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# A policy toolkit for global mass heat pump deployment


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## List of Figures

## List of Tables



## Acronyms

COP: Coefficient of Performance

HaaS: Heat as a service

IEA: International Energy Agency

MEPS: Minimum energy performance standards

NZE: Net Zero Emissions by 2050 scenario

# Contents

# 1 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 consulting firms, such as McKinsey & Company, point to heat pumps being the most important technology to decarbonise heating, most of which is currently provided by fossil fuels.

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 efficiency; for each unit of electricity consumed to operate them, 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.

Heat pumps also are commonly found in Nordic countries — despite their relatively cool climates — where, in part because of previous energy price crises, they have been actively supported to efficiently provide heating and support a transition from fossil fuels. Outside of Nordic countries, heat pumps tend to make up a relatively small share of heat mixes. For global energy and climate goals to be achieved, heat pumps must rapidly become a dominant heating technology worldwide.

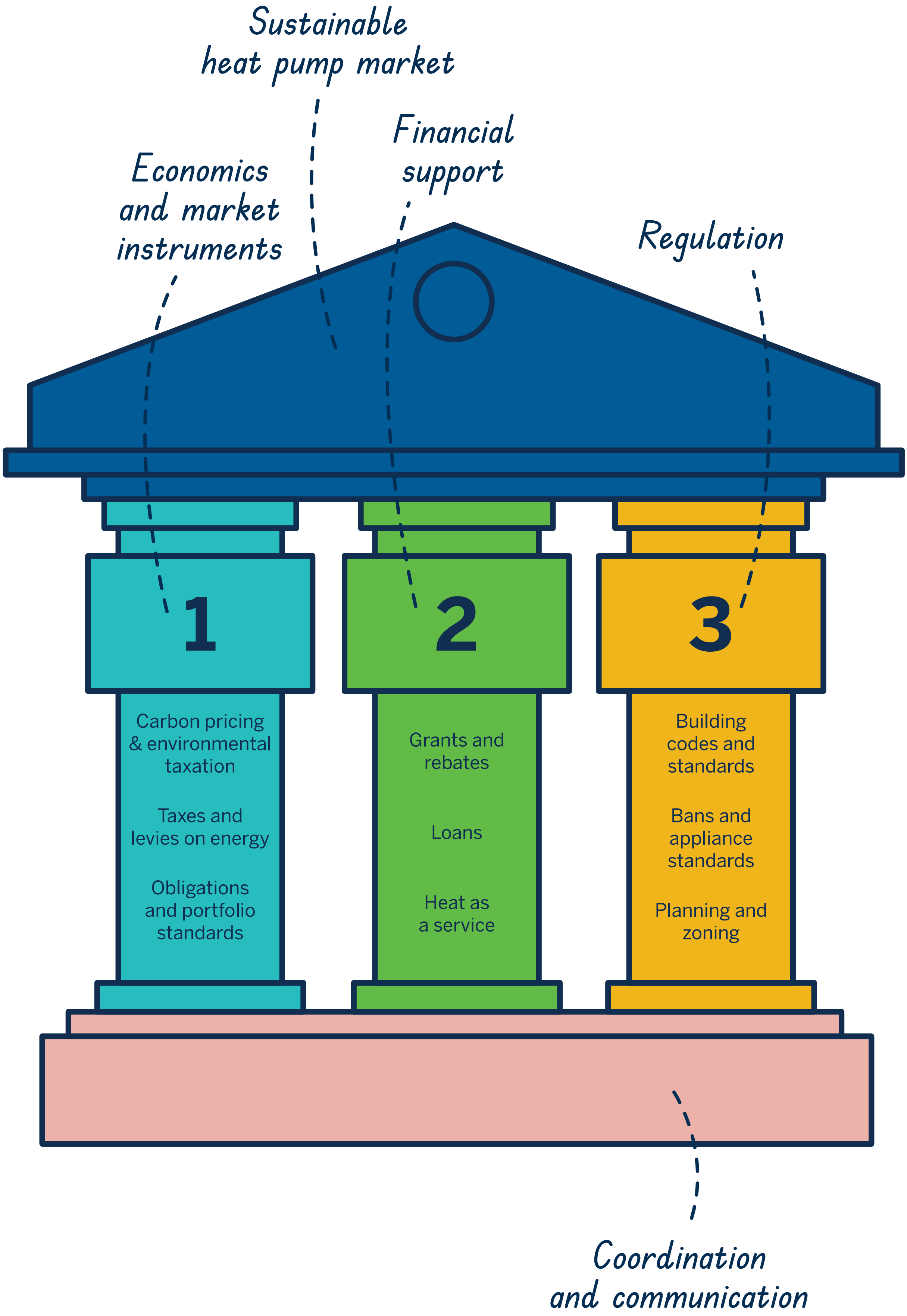
## About this toolkit

The aim of this toolkit is to arm policymakers and associated interests with a suite of 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, 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 relevant element of the toolkit. Together, these videos make up a short series which complements this document.

## 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 and potential issues with, and solutions to the various policy elements we discuss.


Sustainable heat pump market
Economics and market instruments
Financial support
Regulation
1
2
3
Carbon pricing & environmental taxation
Taxes and levies on energy
Obligations and portfolio standards
Grants and rebates
Loans
Heat as a service
Building codes and standards
Bans and appliance standards
Planning and zoning
Coordination and communication

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 now also briefly describe.

But 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 but 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 and that switching to a heat pump leads to lower energy costs compared to fossil fuel alternatives.

**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 readied 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 heat use 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 obligations and portfolio standards.

**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 — financial models which eliminate the requirement for building owners to provide capital.

**Pillar 3 considers regulations and standards.** These are the rules and requirements that shape markets. We consider buildings 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 the reliance on fossil fuels phased out. We hope this toolkit provides some clarity for policymakers on how to achieve these goals.

# 2 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 3) and the expected role of heat pumps in the future (section 4).

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.

Many countries offer targeted heat pump support. Some, particularly 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 5, we consider a necessary focus on equity in delivering any heating transformation. In section 6, we introduce our policy toolkit, the structure of which emphasises the need for foundational governance support alongside three policy pillars of 1) energy economics reform, 2) targeted financial support and 3) regulation.

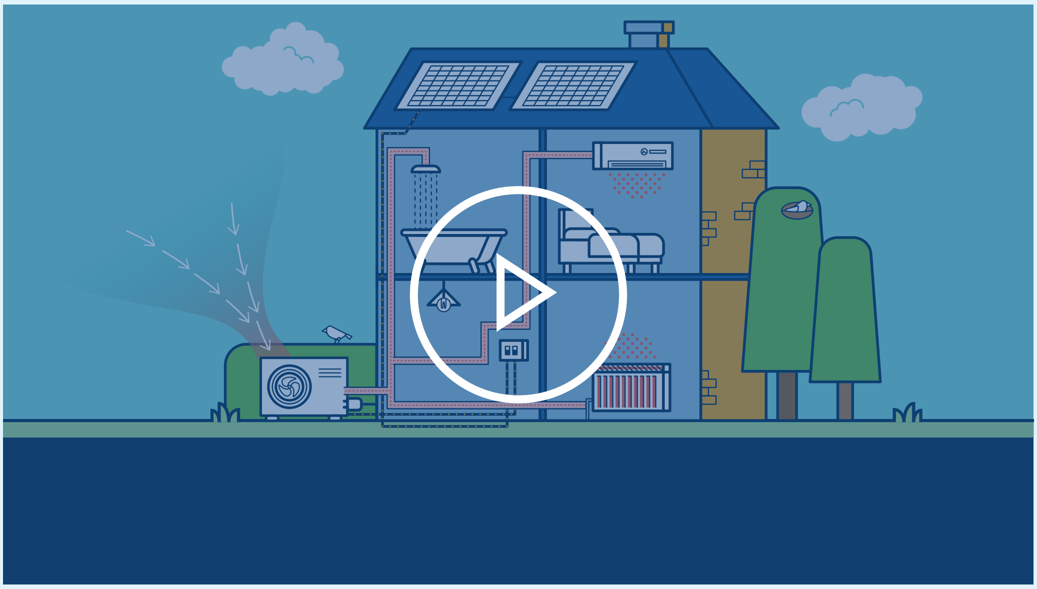
Often, countries have attempted to support heat pump markets using one single policy instrument, typically a subsidy programme. Our toolkit structure demonstrates the need for coordinated packages of policy which go beyond single instruments. Sections 7, 8, 9 and 10 expand on various elements of the toolkit, providing examples of these policy approaches, the benefits and potential issues associated with them and key decisions policymakers may need to consider.

The toolkit is briefly summarised in section 11, recognising that this area of policy and technology is rapidly innovating.

# 3 Heat pumps and their benefits

Heat pumps are widely recognised as a critical clean energy technology. This section considers how these devices work and why they have repeatedly been seen as 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.

## 3.1 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 can provide both heating and cooling. 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).

Heat pumps tap into thermal energy from three main sources: ambient air, the ground and water. Air-source heat pumps, which resemble well-known air conditioning units, extract heat by using fans to blow air across a large surface. 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.

