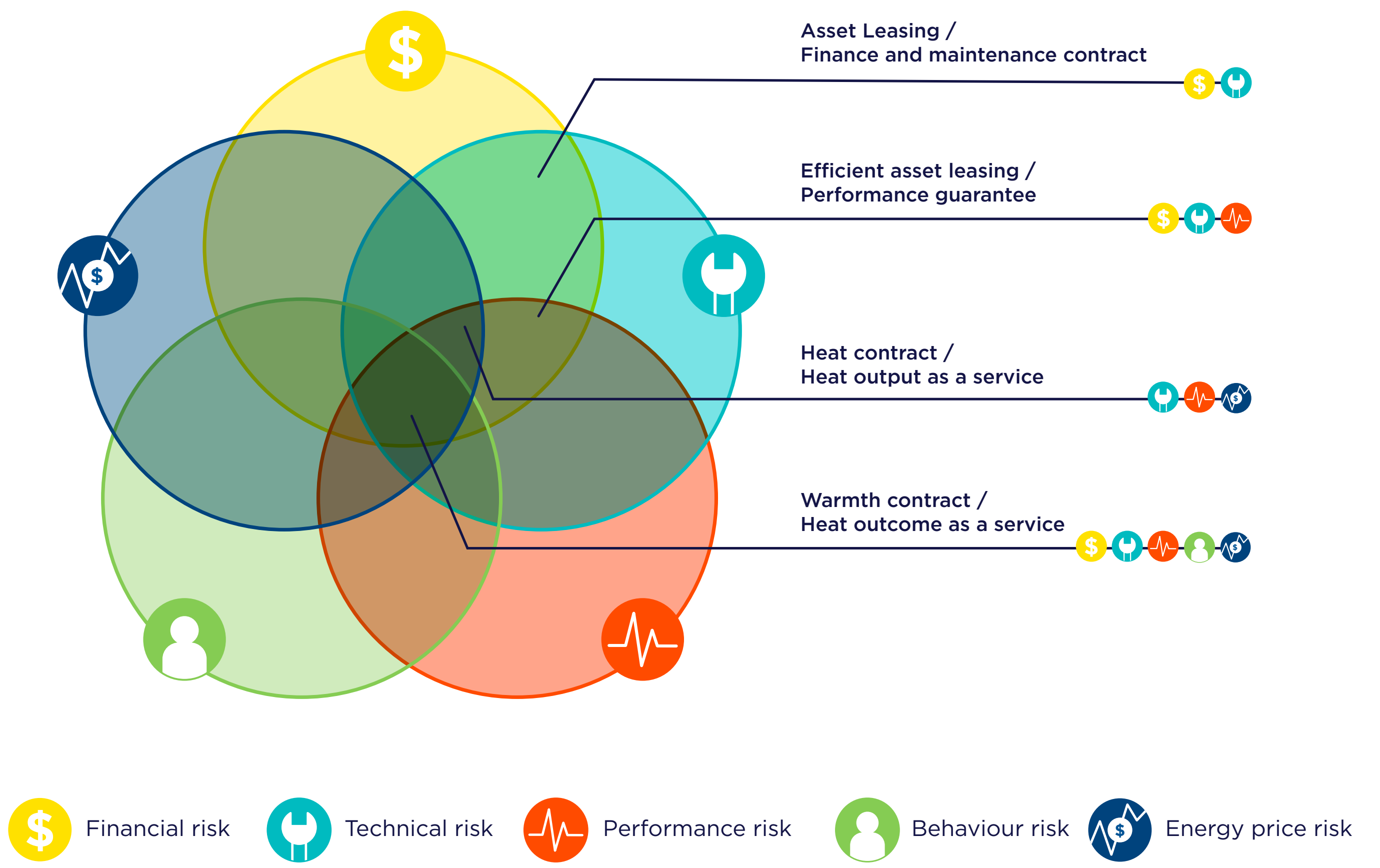
136 Dayen, D. (2017, December). *I tried to make my home energy efficient and it's ruining my life.* Economic Hardship Reporting Project. https://economichardship.org/2017/12/i-tried-to-make-my-home-energy-efficient-and-its-ruining-my-life/

137 Fleck, R., Annam, A., Hunt, E. and Lipson, M. (2021, January). *The potential of Heat as a Service as a route to decarbonisation for Scotland.* Climate Change & Energy Catapult Systems. https://www.climatexchange.org.uk/ media/4979/cxc-the-potential-of-heat-as-a-service-as-a-route-to-decarbonisation-for-scotland-january-2021.pdf

How does it work?

In HaaS offers, energy companies can take on various types of risk that are typically borne by the customer.[138] These include technical risk (maintenance and possible replacement of the heating appliance), performance risk (appliance and building efficiency), and energy price risk. Energy companies assume these risks, increasing the overall attractiveness of the heating offer to the consumer. In return, the customer agrees to pay a fixed subscription fee, providing the energy supplier with a stable and predictable long-term revenue stream. Energy suppliers typically provide these contracts; however, an increasing number of device manufacturers (e.g. Viessmann) are beginning to provide offers directly to consumers.[139] Figure 16 below shows different HaaS models and the various risks within such models.[140]

Figure 16. Risks assumed by energy provider under certain heat-as-a-service business models



Source: Sugden, L. (2021, December). *Heat as a Service propositions: One of the keys to unlocking the residential retrofit market for heat pumps.* IEA HPT. Adapted with permission from Lindsay Sugden, LCP Delta (formerly Delta-EE).

138 Pieterse, R. (2019, July). *Defining heat as a service.* LCP Delta. https://www.delta-ee.com/blog/defining-heat-as-a-service/

139 Sugden, L. (2021, December). *Heat as a Service propositions: One of the keys to unlocking the residential retrofit market for heat pumps.* IEA HPT. https://doi.org/10.23697/Z0K7-9A58

140 Adapted from Sugden, 2021.

Key benefits

On the consumer side, economic benefits include a lack of the major upfront expense typically related to a heat pump installation. In addition, consumers are becoming more familiar with monthly subscriptions and report a willingness to pay, knowing that they will receive a guaranteed service for a fixed price and avoid the energy price risk.[141] By moving technical and performance risk to companies, service-based contracts can also increase public trust in heat pumps and generate skills around optimal heat pump performance.

For suppliers, benefits range from predictable income streams to an expanded potential client base thanks to the removal of major upfront cost. In addition, suppliers can access the performance data and use it to improve their devices, and future value streams could be unlocked by using their networked heating devices as a source of demand-side flexibility. Thorough maintenance regimes alongside monitoring can also support long heat pump lives, providing a sustainable outcome.

Examples

Although HaaS contracts accounted for less than 1% of European heating appliance sales in 2020, these offers have seen growing uptake across the continent.[142] Companies in Denmark and Germany first introduced the models in 2015. Since then, energy companies in numerous European countries have begun offering heat supply contracts in different forms. Up to 10% of heating systems (100,000 heat pumps, up from 3,000 today) could be sold on a contract basis by 2030.[143]

In Germany, Viessmann 'rents heat' by charging a monthly fee for the equipment, maintenance and amount of heat delivered. In June 2022, heating start-up Thermondo began leasing heat pumps with a two-year maintenance agreement for EUR 159 per month. UK-based Energy Systems Catapult trialled HaaS offers in conjunction with other UK companies by paying for 'Warm Hours.'[144] In the Netherlands, Eneco has trialled a guaranteed 20 °C temperature for space heating and sanitary hot water for a monthly fee. BLOCPOWER in the United States and ClimateCare in Canada offer zero-upfront-cost heat pump systems with ongoing maintenance and performance guarantees for an ongoing charge.[145,146]

141 Catapult Energy Systems. (2019). *Heat as a Service: An introduction.* https://es.catapult.org.uk/report/ssh2-introduction-to-heat-as-a-service

142 Sugden, 2021.

143 Sugden, 2021.

144 Catapult Energy Systems. (n.d.). *Baxi and Bristol Energy trial heat-as-a-service with an eye towards zero carbon.* https://es.catapult.org.uk/news/baxi-and-bristol-energy-heat-services/

145 Bloc Power. (n.d.). *All-electric heating and cooling for a healthy, green, comfortable home.* https://www.blocpower.io/

146 Clarity by Climate Care. (n.d.). *Keeping your home comfortable shouldn't be a hassle.* https://www.climatecare.com/clarity/

Potential issues

Issues facing service-based contracts include the potentially significant energy price risk assumed by the service provider. In some countries, regulations require energy suppliers to offer the source of energy with the lowest running cost, or limit third-party access to subsidies available for heat pumps. Countries have begun putting in place policies to address these barriers, such as subsidies from the Danish government for heat pumps installed on a contract basis. Market reform may also be needed if energy companies can only legally bill customers per kWh.[147] Finally, the homeowner who decides on heating appliances (e.g. the landlord) may not directly receive the financial and convenience benefit of the HaaS contract, meaning that the incentives are not aligned. This barrier is especially problematic in countries with low rates of home ownership.[148]

Key decisions

- Could an obligation to offer heat as a service be placed on a market participant, and if so, on whom?
- Do energy suppliers have access to the same financial support (grants and rebates) as third parties (e.g. consumers)?
- Do regulations allow suppliers to sell energy services, and not only per kWh or BTU?
- Are energy suppliers able to access additional value streams with these assets, such as flexibility?

Image courtesy of Your Energy Your Way.

