LCPDelta

How to finance the European heating and cooling transition

NOVEMBER 2025

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Introduction - Decarbonising Residential Heating & Cooling

Finance is crucial for successfully decarbonising the sector

Decarbonising the residential heating and cooling (H&C) sector is vital to achieve EU energy security and climate goals. The financing of upfront costs is key to its success.

Synopsis

- H&C represents around 50% of the EU's final energy consumption, with approximately 26% of this being achieved by renewables. Yet only around 6% points of energy consumption comes from non-polluting renewable energy sources. The scale of the sector means that its decarbonisation is a core component of becoming climate neutral by 2050.
- The technologies needed to decarbonise the sector are available today. However, the upfront cost of their installation is often significant. Solutions need to be found to make them more easily affordable for households.

This Study

By analysing the markets of seven Member States (MS) of the EU: Czechia, France, Germany, Italy, the Netherlands, Poland and Spain, we provide **insight into the financing that will be needed to successfully transition to a clean residential H&C sector**, detailing:

- The financing needed to fill the gap between the current trajectory of the rollout and two decarbonisation rollout scenarios of 2040 & 2050.
- Public policies to support financing for households to make clean technologies affordable.
- The private sector's potential to be a significant provider of the finance if effective policies are put in place.

> *"At the EU level, the annual €78bn of extra funding required for the transition is comfortably covered by the €111bn of fossil fuel subsidies that were provided in 2023. Even the lower figure from 2015 of €57bn would cover three-quarters of the funding, and this does not even allow for the huge private sector funding that is also available."*
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Executive Summary

- Financial benefits to transitioning to clean heating & cooling
- Current trajectory
- Policies to build momentum & support households with the transition
- Finance chain to provide required funding for public and private sector

Monetary savings are the ultimate outcome of transitioning to clean H&C

To achieve the savings though, substantial upfront costs are required. With effective policies in place the financing of upfront costs can be easily achieved.

1) Households could see savings and a cheaper future

- The study finds that by 2050, households in five of the seven Member States (MS) analysed will save money from transitioning to clean residential H&C. Households in the remaining two MS will save money if the right policies are put in place.
- The monetary savings result from the lower running costs of clean technologies, because of the energy efficiency of technologies such as heat pumps.

2) But households require support in the present

- To capture the ultimate savings from lower running costs, the sizeable upfront costs of installing the equipment needs to be funded.
- Currently, partly due to the incomplete pricing of the externalities of air pollution, health costs and climate change impacts, upfront costs of clean technologies can be twice as much as the incumbent technology. Consequently, households need support to transition their H&C systems, to be able to enjoy the lower running costs.

3) Support can come from the public and private sectors

- Public policy can provide support to households through a number of instruments, including subsidies, grants, tax incentives, guarantees to provide lower interest rate costs, and adjustments to the pricing mechanisms to reduce electricity prices.
- The private sector can support households by providing affordable finance solutions that remove the upfront cost and replace it with manageable and consumer-friendly monthly payments.

4) Required finance for the support is available

- Finance to fund public policy can be sourced through a mixture of redirecting existing fossil fuel subsidies and mechanisms such as the Emissions Trading System 2 (ETS2).
- Finance to enable the private sector to provide households with attractive finance offerings can be sourced through a mixture of the reinvestment of profits and equity raising.
- Finance for both public and private sectors can be raised from the global bond market in the form of green bonds.

Current trajectory versus what is needed for decarbonisation by 2050

Current trajectory is for a significant shortfall

The transition of residential H&C is behind where it needs to be to fully decarbonise by 2050.

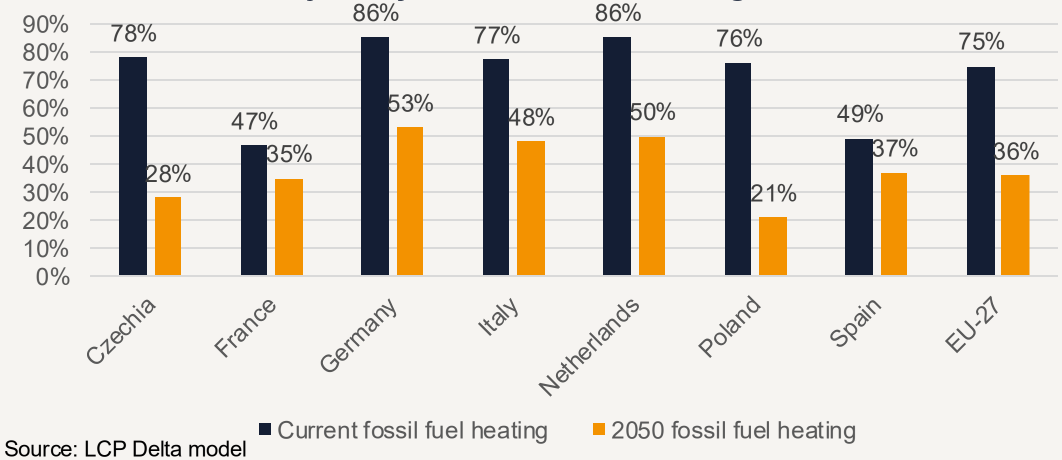
- As illustrated in chart 1, if no additional measures are taken, **fossil fuels are forecast to still play a prominent role** in the MS included in this study, with Germany, Italy and the Netherlands predicted to use fossil fuels for ~50% of their heating needs in 2050. The EU as a whole will still be using fossil fuels for over a third of its heating requirements.
- To reach the EU's net zero by 2050 target, we need to replace fossil fuels in the heating sector with clean technologies like heat pumps, solar thermal and decarbonised district heating through technologies such as geothermal. Looking at the first of these as an example, chart 2 shows the expected **shortfall in the number of heat pump installations** that are needed between 2025 and 2050 to decarbonise the residential sector, if no other policies are added. On the current trajectory, Germany falls short by over 14 million fewer installations than it needs to be decarbonised. The **EU will have 61 million fewer heat pumps than is required by 2050**.

Finance is a large reason why

The **affordability of technologies** that can decarbonise residential H&C is a large reason behind this expected shortfall. Whilst in many EU MS, the running costs of the clean technologies are attractive compared to their fossil fuel alternatives, the upfront costs are a significant challenge for households, often requiring more than twice the upfront payment compared to the incumbent fossil fuel technology.

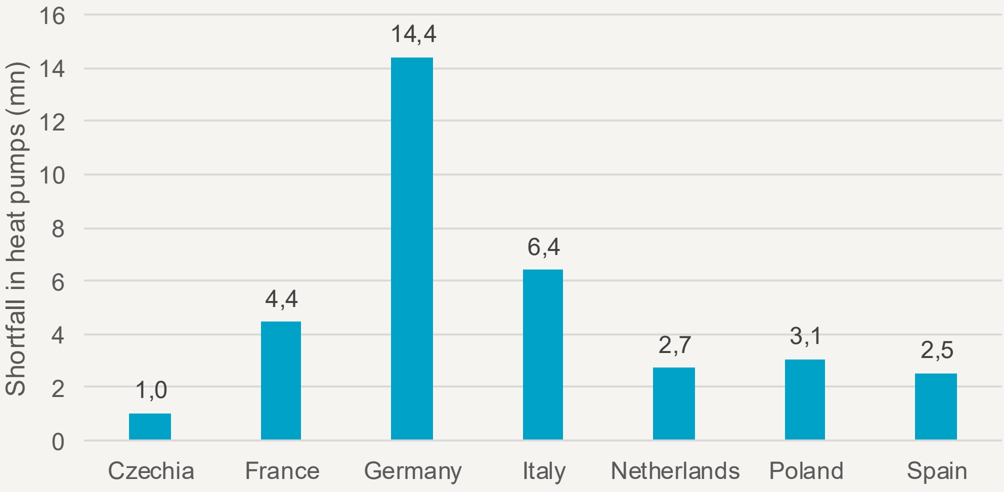
Successfully conquering this challenge will require effective solutions from both the public and the private sectors.

Chart 1: Current trajectory for fossil fuel heating



Source: LCP Delta model

Chart 2: Forecast shortfall of heat pumps by 2050 (mn)



Source: LCP Delta model

Public policy - establishing momentum in the market (1/2)

Effective public policy is vital to support households and optimise the private sector's role to build the necessary momentum for transitioning to a decarbonised residential H&C sector.

Policy design should include:

1) Consistency of subsidies. The stop-start nature of national subsidy schemes has caused great uncertainty in the private sector. This has been seen with the MaPrimeRénov and Superbonus schemes in France and Italy. This uncertainty prevents private companies making the necessary investments to scale up their operations and further developing their product offerings. It also prevents individual households from gaining the confidence to invest in clean technologies. Setting a principle of good governance for policy that ensures it is long-term and consistent will create the environment to enable the private sector to thrive and optimise its role in the transition, in this regard the French Fonds Chaleur that has been in place since 2009 is a positive example.

2) Correctly sized and targeted subsidies. As detailed on page 20, the sizeable amount of upfront costs is putting off 60% of households. This study has modelled the subsidies required for each income decile that makes clean technology the clear choice over its fossil fuel alternative. Sizing subsidies appropriately to make clean technology the obvious choice for households will help drive the transition. These subsides also need to be available to all those who need them, be it homeowners, landlords or tenants. The Conto Termico 2.0 in Italy is a good example of an income-calibrated renewable heating incentive.

3) Reform of electricity taxation and VAT on clean H&C technologies. Lowering the taxation on clean technologies would benefit households by lowering the upfront CAPEX. A reduction of VAT on the equipment has shown itself to be effective in MS such as France. A reduction of VAT on the running costs could also prove to be effective at making running costs even more attractive.

Public policy - establishing momentum in the market (2/2)

4) Adjusting the carbon price and closing the 'spark gap'. Making running costs as low as possible will make households more willing to fund the high upfront costs. To achieve optimal running costs, the uneven pricing between electricity and gas (the 'spark gap') should be addressed to make electrification more affordable for households. This can be done through schemes such as the ETS2, which would drive greater adoption of renewable heating as it improves the economic case for it. The effectiveness of this type of policy has been shown in Sweden when it imposed a significant CO_2 tax in the 1990s, resulting in increased uptake of heat pumps.

5) Building regulations. By implementing EU regulations on the types of heating system that can be installed, this would increase demand for clean technology options. Additionally, stringent EU energy efficiency regulations for buildings would require smaller, more affordable H&C systems. An example of regulations driving change is Germany's GEG act, implemented in 2024, which requires that new developments must include 65% renewable energy in their heating systems.

6) Simple & straightforward access. One of the common themes in the analysis of existing public policies is the complexity and difficulty for households in accessing the various subsidies and grants that are available. This makes households postpone their decisions and as a result the transition fails to gather the pace it needs. The private sector has spent decades crafting simple and straightforward solutions that are attractive to households. To accelerate the transition, policymakers should adopt processes used by the private sector, in particular banks, to ensure households can gain access efficiently to the support they need. The success of éco-prêt à taux zéro in France is an example of where public policy used the existing strong framework of the private sector to great effect.

7) Co-ordination. All of the above could be enhanced by the official inclusion of the transition to clean H&C into the tripartite agreement model that is used for other aspects of EU policy. These agreements are concluded between a Member State (e.g. an Eco Fund), the beneficiary (e.g. vulnerable consumer) and the contractor (e.g. heat pump installer). The beneficiary does not receive the funding directly. Instead, the money is transferred to the contractor after the works are completed and all relevant documentation submitted.

Effective policy design and implementation will signal to the private sector that stable, growing market opportunities exist in clean H&C, which will bring more private finance to the sector from companies, who will design innovative solutions, which in turn will enable more households to be able to afford the technologies, leading to further developments by private companies and a virtuous circle will be achieved, resulting in the highly beneficial outcomes that are detailed on page 11.

The pool of finance available for gathering the momentum

Funding the upfront costs

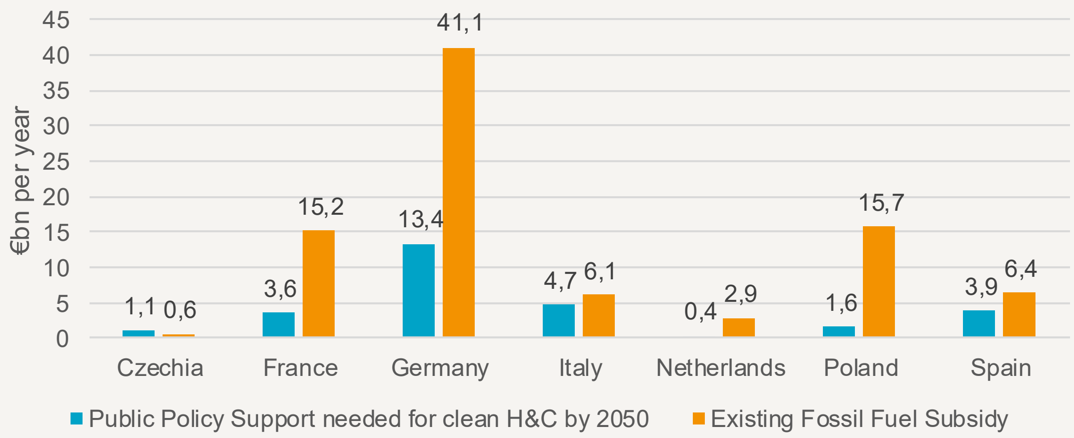
This study details that for a household installing clean technology, upfront costs can be made affordable through a mix of a subsidy payment from the government and a financing arrangement in the private sector, most likely through a bank, which would spread the upfront cost over a number of years. (It is important to note that there are other options that can also spread the cost, such as heat as a service, but this study focuses on the ownership model.) There are several promising developments in this area, with examples provided in this study, that give confidence that transitioning the residential H&C sector can become more affordable for households.

Governments and companies can source funds in multiple ways, with reallocating existing fossil fuels subsidies and raising finance on capital markets deserving special attention.

The scale of fossil fuel subsidies used in 2023, with the exception of Czechia, more than covers the required subsidies that this study calculates are required from governments to fund the residential transition to clean H&C by 2050. **At the EU level, the annual €78bn of additional financing required for the transition is comfortably covered by the €111bn of fossil fuel subsidies that were provided in 2023**(chart 3). In providing this level of fossil fuel subsidies, the EU has set a precedent for the level of subsidies that are possible and could be used to support the decarbonisation of H&C. However, even the lower levels from 2015 would be sufficient for most MS in this study to support their H&C transition.

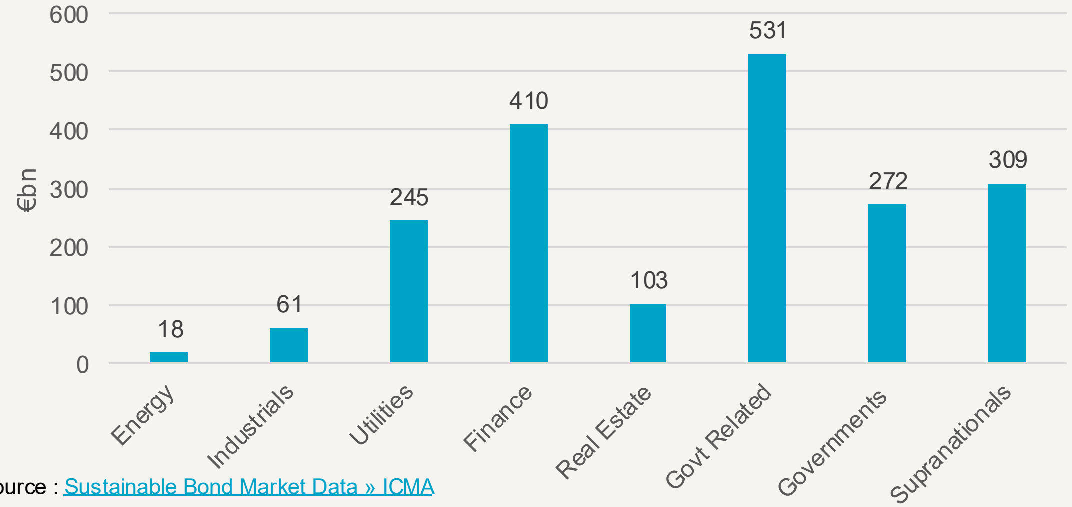
Another enormous source of finance available to governments and private companies is the green bond market. The sectors likely to be involved in the H&C transition are shown in chart 4 and, to-date, they have already raised €1.9 trillion* since the green bond market first opened in 2007, with the bulk of this finance raised this decade.