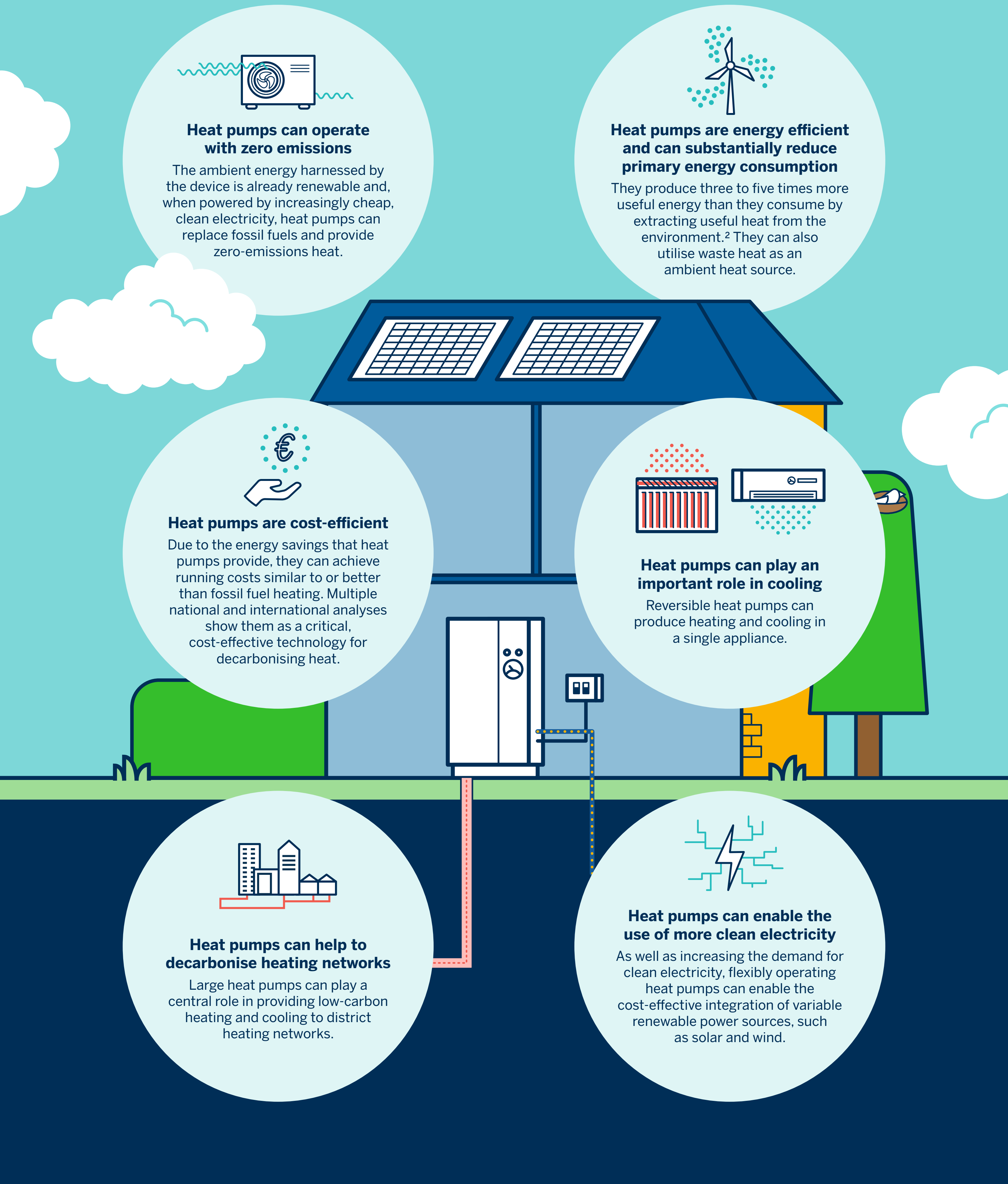

Left: Air-source heat pumps in situ (image courtesy of Joe Smyth). Right: A Slinky-style ground-source heat pump ground array (image courtesy of David Brooke). Images reprinted with permission.

While the amount of renewable heat which can be harnessed from the environment is vast, the temperature of ambient thermal energy tends not to be hot enough for immediate use. Once the environmental 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.

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.

## 3.2 The benefits of heat pumps

Heat pumps are an extremely efficient way of providing heating and have multiple benefits compared to other heating technologies:[1]



# 4 The role of heat pumps in a clean energy system

To achieve goals relating to climate change mitigation and sustainable development and reduce exposure to fossil fuels, heat pumps have been repeatedly identified as a key alternative to heating with 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.

Heating and cooling currently makes up around half of global energy demand. Of this demand, 46% is related to heating and cooling buildings, and this is mostly driven by providing thermal comfort in residential buildings. As shown in Figure 3, fossil fuels still meet more than 72% of current global heating and cooling demand.[3] In 2021, building operations accounted for 27% of global energy-related greenhouse gas emissions.[4] Emissions from building operations have been increasing at around 1% per year.[5] Most of these emissions, especially direct emissions, are for heating.

1 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/

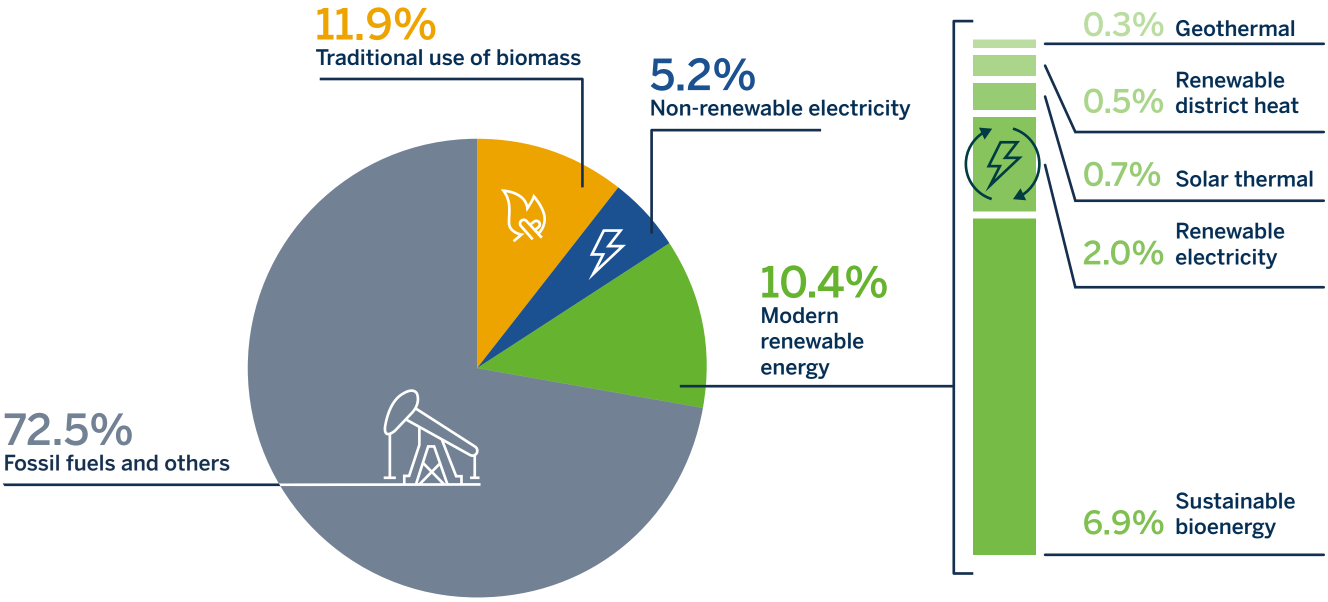
2 Coefficient of performance (COP) is the ratio of useful heat output to electricity input. Seasonal COPs (SCOPs) refer to the seasonal or average performance. COP is analogous to the device's efficiency.

3 Irena, IEA & REN21. (2020). *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

4 Delmastro, C. (2022a, September). *Buildings.* IEA. https://www.iea.org/reports/buildings

5 Delmastro, 2022a.

**Figure 3. Share of energy sources in total final energy consumption for heating and cooling, 2019**




Source: Irena, IEA & REN21. (2020). *Renewable Energy Policies in a Time of Transition: Heating and Cooling*.

To achieve a decarbonised energy system, the use of 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 are adding extra impetus to plans to decarbonise heating.

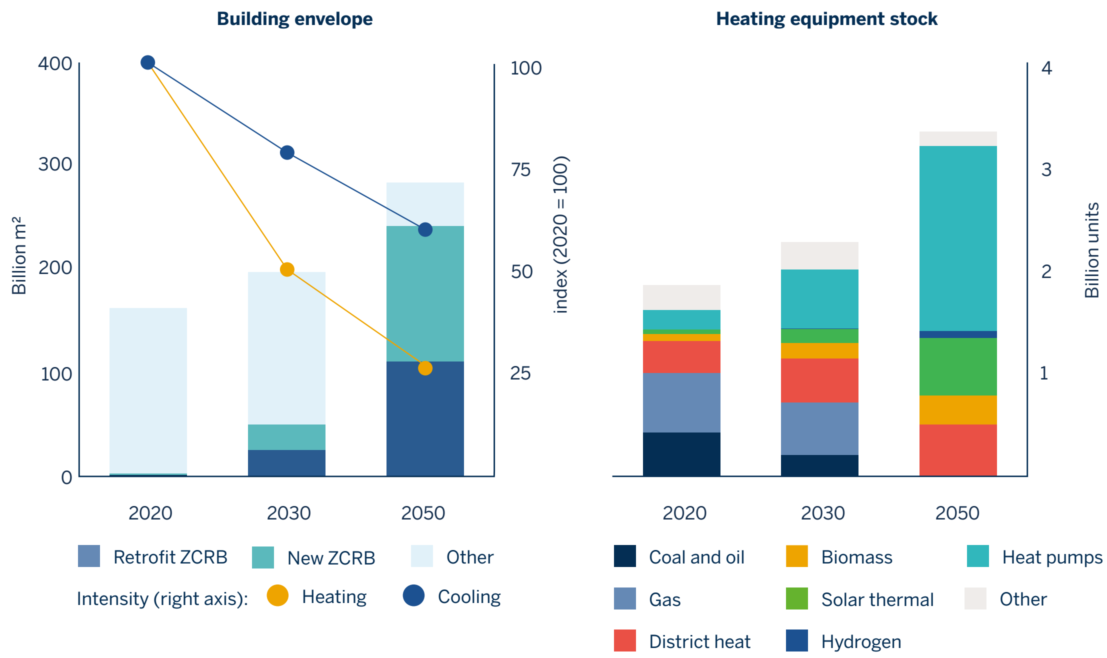
Because of the benefits of heat pumps outlined previously (see section 3.2), multiple analyses at international, national, regional and local levels have pointed to the importance of heat pumps in clean energy systems.

As shown below in Figure 4, the International Energy Agency's (IEA) *Net Zero Emissions by 2050* (NZE) scenario, aligned with limiting global temperature rises by 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.[6] Figure 4 shows that while global floor area grows significantly by 2050,[7] the energy demand for heating (and cooling) can be limited by energy efficiency retrofits and the rollout of heat pumps, alongside ensuring that new buildings are zero carbon.

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

7 IEA, 2021.

**Figure 4. 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*.

The IEA's pathway requires rapid increases in heat pump deployment over the coming decade. The share of building heating needs met by heat pumps needs to increase from the current level of 7% to 20% globally by 2030. More than 600 million electric heat pumps need to be installed in new and existing buildings in the next eight years.[8] This requires global installations of heat pumps to surge from 1.5 million units per month to 5 million per month by 2030.[9]

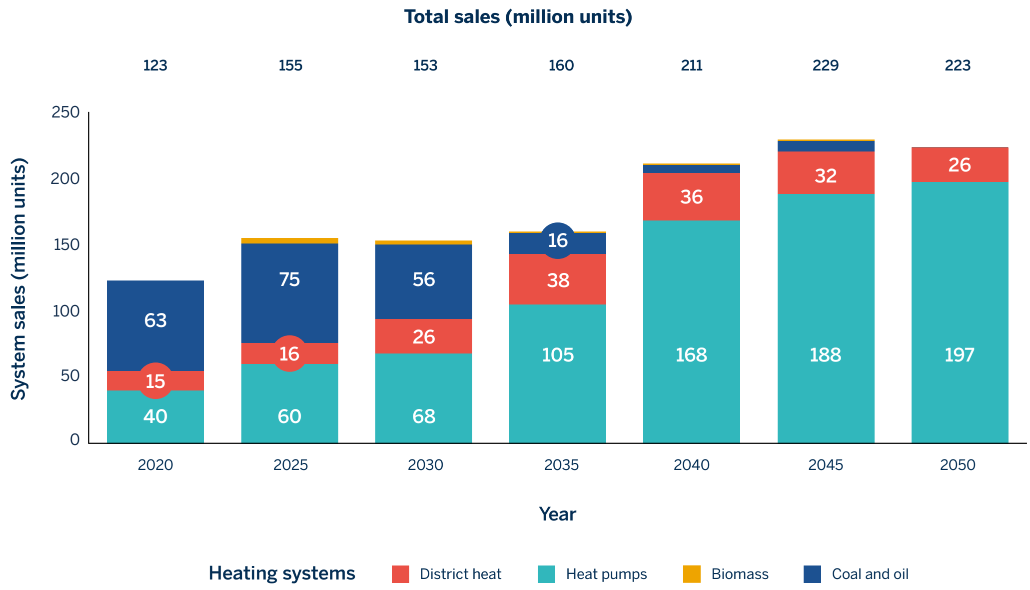
A similar trajectory for heat pumps is shown in analysis by consultancy McKinsey & Company (Figure 5).[10] Under this trajectory, by 2030, heat pump sales increase by 70% from 2020 levels to become the dominant heating appliance type sold. Their share and total number increases even more quicky from 2030 to 2050.