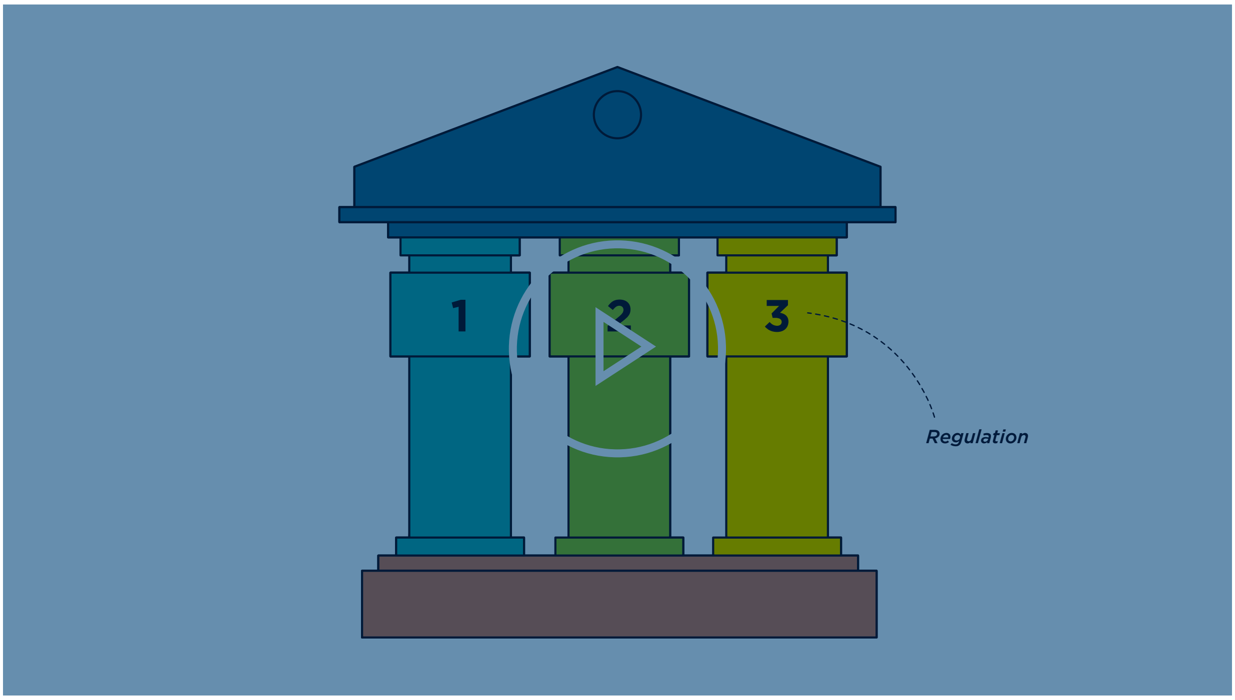
147 Dann, L. (2022, 30 May). Retail market reform not essential for heat-as-a-service model. *Utility Week*. Sponsored post by Capita. https://utilityweek.co.uk/retail-market-reform-not-essential-for-heat-as-a-service-model/

148 Irena, IEA, and REN21, 2020.

9 Pillar 3: Regulatory policies

While financial support and economic drivers are vital policy tools to drive heat pump deployment, regulations and standards are the focus of this chapter in our toolkit. You can watch the short video linked from the image below for a summary.

Figure 17. Policy toolkit pillar 3



Note: Click for a link to section summary video.

It will be impossible to overcome all the barriers to a mass heat pump market solely through voluntary means, even if financial and economic incentives make heat pumps cheaper than fossil fuel alternatives. Social and hassle factors may still be high enough that consumers are reluctant to switch to heat pumps.

Therefore, once there exists sufficient knowledge and experience demonstrating the benefits of heat pumps and the necessary networks and markets to deliver them economically, regulation can help transition the rest of the market.

Regulation establishes clear performance expectations for all stakeholders and provides clarity and certainty on the direction and scope of ambition and innovation required to decarbonise.

Regulation can play two roles in a market transformation campaign: it can be the first step, setting a clear pathway and forming a foundation for voluntary policies, and/or a last step, building on and locking in gains initially achieved through voluntary and subsidised means. As mentioned previously, policy needs to be coordinated and regulation and voluntary policies must work together, building on each other to enable higher levels of efficiency and heat pump adoption.

Whether regarding test methods, performance requirements or qualifications, it is helpful for agencies to attempt to harmonise regulatory standards with international examples and share best-practice case studies. This is because heat pumps and other heating equipment can be internationally traded, and similar requirements across countries bring down the costs of compliance and therefore lead to lower costs for customers, which increases adoption.

Multiple forms of regulation are possible. In this chapter we consider the key regulatory tools of buildings standards and codes, appliance standards and limits, and geographical zoning.

9.1 Building codes and standards

Building codes and standards can apply to new building works and renovations. Requirements can be made for new buildings to be built to achieve minimum energy performance requirements (normally expressed as low-energy intensity benchmarks for different building types), and/or to stipulate that they should have certain characteristics or technologies. Such requirements can include building envelope energy efficiency standards, embodied carbon or emissions intensity standards, and specific technology inclusion. Such measures can all drive the uptake of heat pumps as a contributor to achieving performance requirements. Standards can also be applied to existing buildings to drive improved envelope efficiency or technology upgrades.

How does it work?

Around 80 countries have building codes and standards, including energy codes, and these exist to ensure that buildings are structurally safe and suitable for habitation.[149] Codes and standards vary by region but often consider building energy use from an energy efficiency perspective, mandating limits to energy demand, for example. Such codes are important because buildings last for a long time but many are outdated and do not require near or net-zero performance.[150]

Mandatory energy performance standards in building regulations set minimum energy and emissions requirements for the construction of new buildings, the renovation of existing buildings, and ongoing building performance. It is particularly important to ensure that codes cover new residential construction, because residential buildings contribute the most to the growth in energy demand and associated greenhouse gas emissions.[151] Standards can mandate that no fossil fuel heating can be used, leading to developers installing low-carbon heating, including heat pumps, from the outset. Figure 18 outlines best-practice strategies for energy standards in new buildings.[152]

149 Delmastro, 2022a.

150 UNEP. (2024). *Global Status Report for Buildings and Construction.* https://doi.org/10.59117/20.500.11822/45095

151 Delmastro, 2022a.

152 GBPN. (2022). *Compare dynamic energy efficiency policies for new buildings.* www.gbpn.org/newbuilding codes

Figure 18. Best-practice policy strategies for supporting energy performance regulations in new construction

Source: GBPN. (2022). *Compare dynamic energy efficiency policies for new buildings.*

Because existing buildings will continue to make up a large portion of the building stock, standards can also be applied to this sector. Minimum energy performance standards (MEPS) for buildings can play a pivotal role in generating the necessary momentum. This mechanism sets regulated minimum standards for energy use in, or carbon emissions from, existing buildings. Building owners must make improvements to meet the target by a specific date or upon reaching a chosen trigger point, such as sale or renovation. By setting out a clear trajectory of improvements for individual buildings, they can support a massive increase in the renovation rate and the replacement of fossil fuel heating systems.

Awareness-raising and capacity-building are essential to prepare stakeholders for changes in the mandatory minimum requirements of building codes and policies over time. This work includes aligning public procurement practices with voluntary green building and other building performance rating schemes that have already established zero-energy and/or zero-emissions benchmarks. Governments should also work with product manufacturers and trade organisations to deliver training in designing and installing high-performance heat pumps.

Examples

Net-zero energy use targets: Revisions to South Korea's building codes require new public buildings with an area of at least 1,000 m2 to have net-zero energy consumption. In 2025 this will extend to public buildings of at least 500m2, private buildings of at least 1,000 m2, and apartment buildings with at least 30 units. By 2030, all new structures of at least 500 m2, both public and private, will have to be net zero in energy consumption.This requirement will naturally support the deployment of heat pumps because of their low energy consumption.

New building codes: California's 2022 Energy Code for newly constructed homes and businesses encourages heat pump technology and establishes electric-ready requirements for single-family homes.[153] Revisions to the State of New York's building code require all-electric new construction starting in 2024.[154] China has released and implemented a technical standard for nearly-zero energy buildings (CTS-NZEB, 2021). This defines the performance requirements for nearly-zero energy buildings in China and includes provisions for use of ground-source and air-source heat pumps in residential

153 Balaraman, K. (2022, 11 April). California injects $40M into heat pump water heater effort amid broader push to decarbonize buildings. *Utility Dive.* https://www.utilitydive.com/news/california-injects-40m-into-heat-pump-water-heater-effort-amid-broader-pus/621869/

154 Tan, Y.A., Gruenwald, T. and Shah, A. (2022, March). *New York set to pioneer a move to new all-electric buildings.* RMI. https://rmi.org/new-york-set-to-pioneer-a-move-to-new-all-electric-buildings/

and non-residential buildings.[155] The Future Homes Standard in the UK due to come into force in 2026 is expected to outlaw fossil fuel heating in new buildings, leading to increased heat pump uptake.[156]

The U.S. Department of Energy has adopted minimum energy efficiency appliance standards for consumer water heaters.[157] The standards will go into effect in mid-2029 as an obligation on manufacturers and imports. They are expected to result in over 50% of the newly manufactured electric storage water heaters using heat pump technology, compared to 3% today.[158]

Renovation energy standards: Such incentives vary significantly by geography, by building type, and by the type of requirement. In New York, minimum carbon standards cover large buildings with set carbon reduction levels by 2030 and 2050. In New Zealand, certain efficiency measures and fixed heating systems are mandated for privately rented homes. In Scotland, privately rented homes are required to meet ever-increasing energy performance standards.[159]

Key benefits

Building codes already exist in many geographies, and they often consider energy demand. Strengthening them so that buildings perform better and heat pumps are incentivised can be a relatively straightforward policy change. They are the key tool to ensure that new buildings are constructed with low-carbon heating and heat pumps. For existing buildings, they can be an important tool to protect people in rental accommodation and drive heat pump deployment in advance of eventual appliance bans.