Chart 3: Annual H&C subsidy needed, compared to existing fossil fuel subsidies



Source : European Environment Agency

Chart 4: Vast scale of financing already raised in green bonds



Source : Sustainable Bond Market Data » ICMA

*The figures provided are historic raisings and will have been used for various elements of the transition, not exclusively on H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition

If required momentum is achieved, it provides huge long-term benefits

Comparing the transition to business as usual

If the effective policies on pages 8 & 9 can be combined with the amount of finance that is available detailed on page 10, the **transition becomes affordable for households**, and with it there are huge benefits to be gained.

The total upfront cost that is needed for transitioning the residential H&C sector, at the headline level, appears to be a large amount of finance. However, how does it compare to a “business as usual” (BAU) scenario where the existing fossil fuel heating systems are left in place?

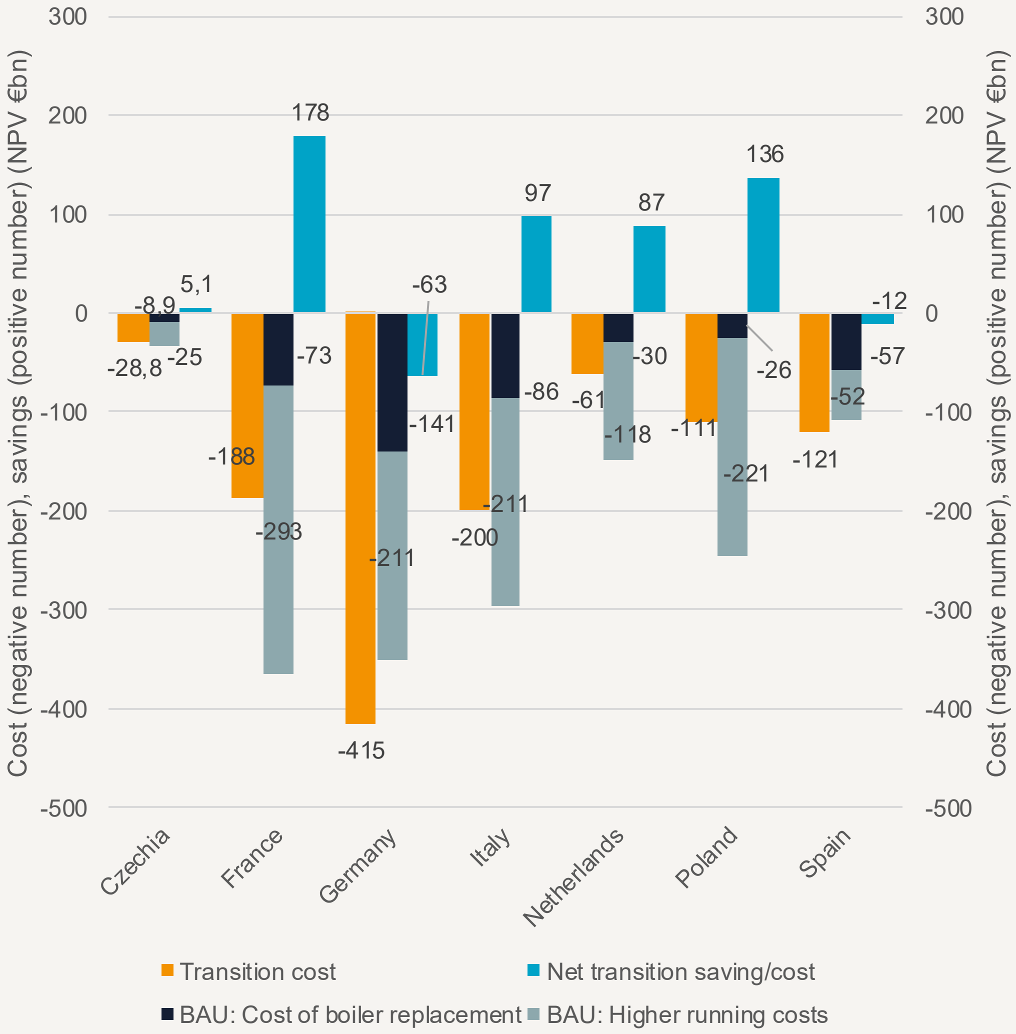
The answer is detailed on chart 5, showing the economic benefits of a swift transition to a decarbonised H&C system. This is because **once the upfront cost hurdle is cleared, the benefits to households are significant** compared to BAU. This is because of two factors:

- If business as usual is maintained, the existing stock of heating equipment would all need to be replaced between now and 2050 anyway. This creates a cost in and of itself.
- The higher running costs of BAU, compared to the lower running costs that clean technologies can benefit from due to their efficiencies.

Comparing the transition to the above BAU reveals MS households saving significant sums of money by 2050, with the exception of Spain and Germany**, but even they would save money if the timeline was run beyond 2050, due to the ongoing superior running costs of clean technologies. Crucially, with the implementation of the right policies and accelerating the decarbonisation of the H&C sector, both countries could save money sooner.

Whilst beyond the scope of this study, it is also important to state that due to further savings from the improved health of the EU populace, overall economic savings will likely be even higher than stated here. As the CE Delft report shows (CE Delft 2022), there are significant costs (Delft estimates social costs at over €26bn for the EU) to the health system caused by current residential heating systems. Furthermore, there are an increasing number of studies showing the ill effects of climate change (e.g. heat wave aging), decarbonising residential H&C can reduce these impacts and lower their costs on society.

Chart 5: Transition versus Business-as-Usual Cost to 2050*



Source: LCP Delta model

* All Net Present Value (NPV) figures; **Due to high CAPEX cost in DE and unfavourable spark gap in ES and DE

Are we on track with finance to obtain these long-term benefits?

Currently there is a financing gap, but several options can close this gap, enabling households to install clean H&C

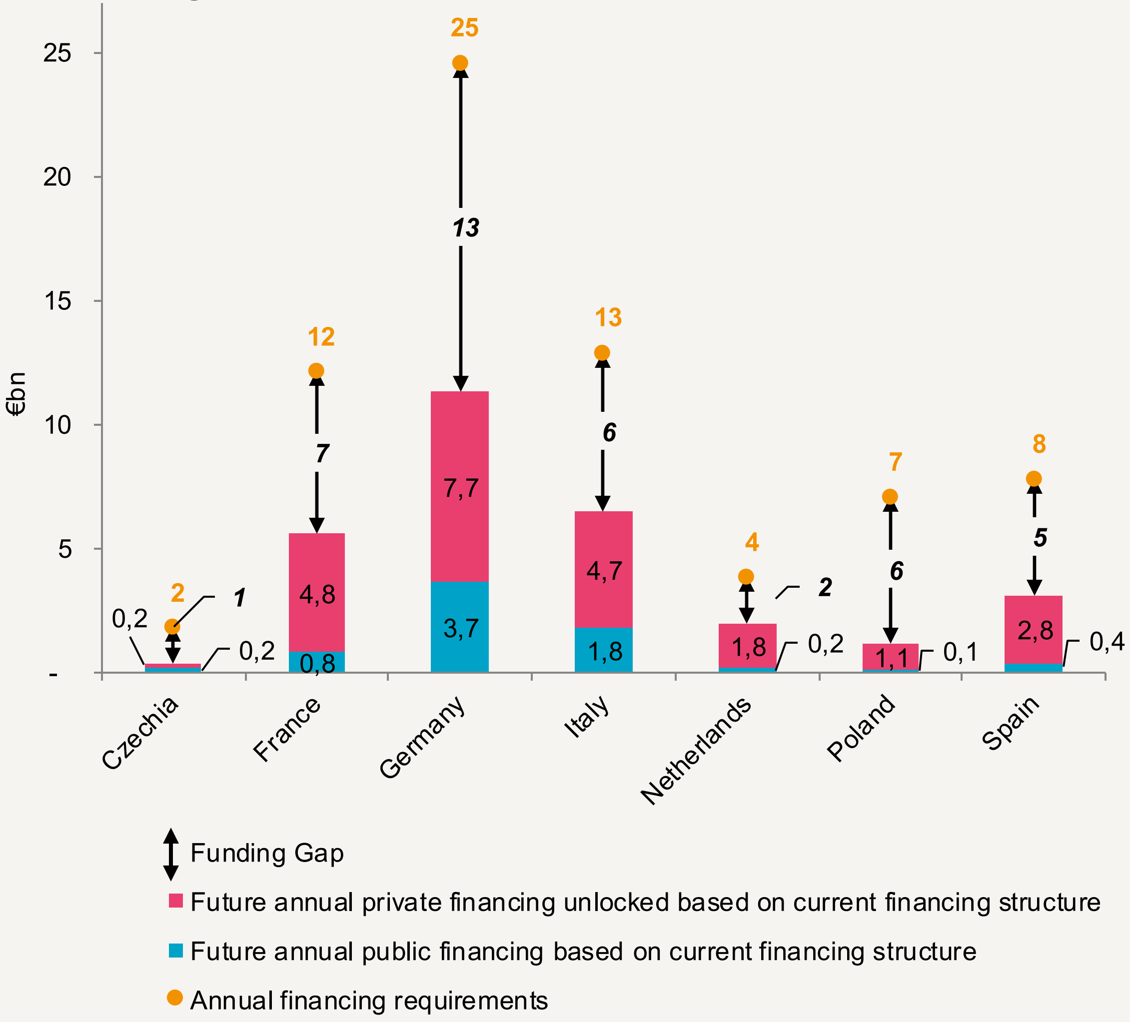
Lower running costs and net savings are huge incentives

As detailed on page 11, by 2050 the majority of MS included in the analysis make considerable savings from transitioning their residential H&C sectors to clean technologies. This huge benefit should be a strong motivation for MS to implement the policies needed to enable households to install clean technologies, not to mention the other benefits of improved energy security, health, and climate change mitigation. Moreover, switching to renewable-based H&C technologies will protect consumers from rising fossil fuel prices linked to the implementation of the ETS2 and fossil fuel price shocks.

This motivation of overall savings will be important because the initial upfront costs of transitioning the sector are a significant hurdle for households and they will require support from both government policy, and attractive offerings from private companies, to make the upfront costs more affordable. At present, as chart 6 illustrates, support for households is insufficient and this funding gap needs to be closed. To achieve this, policies with the characteristics detailed on pages 8 & 9 can embolden the private sector and unlock affordable solutions for households.

The next page outlines the finance chain that needs to be strengthened through the combination of these policies and the private finance that they will unlock. This finance chain can successfully close the financing gap illustrated in chart 6.

Chart 6: Annual Funding Gap for 2050 Scenario, that can be closed by combination of ETS2/redirected fossil fuel subsidies/green bonds/private sector funding

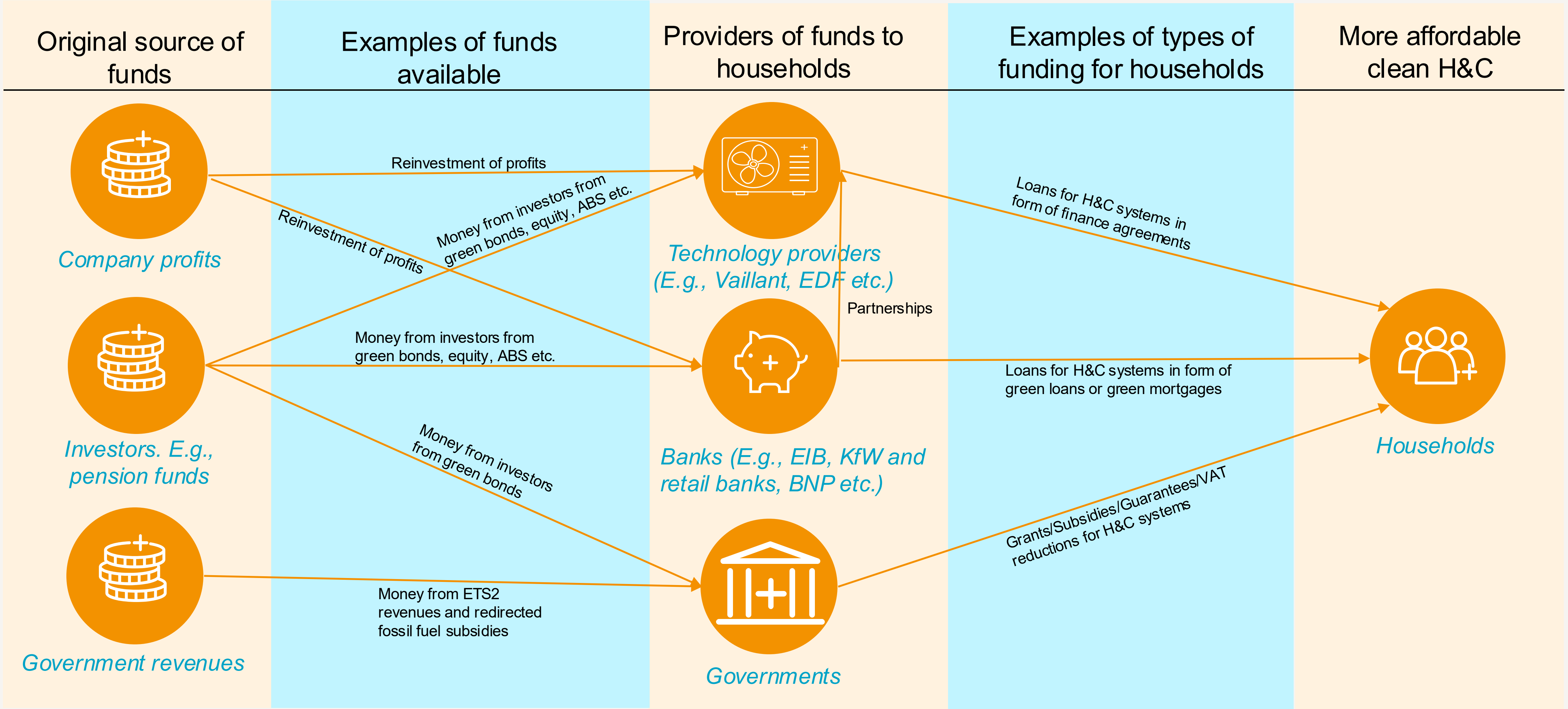


Source: LCP Delta model

Finance chain to close financing gap

The various players and instruments required to provide affordable financing to households already exist. Effective policies will enable them to gather the necessary scale for households to transition to clean H&C.

Diagram 1: Finance chain to enable more affordable H&C systems for households



Summary of finance needed + policies to strengthen finance chain

	Overall investment required (€)	Finance gap (€)	% share public/private to fill finance gap	Annual finance gap to fill (€)	Upfront NPV (€)	Net Upfront NPV (adjusting for boiler replacement costs that would happen anyway)	Total NPV (once lower running costs included)	Summary of policy recommendations
Czechia	€50bn	€40bn	61% / 39%	€1.5bn	€29bn	€20bn	€5bn savings	• Monitor 2025 simplifications for effectiveness • Long term policies to support clean district H&C • Build a financing platform • Cut VAT to close spark gap
France	€329bn	€160bn	37% / 63%	€6.6bn	€188bn	€115bn	€178bn savings	• Consistency of policy following recent pause • Combine private-sector best practices with regulation • Cut VAT to close spark gap
Germany	€665bn	€360bn	73% / 27%	€13.2bn	€415bn	€274bn	€63bn cost	• Encourage efficiencies within the heat pump market • Monitor balance between tenant/landlord/homeowner • Close spark gap by reallocating subsidies • Lower VAT on clean technologies
Italy	€350bn	€174bn	46% / 54%	€6.5bn	€200bn	€114bn	€97bn savings	• Ensure policies have long term sustainability • Increase simplicity of support for households • Increase support for clean district H&C • Reintroduce the *cessione del credito*
The Netherlands	€105bn	€52bn	9% / 91%	€1.9bn	€61bn	€31bn	€87bn savings	• Reintroduce upgrades as mandatory heat pump adoption • Dedicate finance to a Clean Heat Transition Fund • Encourage efficiency within clean district H&C • Clean heat standards for rental properties
Poland	€192bn	€161bn	27% / 73%	€6bn	€111bn	€85bn	€136bn savings	• Enable full support for those on lower incomes • Construction law to increase clean district H&C • Investment strategy for next generation district H&C • Narrowing the technologies under Clean Air Program
Spain	€212bn	€128bn	76% / 24%	€4.7bn	€121bn	€64bn	€12bn cost	• Reduce regulatory barriers for heat pumps • Encourage efficiency within clean district H&C • Reintroduce *Real Decreto* • Cut VAT to close spark gap
EU	€3670bn	€2107bn	Not in scope of study	€78bn	€2112bn	€1331bn	€461bn cost	• Scale up support through 2028-34 MFF • Apply tripartite agreement to clean H&C • Reallocate fossil fuel subsidies

Table 1 Source: LCP Delta model

Putting the upfront costs and outcome into perspective

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Long-term economic benefits of the transition

As outlined on page 11, there is a strong case that it is not just in the interests of the climate but in the clear economic interests of the governments and households of the MS to move ahead with the transition because of the savings it results in. The table below details what the annual upfront costs for the transition are, using different measurements of scale, and the savings/costs per household compared to the BAU scenario.