8 Delmastro, C. (2022b, September). *Heat pumps*. IEA. https://www.iea.org/reports/heat-pumps

9 IEA, 2021.

10 McKinsey Global Institute. (2022, January). *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

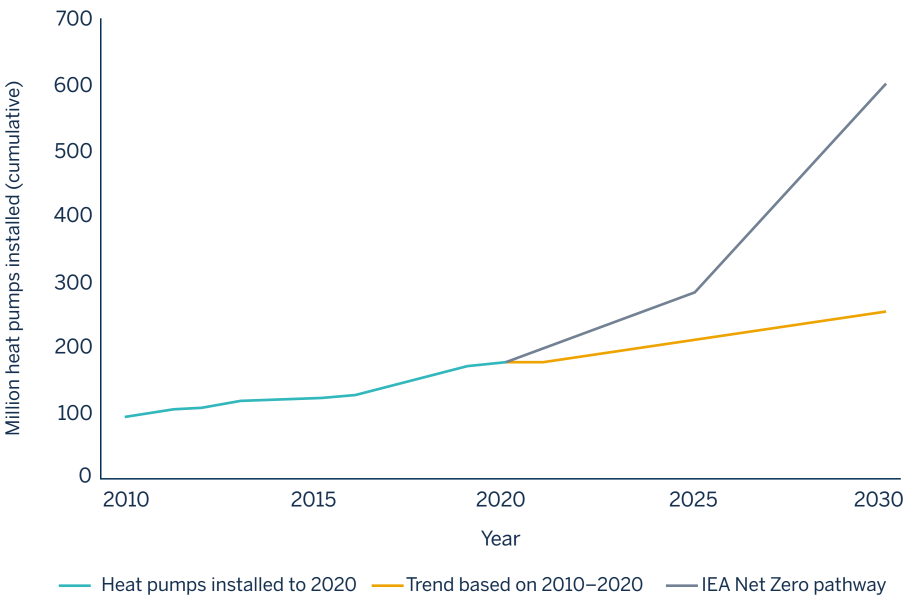
**Figure 5. Global heating system sales under net-zero transition scenario**




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 as 'more efforts needed,'[11] with buildings more broadly classified as 'not on track.'[12] Figure 6 shows that while heat pump installations are increasing,[13] a step change is needed for deployment rates to be aligned with those in the IEA's NZE scenario.

**Figure 6. Global heat pump sales from 2010 to 2020, projected trend and IEA's Net Zero Emissions by 2050 pathway**




Source: RAP graphic

11 Delmastro, 2022b.

12 Delmastro, 2022a.

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

Government policies and regulation undoubtedly have a role in driving the global heat pump market, as evidenced by countries who 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.

### Learning from countries with significant heat pump deployment

Nordic countries, such as Norway, Sweden and Denmark, have been successful in deploying heat pump policy strategies and have the highest heat-pump penetrations as a share of heating systems 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.[14] Studies[15] of the policy frameworks in Norway, Sweden and Denmark indicate that policy packages to deliver heat pumps are needed, rather than single measures, and 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.
- Policy stability, including enhanced building energy performance regulations.
- Financial support that includes grants, tax breaks and carbon taxes, alongside financial penalties for the use of fossil fuels when renewable alternatives are available, accessible and affordable.

14 Sovacool, B. & Martiskainen, M. (2020, April). Hot transformations: Governing rapid and deep household heating transitions in China, Denmark, Finland and the United Kingdom. *Energy Policy, Volume 139,* 111330, ISSN 0301-4215. https://doi.org/10.1016/j.enpol.2020.111330.

15 Hanna, R., Parrish, B., & Gross, R. (2016, December). *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://d2e1qxpsswcpgz.cloudfront.net/uploads/2020/03/heat-what-works-working-paper.pdf

# 5 An equitable toolkit

Ensuring an equitable transition to clean energy should be an overarching strategic concern for policymakers.[16] 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. Policies can also 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, capital and running costs are expanded below.

## 5.1 Managing upfront costs

Heat pumps and additional building decarbonisation efforts, such as fabric efficiency, generally require 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 will nearly always cost more than a like-for-like replacement of an existing system.[17] Many of these additional costs are to prepare the heating system itself and may include:

- The heat pump unit and its controller.
- A new hot-water cylinder (tank) or standalone hot-water heat pump, if needed.
- Higher-output radiators or duct work suitable for lower-temperature heating.
- Pipework upgrades which may be required for lower-flow temperatures.
- Drilling of boreholes, digging of trenches and laying of pipes for ground- or water-sourced systems.
- Electrical system upgrades.
- 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 these 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. Such costs are, therefore, more akin to infrastructure costs than standard heating system replacements. Decarbonising heating therefore naturally requires a policy focus on equitably providing financing where it is needed. This could include 100% funding for low-income households.

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

17 Lowes et al., 2022.

## 5.2 Managing ongoing costs

The main ongoing costs associated with heat pumps are the electricity charges for running them. 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.[18] Over time, heat pump running costs are expected to become even lower than alternatives as the cost of renewable electricity falls further.[19]

To encourage uptake of heat pumps, governments should ensure that a switch will result in lower energy bills, particularly for low-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 ,[20] and generous energy efficiency grants are offered alongside support for installing a heat pump.[21] Policy support for energy efficiency measures should be generous, but low-income householders — who disproportionately live in homes with poorer energy efficiency — should be provided with greater support for fabric energy efficiency measures.

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. Rebalancing these taxes and levies would lead to a more equitable outcome, whereby supporting households to switch to heat pumps would also lead to lower bills.[22]

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.

18 For example, the annual cost of operating a heat pump in the Netherlands was estimated at 4% cheaper than a gas boiler following 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., & 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/

19 BEUC. (2021, November). *Goodbye gas: why your next boiler should be a heat pump.* https://www.beuc.eu/sites/default/files/publications/beuc-x-2021-112_goodbye_gas_why_your_next_boiler_should_be_a_heat_pump.pdf

20 Sustainable Energy Authority of Ireland (SEAI). (2022, April). *Technical Assessment Process for Heat Pump System Grants.* https://www.seai.ie/publications/Technical_Advisor_Role.pdf

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

22 Rosenow et al., 2022b.

# 6 Toolkit design

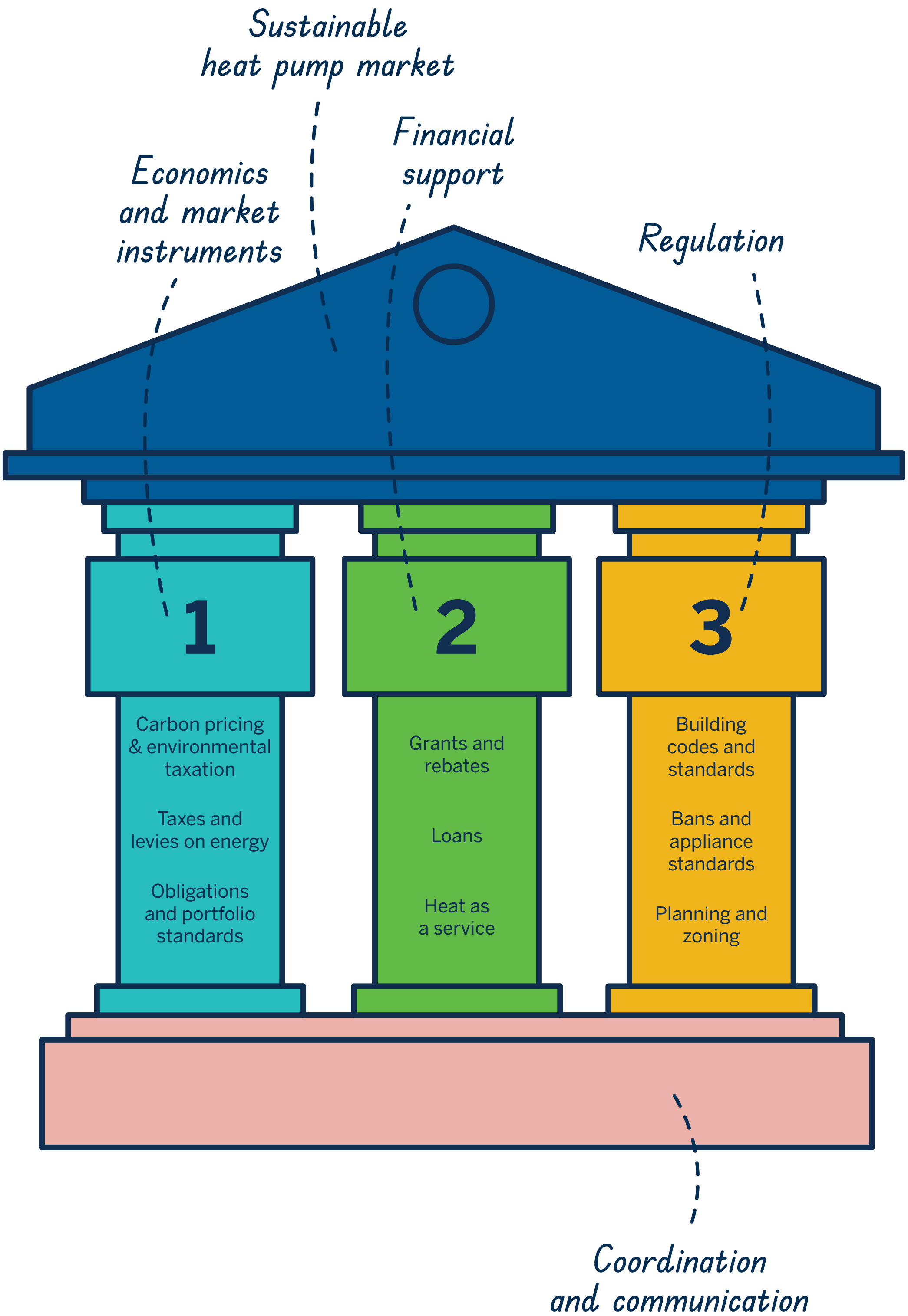
This document is primarily a toolkit to support policymakers looking to rapidly deploy heat pumps in buildings. In the same way that there are many ways to build a new home, there are multiple policy tools to drive heat pump markets. For optimal and rapid deployment, different combinations of measures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

The toolkit is composed of two main elements, as shown in Figure 7:

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, indicating that all pillars are needed to support the heat pump market.