Potential issues

Implementation, compliance and enforcement of building energy codes remains challenging, especially in the residential sector; it can also be a slow process. Barriers to effective implementation include a lack of baseline data (or access to data) on building stock profile, age and energy demand; under-resourced governance of code implementation and poor coordination between national, regional and local governments on code development, adoption and enforcement; and a lack of administrative capability for code enforcement, compliance reviews and site inspections.

Key decisions

- What is your goal and the date by which it is to be achieved?
- How will you manage stakeholder engagement and build capacity to ensure that the energy performance provisions of codes are understood and accepted by the building industry?
- How will national policies work locally?
- Will funding be needed for certain sectors, in particular the public sector?
- How do minimum energy performance standards for retrofits dovetail with other policy measures?

155 Kang, Y., Wu, J., Liu, R., He, L., Yu, Z. and Yang, Y. (2020, May). Handshaking towards zero-concept analysis and technical measures of LEED zero-energy building in connection with technical standard of nearly zero-energy building in China. *Energy Exploration & Exploitation 39*(2): 669-689. doi:10.1177/0144598720923149

156 UK Government. (2024, March). *The Future Homes and Buildings Standards: 2023 consultation* [closed]. https://www.gov.uk/government/consultations/the-future-homes-and-buildings-standards-2023-consultation/the-future-homes-and-buildings-standards-2023-consultation

157 U.S. Department of Energy. (2024a, May). *Energy Conservation Program: Energy Conservation Standards for Consumer Water Heater.Heaters Final rule*. https://www.govinfo.gov/content/pkg/FR-2024-05-06/pdf/2024-09209.pdf.

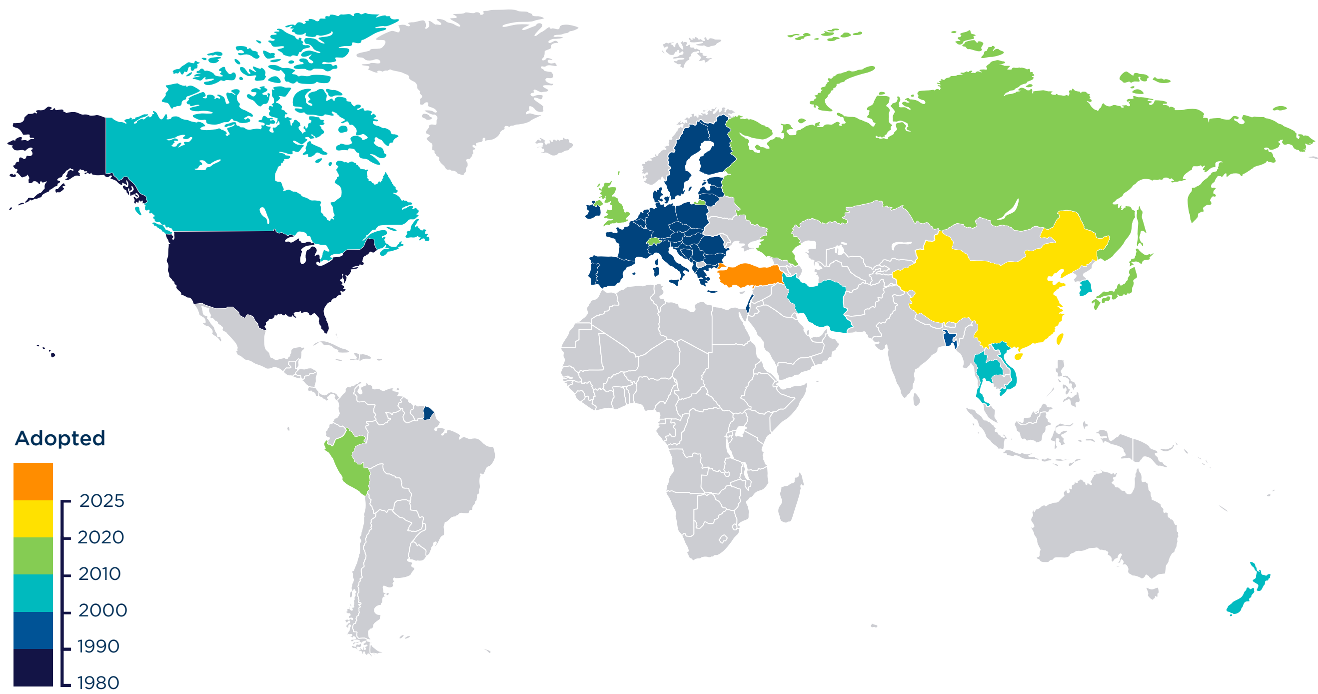
158 U.S, Department of Energy. (2024b, April). *DOE Finalizes Efficiency Standards for Water Heaters to Save Americans Over $7 Billion on Household Utility Bills Annually.* https://www.energy.gov/articles/doe-finalizes-efficiency-standards-water-heaters-save-americans-over-7-billion-household.

159 A review of existing minimum energy performance standards is available here: Sunderland, L. and Santini, M. (2021, June). *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/

9.2 Appliance standards and sales limits

Whereas building codes control the installation of heating equipment, appliance standards and sales limits typically control what heating equipment can be sold, imported, manufactured (or even exported depending on the relevant legal authority). Figure 19 shows countries that have heating equipment appliance standards and their initial adoption date.[160]

Figure 19. Countries with space heating appliance standards and their initial adoption date



Source: CLASP. (n.d.). *CLASP Policy Resource Center.*

How does it work?

Sale restrictions or additional requirements on heating equipment (such as on fossil fuel or electric resistance heating, or one-way air conditioners[161]) can make them either illegal to sell or prohibitively expensive compared to alternatives. Increasing the efficiency, cold-weather performance or quality of heat appliances, thereby improving customer economics and satisfaction, can indirectly drive consumers towards heat pumps — or, indeed, towards better heat pumps.

The range of policies of both types that can promote heat pump adoption is shown in Table 2 below.

160 CLASP. (n.d.). CLASP Policy Resource Center. https://www.clasp.ngo/tools/clasp-policy-resource-center/

161 Manufacturers often offer two-way (heat pump) versions of air conditioners that heat as well as cool. Depending on their capacity and low-temperature performance, these products may not always meet the entirety of the building's load but can displace significant amounts of fossil fuel at low cost. See: Malinowski, M., Dupuy, M., Farnsworth, D. and Torre, D. (2022, July). *Combating high fuel prices with hybrid heating: The case for swapping air conditioners for heat pumps.* CLASP and Regulatory Assistance Project. https://www.clasp.ngo/research/all/ac-to-heat-pumps/

Table 2. Different types of appliance policies and how they promote cleaner heating

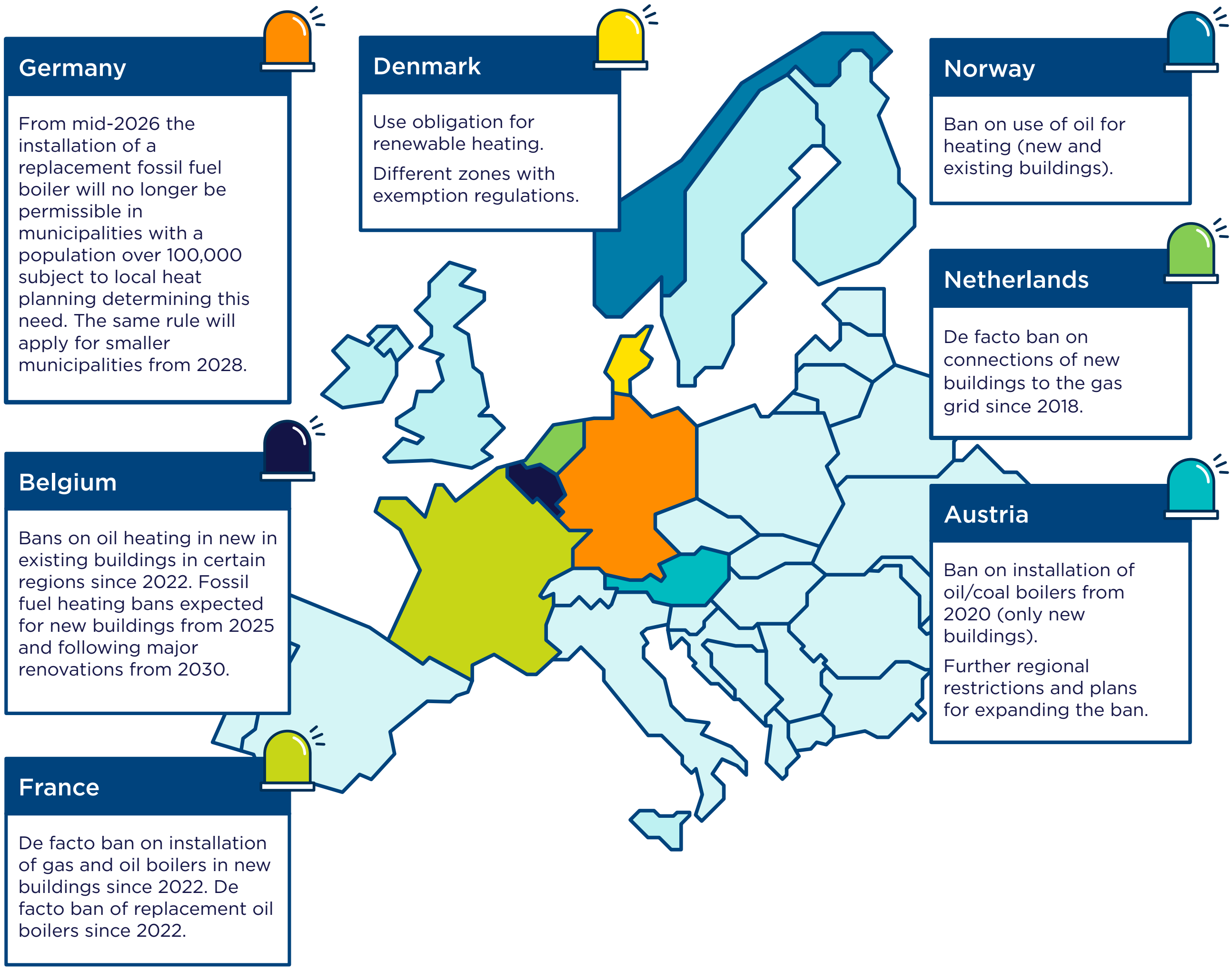
	Type of equipment controlled	
Policy type	**Legacy equipment** *(fossil fuel or electric resistance heating, or one-way air conditioners)*	**Heat pump**
Ban	• Outright ban • Withdrawal of endorsement label	• Not applicable
Appliance standard	• Efficiency requirements: (condensing >90% or heat pump >100%) • Direct emissions limits (low NOx) • Low global warming potential refrigerant	• Efficiency • Low-temperature performance (efficiency, maintaining capacity) • Noise • Correct operation of controls under realistic conditions • Low global warming potential refrigerant

Examples

Several countries in Europe have limited or will soon limit the installation or use of fossil fuel heating, as can be seen in Figure 20[162] below. Building codes typically may make sense for new buildings, but for existing buildings, appliance bans and limits on sales may be needed to drive the retrofit market.