- Depending on the MS and not including the benefits of any subsidies or grants, it would cost a household between 0.5-1.3% of their annual net income per year.
- On a cost per day basis, it ranges between less than a euro in Spain and France, to ~€1.50 in Germany.
- Once the overall costs by 2050 are compared to business as usual, as detailed on page 11, households in the majority of the MS in this study save money. Importantly, if improvements are made to the current sub-optimal market dynamics, for example by adjusting the spark gap in Germany and Spain, then the figures in the final column will improve further, including the potential to move German and Spanish into savings territory.

Table 2: Funding the decarbonisation by 2050 scenario (source: LCP Delta model)

Member State	Upfront annual Cost	Upfront cost as % of GDP per year	Upfront cost as % household annual net income*	Upfront cost per household per day	Total savings/costs per household compared to BAU
Czechia	€1.8bn	0.58%	1.3%	€1.13	€1133 savings
France	€12.2bn	0.42%	0.5%	€0.89	€4734 savings
Germany	€24.6bn	0.57%	0.8%	€1.55	-€1443 costs
Italy	€12.9bn	0.59%	1.0%	€1.38	€3760 savings
The Netherlands	€3.9bn	0.34%	0.5%	€1.33	€10868 savings
Poland	€7.1bn	0.84%	1.3%	€1.24	€8662 savings
Spain	€7.9bn	0.49%	0.7%	€0.80	-€446 costs

* Household with one earning average wage and one earning 2/3rd of average wage, source: eurostat

The Study

The context to decarbonising heating & cooling

Successfully decarbonising heating & cooling is both vital & beneficial

A crucial sector for delivering on the EU's 2030 and 2050 decarbonisation goals

- H&C represents around 50% of the EU's final energy consumption, with approximately only 26% of this currently being achieved by renewables. Yet only around 6% points of energy consumption comes from non-polluting renewable energy sources.
- The weight of H&C on households' energy consumption is illustrated in the adjacent chart, detailing that **nearly 80% of a household's energy consumption is related to H&C**.

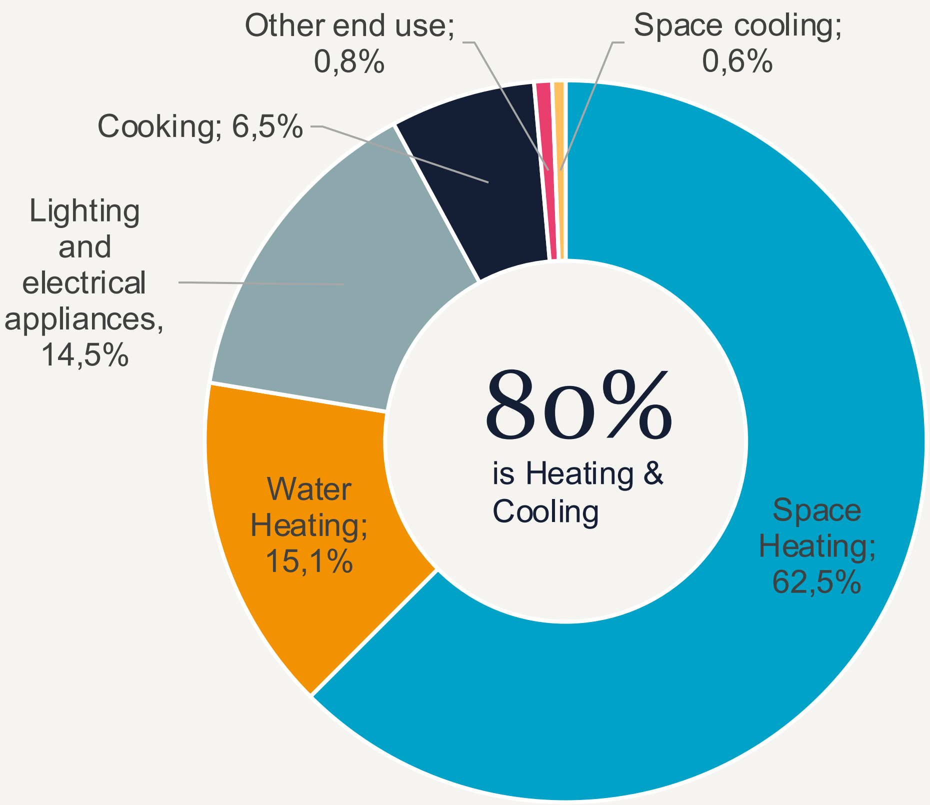
These numbers clearly highlight the importance of decarbonising the H&C sector to reach EU's target of climate neutrality by 2050.

In addition to the decarbonisation benefits, there are further benefits to transitioning to a clean H&C system:

- A clean H&C sector improves EU energy security and removes dependencies that exist with reliance on fossil fuels. In 2024, the EU imported €376bn of energy products (europa.eu).
- The efficiency of clean technologies will result in lower energy bills for the population and also lead to skills advancement and the creation of jobs.
- Decarbonising H&C addresses the health risks associated with burning fossil and solid fuels, like premature deaths and lower indoor air quality.

The good news is, the technologies required for a decarbonised, secure and cheaper residential H&C sector already exist, and we look at how the transition is progressing on the next page.

Chart 7: Energy Consumption in EU Households in 2023



Source: Eurostat (2023)

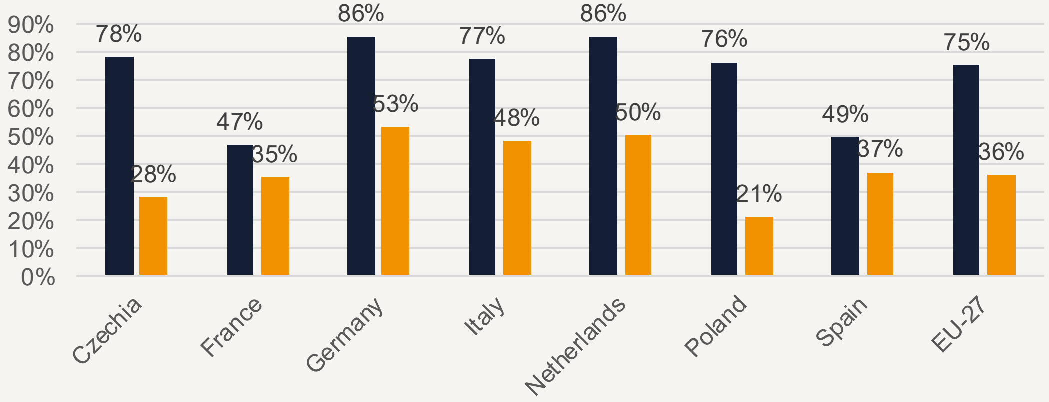
Where does the current trajectory take us?

Falling a long distance short

The installation of technologies required for a clean H&C sector, whilst growing, is not increasing at the pace required to decarbonise the H&C sector by 2050.

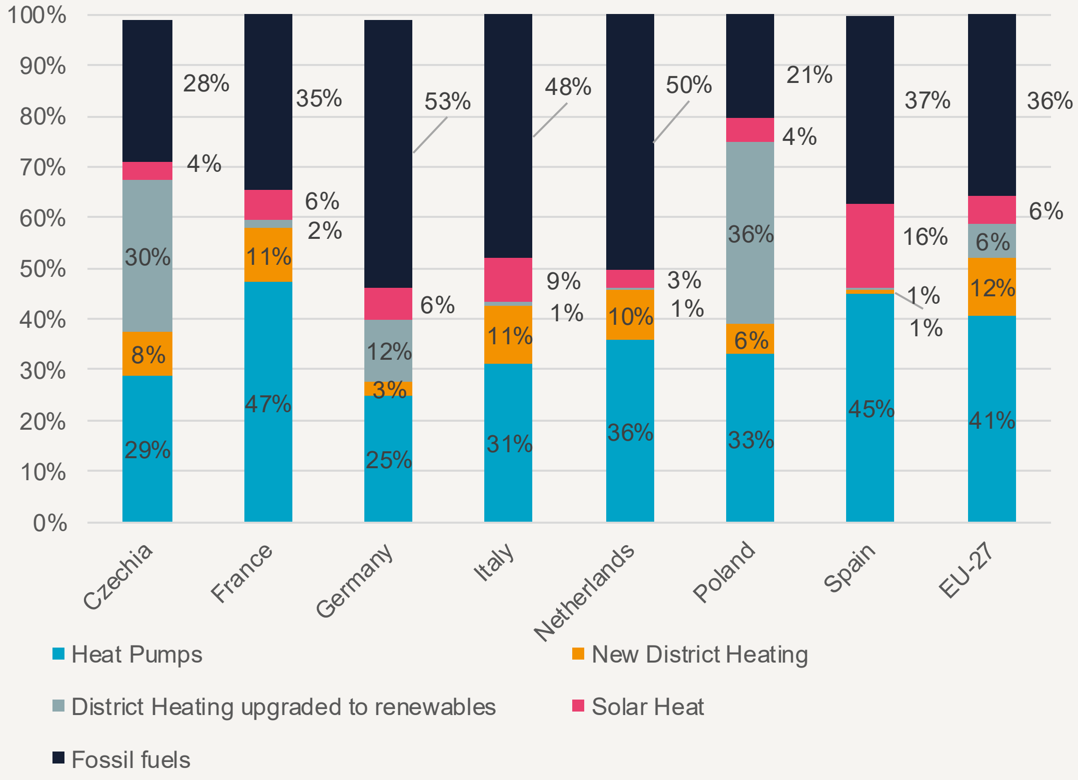
- **Chart 8 illustrates that on the current trajectory,** fossil fuels used for heating declines in all seven MS and across the EU as a whole by 2050. However, Germany, Italy and the Netherlands would continue to cover almost half of their residential heating needs with fossil fuels, with France, Spain and the EU's figures at around a third.
- **Chart 9 shows clean technologies that reduce fossil fuel usage**, with heat pumps amongst the largest individual share in each state. Solar thermal has a relatively large presence in Spain, France and Italy, while decarbonised district heating plays a prominent role in Czechia and Poland.

Chart 8: Current trajectory for fossil fuel heating



Source: LCP Delta model

Chart 9: Heating mix in 2050 based upon current trajectory



Source for charts: EU report , Cool Heating Coalition, LCP Delta

If clean technologies are so beneficial, why is the uptake slow?

Two factors dominate the slow uptake

1) Upfront Costs

Although the lower running costs of clean technologies, such as heat pumps, are beneficial for households (as detailed on page 11), upfront costs of these clean technologies can be more than double the upfront cost of installing a gas boiler. This upfront cost is a significant factor in the transition's slow pace. A recent survey by LCP Delta (The Road Ahead) of households across seven countries found that 60% of households consider the upfront costs of new energy technologies as too expensive, especially heat pumps.

In order to successfully tackle the challenge of upfront costs will require input from both public and private sectors, which leads to the second major reason for the forecasted shortfall.

2) Lack of clarity from the public sector has held back private investment

The public sector plays a vital role in financing the transition, providing subsidies and incentives to support households shift to clean technologies. Thus far, whilst there have been subsidies and incentives in place across the EU, they have been too inconsistent to provide the stability the private sector needs, both at household and company level. (EHPA)

Without the stability of policy, companies are reticent to invest, which holds back the potential for innovation and economies of scale that can drive a sector forward with lower cost innovative products. Similarly, without stability of policy, households' uncertainty increases, and holds back individual decisions to invest in clean technologies.

Aim of this study:

The failure to consistently and affordably finance clean H&C technologies is a problem that needs to be addressed. It is vital to research financing possibilities that currently exist and those that can be developed further, to make the transition more affordable for households and therefore successfully decarbonise the H&C sector.

Policy, instruments, finance and the impact on households

More affordable clean H&C systems for households will require support from both public and private sectors.

- The public sector needs to implement the right policies.
- Effective policies will in turn enable the private sector to develop attractive, affordable offerings for households.

This section details:

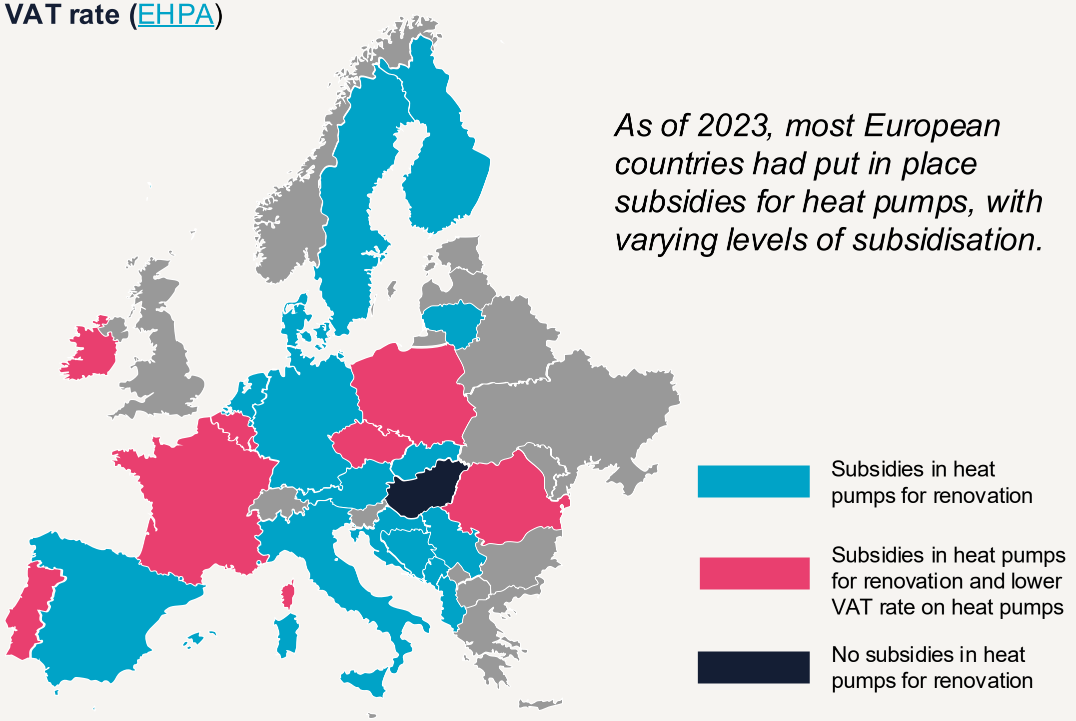
- A selection of current policies
- Various instruments available to support households
- How these instruments can be financed
- Examples of how finance for clean H&C currently looks for households in the 7 MS included in this study

Current policy situation and its flaws

Support exists across EU, national, and regional levels, but its scope and focus vary widely between MS.

Support for the residential heating sector is already available through mechanisms at the EU, national, and regional levels (rhc platform). However, the range and focus of these tools differ significantly between MS and the technology supported.

Chart 10 : Overview of subsidies in renovation for residential heat pumps and lower VAT rate (EHPA)



Source: EHPA

Uncertainty in support mechanisms weakens their overall impact.

Despite strong support mechanisms in several MS, the effectiveness of existing policies has been undermined by persistent policy uncertainty.

- In Italy, the abrupt termination of key incentives such as the invoice discount (*sconto in fattura*) and credit transfer (cessione del credito) significantly disrupted demand for low-carbon heating systems in the retrofit market throughout 2023 and 2024.
- Similarly in France, the government unexpectedly announced a partial suspension of the MaPrimeRénov programme as of July 1st, 2025 (the pause is only for major renovations, still available for single interventions). It cited the need to combat fraud and restructure the administrative processing of applications, sending a destabilising signal to households and market actors alike.

More examples of the inconsistent policies outlined above are detailed in the section that assesses the individual MS. Ultimately, effective and consistent policy is vital to strengthening the finance chain, depicted on page 13, required for enabling households to transition to clean H&C. The combination of these types of policies, alongside private sector solutions, is developing a growing number of instruments that can be used to provide households with access to more affordable clean H&C. The following page outlines a selection of these instruments.

Instrument options to support households in the transition

The H&C transition by 2040/2050 will require unlocking untapped policy and financing opportunities for households.

While most innovative instruments have historically focused on energy efficiency measures, they have also been applied to clean H&C, particularly in the U.S., offering a model the EU could follow. A selection are detailed below, with a larger summary of options outlined in Chart 11.