**Figure 7. The Heat Pump Policy Toolkit framework**



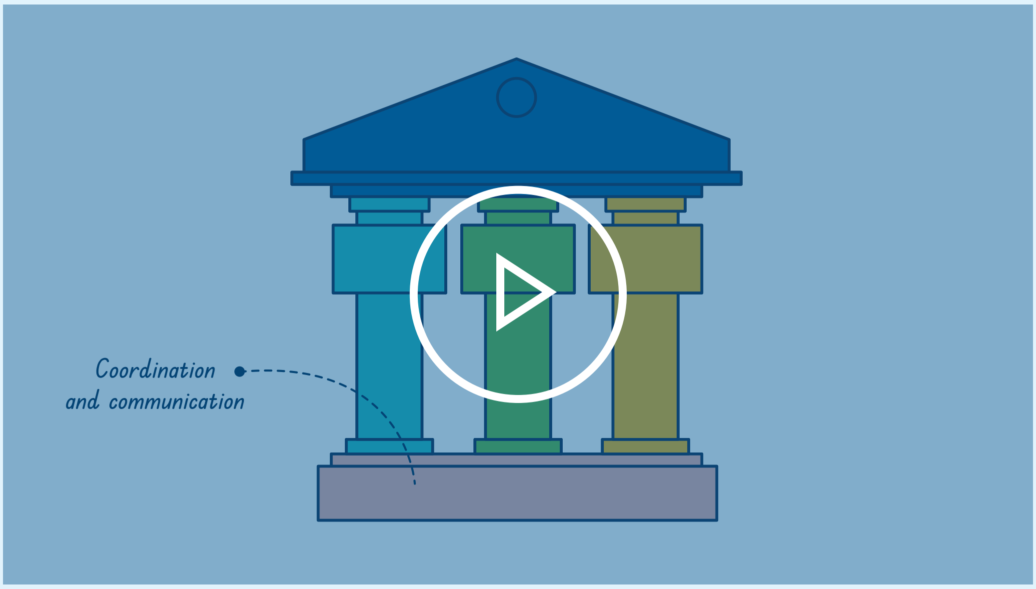

Each pillar represents a particular category of policy and contains various policy options. For a successful heat pump programme, strong foundations are required, as well as at least one element from each of the pillars. Ideally all elements of each pillar should be considered.

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.

# 7 Foundations: Coordinated policy effort

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 8 below provides a link to a video overview of this section.

**Figure 8. 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 or 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 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.[23, 24] 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.

23 Li, J., Yu, Y., & Zeng, S. (2016, March.) *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

24 IEA. (2020). *Minimum allowable values of the energy efficiency and energy efficiency grades for room air conditioner.* https://www.iea.org/policies/11661-minimum-allowable-values-of-the-energy-efficiency-and-energy-efficiency-grades-for-room-air-conditioners

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.[25]

Several examples of policy mixes are included in Table 1.

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

| Country | Coordination | Communications | Training | Economic & market | Financial support | Regulations |
|---|---|---|---|---|---|---|
| China[26,27] | | | | | Subsidies | Minimum energy performance standard (MEPS) |
| Switzerland[28] | Conferences | Exhibition | Installer training, driller quality label | | Subsidies | Non-renewable standard, labelling |
| Sweden[29,30] | Expert groups | Public demonstrations, information, and advice | Training of installers | Increased tax on oil | Subsidies and loans | Labelling |
| Denmark[31] | Promotion | | Quality assurance for installers | Increased taxation of electricity, but not fossil fuels (!) | Subsidies | Electric resistance and oil ban |
| Finland[32,33] | | 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 three key foundational elements of heat pump deployment: communication with energy consumers, the management of the heating workforce and utility-level integration.

25 Kiss, B., Neij, L., & Jakob, M. (2011). *Heat pumps: A comparative assessment of innovation and diffusion policies in Sweden and Switzerland.* Doi.org/10.1017/CBO9781139150880.013

26 Li et al., 2016.

27 IEA, 2020.

28 Kiss et al., 2011.

29 Kiss et al., 2011.

30 Lopes, C. (2018, October 4). *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

31 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.

32 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

33 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/.

## 7.1 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 efforts will be critical in successfully accelerating heat pump deployment in regional markets.

Strategic communication efforts can be delegated to target different parts of the procurement process, from manufacturer to installer to end user. Each group requires specialised outreach. When attempting to influence households and individual consumers, robust information sharing and community engagement have demonstrated lasting results.

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

The following sections provide a range of communication activities proven through practice or research to be critical in heat pump deployment efforts. There are limited examples of the fossil-fuel-to-heat-pump switch supported by the activities proposed in this toolkit. The instances highlighted below draw on case studies and research into successful deployment of heat pumps in any relevant market, as well as high-level experiences of facing abrasive industry interests.

## 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.

According to research in Belgium, a market that is beginning to hasten its adoption of heat pump technologies, installers highlighted the need for robust information sharing and awareness-raising efforts for consumers.[34] 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 twentieth century, Sweden's government bolstered heat pump deployment efforts through a combination of well-funded R&D programmes, subsides, trainings, loans and consumer information campaigns.[35] 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 turned out to be fruitful, with heat pump sales doubling between 1995 and 1996.[36]

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.[37,38] The collaboration is at least partially credited for sustained market growth in the years following.

## Community-led 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.

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.[39] 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.

34 Decuypere, R., Robaeyst, B. Hudders, L., Baccarne, B. & Van de Sompel, D. (2022, February). Transitioning to energy efficient housing: Drivers and barriers of intermediaries in heat pump technology. *Energy Policy, Volume 161,* 112709, ISSN 0301-4215. https://doi.org/10.1016/j.enpol.2021.112709.

35 Kiss et al., 2011.

36 Kiss et al., 2011.

37 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

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

39 Peran, 2021.

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.[40] 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 quelling anxieties about how the equipment would function in cold winter temperatures.[41]

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

40 BEIS, 2017.

41 Sovacool & Martiskainen, 2020.

## 7.2 Installer communication, training and certification/ verification

Since heat pumps are professionally installed and typically purchased through the installer, outreach to installers is crucially important. This outreach takes three 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 also may have a role by providing unbiased technical information, such as sizing and selection for the local climate[42] or installation standards appropriate to the locally available equipment and building stock.[43,44,45]

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

Second, to ensure customer satisfaction with heat pumps and avoid underperformance, governments should implement or support training programmes. For example, in the United States, more than a quarter of a ducted air-to-air heat pump's energy use is wasted due to flaws during installation.[46] Building up the workforce will require ambitious recruiting efforts and tax relief to increase the number of installers,[47] may take several years for them to gain the necessary experience[48] and may also require the help of manufacturers, who can help train installers.[49]

42 CanmetENERGY. (2020, December). *Air-source heat pump sizing and selection guide: Procedure for mechanical designers and renovation contractors.* https://www.nrcan.gc.ca/sites/nrcan/files/canmetenergy/pdf/ASHP%20Sizing%20and%20Selection%20Guide%20(EN).pdf

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

44 National Energy Commission (China) (2020, October). *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

45 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

46 ENERGY STAR® (n.d.). *HVAC quality installation program: A new approach to residential HVAC efficiency and performance.* Retrieved 4 July, 2022, from https://www.energystar.gov/ia/home_improvement/downloads/ESQI_factsheet.pdf?07d7-31fc

47 Norman, A. & 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/

48 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/

49 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/

An example of the training gap can be seen in China. On the one hand, there were already 100 million ductless air-to-air heat pumps in 2016 — basically air conditioners that can run in reverse, providing heating in the country's warmer regions.[50] 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 OEM 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.[51]

One way of improving installation quality is through certification, where a third party validates installer skills, or verification, where a third party confirms quality of the installation. The International Ground Source Heat Pump Association offers certification,[52] 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.[53]

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. One way to resolve this paradox is to find ways to value quality installation, as the following perspective demonstrates.

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

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

52 International Ground Source Heat Pump Association. (n.d.). *Training.* Retrieved 4 July, 2022, from https://igshpa.org/training/

53 Air Conditioning Contractors of America. (n.d.). *Existing homes program.* Retrieved 4 July, 2022, from https://www.acca.org/qa/existing-homes

### Business model trumps technical training

*Nate Adams is CEO of HVAC 2.0 and is a long-time advocate and practitioner of home decarbonisation.*


Image courtesy of Nate Adams.

'In our experience, there's a critical piece missing in the discussion of space-heating electrification: a contractor/engineer business model. Since this is the industry that will sell and install heat pumps, it is the lynchpin to sustainably scaling space-heating decarbonisation.

The industry already has a complex job both selling and installing equipment. Unless contractors and heating engineers see a profitable path to selling and installing heat pumps, technical training is unlikely to be used.

It's vital to provide excellent experiences for both contractors and homeowners, otherwise bad publicity or business results are likely to slow the transition. We've been striving for years to find a path for this. It's a very narrow path that requires eliminating fear, teaching value creation and only then undertaking technical training.

Reducing fear requires hands-on experience with the technology, seeing others do it successfully and being given a path to reduce the risk of bad results.

Building value is critical since heat pumps are generally more expensive to install than their traditional counterparts. Typically, this involves identifying and solving issues of comfort and air quality in homes through a consultative sales process. Without this, adoption is likely to be limited if incentives are removed.

Once contractors and engineers believe that heat pumps can work and that they can sell them profitably, then they are open to technical training.

Achieving all this requires a business model that is markedly better than business as usual, so that contractors don't easily return to business as usual. Without a solid business model, heat pump adoption is likely to vary with the political winds.

Policymakers should keep a tight focus on providing excellent experiences for both contractors and homeowners so the transition happens without resistance.'

## 7.3 Utility integration

Much of the work associated with installing heat pumps happens at a building level; however, shifting an energy use as sizeable as heating will have a large impact on the electricity system to which the heat pump is connected. These impacts need to be coordinated to ensure that heat pumps provide maximum environmental 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 for those disconnecting from the gas grid, costs are not prohibitive.

Detailed modelling using realistic data on temperature-dependent efficiency of heat pumps, climate conditions, current peak electric demand and electric and fossil fuel emission factors and costs can reveal heat pumps' emissions of greenhouse gases and other pollutants compared to legacy heating systems, as well as their impact on peak demand and cost-optimal deployment.[54]

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 factor (e.g. through utility policies). Similar calculations should be performed for peak electricity demand, other pollutants such as nitrogen oxides (NOx)[55] and costs.

These impacts can be further mitigated through demand flexibility: the ability of heat pumps to avoid electricity consumption peaks, which result in higher emissions and costs. 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 (typically off-peak) encourages the use of renewables[56]

Buildings with heat pumps can be equipped with thermal energy storage and smart controls to provide demand flexibility. Air-to-water heat pumps for hydronic/radiator heating or domestic hot water can store energy directly in the hot-water tank. Several U.S. states already require electric storage heaters to include a communication port for easier participation in demand-flexibility programmes.[57] Meanwhile, air-to-air ducted heat pumps can store heat in a compartment filled with ceramic bricks, placed in-line with the air handler.[58] Finally, better insulated and tighter buildings can stay warm without heating and can simply have heating turned off at peak times.

Understanding and mitigating any impacts of a heat pump transition on the environment, infrastructure, health and consumer costs will ensure that the transition to heat pumps will be broadly beneficial.