162 Braungardt, S., Tezak, B., Rosenow, J. and Bürger, V. (2023, September). Banning boilers: An analysis of existing regulations to phase out fossil fuel heating in the EU. *Renewable and Sustainable Energy Reviews, Volume 183,113442. ISSN 1364-0321,* https://doi.org/10.1016/j.rser.2023.113442

Figure 20. Fossil fuel heating restrictions in EU Member States and Norway



Source: Based on Braungardt, S., (2023, September). Banning boilers: An analysis of existing regulations to phase out fossil fuel heating in the EU. *Renewable and Sustainable Energy Reviews.*

Also in the United States, the *voluntary* ENERGY STAR endorsement programme has stopped recognising fossil fuel as 'Most Efficient,'[163] does not recognise electric resistance at all,[164,165] and recently imposed additional standards on cold-climate heat pumps to ensure satisfactory performance. Cold-climate heat pumps not only have to meet efficiency requirements at the default national testing conditions (including 17 °F/-8 ° C), but also must maintain efficiency and capacity at 5 °F/-15 °C while using their native controls in default mode.[166,167] Meanwhile, the latest proposed *mandatory* standards for methane and propane gas furnaces would

163 Bailey, A. (2021, September). *EPA will not be recognizing ENERGY STAR Most Efficient furnaces, boilers, or gas dryers in 2022* [ENERGY STAR Most Efficient 2022 Final Criteria Memo]. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Most%20Efficient%202022%20Final%20Criteria%20Memo_0.pdf

164 U.S. Environmental Protection Agency. (2013, February). *ENERGY STAR® program requirements product specification for furnaces: Eligibility criteria version 4.1.* https://www.energystar.gov/sites/default/files/Furnaces%20Version%204.1_%20Requirements_0.pdf

165 No electric resistance water heater specifications at U.S. Environmental Protection Agency. (n.d.[a]). *Product Specifications & Partner Commitments Search.* https://www.energystar.gov/products/spec

166 The cold-climate requirements were pioneered by the Northeast Energy Efficiency Partnership (NEEP). See NEEP. (2024). *CCASHP specification & product list.* https://neep.org/heating-electrification/ccashp-specification-product-list

167 U.S. Environmental Protection Agency. (n.d.[b]). *ENERGY STAR Cold Climate Heat Pump Controls Verification Procedure (CVP).* https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Cold%20Climate%20Heat%20Pump%20Controls%20Verification%20Procedure_0.pdf

increase efficiency from 80% to 95%, requiring the use of condensing technology. The added cost is expected to shift 7% of customers to heat pumps.[168]

Finally, two US states and four local 'air quality management districts' have set nitrogen oxide (NOx) pollution limits on fossil fuel water heaters. Similar requirements could be set on other fossil fuel equipment, as NOx pollution from appliances exceeds that from power plants. Limiting NOx could shift demand to heat pumps, while also limiting the impacts of fossil fuel appliances that continue to be installed.[169]

Key benefits

Appliance standards and sales limits control equipment at the point of sale or manufacture, and so are more centralised and can have higher compliance than, for example, building regulations. They may also be important for the retrofit sector. In addition, they can be more equitable than voluntary programmes, such as incentives, which tend to benefit people who are richer, better-resourced, more knowledgeable, own their home, and, in the case of tax credits, have a tax liability.

Potential issues

Of the two policies, sales limits are more straightforward: any equipment that meets a definition may no longer be sold. Appliance standards, on the other hand, do not ban equipment but improve its performance. They are more incremental but also typically more complicated, requiring the establishment of test procedures, specific performance requirements, and compliance mechanisms.[170,171]

While standards on legacy equipment have the effect of increasing the equipment's upfront costs, that is not their primary purpose, and they should not be viewed simply as a way to tilt the playing field in favour of heat pumps. Rather, standards are typically a genuine attempt to address key shortcomings of legacy technologies, such as their inefficiency or pollution.

Of course, appliance standards may also increase the upfront costs of heating systems, so regulators often make sure these higher costs will be offset through lower operating costs. However, there is evidence that in the long term appliance standards drive down both upfront and operating costs, by bringing economies of scale to formerly niche efficiency technologies.[172]

Key decisions

- Does the policymaker have the authority to completely ban equipment or develop standards? Does a regulatory framework exist?
- What are the likely impacts of a sales limit or standard, and have a broad range of costs and benefits been considered (e.g. not just financial costs but health and emissions as well)?
- What are the impacts on disadvantaged populations?

168 Walton, R. (2022, 14 June). Proposed gas furnace efficiency rule expected to move 9% of customers toward electric heat: DOE. *Utility Dive.* https://www.utilitydive.com/news/doe-proposed-gas-furnace-efficiency-rule-electric-heating/625426/

169 Seidman, N., & Shenot, J. (2021, December). *NOx, NOx — Who's There? Regulatory Assistance Project.* https://www.raponline.org/knowledge-center/nox-nox-whos-there/

170 For an overview of standards and labelling, see: CLASP (2005, March). *S&L guidebook — English version.* https://www.clasp.ngo/research/all/s-l-guidebook-english-version/

171 Standards can be set based on minimum, average or maximum performance. See: Ministry of Economy, Trade, and Industry, Agency for Natural Resource and Energy. (2015, March). *Top runner programme: Developing the world's best energy efficient appliance and more.* https://policy.asiapacificenergy.org/sites/default/files/toprunner2015e.pdf

172 Van Buskirk, R.D., Kantner, C L.S., Gerke, B.F. and Chu, S. (2014, November). A retrospective investigation of energy efficiency standards: Policies may have accelerated long term declines in appliance costs. *Environmental Research Letters 9*(11). https://iopscience.iop.org/article/10.1088/1748-9326/9/11/114010/meta

9.3 Planning and zoning

Heat pumps tend to be distributed mostly at a building level. However, in densely populated areas and/or in buildings containing multiple dwellings, more centralised heat pump systems which distribute heat across a building or at a city level (i.e. using district heating) may be more cost-effective and easier to install, and the IEA's net-zero scenario suggests the number of buildings on heat networks will double by 2050.[173] In these situations, planning will be needed to develop and coordinate such systems. Planning may also be important for managing power network expansion and gas network decommissioning.

How does it work?

Local energy governance requires a local government that is actively engaged in cooperation with central or regional government, which provides a stable framework and financial support.[174] Local governments, potentially in collaboration with or led by private actors, effectively analyse and map areas to determine optimum heating solutions, and consider where heat pumps or heat networks may be required and how heat will be produced, depending on heat demands and resource availability.

Following mapping, local governments work at municipal level or with business to deliver planning elements, such as heat networks or building upgrades.

Examples

As shown in Figure 21 below,[175] heat networks already exist at scale in several Nordic and eastern or central European countries, following the establishment of programmes to support their deployment.

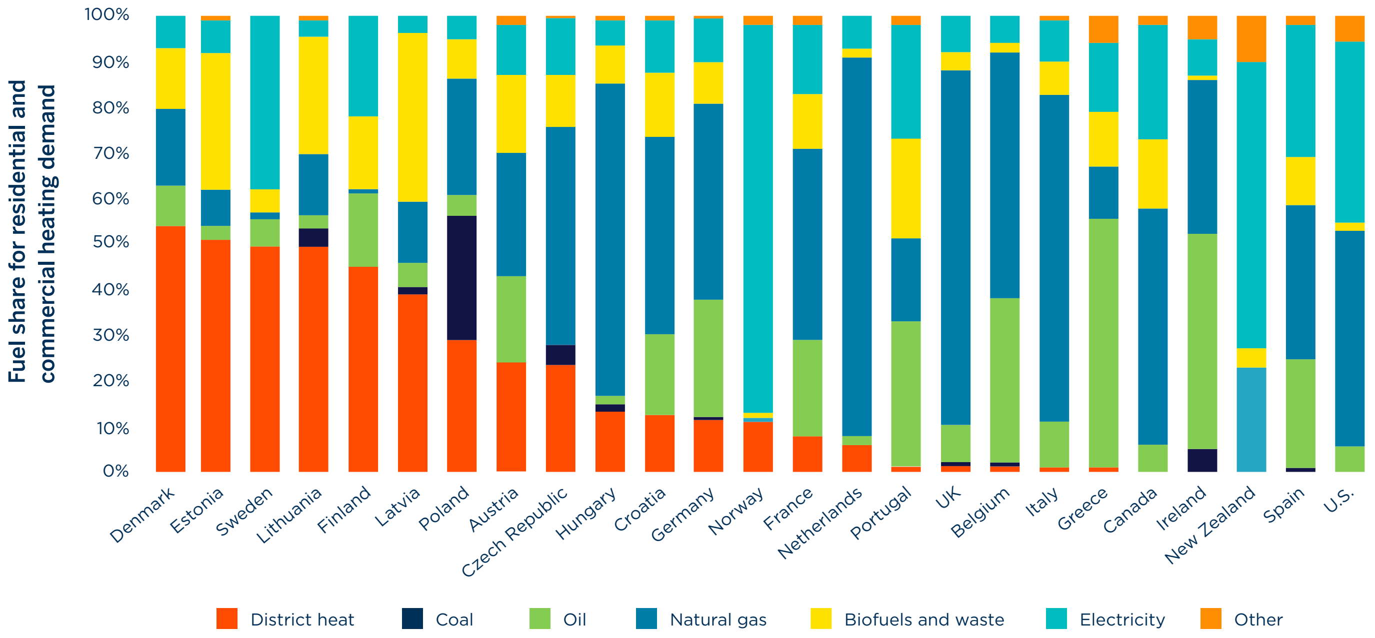
Boreholes being drilled for a shared ground loop heat pump scheme. Courtesy Kensa Heat Pumps.