- Innovative payment structures like **on-bill financing** allow households to spread the high upfront cost of energy-efficiency retrofits over time. By adding repayments directly to the utility bill, this approach makes upgrades more accessible and manageable for households.
- **Property-Assessment Clean Energy** (PACE) programmes allow for the financing of energy-efficiency retrofits by having municipalities issue special-purpose bonds. The proceeds are lent to property owners for eligible upgrades, and the debt is repaid via an extra line on the property-tax bill. The innovation lies in using the existing property-tax collection system as the repayment mechanism. Although the pilot stage in the EU only began in 2020 (EuroPACE), over the past decade, U.S. residential PACE has channelled about $3 billion into energy efficiency upgrades for more than 120,000 homes, with activity accelerating in the last two years.
- **Energy Efficient Mortgages** (EEMs) are another example of innovative financing schemes. EEMs are home loans that usually offer lower interest rates or higher borrowing capacity, for properties that meet certain energy performance standards or are upgraded to become more energy-efficient. In the EU, the EEM Label promotes standardised green loans, requiring at least a 30% energy performance improvement for renovated buildings. To date, 18 mortgage products and 11 other loan products meet this definition. For example, Berlin Hyp, one of the 48 participating lenders, has issued more than €489 million in EEM-compliant loans for green buildings.

Chart 11: Overview of current financial instruments supporting energy renovations for residential building in owner-occupied and institutionally owned residential buildings (Bertoldi et. al., 2020)

	Traditional & well-established	Tested & growing	New & innovative
Non payable rewards	Grants and subsidies; Tax incentives	Energy Efficiency Obligations; Energy performance contracts	Energy Efficiency Feed-in tariffs
Debt financing	Green Loans at attractive rates; Leasing	Energy performance contract; Energy service agreements; Revolving funds; Commercial loans	Energy efficient mortgages; On-bill finance; Property assessment Clean Energy
Equity Financing		Energy performance Contracts; Energy services agreements	

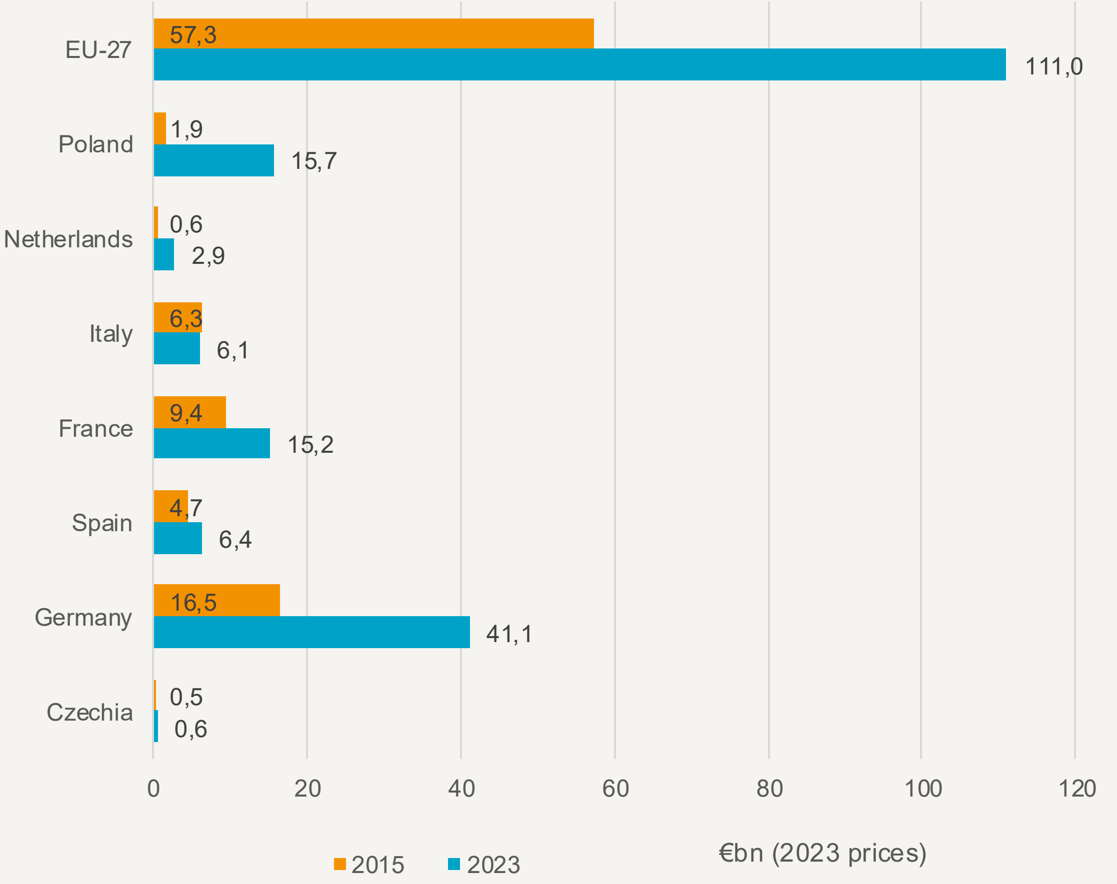
Source: WIREs

Funding public policy (1/2):

New policy support could draw on reallocated fossil-fuel subsidies and revenues generated through the expanded ETS2 framework.

- Extending emissions trading to fuels used in buildings and road transport (ETS2) will open a major **new revenue stream**. At an assumed carbon price of €45 per tonne, ETS2 could raise about €260 billion between 2026 and 2032. Around €86.7 billion will go to the Social Climate Fund (SCF), which uses ETS2 revenue to provide income support and efficiency upgrades for vulnerable households and small firms.
- ETS2 could also drive greater adoption of renewable heating as it **improves the economic case**. Sweden has imposed a significant CO_2 tax since the 1990s which has brought the cost of electricity in line with fossil fuels. Despite offering no subsidies for heat pump adoption, they have become the default option: over 40% of existing buildings use them, and they account for 94% of current heating system sales.
- Financing currently tied up in **indefinite fossil-fuel subsidies** could instead accelerate the clean H&C transition. These subsidies swelled in 2022, when EU governments shielded households and industry from the price shock triggered by Russia's invasion of Ukraine. The figures in the chart relate to 2023 and illustrate the level of subsidies that the EU has now shown it is capable of providing. These should be transferred to supporting the decarbonisation of H&C. According to the European Environment Agency, 48% of fossil fuel subsidies, amounting to €53.1 billion, have no end date, leaving a sizeable pot that could be redirected to meet Europe's H&C decarbonisation targets.

Chart 12: Overview of Fossil Fuel Subsidies in the EU and select member states, in 2015 & 2023



Source : European Environment Agency

Funding public policy instruments (2/2):

The bond market: world's largest capital market

As detailed on the previous page, there is a wealth of resources available for funding the policies needed to decarbonise residential H&C. If further resources are needed, governments also have access to the bond market, the largest capital market in the world. Governments can raise money in the bond market that can then be used to provide households with the support they need.

Governments, government related entities, municipalities and cities all regularly raise finance in the bond market and in recent years have issued green bonds, whose proceeds are fully focused on the decarbonisation of their economies. We look at the enormous depth of this rapidly growing green bond market for public related entities that can be a source of funds for the policies needed for clean H&C.

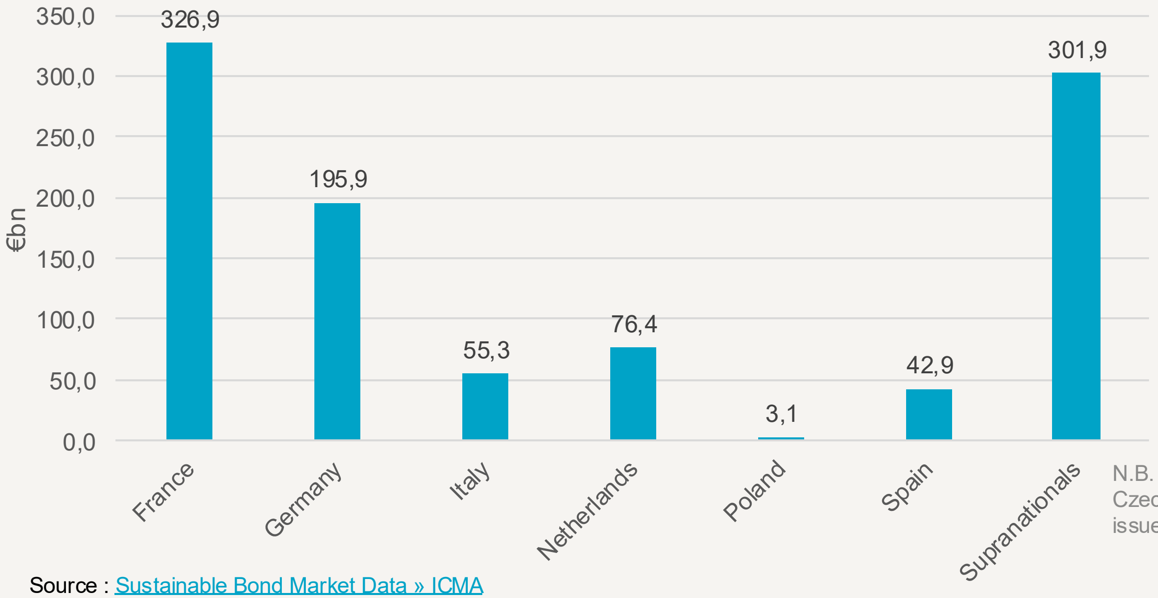
The chart shows the amount of money raised by public related entities in the seven MS included in this study and EU wide supranational entities, in the form of green, sustainability and social bonds (for simplicity we use the term green bonds as a summarising term) since the market began in 2007. For clarity, whilst the monies detailed in the chart will have been used to finance various elements of the transition, not just clean H&C, the point is that there are **vast financial resources available for financing the transition of H&C**. Here we provide some examples of entities included in chart 13 and a selection of types of policies that the funds from green bonds could support in future:

- Governments across the covered MS have raised over €220bn in the past 18 years, with the bulk of this in the last decade.
- Government related entities have been able to raise vast amounts of finance, for example, German entity KfW has raised €73bn.
- A large number of cities including Barcelona, Berlin, Lyon, Madrid, Munich and Paris have all issued green bonds.
- Supranational institutions such as European Investment Bank and EBRD have issued over €300bn.

This type of funding can support policies such as:

- Grants and subsidies needed for those on lower incomes to install decarbonised H&C systems.
- Providing guarantees on loans to those able to access personal finance to ensure interest rates are attractive.
- Financing of district heating systems within cities or regions. E.g., Gothenburg has already issued a green bond for this purpose.

Chart 13: Green/sustainability bond issuance by public entities



N.B. To date Czechia is yet to issue

Source : [Sustainable Bond Market Data » ICMA]

Funding in the private sector:

The private sector has a number of avenues open to it for sourcing the finance that it will need to provide households with the affordable offerings for clean H&C systems. These include:

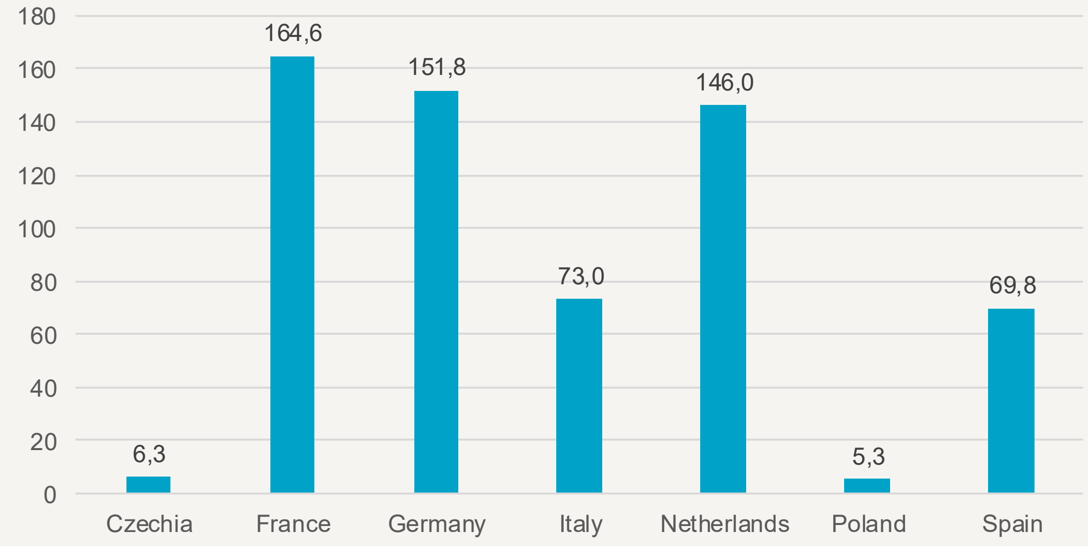
- Reinvestment of profits into developing and expanding their product offerings.
- Raising new money by issuing equity to their investors.
- Raising new money by issuing bonds, specifically green bonds.

Given, as stated, the bond market is the largest capital market in the world, we focus on this avenue in this study.

As chart 14 shows, the green bond market has already been the source of huge finances being raised by the private market in the 7 MS detailed in this study. The chart shows ~€620bn of green bond issuance by companies from various sectors that will play a role in the rollout of decarbonised H&C; from banks to manufacturers, from property companies to utilities. As stated on the previous slide, the historic monies raised in the chart have not all been dedicated to decarbonising H&C, but the finance needed from the private sector to fund household purchases of clean technologies, could easily be sourced by companies in the global green bond market. This financing could then be used to provide the household with access to the types of affordable finance options detailed on slide 26. Here, we highlight a few examples of specific companies' finance raising:

- **Danfoss**, the Danish manufacturer that includes heat pump components in its products, raised €475m in 2023, illustrating its potential to raise significant amounts of finance to further develop its H&C equipment.
- **Electricite de France** (EDF) has issued ~€15bn in green bonds, showing the ability of the French national champion to raise huge amounts of finance to drive its and its customers' decarbonisation.
- **Unicredit**, the Italian bank, currently has ~€2.7bn in green bonds that have been used to finance the transition. Further issuance is possible, which can provide the finance needed for its customers to install decarbonised H&C.
- **Iberdrola**, the global utility company headquartered in Spain, similar to EDF, has shown the huge demand it has from its investors, raising over €12bn in green bonds.

Chart 14: Green/sustainable finance raised by private companies since 2007



Source : Sustainable Bond Market Data » ICMA

Ultimate aim: improve affordability for households

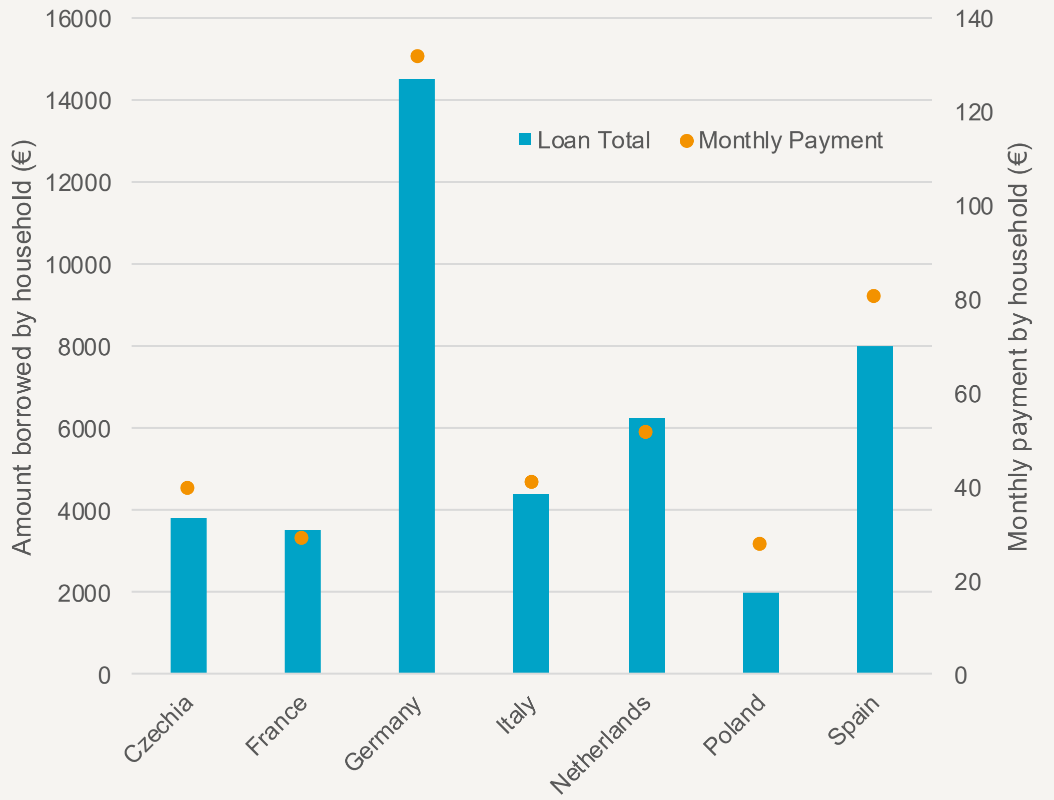
Through the combination of effective public policy and attractive private sector offerings, clean H&C can become more affordable for households. It can reduce upfront costs from thousands of euros, to monthly payments of ~€50 (MS dependent). Here we look at examples of what is possible in the MS included in this study:

Whilst there are a number of different variables (size of property, eligibility for subsidies etc.), which will make the cost of installing clean H&C vary depending on household specifics, we use the following criteria for the example illustrated in chart 15:

- The current price of installing an air/water heat pump used in the model
- Less the current full subsidies available as per EHPA (EHPA summary)
- To arrive at the size of the private finance required (It is assumed the household does **not** use any cash deposit)
- It also does **not** include the benefits of the lower running costs of the decarbonised technology that would likely offset an element of the monthly payments
- The remaining finance needed is assumed to be sourced from one of the banks providing specialist financing options available in the MS.