54 Pistochini, T., Dichter, M., Chakraborty, S., Dichter, N., & Aboud, A. (2021, April). Greenhouse gas emission forecasts for electrification of space heating in residential homes in the US. *Energy Policy 163:* 112813. https://doi.org/10.1016/j.enpol.2022.112813.

55 Seidman, N., & Shenot, J. (2021, 16 December). *NOx, NOx — Who's there?* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/nox-nox-whos-there/

56 Yule-Bennett, S., & 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/

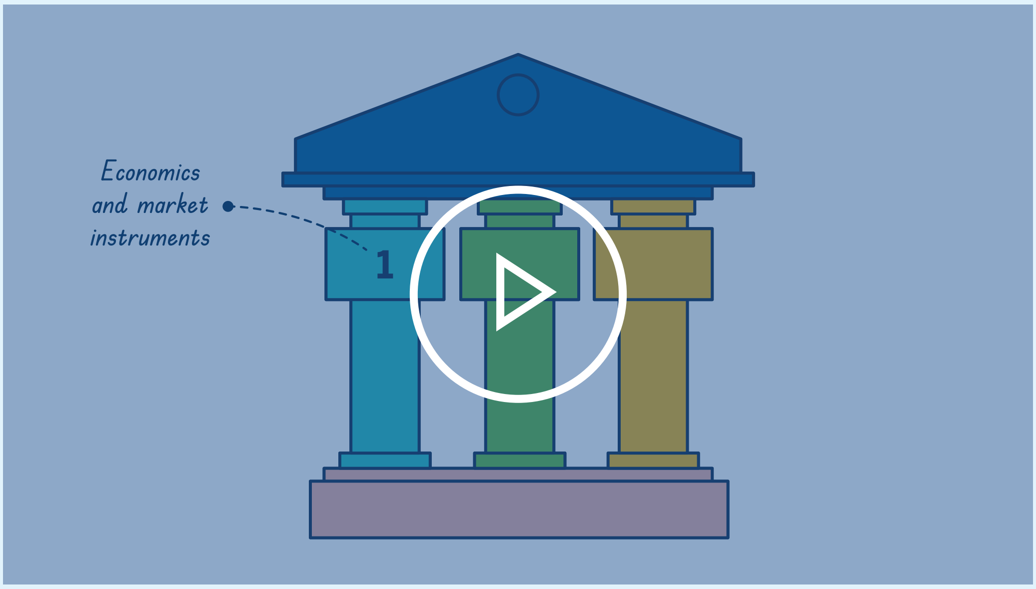
57 California, Oregon, Washington and Nevada, and a national requirement is also under consideration in Congress (H.R.7962). https://www.congress.gov/bill/117th-congress/house-bill/7962?q={%22search%22:[%22hr+6%22]}&s=1&r=32

58 Steffes. (n.d.). *Comfort for the future with serenity.* Retrieved 4 July, 2022, from https://www.steffes.com/ets/hq-serenity-eng/

# 8 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 9. Policy toolkit pillar 1**




Note: Click for a link to section summary video.

Without a strong economic framework on 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.[59]

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 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.

59 Rosenow et al., 2022a.

## 8.1 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 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.[60] Only in Sweden, however, is the carbon price on fossil heat higher than the EU ETS allowance price, which is passed through to electricity users.[61] Denmark has a comprehensive approach, taxing carbon dioxide, nitrogen oxides and sulphur dioxide emissions.[62] In 2021, the European Commission proposed an EU-wide trading system for carbon emissions from the buildings and road transport sectors (ETS 2), which would come into effect in the second half of the 2020s.[63] 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.[64]

Canada has a carbon tax that covers buildings, heating fuels and the power sector, with provinces able to set up their own schemes if at least equivalent. The Canadian carbon tax is set to increase each year from 50 to 170 Canadian dollars by 2030.[65] 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.[66]

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

61 Thomas, S., Sunderland, L. & Santini, M. (2021, June). *Pricing is just the icing: The role of carbon pricing in a comprehensive policy framework to decarbonise the EU buildings sector.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/pricing-just-icing-role-carbon-pricing-comprehensive-policy-framework-decarbonise-eu-buildings-sector/

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

63 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://ec.europa.eu/info/sites/default/files/revision-eu-ets_with-annex_en_0.pdf

64 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

65 Government of Canada. (n.d.[a.]). *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

66 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.[67] It is worth noting that most carbon pricing instruments currently cover electricity and not heating fuels,[68] 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. Raising the prices of fossil fuels (and biomass, if applied to multiple pollutants) improves the 'total cost of ownership' of a heat pump, compared with a boiler. It also means that clean heat regulations could meet less resistance on the grounds of cost and heat pump subsidies could be lower.

A tax provides more certainty and visibility for the price, while an ETS provides more certainty over the environmental outcomes. 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, are 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,[69] 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 bill payers. 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.[70]

## 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?

67 World Bank, 2022.

68 OECD. (2021). *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

69 Mehleb, R., Kallis, G. & Zografos, C. (2021, September). A discourse analysis of yellow-vest resistance against carbon taxes, *Environmental Innovation and Societal Transitions, Volume 40.* Pages 382-394, ISSN 2210-4224. https://doi.org/10.1016/j.eist.2021.08.005

70 Government of Canada. (n.d. [b.]). *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

## 8.2 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 long-term economics. 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 10,[71] in Europe, for example, these instruments applied to electricity can be around 10 times higher per unit of energy than those on natural gas.[72] In the United Kingdom, an environmental levy accounts for around 23% of an electricity bill, while the same charge makes up less than 2% of the gas bill.[73] Germany's Renewable Energy Surcharge (EEG) has historically accounted for up to 20% of household electricity bills.[74] The ratio of electricity to fossil gas residential prices averages 3.3:1 in the United States, but varies greatly, from as low as 1.5:1 in Florida to around 4.5:1 in Vermont, Rhode Island, Wisconsin and New Jersey and nearly 6:1 in Minnesota.[75]

71 Rosenow, et al., 2022b.

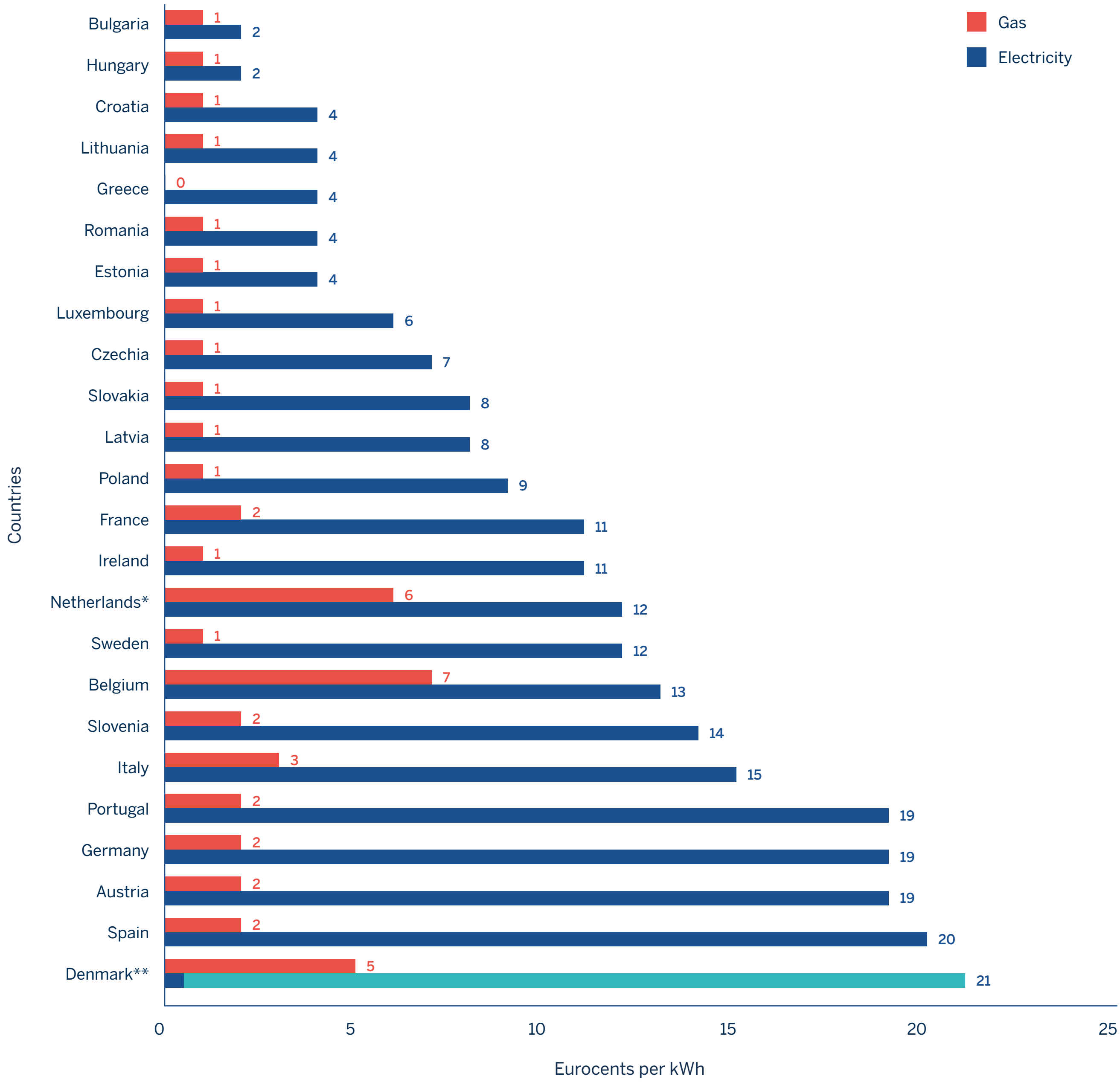
72 Rosenow, et al., 2022b.

73 Lowes, R., Rosenow, J., & Guertler, P. (2021, March). *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/

74 Strompreisentwicklung. (n.d.). *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

75 US EIA. (n.d.). *Natural gas prices.* Natural Gas, data for December 2021 or latest month available before that. Retrieved 18 May 2022, from https://www.eia.gov/naturalgas/weekly/; US EIA. (n.d.). *Average retail price of electricity: Residential by state.* Electricity Data Browser. Retrieved December 2021 from https://www.eia.gov/electricity/state/; US EIA. (n.d.). *Heat content of natural gas consumed.* Natural Gas, data for December 2021. Retrieved 18 May 2022, from https://www.eia.gov/dnav/ng/ng_cons_heat_a_EPG0_VGTH_btucf_a.htm

**Figure 10. Levies and taxes (including VAT) on residential gas and electricity (euro cents per kWh) in EU Member States (average in 2021)**




Source: RAP graphic.

* The taxes and levies on electricity in the Netherlands do not include the lump sum rebate given to electricity consumers, as this is not directly related to electricity consumption.

** The taxes and levies on residential electricity consumption over 4 000 kWh per year for residential consumers registered as using electricity for space heating in Denmark is the lowest in the EU. All other residential electricity consumption is subject to the highest rate in the EU.