173 IEA, 2021.

174 Rao, L., Chittum, A., King, M. and Yoon, T. (2017, May). *Governance Models and Strategic Decision-Making Processes for Deploying Thermal Grids.* IEA. https://www.districtenergy.org/HigherLogic/System/DownloadDocumentFile. ashx?DocumentFileKey=e24e4c4e-3cd8-825e-d1eb-518dc945632c&forceDialog=0

175 BEIS, 2017.

Figure 21. Residential and commercial heating mixes in selected OECD countries, stacked according to share of district heating in heat mixes



Source: BEIS. (2017, November). *Annex: International comparisons of heating, cooling and heat decarbonisation policies.* Recent data compiled by RAP.

Denmark, which has district heating providing heat to around 63% of homes,[176] initially started its rollout in the 1920s, but after the oil crises of the 1970s it legally obligated municipalities to map and plan for the location.[177] Heat networks were delivered on a socially just, not-for-profit basis, and Denmark is now looking to move towards increased use of heat pumps.

The city of Bristol in the UK used mapping to identify a 'heat priority area' for heat networks[178] and has since entered into a commercial agreement with US firm Amaresco to deploy solar PV, heat networks and heat pumps across the city at scale.[179] In Scotland, the government has driven a programme to develop local 'Heat and Energy Efficiency Strategies.'[180]

The government of the Netherlands now requires municipal governments to develop heat plans, and provides them with the resources to do this.[181] In Colorado, municipal gas distributors are required to produce cost-efficient 'clean heat plans' aligned with specific emissions reductions; such plans could include heat networks and heat pumps.[182]

176 Solar Thermal World. (2015). *Country-by-country 2015 overview.* https://solarthermalworld.org/wp-content/uploads/2016/07/2015-country-by-country-statistics-overview_euroheat.pdf

177 DBDH. (n.d.). *District heating history: Zoning — regulating the supply of gas and district heating.* https://dbdh.dk/d hc-in-denmark/district-heating-history/#no_07

178 Energy Service Bristol. (n.d.). *Heat networks.* https://www.energyservicebristol.co.uk/business/heat-networks/

179 Energy Service Bristol. (n.d.). *Bristol's city leap.* https://www.energyservicebristol.co.uk/cityleap/

180 Scottish Government. (2022, January). *Local Heat and Energy Efficiency Strategy (LHEES) pilot programme: Synthesis evaluation.* https://www.gov.scot/publications/synthesis-evaluation-local-heat-energy-efficiency-strategy-lhees-pilot-programme/

181 Devenish, A. (2022, January). *Dutch municipalities are tasked to lead the heat transition to quit gas — do they have the right tools for the job?* Going Dutch. https://www.going-dutch.org/news-1/dutch-municipalities-are-tasked-to-lead-the-heat-transition-to-quit-gas-do-they-have-the-right-tools-for-the-job

182 Colorado General Assembly. (2021, June). *SB21-264. Adopt Programs Reduce Greenhouse Gas Emissions Utilities. Concerning the adoption of programs by gas utilities to reduce greenhouse gas emissions, and, in connection therewith, making an appropriation.* https://leg.colorado.gov/bills/sb21-264

The EU's Energy Efficiency Directive, updated in 2023, creates requirements for all regions with more than 45,000 citizens to conduct heating and cooling planning.[183]

Key benefits

In a transition, heat planning and zoning can prevent individual solutions from threatening the viability of district solutions (which are likely to use large heat pumps) while simultaneously identifying areas for building-level heat pump deployment. Such zoning can provide regulatory certainty. Coordinating infrastructure development can also reduce costs.

Potential issues

For countries and regions which haven't delivered heat networks, the use of planning and municipal delivery may present a novel and complex energy problem, unsuited to existing governance structures. Because local planning is likely to be needed alongside national-level policies, heat planning needs to be coordinated across scales of governance (i.e. considered and regulated for simultaneously at a local and national political level). Consumer engagement, acceptance and protection must also be considered as part of heat planning.

Key decisions

- At what scale is a local body — this may be a U.S. state, a regional authority, or a city or town — best placed to drive planning? This decision will depend on the existing governance structure and the population size.
- What legislative powers are devolved to local lawmakers and regulators, and what others are needed?
- Who should be involved in the planning process?

183 EUR-Lex. (2023. September). *Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast) (Text with EEA relevance).* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AJOL_2023_231_R_0001&qid=1695186598766

10 Employing the toolkit across the globe to assess and advise

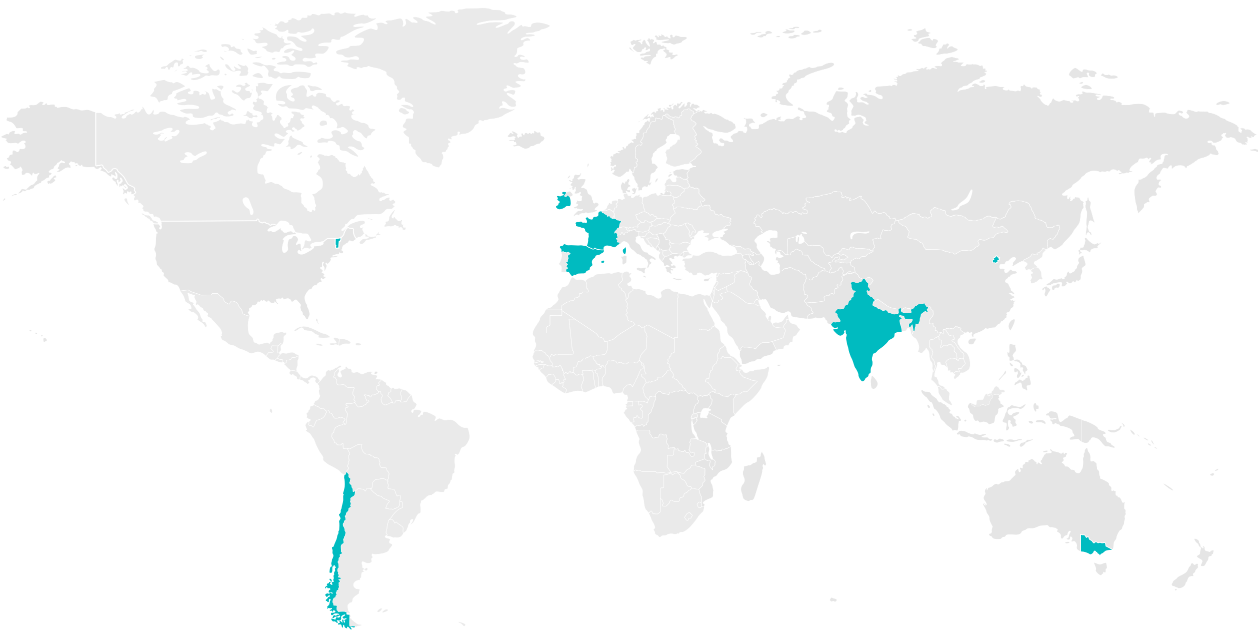
As a new addition to Version 2.0 of this toolkit, we have assessed the heat pump policy support of several countries based on the toolkit structure. These qualitative case studies are presented individually and summarised below in a 'traffic light' style table for comparison, where green is 'sufficient', orange is 'attention needed,' and red is 'significant gap'.

The jurisdictions evaluated are Victoria (Australia), Chile, Beijing (China — not included in traffic light document due to lack of information), Spain, France, India, Ireland and Vermont (United States). These are all places where the organisations involved in the toolkit have expertise and have conducted local research or engagement.

Our analysis highlights significant variations in heat pump support around the world; and of the countries considered, none receive a perfect review, showing that despite lots of good practice, further policy progress is needed across the board. We also recognize a general lack of carbon pricing mechanisms covering the heat sector in these jurisdictions. Heat-as-a-service offerings are apparently not given public support in any of them.

Image from Shutterstock.