The chart details both the amount of finance needed by the household after available subsidies, and monthly payment made by the household based upon a 10-year term for the finance taken out with the bank.

Chart 15: Example of household private financing needed after government support



Source: LCP Delta, EHPA, Ceska Sporitelna, BNP, KfW, Intesa Sanpaolo, Warmtefonds, InBank, Santander

Simplicity of access can accelerate the transition

It is worth highlighting that due to the expertise of finance providers with their processes for arranging finance, a benefit of their involvement is the likely ease and smoothness in the provision of funds to households. This can help make the process simple for individuals and therefore increase the speed of transitioning to clean H&C.

EU & Individual Member State Assessments

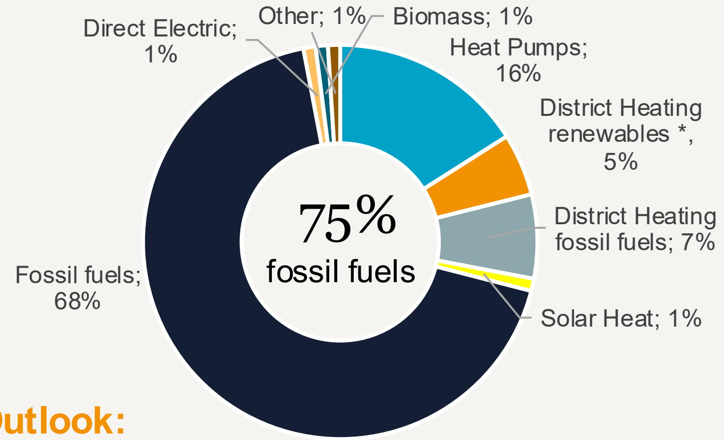
Having outlined the types of policy, instruments and financing required for more affordable products for households, this study now provides detailed assessments of the progress seven MS (Czechia, France, Germany, Italy, the Netherlands, Poland, Spain) are making in their journey towards clean H&C.

For the EU and each of the seven MS, using LCP Delta's finance model*, we assess the technologies needed, costs of the technologies, financing these costs, policy frameworks, policy recommendations and private sector financing potential.

*The methodology for the model can be found in the appendices

EU – technologies needed for decarbonising residential H&C

Chart 16: Current heating mix



Source: LCP Delta model

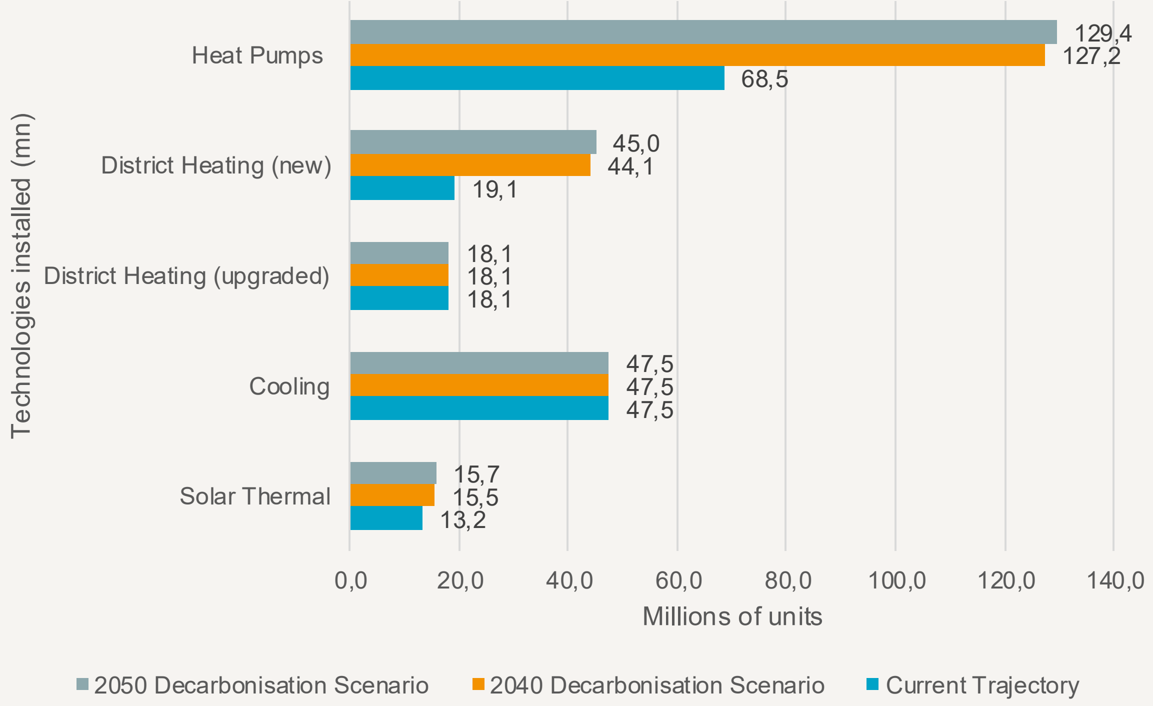
Heating Mix Outlook:

Three quarters of the EU's current residential heating uses fossil fuels, which illustrates the scale of the decarbonisation task ahead.

- The EU's well publicised heat pump target of 2030 that could reach 60 million (REPowerEU), is now increasingly likely to be missed. However, accelerating the rollout of this technology is crucial for both energy independence and decarbonisation. Over 120m new heat pumps are required for both of the 2040 and 2050 scenarios, nearly double that of the current trajectory.
- Similar to heat pumps, there is a large gap between the current trajectory of district heating and the number of installations that are needed for 2040 or 2050. However, a steady annual growth rate of 6% or 3.6% can put the EU on track to clean H&C by 2040 and 2050 respectively.
- Solar thermal is set to play a significant role in the south of the EU and also in decarbonising district heating more broadly. The growth rates to achieve this by 2050 are 8.1% per year.

*includes biomass

Chart 17: Number of new individual installations under the three scenarios



Source: LCP Delta model

Table 3: Compound annual growth rate (CAGR) required for each technology

	Heat Pump	District Heating	Solar Thermal
Current Trajectory	3.9%	2%	7.4%
Decarbonised by 2040	9.7%	6%	13.7%
Decarbonised by 2050	5.8%	3.6%	8.1%

Source: LCP Delta model

EU – Cost of decarbonising residential H&C

Achieving a decarbonised heating system in the EU by 2050 will demand €3670 billion (NPV €2112bn), or roughly €136 billion per year.

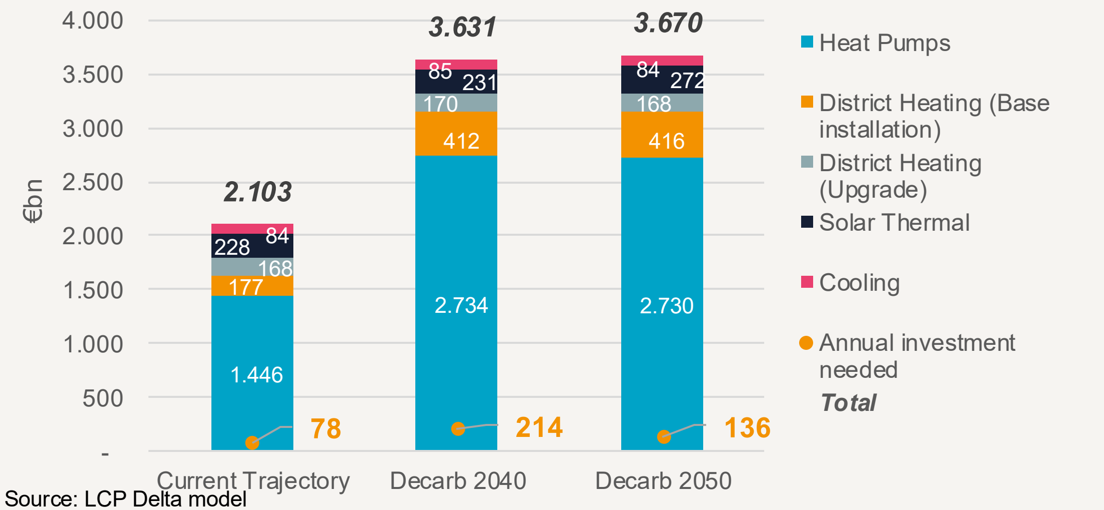
Heat pumps account for most of the H&C transition costs, representing around 75% of the total. District heating networks are the second-largest cost component, making up about 16%.

- While district heating is the next largest cost component, the bulk of this cost, around 70%, would be dedicated to upgrading existing networks.
- It is worth highlighting that even if the transition was not required, replacing gas boilers that would break between now and 2050 would cost €1075bn (NPV €781bn).

In dense urban areas, district heating networks are expected to have the lowest running costs of all technologies, thanks to the high efficiency of large central air-source heat pumps.

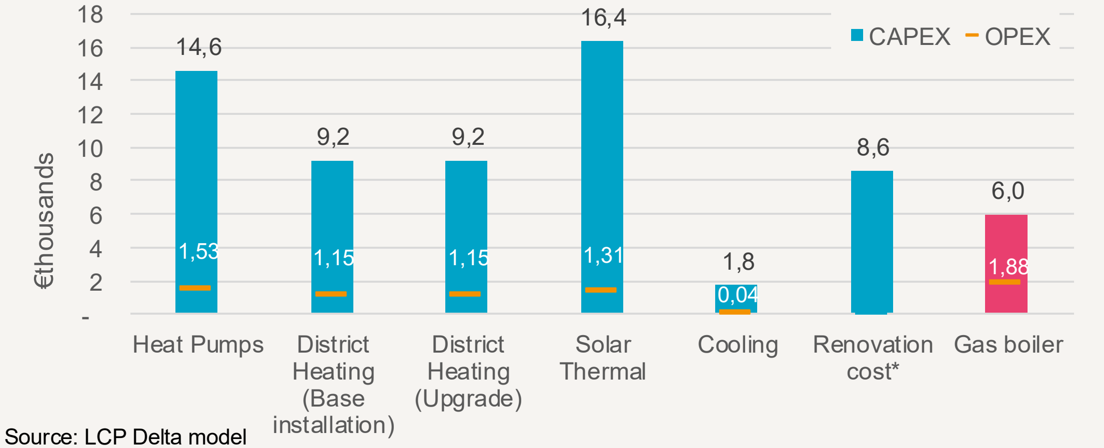
- The high CAPEX costs and forecast high electricity costs mean that the EU does not reach the point in the model where the lower running costs offset the CAPEX costs by 2050. They do however lower the NPV to €1242bn.

Chart 18: Total and Annual Investment Costs by Scenario and Technology (€bn)



Source: LCP Delta model

Chart 19: CAPEX and Annual OPEX by Technology, Including Renovation Costs (€k)



Source: LCP Delta model

**Renovation costs apply to the share of the building stock constructed before 1990 and requiring heat pumps.*

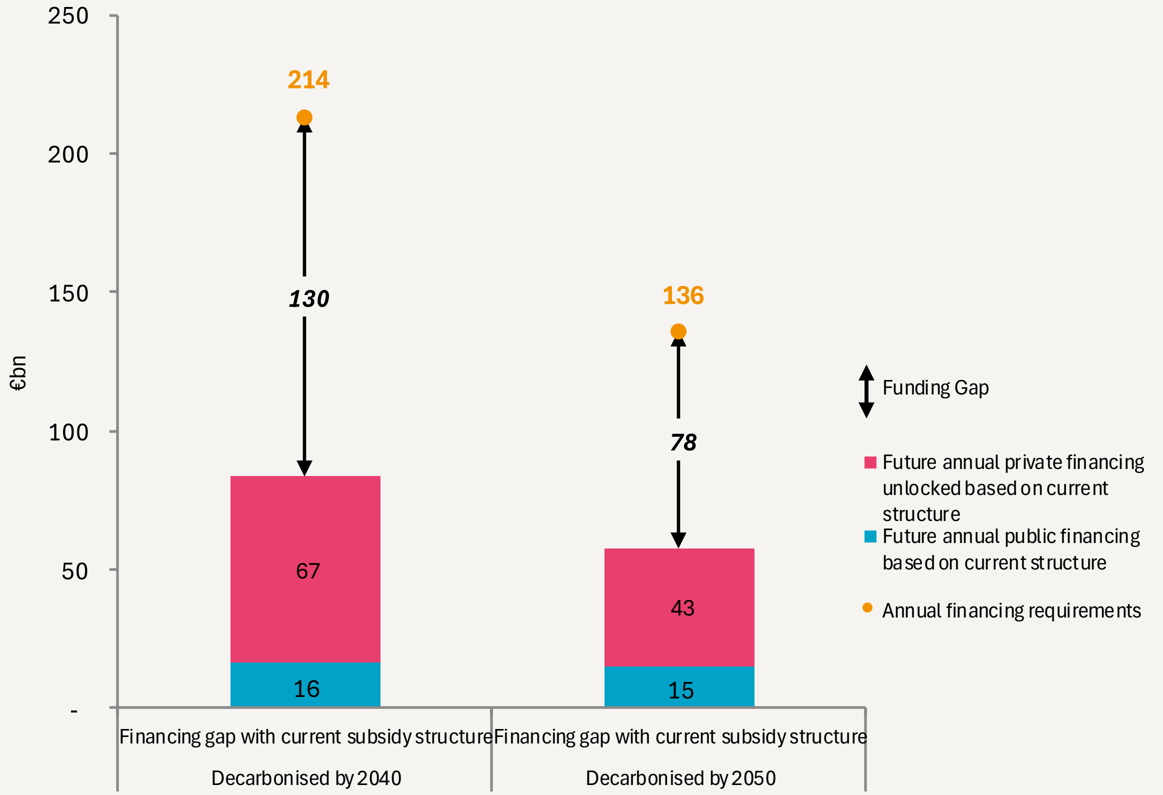
EU - Financing decarbonisation of residential H&C

€78 billion in annual investment needed to close the gap and decarbonise heating in the EU by 2050.

The EU is currently not on track to meet the investment levels required to decarbonise the H&C sector, financing on average only 40% of the annual investment needed.

- **For 2050**, the model calculates that €15bn of public sector financing results in €43bn of private sector financing, leaving a €78bn shortfall of the €136bn annual total funding that is required to reach a decarbonised residential H&C.
- **For 2040**, with a public finance level of €16bn, the EU private sector would provide €67bn of funding for the transition to 2040, leaving an annual shortfall of €130bn.
- Fossil fuel subsidies of €111bn were provided across the EU in 2023 and if these were redirected to the decarbonisation of residential H&C, this could fill the gap required for 2050 and close a significant proportion of the 2040 gap. Indeed, this does not even account for the fact that the private sector would also provide funding to fill the financing gap. Once this private sector funding potential is taken into account, even redirecting the lower amount of fossil fuel subsidies from 2015 of €57bn could be sufficient to fund the gap.
- The next pages look at existing schemes and consider further recommendations that could be used by the EU to channel the finance to households to install clean H&C systems.