## 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, also can lower the operating costs of heat pumps.

## Examples

As of January 2021, electricity use for home heating in Denmark has been subject to the minimum allowable taxation rate under EU law, a decrease from €120/MWh to €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. This dual revision greatly improved the economics of running a heat pump compared to a natural gas boiler.[76]

## 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. 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. These tax and levy reforms need to be carefully evaluated through a wider social lens.

## 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?

76 Rosenow et al., 2022b.

## 8.3 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. While the use of such mechanisms for heat pumps is relatively innovative, they could be a key tool for driving heat pump deployment to mass-market levels, in advance of fossil fuel phaseouts.

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

Obligations have been popular policy tools to deploy energy efficiency measures, with energy suppliers and network companies obligated around the world. Under some energy efficiency obligations, heat pumps have been a deployable energy efficiency technology.[77] Outside of buildings, mandates have also been introduced on vendors of vehicles to require a certain proportion of vehicle sales to be electric.[78]

### Examples

Heat pump-specific obligations and standards are rare. and novel mechanisms with the leading examples are currently under development. The United Kingdom's proposed 'Market Based Mechanism' is due to be launched in 2024.[79] This policy plans to place an obligation on manufacturers of fossil fuel heating equipment to ensure that a certain proportion of their sales are heat pumps or that they provide enough vouchers for heat pump installs.

An obligation in Spanish building regulations on building owners requires the installation of renewable hot-water heating for new buildings and those undergoing renovations.[80] Both heat pumps and solar thermal count towards this obligation.

77 Lees, E. & 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/

78 BC Gov News. (2020, July 30). *Province puts in place rules for 100% electric-vehicle sales by 2040.* https://news.gov.bc.ca/releases/2020EMPR0031-001416

79 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

80 Ministerio de Transportes, Movilidad. (2022, June). *Documento Básico HE Ahorro de energía.* https://www.codigotecnico.org/pdf/Documentos/HE/DccHE.pdf

In Colorado, U.S., a 2021 act (Bill 21-264) places an obligation on gas distributors to develop plans and deliver carbon savings associated with heat use which can include 'beneficial electrification.'[81] Plans in Vermont, U.S., for a 'Clean Heat Standard' which would have obliged gas utilities and suppliers of other fuels to meet a certain proportion of their heat supplies from clean heat, such as heat pumps,[82] reached an advanced stage but have not yet become law and are subject to further consideration.

More general energy efficiency standards, such as Energy Efficiency Resource Standards[83] and grid operator efficiency standards, can also support heat pumps as part of wider programmes.[84]

## Key benefits

Obligation-based policies are expected to lead to lower cost outcomes than using grants, because competitive pressure means obligated parties 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 placed 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 a scheme means that their performance is unclear in terms of the response from both industrial and building owners. As such schemes tend to deliver the most cost-effective projects, there is a risk that certain household/building types may not receive the benefit of them.

## 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 is delivery supporting low-income households?

81 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

82 Cowart, R. & Neme, C. (2021, December). *The Clean Heat Standard.* Energy Action Network. https://www.raponline.org/wp-content/uploads/2022/05/rap-ean-clean-heat-standard-VT-2021-december.pdf

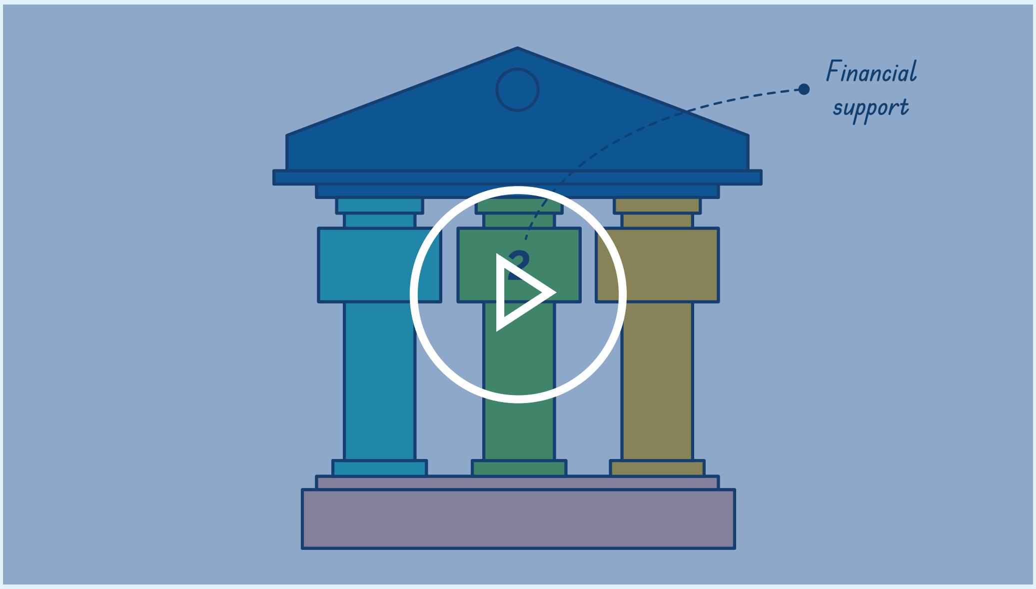
83 ACEEE. (n.d.). *Energy Efficiency Resource Standards.* https://database.aceee.org/state/energy-efficiency-resource-standards

84 Crossley, D. & Wang, X. (2015, August). *Case Study: China's Grid Company Energy Efficiency Obligation.* Regulatory Assistance Project. https://www.raponline.org/wp-content/uploads/2016/05/rap-crossley-casestudychinagridcompanyeeo-2015-aug.pdf

# 9 Pillar 2: Financial support

Providing financial support to building owners, our second policy pillar, is a key element of heat pump deployment policy which is expanded on in this section and considered in the short video below.

**Figure 11. Policy toolkit pillar 2**




Note: Click for a link to section summary video.

In most countries, the upfront costs of heat pumps remain higher than many of the existing alternatives they need to replace.[85] This is in part because the capital cost of a heat pump unit is likely to be more than an equivalent furnace or boiler.[86] However, first-time heat pump installations are likely to cost more than a boiler/furnace replacement due to potential additional work, such as upgrading the heat-emitter 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 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 to support these capital costs. The varying affluence and characteristics of building owners means that the type and amount of support needed is likely to vary.

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.

85 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

86 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

## 9.1 Grants and rebates

One of the simplest policy tools available to support heat pumps 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 such schemes may require households to fund the entire system initially and claim money back, a situation which may not be possible for many due to the significant upfront expense.

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

### 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 cash flow burden for households but moving it to installers. Grants schemes tend to be funded via government spending but 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 of forming the now well-developed Swedish and Swiss heat pump markets.[87]

87 Kiss, B., Neij, L. & Jakob, M. (2013, December). *Heat Pumps: A Comparative Assessment of Innovation and Diffusion Policies in Sweden and Switzerland. Knowledge in the Energy Technology Innovation System.* https://www.cambridge.org/core/books/energy-technology-innovation/heat-pumps-a-comparative-assessment-of-innovation-and-diffusion-policies-in-sweden-and-switzerland/E978A074F743FADA1047CA544EA1AA4C

## 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.[88]

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,[89] in a scheme which also supports hybrid systems.[90] 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.[91]

In the UK, hybrid systems are not subsidised, and different levels of subsidy are available to ground- and air-source heat pumps (GBP 6000 and GBP 5000, respectively),[92] but a flat rate exists for all house types and sizes. The grant is paid to the installer, thus reducing cash flow risk for households. The Canadian scheme is similar to the UK scheme, but grants are instead paid to households.[93] Grants for heat pumps in New Zealand of up to NZD 3000 are available, although only for low-income households.[94]

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.[95] The UK government this year eliminated sales tax (VAT) from heat pumps and maintains its provision of grants.[96]

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). Under the scheme, installers can claim the rebate directly,[97] meaning that households see no impact on their finances when switching to a heat pump.

88 Farabi-Asl, H., Chapman, A., Itaoka, K. & Noorollahi, Y. (2019, February). Ground source heat pump status and supportive energy policies in Japan. *Energy Procedia, Volume 158.* Pages 3614-3619, ISSN 1876-6102, https://doi.org/10.1016/j.egypro.2019.01.902

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

90 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.

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

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

93 Government of Canada. (n.d.[c.]). *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

94 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/

95 British Columbia Provincial Government. (2022, February). *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

96 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

97 Sunderland, L. & 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

## 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 leading to rapid and potentially unsustainable market responses. Following market booms, the withdrawing of heat pump subsidies in Swiss and Swedish markets led to a rapid fall in the number of installations.[98]

## 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?

98 Kiss et al., 2013.

## 9.2 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 any other home renovation or other personal loan. 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).[99]

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.

### Examples

In Scotland[100] and Canada,[101] 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.[102]

Another set of programmes growing in popularity in the United States is 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[103] 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).[104,105] The efficiency savings above costs are passed on to customers, but relying on the energy savings alone can limit the value of the investment and cut out important considerations such as safety and comfort.

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99 Energy Sage. (2021, August 20). *Energy efficiency loans for homeowners.* https://www.energysage.com/energy-efficiency/financing/loans/.

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

101 Government of Canada, n.d. (c.).

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

103 '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., & 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/

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

105 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 U.S. 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 — electric bill payment history is used instead.[106] 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.[107]

## 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, they may have a cost of finance and therefore 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.[108] 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?

106 Capital for Change. (2022). *What is the Energize CT Heat Loan Program?* https://ctheatloan.com/about

107 CT Green Bank. (2021). *Heat pumps provide savings and comfort.* https://www.ctgreenbank.com/programs/smarte-heat-pump/

108 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/

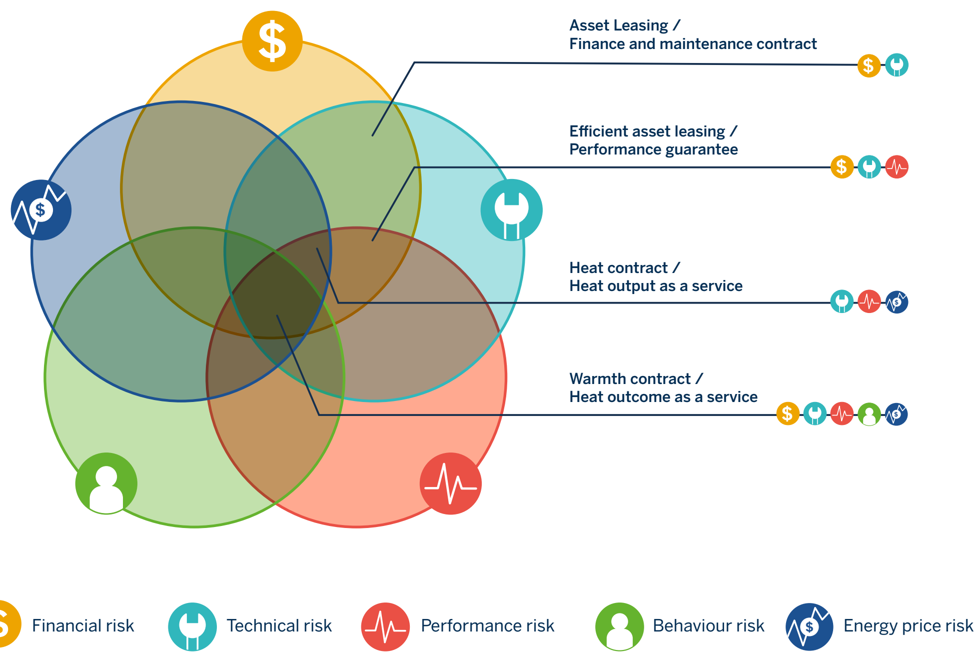
## 9.3 Heat as a service

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.'[109] 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.