Figure 22. Traffic light classification of the heat pump policy mixes of chosen jurisdictions



		Victoria, Australia	Chile	Spain	France	India	Ireland	Vermont, USA
Regulation	Heat planning and zoning	Attention needed	Attention needed	Significant gap	Attention needed	Significant gap	Attention needed	Sufficient
	Building codes, appliance standards	Sufficient	Sufficient	Attention needed	Attention needed	Attention needed	Attention needed	Significant gap
Economic and market instruments	Carbon taxation	Significant gap	Significant gap	Significant gap	Sufficient	Significant gap	Sufficient	Significant gap
	Taxes and levies (pricing)	Attention needed	Attention needed	Attention needed	Attention needed	Attention needed	Attention needed	Attention needed
	Obligations and portfolio standards	Attention needed	Attention needed	Sufficient	Attention needed	Significant gap	Attention needed	Sufficient
Financial Support	Grant and tax rebates	Attention needed	Significant gap	Sufficient	Sufficient	Significant gap	Attention needed	Sufficient
	Loans	Attention needed	Significant gap	Significant gap	Sufficient	Attention needed	Sufficient	Sufficient
	Heat as a service	Significant gap	Significant gap	Significant gap	Significant gap	Significant gap	Significant gap	Significant gap
Communications and coordination	Communication	Attention needed	Attention needed	Significant gap	Sufficient	Significant gap	Significant gap	Sufficient
	Installer training and certification	Attention needed	Attention needed	Significant gap	Attention needed	Significant gap	Attention needed	Attention needed
Broad equity support	Low-income support	Attention needed	Sufficient	Significant gap	Sufficient	Significant gap	Significant gap	Attention needed

- Sufficient
- Attention needed
- Significant gap

Note: **Some states and territories in Australia score better than others. This focuses on Victoria and its access to national programs.*
***This refers to the U.S. state of Vermont and its access to U.S. federal programs.*
**** Beijing Municipality is not included in this table owing to comparability issues.*

Please refer to Chapters 8-10 for definitions of each policy support action.

10.1 State of Victoria (Australia)

National and state objectives

To meet the goals of the Paris Agreement, Australia has three current emissions reduction targets: i) a commitment to reduce greenhouse gas emissions to 43% below 2005 levels by 2030, implemented as a single-year point target; ii) a multi-year emissions budget for the period 2021 to 2030, corresponding to the 43% target; and iii) achieving net-zero emissions by 2050.

The Victorian Renewable Energy Target aims to have 95% renewable energy generation by 2035. It also sets an emissions reduction target of 75-80% by 2035.

Market overview

Australia is experiencing a surge in heat pump sales, and this is expected to rise as gas appliances are phased out. Because of the federation state structure, there are various regulations, standards and policies that may not apply uniformly across the country.

Regulation

Victoria's Gas Substitution Roadmap outlines Victoria's transition from fossil gas to sustainable alternatives. From 2024, new gas connections for new dwellings, apartment buildings and residential subdivisions requiring planning permits are being phased out in the state. The Victorian government is also in the consultation phase to introduce minimum standards for rental properties, including encouragement of heat pumps for space heating and cooling, and hot water.

Economic and market-based instruments

The Victorian Energy Upgrades (VEU) program provides access to discounted energy-efficient products and services. Large energy retailers are required to acquire and surrender Victorian energy efficiency certificates (VEECs) to meet the annual target set in Victorian legislation.

Financial support

Victoria's Solar Victoria Hot Water Rebate provides households with up to AUD 1,000 for eligible heat pump hot water systems. Incentives from the VEU and Solar Victoria can be combined by householders, to further reduce the cost of the product. There are also some national financial support options accessible to Victorians.

Communications and coordination

There is no central national source of information and tools related to heat pumps in Australia, but there are a range of sources available to the public from a variety of stakeholders, including governments.

Links to further resources

Climate Change Authority. (2024, October). *2035 Emissions Reduction Targets*. https://www.climatechangeauthority.gov.au/2035-emissions-reduction-targets

Victoria State Government. (2023, May). *Victoria's 2035 Emissions Reduction Target – Driving Real Climate Action*. https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0028/635590/Victorias-2035-Climate-Target_Driving-Real-Climate-Action.pdf

Australian Government. (2023, September). *Heat pumps – Emerging trends in the Australian market.* https://www.dcceew.gov.au/sites/default/files/documents/heat-pumps-emerging-trends-in-australian-market.pdf

Victoria State Government. (2024, May). *Victoria's Gas Substitution Roadmap.* https://www.energy.vic.gov.au/renewable-energy/victorias-gas-substitution-roadmap

Victoria State Government. (2024, August). *Victorian Energy Upgrades for homes.* https://www.energy.vic.gov.au/victorian-energy-upgrades/homes

Solar Victoria. (2024). *Hot water rebate.* https://www.solar.vic.gov.au/hot-water-rebate

10.2 Beijing Municipality (China)

National objectives

In November 2023, Beijing municipality (Beijing) — which has status similar to a provincial government in China's system — issued a 'New Energy Heating' policy implementation framework. The framework requires 'new energy heating' — heat pumps, waste heat and geothermal heat — to make up more than 10% of the city's heating floor space in 2025 and more than 15% in 2030. This was the first time a major provincial- or municipal-level government in China has issued a policy specifically promoting electrification over fossil gas heating. The Beijing framework moves beyond the national guidance in the current five-year plan, in which electric heat pumps and fossil gas heating are both officially classified as 'clean heating.'

Market overview

China is the world's largest market in terms of heat pump installations. The market grew by 12% in 2023. However, coal still accounts for about half of final energy use for heating. Cities in the north, such as Beijing, feature significant use of district heating systems and central heating systems. Most of these northern systems still rely on coal, although Beijing is a leader in shifting away from coal. New energy heating represented 4% of the municipality's heating floor space in 2020.

Regulation

Starting in 2018, Beijing effectively phased out coal use (including for heating and power generation) within municipal borders, but increased use of fossil gas. The 2023 policy implementation framework builds on this by 'prohibiting' new construction or expansion of fossil gas heating systems, albeit with significant possible exceptions, including for small residential wall-mounted fossil gas water heaters.

Economic and market-based instruments

Beijing has an existing programme of subsidies for heat pump equipment, and the new policy framework calls for development of additional incentives for new energy centralised heating. China has a national carbon trading mechanism, and Beijing implemented one of the original pilot local government carbon trading mechanisms in the 2010s; local carbon trading schemes (such as the ETS in Beijing) include emissions from heating.

Financial support

Following the release of the November 2023 policy framework, which only broadly encourages additional funding for new energy investments, Beijing publicised a special programme for funding 'new energy heating' projects. A maximum of 30% of the investment cost for a new construction or expansion of a heating project can be supported if the project utilises over 60% of 'new energy'.

Communications and coordination

The 2023 framework gives primary responsibility to a Beijing Commission for 'formulating new energy heating support policies and development plans, promoting the green and low-carbon transformation of energy and the reconstruction of heating systems; proposing the planning and layout of major projects for new energy heating, strengthening the overall coordination and service scheduling of key projects for new energy heating…'

Links to further resources

Beijing Municipal Development and Reform Commission. (2023, November). *Notice of ten departments including Beijing Municipal Development and Reform Commission on issuing implementation opinions on comprehensively promoting high-quality development of new energy heating*. https://fgw.beijing.gov.cn/fgwzwgk/zcgk/bwqtwj/202311/t20231108_3297412.htm

IEA. (2024b, March). *The Future of Heat Pumps in China.* https://www.iea.org/reports/the-future-of-heat-pumps-in-china

Beijing Municipal Ecology and Environment Bureau. (2023). *Notice of Beijing Municipal Ecology and Environment Bureau on the Management of Carbon Emission Units and the Pilot Project of Carbon Emission Trading in 2023*. https://sthjj.beijing.gov.cn/bjhrb/index/xxgk69/zfxxgk43/fdzdgknr2/zcfb/hbjfw/326071951/326091327/index.html

Beijing Municipal Development and Reform Commission. (2024, July). *Notice on publicly soliciting fixed asset investment from the municipal government to support new energy heating and photovoltaic power generation projects.* https://fgw.beijing.gov.cn/gzdt/tztg/202407/t20240711_3743432.htm

10.3 Chile

National objectives

By 2050, Chile aims to achieve 80% sustainable energy use in heating and cooling, focusing on renewable energy like biomass and solar PV, supplemented by electric heat pumps. The country also targets electric heating for 56% of houses and 70% of apartments, and plans for 90% of industrial heating and cooling energy to come from sustainable sources. Additionally, Chile seeks to reduce particulate matter pollution from heating by 70% compared to 2018 levels, addressing the significant impact of firewood use. In 2021, Chile launched its Heat and Cold Strategy, a public policy framework that aims to reduce greenhouse gas emissions from heating and cooling by 65% by 2050.

Market overview

Chile's climate is diverse due to its 4,300 km length and wide-ranging geography, resulting in varying heating and cooling needs across the country. The market faces several heating challenges including the widespread use of firewood for heating. Firewood is the main source of heating in Chile at 30% nationwide, but reaching up to 90% in southern rural areas, causing severe air quality, biodiversity and health concerns.

Regulation

Chile has established energy efficiency policies specifically targeting certain refrigeration and air-conditioning equipment, primarily for domestic use. These include energy efficiency certification, labelling, and minimum energy performance standards. The Ministry of Energy determines which products require certification and labelling. Chile's General Ordinance of Urbanism and Construction (Decree 47, Article 4.1.10), adopted by the Ministry of Housing, mandates energy efficiency standards for residential building envelopes. This standard, updated in May 2024, is the primary energy efficiency requirement for residential buildings.

Economic and market-based instruments

Chile currently has a carbon tax of USD 5 per tonne of CO2 from stationary sources, lower than the government's estimated social cost of carbon at USD 32.5 per tonne. The country aims to increase this tax to at least USD 35 per tonne by 2030. Additionally, the recently implemented Green Tax Emissions Compensation System and National Emissions Certification Programme support carbon-neutrality and aim to encourage investments in new technologies, potentially promoting the use of heat pumps in the industrial sector.