Chart 20: Current Annual Financing Capacity vs. Required Annual Financing Capacity per Scenario in the EU-27 (€bn)



Source: LCP Delta model

EU - Selection of public schemes

The EU's package sets firm clean heat targets and boiler bans backed by carbon pricing and social fund, but its impact risks being blunted by delayed implementation, and insufficient protections for low-income households.

Table 4

Policy	Summary	Timeline	Positive	Negative
Renewable Energy Directive (REDIII)	The revision obliges every MS to raise the renewable share in H&C by at least 0.8 %-points each year from 2021 to 2025 and 1.1 %-points each year from 2026 to 2030, and it requires district heating operators to boost the combined share of renewables and recovered waste-heat fed into their networks by 2.1 %-points per year after 2026.	Transposition of the main article was due in May 2025	• First-ever binding growth rate for renewable heat	• RED III's binding targets largely mirror the existing business-as-usual trajectory and covers only about 1/3 of what's needed to achieve a net-zero building sector by 2050
The Energy Performance of Buildings Directive (EPBD)	The regulation mandates that all new buildings must be zero-emission by 2030 (public buildings by 2028), sets staged minimum energy-performance standards for the worst 16 % of the stock by 2030 and 26 % by 2033, prohibits national subsidies for stand-alone fossil-fuel boilers after 2025, and requires MS to ensure that fossil-only boilers are entirely phased out from 1 January 2039.	Directive entered into force in 2024	• Phase out of fossil-fuel boilers from 2039	• Lags financing gap for deep retrofit, low-income households could be left behind without robust SCF linkages
EU ETS2	The regulation establishes a new emissions-trading system that will make fuel suppliers for buildings and road transport surrender allowances from 1 January 2027, with an option to postpone to 2028 if energy prices are exceptionally high; auction revenues flow partially into the SCF, which can finance heat-pump and insulation support for vulnerable households.	Trading starts in 2027	• Strong price signal to switch from fossil boilers, while SCF revenues can cut bills for the lowest deciles	• Price volatility in the early years could undermine investor confidence and make SCF budgeting uncertain
Ecodesign and Energy Labelling Directive	The current Ecodesign rules forbid placing on the market any boiler or heat pump, whose seasonal space-heating efficiency is below 86 %, and the Commission's draft 2025 revision proposes raising the minimum to about 115 %, which would in practice exclude new stand-alone fossil-fuel boilers from 2030.	Strengthened limits to take effect from 2030	• De-facto 2030 fossil-boiler ban, accelerating heat-pump scale-up	• Exemptions for hydrogen-ready boilers and certain hybrid units could keep fossil-gas pathways alive, undermining decarbonisation targets
Fluorinated-gas Regulation (F-Gas)	The new F-gas regulation accelerates the HFC phase-down and bans refrigerants with a global-warming potential (GWP) ≥ 150 in new monobloc heat pumps and air-conditioners under 12 kW from 1 January 2027, extending the same GWP ceiling to split systems under 12 kW from 1 January 2029 and to larger split units from 2035; it also tightens leak-checking and technician-training requirements across the EU.	Regulation applies since 11 March 2024	• Clear cut-off dates giving manufacturers planning certainty and stimulating supply-chain investment • Ambitious HFC phase-down	• Supply-chain bottlenecks for compressors and safety-trained installers could slow heat pump roll out if not matched with skills funding
Revised Energy Taxation Directive	The Commission's July 2021 proposal recasts the ETD to align energy taxation with climate goals by taxing energy carriers according to carbon and environmental impact rather than volume. It aims to raise minimum tax rates on fossil fuels, phase out outdated exemptions (e.g., for aviation, maritime), and allow reduced rates on renewables and electricity.	No consensus yet, voting requires unanimity in the Council	• Applies the polluter-pays principle • Harmonises tax treatment across EU	• Compromise proposals include multi-year transition periods, diluting short-term impact

EU - Recommendations

Summary of the strategic direction of the recommendations

1. **Scale up EU budget for support for clean H&C in 2028-2034 Multiannual Financial Framework (MFF).**

   Ensure that the 2028–2034 MFF allocates at least 50% of its total budget to climate and nature related investments, with the remaining resources dedicated to major social and development objectives. Such a commitment would align EU spending with its 2030 climate and biodiversity targets, strengthen the funding base for clean H&C deployment. This could include support for the upfront costs through low interest finance.

2. **Apply the EU's existing tripartite agreement framework to clean H&C policies.**

   The European Commission should revive and adapt the EU's existing tripartite agreement framework to accelerate the clean H&C transition. A new Clean Heating & Cooling Tripartite Agreement model would commit all levels of governance to binding delivery targets, financing plans, and regulatory measures for clean H&C technologies.

3. **Reallocate fossil fuel subsidies to support vulnerable households.**

   Strengthening the economic case for low-carbon heating technologies is crucial. ETS2 is a step in the right direction, but its impact needs to be far greater. This would be the case if combined with the complete removal of fossil-fuel subsidies and the reallocation of this support to make clean H&C solutions affordable for the most vulnerable households. In 2023 alone, EU MS spent €111 billion subsidising fossil fuels, showing the scale of finance that could be made available to support the decarbonisation of H&C.

With these types of public sector developments in place, this will unlock the private finance needed to fill the financing gap. The next page looks at how the EU funding institutions and private sector can play their role in providing households with solutions for more affordable clean H&C.

Source : Bruegel; Cool Heating Coalition

EU – Supranational & private sector's role in provision of finance

The model details that an extra €78bn per year is required across the EU to achieve clean H&C by 2050. Rather than purely focus on the private sector, the analysis on this page also looks at the role that the EU wide institutions can play in providing this level of finance.

High potential for companies to raise finance*

The scale of finance raised from investors in the form of green bonds by the various private sector entities across the EU is vast, totalling over €900bn since the first issue in 2007. In this regard, companies across the EU, such as those covered in the individual MS studies in this study, are well placed to play their role in financing, be it through green bond finance, reinvested profits or equity raisings.

EU wide institutions with huge potential to raise finance*

The EU wide institutions listed below have the ability to raise finance and they have been highly effective in this endeavour, sourcing over €200bn from the green bond market :

- European Investment Bank (EIB)
- European Union (EU)
- European Bank for Reconstruction and Development (EBRD)
- Nordic Investment Bank (NIB)

This ability to raise huge amounts of finance makes these EU institutions hugely beneficial to the transition. If clean H&C were added to the tripartite agreements, then the finance raised by these institutions could be co-ordinated to ensure maximising the impact the monies have on decarbonising residential H&C.

The role of EU institutions in financing district heating

Example 1:

EIB and the Paris District Heating Concession

- In 2024 the EIB approved the provision of €375m to Paris to enable the development and decarbonisation of the Paris district heating network. The funds are to be used to expand the network into new areas, densify the grid which will grow its economies of scale and replace fossil fuel heating.

Example 2:

EBRD support in Poland

- For the EBRD's latest Poland Country Strategy which runs from 2024-2029, it outlines that the country needs further investment in energy efficiency, especially for district heating networks, with only 17% of existing systems meeting the efficiency standards required. The EBRD sees its role as enabling the arrangement of financing products for these energy efficiency improvements in district heating and classifies this decarbonisation of district heating as a top priority.

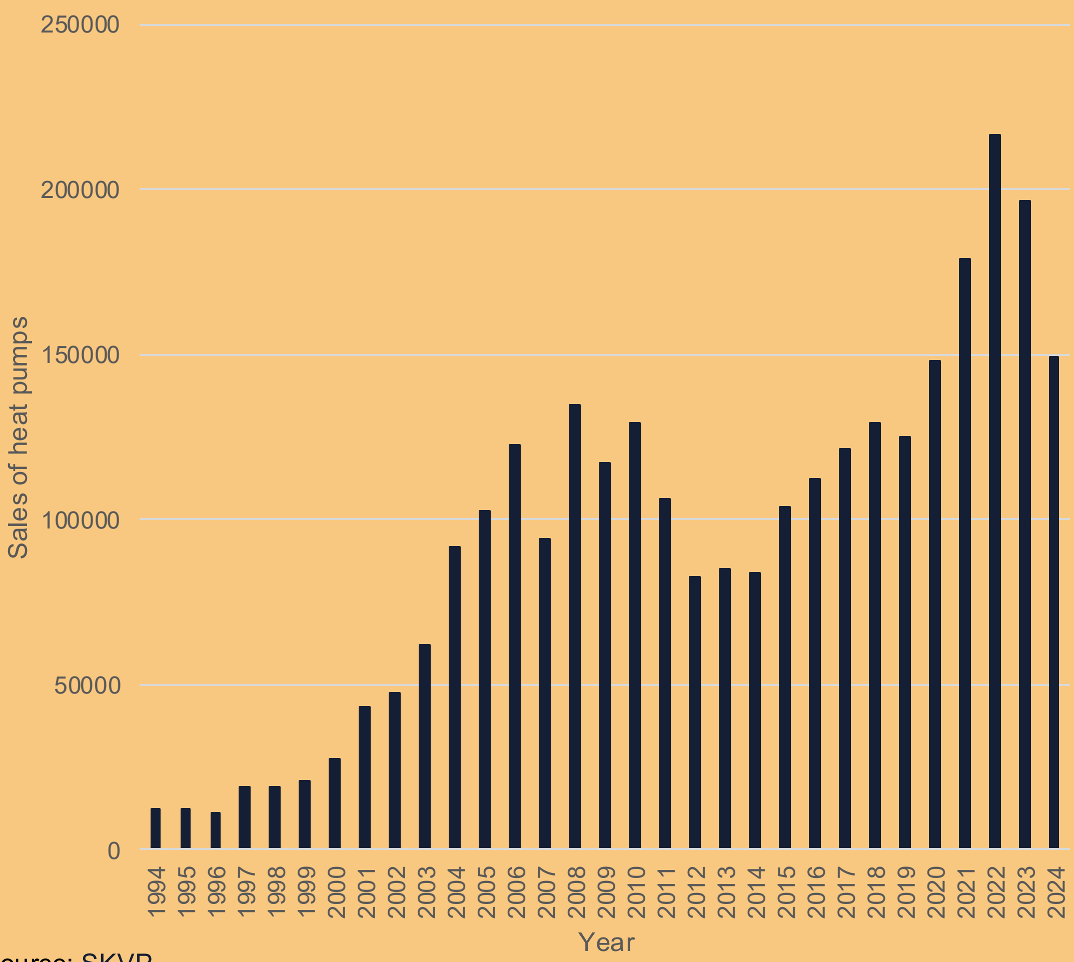
*For clarity, the figures provided are historic raisings and will have been used for various elements of the transition, not exclusively on H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition

Case Study – Sweden: Impact of combining policies effectively

Long term policy results in long term private sector leadership

- Sweden was one of the Nordic countries that decided to remove its reliance on oil heating following the energy crisis of the 1970s.
- The introduction of a carbon tax in 1991 helped drive the demand for non-carbon heating. This is one of the first examples of how the electricity-to-gas-price ratio can significantly influence market behaviour.
- Government subsidies to replace oil boilers contributed to an increase in the installation of heat pumps, aided by the government covering part of the costs of the installation.
- Low interest loans were made available by major commercial banks that could cover the cost beyond direct subsidies.
- As chart 21 shows, with the correct policies in place that make heat pumps the most financially attractive choice for households, the growth in sales follows.
- Moreover, Sweden focused on providing district heating for multi-family buildings in urban areas.
- Thanks in part to never having developed a major gas grid, Sweden has become a leading example of how to phase fossil fuels out of heating, which now relies on them for under 3%.
- From a current support perspective, other than the tax deductibility of the installer services, there is no state financial incentive to buy a heat pump and yet, of those homes not connected to a district heating network, it has a market share of 94% of all heating systems sold, with boilers less than 6%.

Chart 21: Sales of heat pumps in Sweden

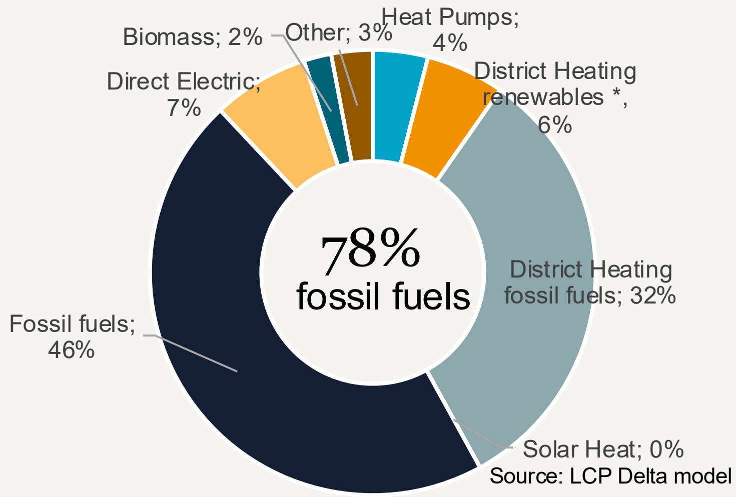


Source: SKVP

Czechia – technologies needed for decarbonising residential H&C

LCPDelta

Chart 22: Current heating mix



Source: LCP Delta model

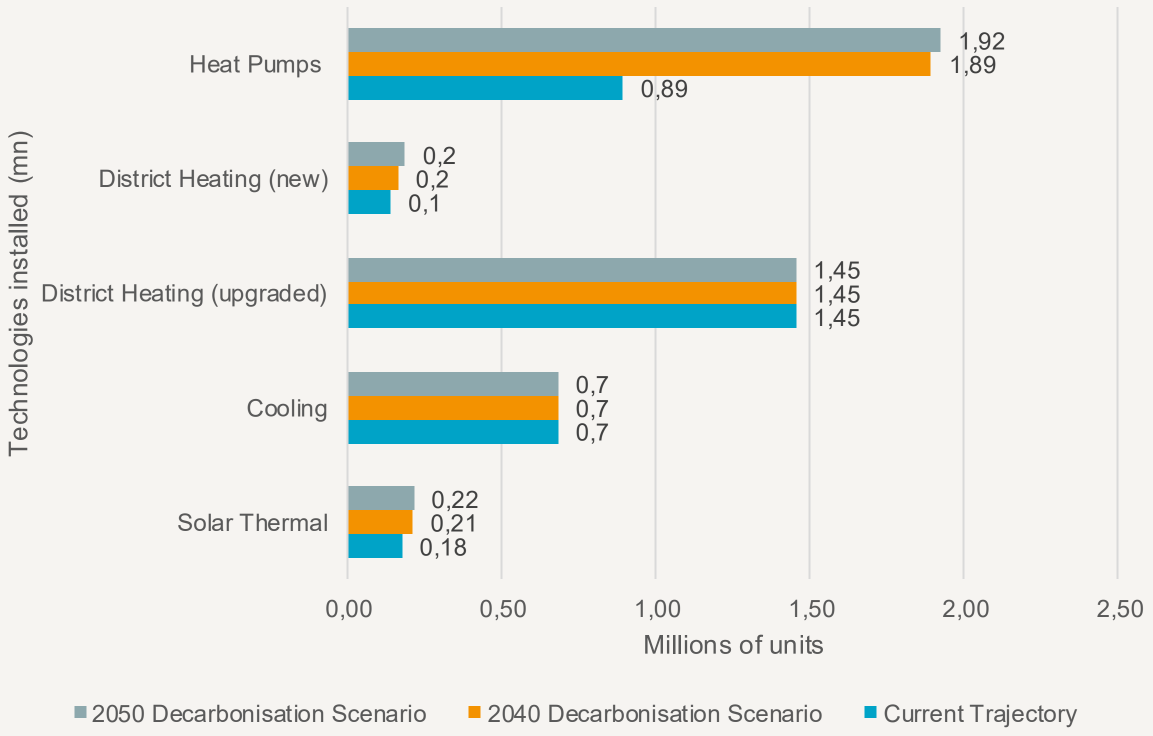
Heating Mix Outlook:

On its current trajectory, although Czechia is set to grow its heat pumps, solar thermal technologies and decarbonise its existing district heating, it will still have 27% of heating based upon fossil fuels in 2050. A significant increase in growth rates is required to achieve full decarbonisation:

- **Heat pump** growth needs to more than double to ~18% if the decarbonisation target is to be met by 2040 and maintain a double-digit growth if the target is to be met over the longer time-period to 2050.
- **District heating** is a large component of Czechia's existing heating system and is largely powered by fossil fuels. The task of decarbonising the existing structure will be a challenge but there are strategies in place to achieve this (gov.cz).