### How does it work?

In HaaS offers, energy companies can take on various types of risk that are typically borne by the customer.[110] 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 provider offers directly to consumers.[111] Figure 12 below shows different HaaS models and the various risks within such models.[112]

**Figure 12. 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).

109 Fleck, R., Annam, A., Hunt, E. & 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

110 Pieterse, R. (2019, July 10). Defining heat as a service. *LCP Delta.* https://www.delta-ee.com/blog/defining-heat-as-a-service/.

111 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

112 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 would receive a guaranteed service for a fixed price and avoid the energy price risk.[113] 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 the suppliers, benefits range from predictable income streams to an expanded potential client base given 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.[114] 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.[115]

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 €159 per month. UK-based Energy Systems Catapult trialled HaaS offers in conjunction with other UK companies by paying for 'Warm Hours.'[116] 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.[117, 118]

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

114 Sugden, 2021.

115 Sugden, 2021.

116 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/

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

118 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 lowest running cost source of energy 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 also may be needed if energy companies can only legally bill customers per kWh.[119] 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.[120] If heat pumps are not owned by the same people who own the building, this can place some risk on the device owner if access to the premises cannot be guaranteed.[121]

## 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?
- 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?

119 Dann, L. (2022, May 30). 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/

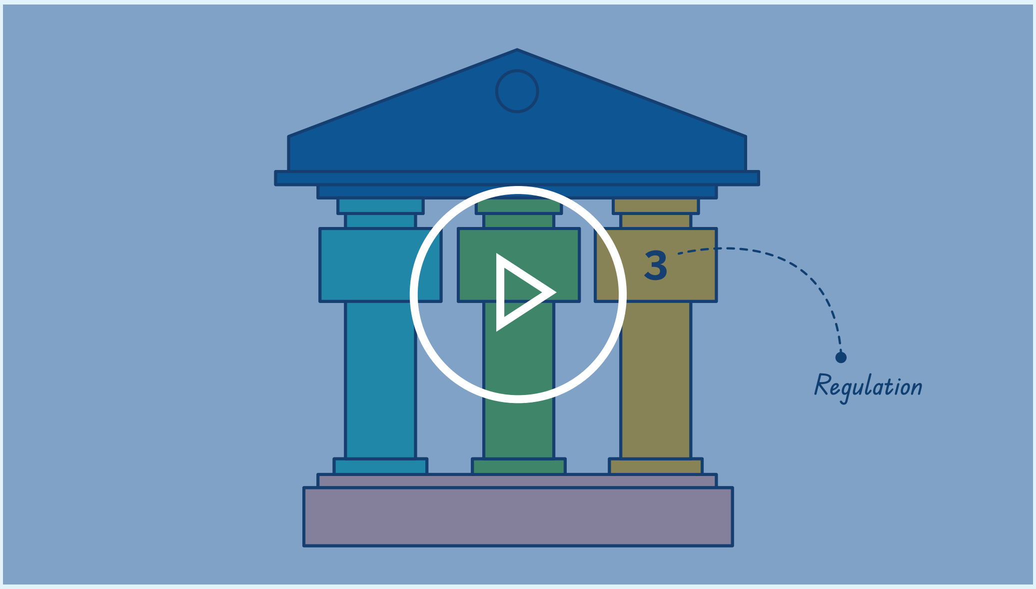
120 Irena, IEA, & REN21, 2020.

121 Britton, J., Mae Minas, A., Catarina Marques, A. & Pourmirza, Z. (2021, January). Exploring the potential of heat as a service in decarbonization: Evidence needs and research gaps. *Energy Sources, Part B: Economics, Planning, and Policy. Volume 16,* Issue 11-12. New Energy Downstream. Emerging business models and innovative best practices: an economic, institutional and behavioural focus. https://www.tandfonline.com/doi/full/10.1080/15567249.2021.1873460

# 10 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 the final chapter in out toolkit. The short video linked from the image below summarises this chapter.

**Figure 13. Policy toolkit pillar 3**




Note: Click for a link to section summary video.

It will be impossible to overcome all 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, regulations 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 harmonise with international examples, as heat pumps and other heating equipment can be internationally traded and similar requirements across countries bring down costs of compliance and therefore lead to lower costs for the 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 bans and geographical zoning.

## 10.1 Building codes and standards

Requirements can be made for new buildings to be built with certain characteristics or technologies. Such characteristics can include fabric energy efficiency standards, carbon standards and specific technology inclusion, all of which can drive the uptake of heat pumps if designed appropriately. Standards can also be applied to existing buildings to drive fabric efficiency or technology upgrades.

### How does it work

Although only 80 countries have building energy codes and standards, these exist to ensure that buildings are structurally safe and suitable for habitation.[122] 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.

Mandatory energy performance standards in building regulations set minimum energy and emissions requirements for construction of new buildings, renovation of existing buildings and ongoing building performance. It is particularly important to ensure codes cover new residential construction because residential buildings contribute the most to growth in energy demand and associated greenhouse gas emissions.[123] 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 14 outlines best practice strategies for energy standards in new buildings.[124]

**Figure 14. 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.

122 Delmastro, 2022a.

123 Delmastro, 2022a.

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

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 $m^2$ to have net-zero energy consumption. In 2025, this will extend to public buildings of at least 500$m^2$, private buildings of at least 1,000 $m^2$ and apartment buildings with at least 30 units. By 2030, all new structures of at least 500 $m^2$, both public and private, will have to be net zero in energy[125] consumption. This requirement will naturally support the deployment of heat pumps because of their low energy consumption.

*New codes:* California's 2022 Energy Code for newly constructed homes and businesses, which means they can't be connected to gas, encourages electric heat pump technology and establishes electric-ready requirements for single-family homes.[126] Revisions to the State of New York's building code require all-electric new construction starting in 2024.[127] 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 and non-residential buildings.[128]

*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.[129]

## 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 ensuring 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.

125 Tae-Gyu, K. (2020, January 26). The new wave of S. Korea's zero-energy architecture. *Hankyoreh.* https://english.hani.co.kr/arti/english_edition/e_national/925713.html

126 Balaraman, K. (2022, April 11). 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/

127 Tan, Y.A., Gruenwald, T. & 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/

128 Kang Y., Wu J., Liu R., He L., Yu Z. & 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

129 A review of existing minimum energy performance standards is available here: Sunderland, L & 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/

## 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.

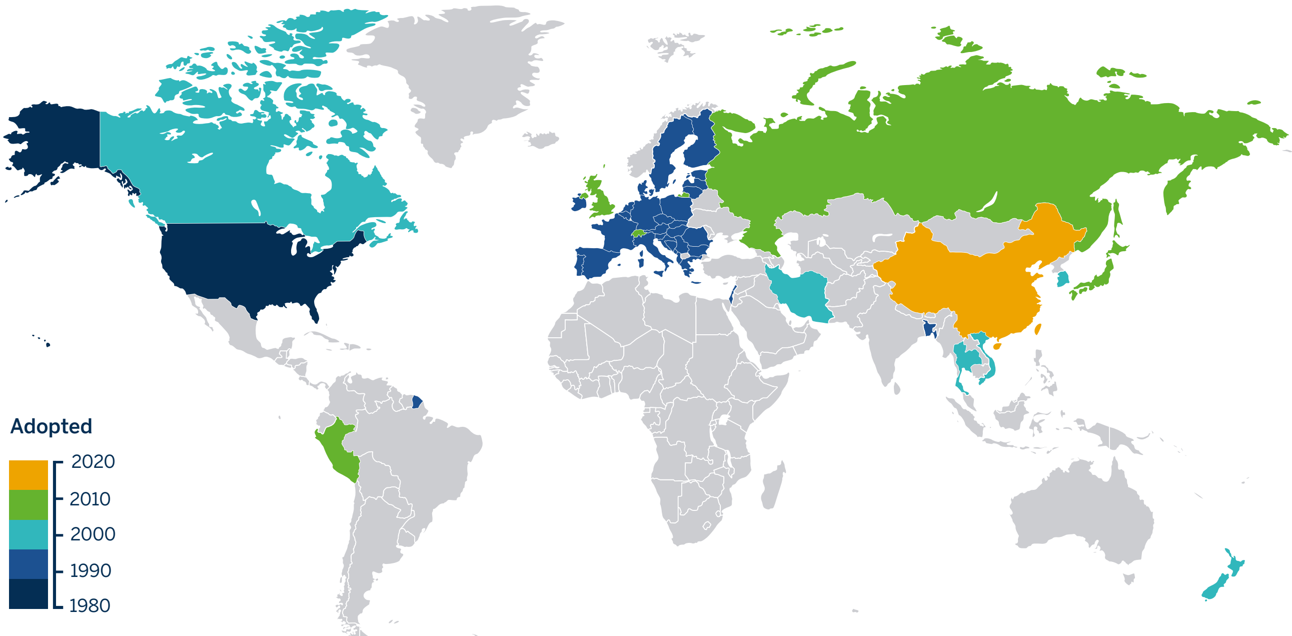
## Key decisions

- 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?

## 10.2 Bans and appliance standards

Whereas building codes control the installation of heating equipment, bans and appliance standards typically control what heating equipment can be sold, imported, manufactured (or even exported depending on the relevant legal authority). Figure 15 shows countries that have heating equipment appliance standards and their initial adoption date.[130]

**Figure 15. Countries with space heating appliance standards and their initial adoption date**




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

130 CLASP. (n.d.). *CLASP Policy Resource Center.* Retrieved 6 September, 2022. https://www.clasp.ngo/tools/clasp-policy-resource-center/

## How does it work?

1. Bans or additional requirements on heating equipment (such as on fossil fuel or electric resistance heating, or one-way air conditioners[131]) can make them either illegal to sell or prohibitively expensive compared to alternatives.
2. Increasing the efficiency, cold-weather performance or quality of heat appliances, thereby improving the customer economics and satisfaction of heat pump can indirectly drive consumers towards heat pumps or, indeed, better heat pumps.