Financial support

Chile has implemented various programmes to promote efficient, less-polluting heating technologies, including the Heater Replacement Programme, the Rechange your Heat Programme (offering 20-30% discounts on electricity tariffs), and heating subsidies. These initiatives aim to reduce wood-burning emissions by encouraging the switch to electric heating and providing financial support for heat pumps in the industrial sector. However, broader education and better planning could improve their effectiveness.

Communications and coordination

Chile has made efforts to enhance coordination and communication strategies on energy topics, including information on sustainable heating and energy efficiency, through initiatives like the Energy Education Strategy and programmes such as My Efficient Home Guideline and the Good Energy Programme. However, further dissemination is needed, including detailed data on heat pump deployment.

Links to further resources

Ministry of Energy. (2021). *Estrategia de Calor y Frio.* https://caloryfrio.minenergia.cl/

Inter-American Development Bank. (2021, November). *Options to Achieve Carbon Neutrality in Chile: An Assessment Under Uncertainty.* https://publications.iadb.org/en/publications/english/viewer/Options-to-Achieve-Carbon-Neutrality-in-Chile-An-Assessment-Under-Uncertainty.pdf

Ministry of Energy. (2022, February). *Transicion Energetica de Chile.* https://energia.gob.cl/sites/default/files/documentos/pen_2050_-_actualizado_marzo_2022_0.pdf

Ministry of Energy. (2021, September). *Resumen de sugerencias para la Actualizacion de la Politica Energetica Nacional.* https://energia.gob.cl/sites/default/files/documentos/mesa1-acceso_equitativo_a_energia_sostenible.pdf

Climate & Clean Air Coalition. (n.d.). *Chile takes action on air pollution*. https://www.ccacoalition.org/news/chile-takes-action-air-pollution

Ministry of the Environment. (2024). *Heater Replacement Program*. https://calefactores.mma.gob.cl/

Ministry of Energy. (2021, May). *Undersecretary of Energy launches the "Rechange Your Heat" Program in Biobío.* https://energia.gob.cl/noticias/nacional/subsecretario-de-energia-lanza-programa-recambia-tu-calor-en-el-biobio

Ministry of Housing and Urban Planning. (1992, June). *Decree 47 Establishes New Text of the General Ordinance of the General Law of Urban Planning and Construction.* https://www.bcn.cl/leychile/navegar?idNorma=8201

Ministry of the Environment. (2023, October). *Ministry of the Environment launches Compensation System to encourage the reduction of pollutants.* https://mma.gob.cl/ministerio-del-medio-ambiente-lanza-sistema-de-compensacion-para-fomentar-la-reduccion-de-contaminantes/

10.4 Spain

National objectives

Spain has the objective of a net-zero energy system by 2050, and heat pumps are expected to play an important role in both heating and cooling. The country's National Energy and Climate Plan aims for a 125% increase in energy produced from heat pumps from 2022 to 2030.

Market overview

The Spanish heat pump market has grown at a steady rate from 83,000 units sold in 2015 to 210,000 in 2023. Most systems sold are air-to-air, followed by air-to-water. Cooling is a growing concern in Spain and is reflected in the market growth, as air-to-air systems have grown at a faster rate than all other heating technologies.

Regulation

New buildings must be nearly-zero energy buildings, but this does still allow the use of fossil fuels. There has been little discussion in Spain on banning the use of fossil fuels in new or existing buildings. EU requirements are that from 2028 all new buildings owned by public authorities and from 2030 all other new buildings are zero-emissions buildings, meaning they cause no on-site emissions from fossil fuels.

Economic and market-based instruments

Levies on electricity and gas play an important role in making heat pumps less economic, and there is no plan to reform them. Spain's energy savings obligation includes heat pumps. Spain does not have a carbon tax, though it will be subject to the European Emissions Trading System 2 when it comes into force.

Financial support

Spain provides up to EUR 3,000 for air-to-water heat pumps and up to EUR 9,000 or EUR 13,500 for ground-source heat pumps. Air-to-air systems do not receive a subsidy. Funding is agreed only on a short-term basis (six months) and is understood to limit industry investment. Spain does not provide low-interest loans for heat pump installation.

Communications and coordination

At the time of writing, we are not aware of any government communication and coordination efforts with the public, or installer training to support heat pump uptake. This constitutes a major gap.

Links to further resources

Lowes, R. and Gibb, D. (2024, September). *Heat pumps for Spain: Reforming Spanish energy policy to support the transition to clean heating.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/heat-pumps-for-spain-reforming-spanish-energy-policy-to-support-the-transition-to-clean-heating/

10.5 France

National objectives

France's decarbonisation plans include a 60% reduction in greenhouse gas emissions in buildings by 2030, as well as objectives for the quantity and share of renewables in heat production (38% by 2030). Heat pump targets are not specifically identified but would contribute to this.

Market overview

France was Europe's largest heat pump market in 2023. Its sales were relatively stable at around 720,000 units. Air-to-water heat pumps comprise 43% of the market and have seen most of the growth. Air-to-air take 32% and hot water heat pumps see 25%. Only a few thousand hybrid and ground-source heat pumps are sold each year.

Regulation

France has restricted the installation of standalone gas or oil boilers in individual new homes (January 2022) and collective housing (January 2025). Heat pumps benefit from France's White Certificate programme — Certificats d'Économies d'Energie (CEE) — which obliges most energy suppliers to meet energy saving targets, achieved through energy efficiency actions among end-users.

Economic and market-based instruments

France introduced a carbon price in 2014 that applies to all sectors of the economy, including buildings. Originally set at EUR 7 per tonne of carbon emitted (tCO2), the price gradually rose to EUR 44.6/tCO2 in 2018 where it remains.

Financial support

France provides grants based on household income. Lowest-income households receive up to EUR 9,000 (combining two government plans), while all households receive at least EUR 2,500. France also provides zero-interest loans and a reduced VAT rate.

Communications and coordination

France has created a one-stop-shop network, FranceRénov, and has published detailed information to help consumers. France also supports installer training programmes and has announced funding of technical expertise centres for heat pumps.

Links to further resources

Gibb, D., Santini, M. and Thomas, S. (2023, November). *Olympic mindset: Making France a heat pump leader.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/olympic-mindset-making-france-heat-pump-leader/. (Also available in French: https://www.raponline.org/knowledge-center/esprit-olympique-remporter-defi-francais-pompes-a-chaleur/)

10.6 India

National objectives

India released an implementation plan for the National Mission on Enhanced Energy Efficiency (NMEEE) in 2010 aiming to increase the size of the energy efficiency market, that was estimated to be worth USD 8.8 billion at the time. India has also developed a cooling action plan that focuses on reducing cooling demand across all sectors.

Market overview

India has a large market for water heaters due to the size of its population. Its water heater is anticipated to grow with a compound annual growth rate (CAGR) of 7.2% to 2029. India's space heater market was valued at USD 95 million in 2023 and is anticipated to grow with a CAGR of 6.8% to 2029. The annual demand for heat pump-based water heaters is ~0.01 million units, with the market expected to grow with a CAGR of 5.8% from 2024-2032.

Regulation

India has a mandatory energy efficiency policy (star labelling) for electric storage water heaters and a voluntary energy efficiency policy for solar water heaters. India's 2017 energy conservation building code sets minimum performance standards to improve the energy efficiency of new commercial buildings. At present, however, India doesn't have an efficiency mandate for heat pumps used for water and space heating or cooling.

Economic and market-based instruments

The Indian Income Tax Act of 1961, as amended since, offers accelerated depreciation benefits up to 80% in the first year for specific categories of energy-efficient equipment and renewable energy devices. However, there is no data on how many users have taken advantage of this benefit. Some local governments offer tax rebates to both developers and residents on eco-housing projects.

Financial support

India's specific financial support for heat pumps is unclear, but there are blanket mechanisms for energy efficiency such as debt-based financing, equity-based financing, government funds and schemes, energy saving performance contracting, and grants.

Communications and coordination

There is no central national source of information and tools related to heat pumps in India, but there are other sources available to the public.

Links to further resources

IEA. (2021). National Mission for Enhanced Energy Efficiency. https://www.iea.org/policies/7449-national-mission-for-enhanced-energy-efficiency

USAID. (2013, October). *Financing Energy Efficiency in India: A review of current status and recommendations for innovative mechanisms.* https://sarepenergy.net/wp-content/uploads/2022/05/EE-REPORT.pdf

Bureau of Energy Efficiency. (2023, December). *Impact of Energy Efficiency Measures For The Year 2022-23.* https://beeindia.gov.in/sites/default/files/publications/files/Impact%20Assessment%202022-23_%20FINAL%20Report.pdf

Bureau of Energy Efficiency. (2019, February). *Unlocking National Energy Efficiency Potential (UNNATEE).* https://beeindia.gov.in/sites/default/files/UNNATEE_report_11.04.19.pdf

10.7 Ireland

National objectives

Ireland is planning a significant increase in heat pump deployment. The National Development Plan sets a target to install 600,000 heat pumps in residential buildings by 2030, with 400,000 of these installations in existing homes. This goal represents approximately one-quarter of all homes.

Market overview

Around 33,000 heat pumps were sold in Ireland in 2023, a large increase on the 20,000 sold in 2022 and 2021. Both air-to-water and air-to-air segments increased. Currently, Ireland is on track to achieve only around half of its 2030 goal.

Regulation

The implementation of the Nearly Zero Energy Building (NZEB) standard in 2019 has effectively prohibited the use of standalone oil and gas boilers in most new buildings. Currently, 86% of new homes in Ireland are equipped with a heat pump.

Economic and market-based instruments

Ireland applies a carbon tax to all heating fuels. The tax was raised to EUR 56/CO2eq in May 2024, which is estimated will respectively add around EUR 122 and EUR 187 to annual gas and oil bills. Ireland also adds to its electricity prices VAT and a levy that is used to fund sustainable energy projects. This levy was removed from 1/10/2023 to 30/09/2024.