*includes biomass

Chart 23: Number of new individual installations under the three scenarios



Source: LCP Delta model

Table 5: Compound annual growth rate (CAGR) required for each technology

	Heat Pump	District Heating	Solar Thermal
Current Trajectory	7.4%	0%	62.2%
Decarbonised by 2040	17.7%	0.6%	126.6%
Decarbonised by 2050	10.3%	0.4%	63.4%

Source: LCP Delta model

Czechia – Cost of decarbonising residential H&C

Achieving a decarbonised heating system in Czechia by 2050 will demand €50 billion (NPV €29bn), or roughly €1.8 billion per year.

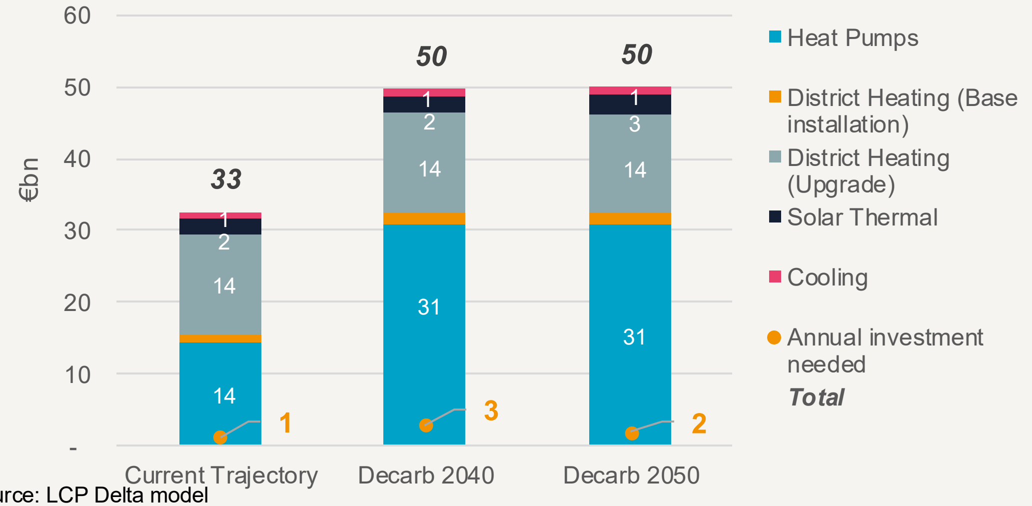
District heating makes up a significant share of the transition, as it will build on converting and expanding the large existing fossil fuel-based networks.

- District heating accounts for about 30% of the total cost of the transition and district heating will remain significant, as a sizable portion of the population lives in high-rise apartment buildings with limited space for a hot water cylinder or an outdoor unit. Consequently, it is more likely and more efficient that the heat generation for these district heating networks will be decarbonised instead.
- It is worth highlighting that even if the transition was not required, replacing gas boilers that would break up until 2050 would cost €12bn (NPV €9bn).

Czechia does not benefit from a favourable spark gap, as gas remains relatively cheap, which limits the competitiveness of electricity-based alternatives.

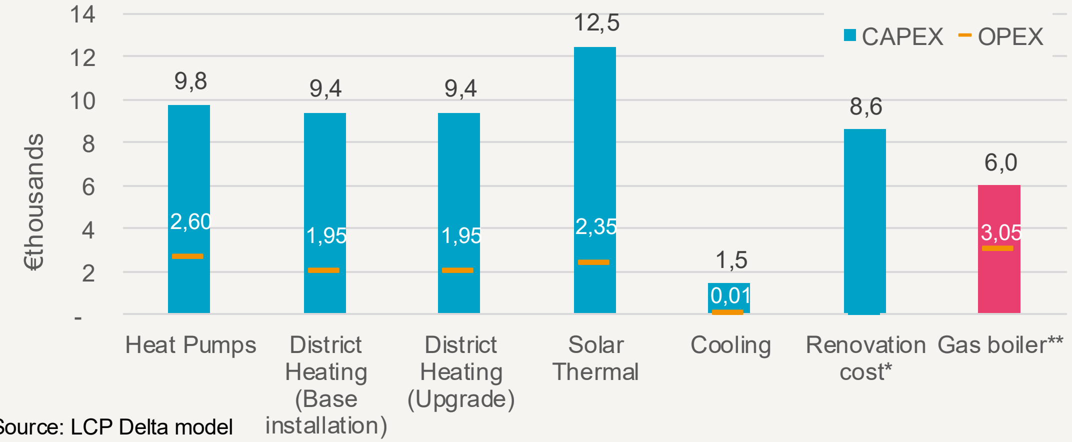
- Despite an unfavourable spark gap, the structural lower running costs of clean heating technologies would be advantageous, such that on a Net Present Value (NPV) basis, Czechia's cost of transition falls to €3.6bn by 2050 even including the significant upfront CAPEX required. On average across the study period, running a gas boiler costs about 18% more than running a heat pump.
- Solar thermal systems have the highest CAPEX among heating technologies, largely because they must be combined with a backup system (a heat pump in this study) to ensure consistent performance year-round.

Chart 24: Total and Annual Investment Costs by Scenario and Technology (€bn)



Source: LCP Delta model

Chart 25: CAPEX and Annual OPEX by Technology, Including Renovation Costs (€k)



Source: LCP Delta model

*Renovation costs apply to the share of the building stock constructed before 1990 and requiring heat pumps.**cost of replacing an old installation with a new gas boiler

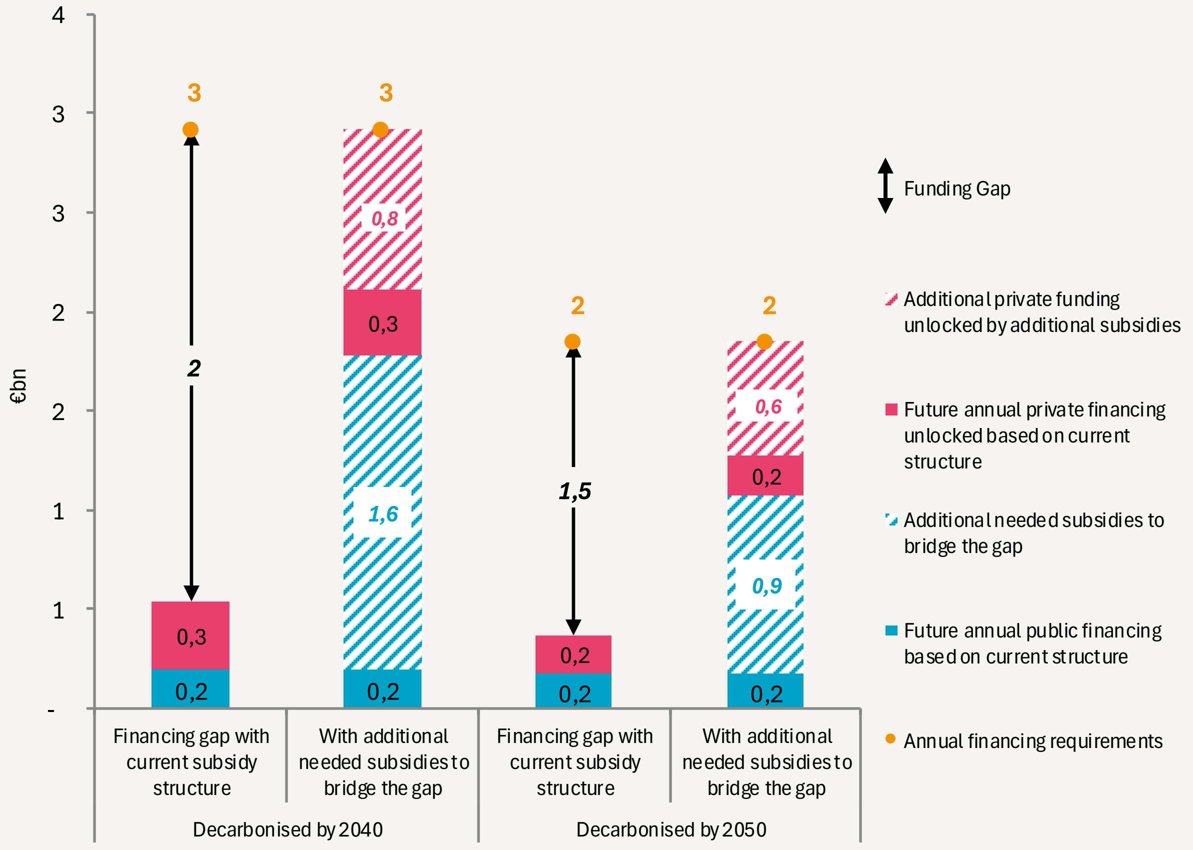
Czechia – Financing decarbonisation of residential H&C

€1.5 billion in annual investment needed to close the gap and decarbonise heating in Czechia by 2050.

Czechia faces a relatively high financing gap, as fossil fuel-based heating systems continue to be attractive compared to clean H&C. A significant increase in both public and private finance is needed to support households.

- In the **2050 scenario**, the model calculates that private financing in its current structure reaches just €0.2 billion per year, with public financing a similar figure. This falls €1.5bn short of the finance that is required. In the model, if public financing were to rise by €0.9bn, this would unlock €0.6bn in private market finance and close the financing gap.
- In the **2040 scenario**, the model calculates that €0.3bn of private funding is realised from €0.2bn of public funding, creating a €2bn shortfall of what is required to clean H&C by 2040. If public financing were to rise by €1.6bn, this would release €0.8bn of private finance to fill this funding gap.
- Whilst the funding gaps in both scenarios may appear significant, once it is put in the context of **fossil fuel subsidies** used in 2023 which were €0.6bn, a redirection of subsidies at this scale would go a long way to providing the public funding required for transitioning H&C, equating to 2/3rds of the 2050 public finance gap.
- The next pages look at existing policies and consider further recommendations that could be used by Czechia to channel finance to households to install clean H&C systems.

Chart 26: Current Financing Capacity vs. Required Financing Capacity per Scenario in Czechia (€bn)



Source: LCP Delta model

Czechia - Selection of policies

Czechia's heat transition is supported by a policy mix that channels Modernisation Fund grants and EU approved state-aid into renewable and district heating upgrades.

Table 6

Policy	Summary	Timeline	Amount	Positive	Negative
The New Green Savings Programme	The programme provides subsidies for environmentally friendly housing and energy-saving renovations. The New Green Savings Programme is funded by revenues from the sale of EUA (European Union Allowance) and EUAA (European Union Aviation Allowance) units.	2021 - ongoing	Up to CZK 5,000,000 (€200,000)	• Breadth of technologies covered • 2025 simplification of process	• Historically less beneficial for those on lower incomes • Only available to homeowners
National Recovery & Resilience Plan	The National Recovery and Resilience Plan includes the modernisation of its district heating networks, focusing on the upgrade of the system, improvements in its energy efficiency and integration of renewable energy sources.	2023 - 2026	N/A	• Prioritises upgrades to improve system reliability.	• An end date of August 2026 causes uncertainty for developers in the sector.
Kettle Subsidy	An element of the broader New Green Savings Programme, the Kettle Subsidy involves grants covering up to 95% of eligible costs are available to low-income households, elderly individuals and those receiving housing benefits, for the replacement of outdated solid fuel boilers.	2023 - ongoing	95% of eligible costs	• The process is relatively simple, requiring elements such as age of boiler and planned replacement	• For some applicants, the subsidy works by reimbursement which means the upfront payment needs to be financed.
Old boiler ban (first and second-class emission boilers)	As of September 2024, first and second-class emission boilers are banned (these were typically installed late 20th and early 21st century), with heavy fines for non-compliance.	2024 - ongoing	N/A	• Provides clarity for households and the private sector enabling them to make decisions with confidence	• The subsidies for new equipment need to be available in required size to ensure its success.

Czechia - Recommendations

1 Close monitoring of impact of 2025 streamlined process.

Although the simplification of processes for the New Green Savings Programme has been brought in for 2025, an early assessment of whether these are proving effective is vital. There is not time for a lengthy assessment of these only to discover in a few years time that the administrative burden is still hindering households and slowing the rollout.

2 Long-term district heating policies beyond existing NRRP that focus on fully decarbonised technologies.

The Association for the District Heating of the Czech Republic is one of many entities looking for clarity on the long-term support that will be available for decarbonising district heating in Czechia, within consistency an issue. As detailed throughout this study, long-term, consistent policy is vital to enable the private sector to optimise its considerable potential in driving the decarbonisation of H&C. One example of the policy that could support would be the spark gap adjustment detailed in recommendation 4 that can assist with a long-term drive towards increased use of clean district heating. It is also recommended that any policies that support district heating should be focused on fully decarbonised technologies rather than gas.

3 Build a financing platform.

Czechia is the one MS of those detailed in this study that has yet to issue a government green bond. Issuance of a green bond by the government would build confidence with its investor base and enable it to raise further finance required to support its households with the transition to clean H&C.

4 Cut electricity VAT to 5% for heat-pump users to narrow the spark gap.

As of January 2025, Czechia applies a standard 21 % VAT rate to household electricity, while natural gas heating benefits indirectly from lower fuel prices through existing fossil-fuel subsidies. Cutting the VAT rate on household electricity from the current 21 % to 5 % for heat-pump users would improve affordability, narrow the spark gap with gas heating, and boost clean-heat uptake. This is already possible under EU law.

With these types of public sector developments in place, this will unlock the private finance needed to fill the financing gap. The next page looks at how the private sector can play its role in providing households with solutions for more affordable clean H&C.

Czechia – Private sector's role in provision of finance

As per the model, the private sector needs to provide an additional €0.6bn per year to fill the 2050 funding gap. To succeed, this will require two elements to be achieved, 1) companies need to have access to the finance and 2) households need to be able to access the funds from the companies. Outlined below are examples of how both of these elements can be achieved.

Element 1: High potential for companies to raise finance*

Czech companies are a growing presence in the green bond market introduced on page 26. Since 2021 companies in sectors that will be involved in financing the heating transition have raised €6.3bn from investors. If future raisings for clean H&C are able to match this pace, that would mean that ~10 years of funding could be raised in less than 4 years and this doesn't include the potential for equity raisings and the additional finance available from reinvested profits. Here, we provide a few examples of types of business that, in combination with the public policy recommendations on page 40, can drive the financing of decarbonising residential H&C in Czechia:

- **Ceska sporitelna,** has raised €1bn in green bonds. As the second largest bank in Czechia, with a market share of 20%, it has a sizeable role to play in accelerating Czechia's H&C decarbonisation through enabling its customers with affordable and efficient financing to decarbonise their homes.
- **CEZ,** a large energy company both in Czechia and other European countries has successfully raised €2.7bn in green bonds as it works on its strategy to decarbonise. As one of the companies involved in district heating in Czechia, this access to large amounts of finance from the capital markets can enable it to both decarbonise existing district heating networks and build new ones.
- **Raiffeisenbank,** is one of the major banks operating in Czechia, has raised €1.3bn in green finance, evidencing its ability to provide the size of finance needed to provide its customers with the finance required to decarbonise their H&C systems.

Element 2: Growing number of finance options for households

Example 1

- The bank **CSOB** provides loans with preferential interest rates of 5.99% and terms of up to 12 years, to decarbonise homes, including through heat pumps and insulation.
- The bank offers an energy-saving configurator to estimate the costs of the technologies and how much can be saved with them.
- CSOB partners with installers to arrange the installation of the technologies, therefore simplifying the whole process for their customers.

Example 2

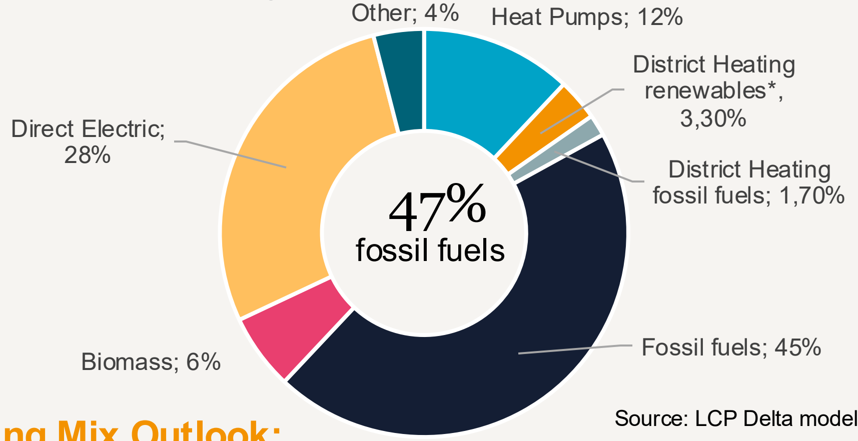
- **CEZ** has partnered with Essox, a subsidiary of **Komercni Banka**, to provide financing for households to install clean H&C equipment.
- The finance is provided at an interest rate of 6.9%, with a term of up to 10 years.
- The application is done online and importantly, the household will find out immediately how much they can finance, adding efficiency to the whole process.