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

**Table 2. Different types of appliance policies and how they promote heat pump adoption**

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

## Examples

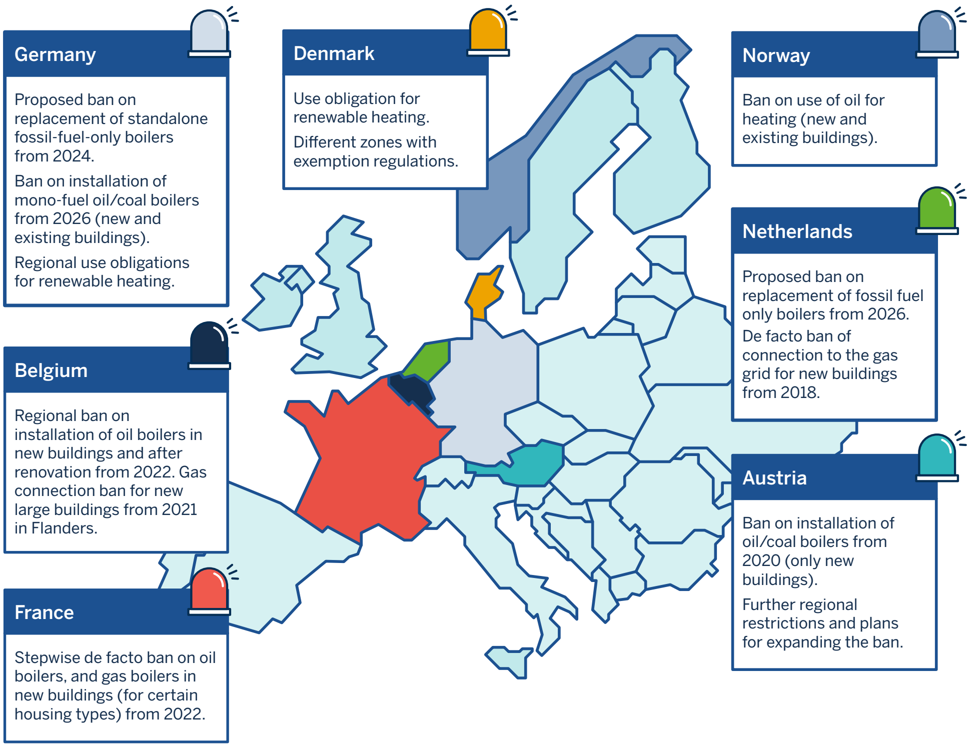
Several countries in Europe have or will soon ban installation or use of fossil fuel heating, as can be seen in Figure 16 below. Meanwhile, in the United States, gas bans have been much more of a local movement, with 50 cities in California and several others around the country, including New York City, banning gas connections in new buildings. This movement, however, has engendered a backlash, with 20 states 'banning the bans' by prohibiting similar local bans within their territories.[132,133]

131 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., & Torre, D. (2022). *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/

132 DiChristopher, T. (2021, November). *Gas Ban Monitor: Calif. count reaches 50 as West Coast movement grows.* S&P Global Market Intelligence. https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/gas-ban-monitor-calif-count-reaches-50-as-west-coast-movement-grows-67732585

133 Building Decarbonization Coalition. (2021). *Zero Emission Building Ordinances.* https://www.buildingdecarb.org/zeb-ordinances.html

**Figure 16. Fossil-fuel heating restrictions in EU Member States and Norway**




Source: Based on Figure 4 from: Braungardt, S. et al. (2021). *Phase-out regulations for fossil fuel boilers at EU and national level.*

Also in the United States, the *voluntary* ENERGY STAR endorsement programme has stopped recognizing fossil fuel as 'Most Efficient,'[134] does not recognise electric resistance at all[135,136] 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.[137,138] Meanwhile, the latest proposed *mandatory* standards for methane and propane gas furnaces would 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.[139]

Finally, two U.S. 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.[140]

134 Bailey, A. (2021, September 28). *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

135 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

136 No electric resistance water heater specifications at U.S. Environmental Protection Agency. (n.d.). *Product Specifications & Partner Commitments Search.* Accessed 2022, 4 July. https://www.energystar.gov/products/spec

137 The cold-climate requirements were pioneered by the Northeast Energy Efficiency Partnership (NEEP). See NEEP. (2022). *CCASHP specification & product list.* https://neep.org/heating-electrification/ccashp-specification-product-list

138 U.S. Environmental Protection Agency. (n.d.). *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

139 Walton, R. (2022, June 14). 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/

140 Seidman & Shenot, 2022.

## Key benefits

Bans and standards 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 can also 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, bans are more straightforward: any equipment that meets a definition may no longer be sold. However, not all agencies have the authority to completely ban equipment. For example, in the United States, the federal Department of Energy may not impose policies that lead to the 'unavailability' of any class of equipment;[141] meanwhile, over a dozen states have forbidden local bans on gas appliances.[142] 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.[143,144]

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.[145]

## Key decisions

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

141 Government of the United States of America. (2010). *42 United States Code 6295(o)(4) - Energy conservation standards.* https://www.govinfo.gov/app/details/USCODE-2010-title42/USCODE-2010-title42-chap77-subchapIII-partA-sec6295/summary

142 DiChristopher, 2021.

143 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/

144 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

145 Van Buskirk, R. D., Kantner, C. L. S., Gerke, B. F., & Chu, S. 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

# 10.3 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 would double by 2050.[146] In these situations, planning will be needed to develop and coordinate such systems.

## How does it work

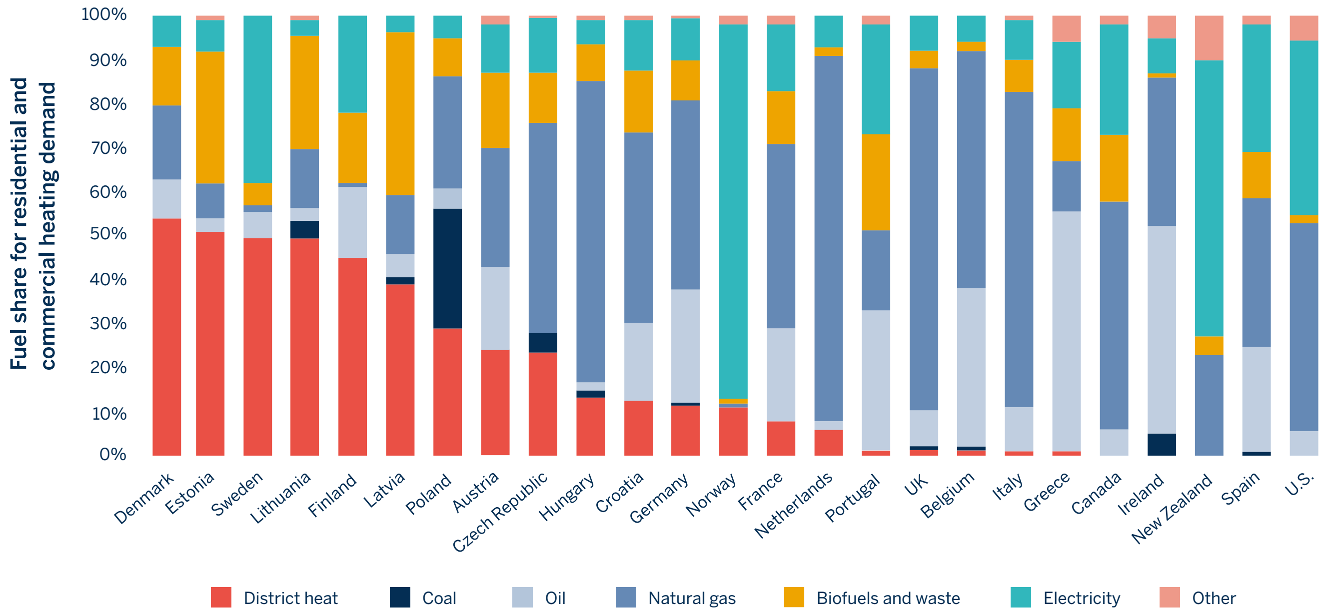
Local energy governance requires a local government that is actively engaged in cooperation with central or regional government which provides a stable framework and.[147] Local governments, potentially in collaboration with private actors, effectively analyse and map areas to determine optimum heating 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 levels or with business to deliver planning elements , such as heat networks.

## Examples

As shown in Figure 17 below,[148] heat networks already exist at scale in several Nordic and eastern or central European countries, following the establishing of programmes to support their deployment.

**Figure 17. 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*.

146 IEA, 2021.

147 Rao, L., Chittum, A., King, M. & 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

148 BEIS, 2017. p29:

Denmark, which has district heating providing heat to around 63% of homes,[149] initially started its rollout in the 1920s, but after the oil crisis it legally obligated municipalities to map and plan for the location .[150] 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[151] and has since entered into a commercial agreement with U.S. firm Amaresco to deploy solar PV, heat networks and heat pumps across the city at scale.[152] In nearby Scotland, the government has driven a programme to develop local 'Heat and Energy Efficiency Strategies.'[153]

The government of the Netherlands now requires municipal governments to develop heat plans and provides them with the resource to do this.[154] 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.[155]

## Key benefits

In a transition, heat planning and zoning can prevent individual solutions 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 more are needed?
- Who should be involved in the planning process?

149 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

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

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

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

153 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/

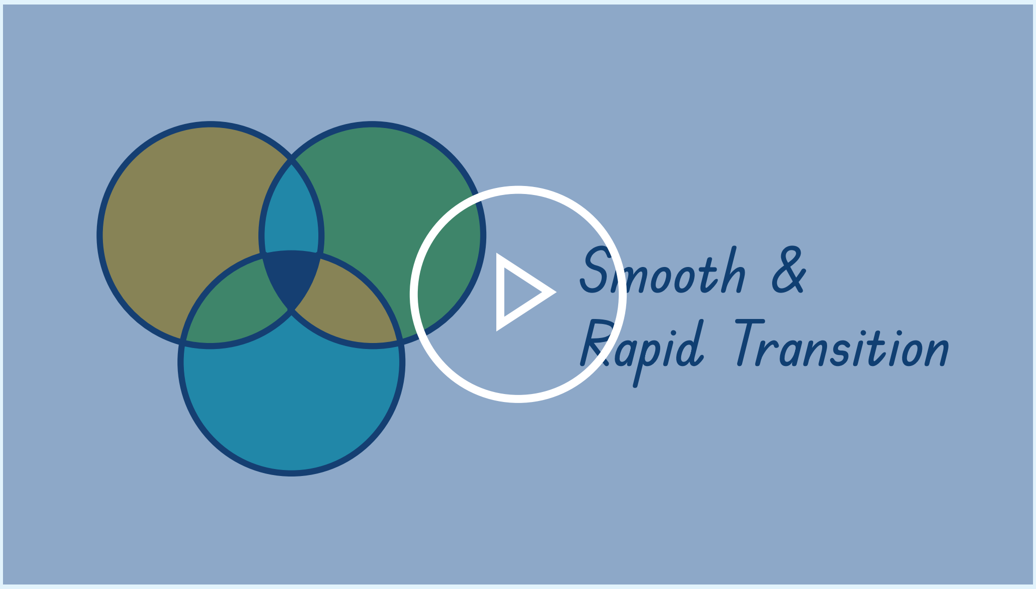
154 Devenish, A. (2022, January). *Dutch municipalities are tasked to lead the heat transition to quit gas – do they have the right tools for the job?* Going Dutch. https://www.going-dutch.org/news-1/dutch-municipalities-are-tasked-to-lead-the-heat-transition-to-quit-gas-do-they-have-the-right-tools-for-the-job

155 Colorado General Assembly. (2021). *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

# 11 Epilogue

It requires coordinated effort to transform heating markets around the world to recognise the 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. The final video in our series shows the benefits of getting heat pump policy right.

**Figure 18. The benefits of getting heat pump policy right**




Note: Click for a link to section summary video.

This 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 to 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 frequently.

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 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 achieve these goals.

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