Financial support

Grants are currently available for households in Ireland for retrofitting heat pumps. The grants offer EUR 6,500 for air-to-water heat pumps in houses and EUR 4,500 for those in apartments. Additionally, air-to-air heat pumps in all types of homes can receive grants of EUR 3,500. Low-cost loans also exist.

Communications and coordination

Ireland's sustainable energy agency (SEAI) provides a heat pump information website and tools for consumers interested in heat pumps. Installers must register with this agency to be eligible for grants.

Links to further resources

Lowes, R. (2022, November). *Good COP/Bad COP: Balancing fabric efficiency, flow temperatures and heat pumps.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/good-cop-bad-cop-balancing-fabric-efficiency-flow-temperatures-heat-pumps/

10.8 State of Vermont (United States)

State objectives

In 2020, the Vermont Legislature passed Act 153, the Global Warming Solutions Act. It requires economy-wide reductions in Vermont's greenhouse gas emissions tied to three time periods — 2025, 2030 and 2050 — resulting in no less than 80% below 1990 emission levels by 1 January 2050. Heat pump adoption is not specifically identified but would contribute to this.

Market overview

Currently, 16% of US homes use electric heat pumps for space heating and cooling, with South Carolina leading with 46%. Vermont (335,000 homes) has more than 63,000 heat pump systems heating homes and businesses — this puts it at roughly 19%, or 97 heat pumps for every 1,000 residents. More than 11,000 were installed in 2023. Overall, Vermont has installed 57,000 residential and 6,000 commercial ducted and mini-split systems.

Regulation

Vermont has not restricted the installation of fossil fuel boilers or furnaces in buildings. Act 18 (2023) directs the Vermont Public Utility Commission to design a Clean Heat Standard in a manner that achieves the thermal sector greenhouse gas emissions reductions necessary to meet the Global Warming Solutions Act requirements, and to file its recommendations with the Vermont General Assembly by 15 January 2025.

Economic and market-based instruments

The Clean Heat Standard is intended to be the mechanism that promotes thermal sector emissions reductions as defined in Vermont's Global Warming Solutions Act by creating a market incentive and programmes focused on Vermont's residential, commercial and industrial thermal sectors.

Financial support

The Clean Heat Standard would create a credit system requiring fossil heating fuel wholesalers to buy credits and rewarding parties that earn marketable credits for adopting 'clean heat resources' such as renewable fuels, heat pump installations, and actions reducing heat demand such as building renovations. Financial rebates from Vermont's electric utilities, the state's one natural gas distribution company, and Efficiency Vermont support heat pump deployment.

Communications and coordination

Efficiency Vermont, the state's clearing house for efficiency resources, has developed a Vermont-specific 'incentive calculator' that gives households a personalised list of the many federal, state and utility offers that they can use for clean technologies and efficiency upgrades.

Links to further resources

Vermont Climate Council. (2021, December). *Initial Vermont Climate Action Plan.* https://climatechange.vermont.gov/sites/climatecouncilsandbox/files/2021-12/Initial%20Climate%20Action%20Plan%20-%20Final%20-%2012-1-21.pdf

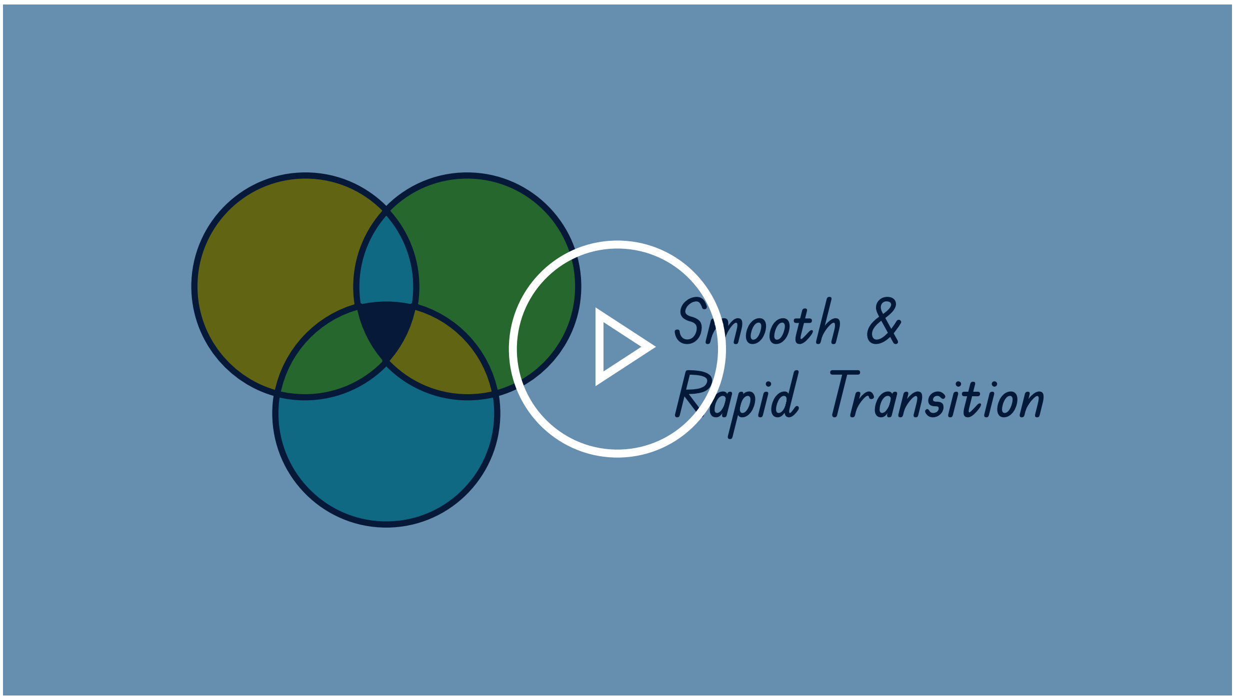
Efficiency Vermont. (2024, 29 January). *With more than 63,000 heat pumps installed, Vermont leads the northeast in zero-emissions heating systems* [Press release]. https://www.efficiencyvermont.com/news-blog/news/with-more-than-63-000-heat-pumps-installed-vermont-leads-the-northeast-in-zero-emissions-heating-systems

Thill, D. (2022, 7 February). Vermont gas utility has a new service: helping to electrify your home. *Energy News Network.* https://energynews.us/2022/02/07/vermont-gas-utility-has-a-new-service-helping-to-electrify-your-home/

11 Epilogue

It will require coordinated effort to transform heating markets around the world to realise the full potential value of heat pumps in a clean energy system. Energy policies and regulations also need to be transformed to support a rapid shift to clean heating, including heat pumps — and this needs to be done in an equitable way. The final video in our series shows the benefits of getting heat pump policy right.

Figure 23. The benefits of getting heat pump policy right



Note: Click for a link to section summary video.

This updated toolkit offers policymakers and energy advocates a guide to the various policy instruments that can be used to drive heat pump uptake. The tools vary in simplicity, ranging from grants to more complex market mechanisms and obligations. They also vary in the level of intervention required, from subtle economic nudges to more pointed tools such as appliance bans.

Evidence shows that the most successful historic examples of heat pump deployment strategies have relied on combinations of policies, which we refer to as heat pump policy packages. While single policy measures may stimulate demand, the required speed and scale of the necessary heat transformation points towards the use of multiple tools at once.

Our toolkit and associated review of policies shows that there are four key elements which should be considered when building a heat pump policy package. With each of these elements, equity must be considered prominently so that any heating transition is an inclusive one.

1. Coordination and communication are needed to provide strong foundations for the heating transformation.
2. Economic or market instruments are needed to reshape markets towards clean heating solutions such as heat pumps.
3. Financial support is likely to be needed for households and building owners to make the switch to a heat pump from fossil fuel heating.
4. Regulations and standards can be used to limit available options in heating markets and drive purchasing behaviours towards heat pumps.

There are multiple options, and combinations of options, to consider with each of these elements. Fundamentally, a good heat pump policy package must consider all four of these elements together.

While our toolkit provides numerous tools that policymakers can use, the suitability of each package will vary between countries and even between subnational regions. The most optimal packages for certain locations will depend on factors such as heat pump market maturity, labour availability and skills, governance culture, and approaches to economic management. It is also worth noting that while the toolkit is thorough and contemporary, new policy approaches are emerging all the time.

Rapid heat pump rollouts need to be well coordinated with wider energy policy. Energy efficiency programmes should be aligned with plans for heat decarbonisation. And naturally, as national heating systems are electrified, the impacts on electricity systems — such as increases in peak demand, the use of flexibility and smart tariffs, and electricity decarbonisation — all need to be coordinated.

The context of clean heating is rapidly shifting. We are witnessing rapid technological innovation, increasing social interest in clean energy, and volatile fossil fuel markets. Indeed, as we researched and assembled the toolkit, global interest in heat pumps grew to unprecedented levels. All these contextual elements can drive the uptake of clean heating and heat pumps more rapidly than had previously been anticipated.

At the same time, policy action is needed. While delivering heat pump policy packages may be complex, the benefits are vast. Heat pumps can reduce global primary energy demand, provide cost-effective low-carbon heating, reduce urban air pollution, drive wider growth in renewable energy, and limit exposure to fossil fuel markets. We hope that this toolkit helps to achieve these goals.

Regulatory Assistance Project (RAP)®
Belgium / China · 德国 / Germany / India / United States

Belgium
Rue de la Science 23
B – 1040 Brussels
Belgium

+32 2 789 3012

Germany
Anna-Louisa-Karsch-Straße 2
D – 10178 Berlin
Germany

+49 30 700 1435 421

info@raponline.org
raponline.org

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