*For clarity, the figures provided are historic raisings and will have been used for various elements of the transition, not exclusively on H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition

France – technologies needed for decarbonising residential H&C

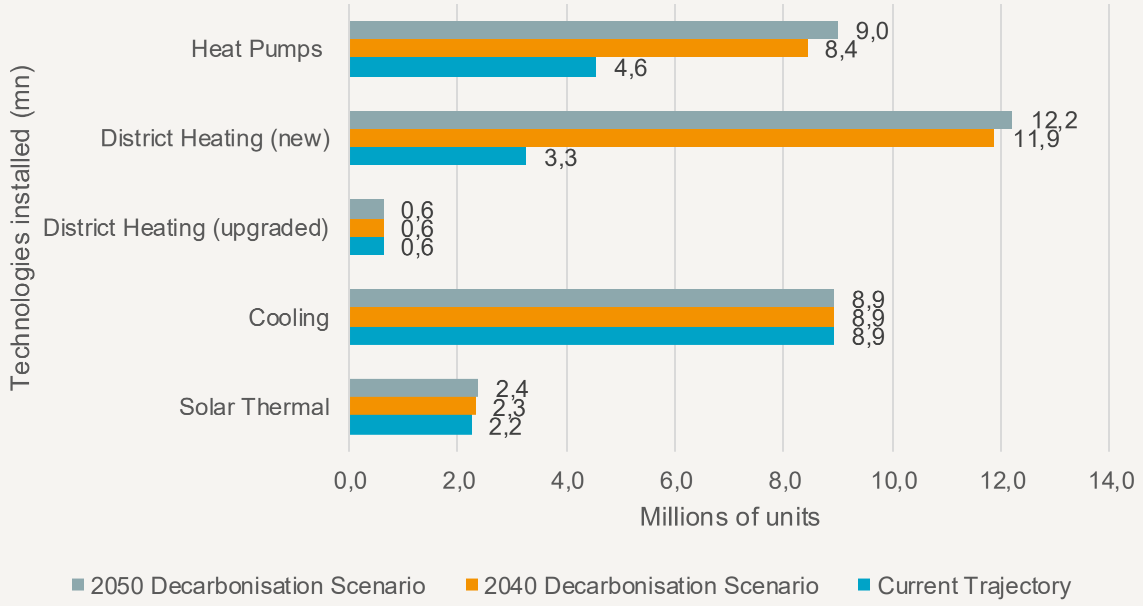
LCPDelta

Chart 27: Current heating mix



Source: LCP Delta model

Chart 28: Number of new individual installations under the three scenarios



Source: LCP Delta model

Heating Mix Outlook:

On its current trajectory, although France is set to grow its heat pump, solar thermal and district heating solutions, it will still end up with 35% of heating based upon fossil fuels by 2050. A step up in the growth rate of the decarbonised technologies is required:

- A 6.6% and 8.4% growth rate in heat pumps and district heating respectively would successfully decarbonise France's residential H&C sector by 2050.
- A more than doubling of the current trajectory growth rate in heat pumps is needed to push for a decarbonised residential H&C sector by 2040.
- In the modelled scenario, district heating moves from being only 5% of the heating base in France in 2024, to becoming a third of the heating solution for residences in the decarbonised sector. This requires a more than tripling of the current trajectory growth rate if that target is to be met by 2040.
- In addition to this, the current heating base that is based upon fossil fuel district heating, also needs to be upgraded to renewable energy.

Table 7: Compound annual growth rate (CAGR) required for each technology

	Heat Pump	District Heating	Solar Thermal
Current Trajectory	4.5%	4%	11.2%
Decarbonised by 2040	10.9%	14.2%	19.5%
Decarbonised by 2050	6.6%	8.4%	11.4%

Source: LCP Delta model

*includes biomass

France– Cost of decarbonising residential H&C

Achieving a decarbonised heating system in France by 2050 will demand €329 billion (NPV €188bn), or roughly €12 billion per year.

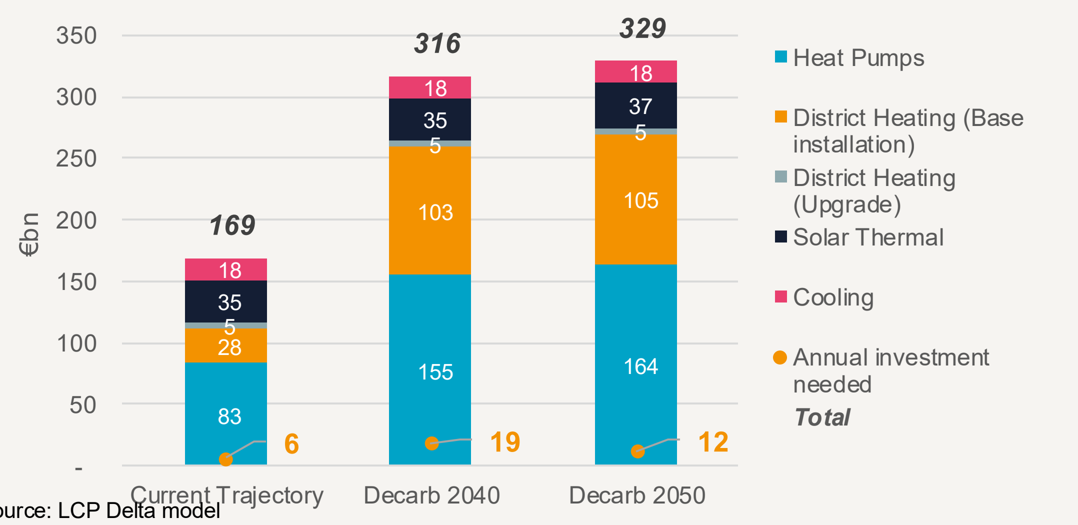
Shifting from the current trajectory to the desired pathway will require almost doubling present investment levels to meet the 2040 and 2050 timeline.

- A funding gap of €160 billion separates the current trajectory from the fully decarbonised scenario, primarily due to the increased need for new heating installations in the latter.
- In all scenarios, heat pumps account for the largest share of total cost at ~50%. This is due to their significant role in the future H&C system and their high upfront costs, particularly when including the renovation work needed to ensure they perform effectively in a large share of the building stock.
- It is worth highlighting that even if the transition was not required, replacing gas boilers that would break up until 2050 would cost €101bn (NPV €73bn).

Low running costs help offset the high upfront investment in decarbonised heating systems.

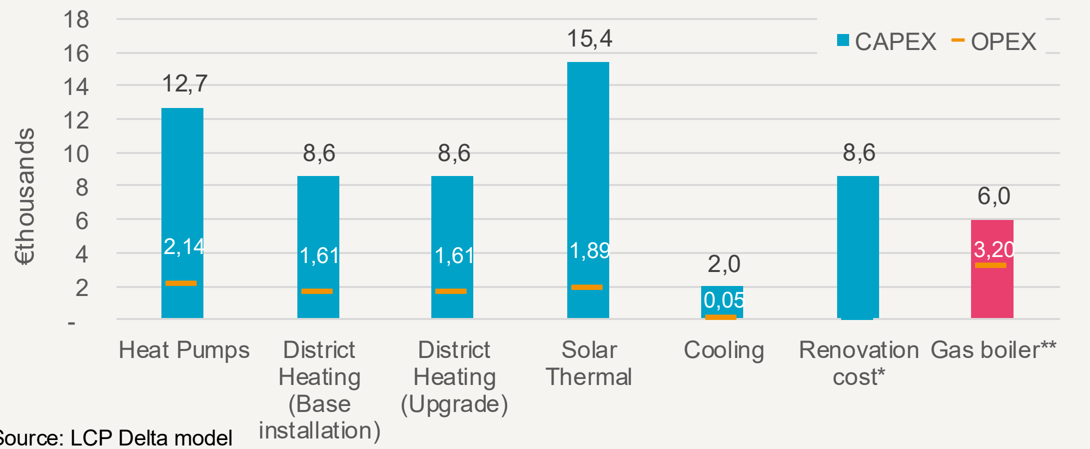
- Relatively low electricity prices and high heating system efficiency contribute to lower operating costs. On average, a heat pump is ~33% cheaper to operate per year than a gas boiler.
- The lower running costs could be so advantageous that on an NPV basis, France could be €105bn better off by 2050 even including the significant upfront CAPEX required.

Chart 29: Total and Annual Investment Costs by Scenario and Technology (€bn)



Source: LCP Delta model

Chart 30: CAPEX and Annual OPEX by Technology, Including Renovation Costs (€k)



Source: LCP Delta model

**Renovation costs apply to the share of the building stock constructed before 1990 and requiring heat pumps.*

France– Financing decarbonisation of residential H&C

€7 billion in annual investment needed to close the gap and decarbonise heating in France by 2050.

A strong private sector multiplier effect can lead France to fill the €7 billion annual finance gap needed for the 2050 scenario.

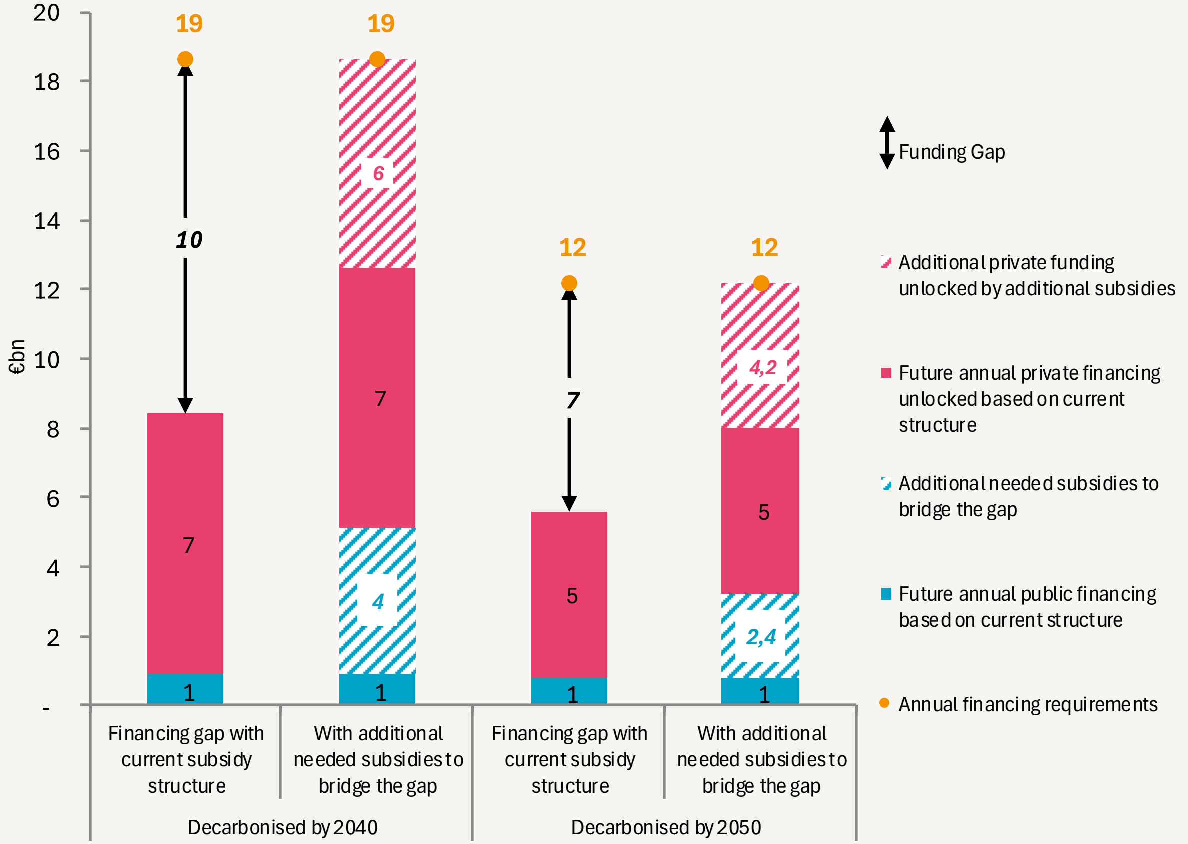
- In the **2050 scenario**, the model calculates that private financing reaches €5bn per year, based on public financing of just €1bn, detailing a strong multiplier effect. However, there is still a shortfall of €7bn. For this €7bn gap to be filled, requires €2.4bn of further public finance, which unlocks €4.2bn of private financing.

- In the Decarb **2040 scenario**, the model calculates that private financing reaches €7bn based upon €1bn of public spending. Given the shorter timeline to reach the target, the financing gap is larger at €10bn. However, this can be closed through an additional €4bn in public funding, which would unlock €6bn in private investment.

- Similar to the majority of the MS detailed in this study, the extra public finance required for the two scenarios could be covered through the redirection of **fossil fuel subsidies.** In 2023, these stood at €15.2bn, a 6x multiple of the extra €2.4bn needed for the 2050 scenario. Even the lower €9.4bn figure from 2015 cited in chart 12 of this study would be sufficient.

- The next pages look at existing policies and consider further recommendations that could be used by France to channel the finance to households to install clean H&C systems.

Chart 31: Current Annual Financing Capacity vs. Required Annual Financing Capacity per Scenario in France (€bn)



Source: LCP Delta model

France - Selection of policies*

France has a comprehensive mix of policies supporting the H&C transition, often focused on building fabrication such as insulation, but recent policy uncertainties (e.g. MaPrimeRénov') appear to be undermining their effectiveness.

Table 8

Policy	Summary	Timeline	Amount	Positive	Negative
MaPrimeRénov'	Funding is offered through MaPrimeRénov', the government's main support for energy renovation, available to all homeowners and joint owners. The amount varies based on household income and the renovation project. (N.B. – limitations in place until September 2025)	2021 - ongoing	Up to €70,000 per work	• Breadth of eligible technologies • Tailored size of support based on income • Ease of accessibility	• Current pause, though limited, has caused confusion and could hinder private sector confidence and development • New lower levels for those on lower incomes
Fonds Chaleur	Le Fonds Chaleur is a French government funding mechanism designed to support the development of renewable and recovered heat sources, with a strong focus on district heating networks.	2009 - ongoing	Networks of heat/cold: Up to 60% of investment	• Long-standing presence. • ADEME regional office involvement enables expertise at the local level	• Approval times can be slow • Documentation needs can hinder small developers
Energy efficiency obligation scheme (White certificates)	Funding is offered through the Energy Savings Certificate (CEE) system, a key tool for managing energy demand. In this system, public authorities impose a three-year energy savings obligation on "obligated subjects," such as energy suppliers. CEEs are awarded to actors performing energy-saving operations across various sectors.	2006 - ongoing	N/A	• Breadth of eligibility, including households, social housing and local authorities • Certified installers often take on administration, easing process for households	• Documentation requirements, unless dealt with by installers, can be onerous for households • Inertia in technology evolution, slow to update eligible technologies. • High level of fraud.
Zero-interest eco-loan	Funding is available through an interest-free loan designed to support renovation projects that improve the energy efficiency of residential properties. Eligible measures include insulating walls and roofs, replacing windows, upgrading heating systems, etc.	2009 - ongoing	Up to €15,000 for a single action	• Breadth of eligible technologies • Zero interest and length of term	• Relatively low uptake by banking sector
VAT reduction for building renovation works	A reduced VAT rate of 5.5% applies to energy renovation work in residential properties, provided the improvements enhance the building's energy efficiency.	2014 - ongoing	N/A	• Paperwork is relatively straightforward, only requiring retaining for 5 years in case of request by tax authority	• Potential for installers to adjust prices, reducing impact of VAT reduction.

* This table focuses on national policies; there are additional schemes available at the regional and city level.

France - Recommendations

1 Consistency of policy is crucial.

As detailed in the executive summary, consistency of policy is a strong factor in making policies effective. The consistency of the Fonds Chaleur is a good example of how effective this can be. On the other hand, the partial pause of the MaPrimeRénov, the latest change to the scheme, is unhelpful and causing confusion. Once this policy is restarted, long-term consistency should be aimed for to again unlock the full potential of the private sector .

2 Leverage private-sector best practices, anchored by clear regulatory milestones and public risk-sharing.

Maximising the simplicity for households to access the finance is key. The success of the éco-prêt à taux zéro detailed in the case study, shows how effective leveraging private sector expertise can be. However, in France, many small owners lack a strong private return on renovation, so simplifying access to finance alone will not suffice. Crucially, this must be coupled with regulatory frameworks, clear standards and trigger points at rental or sale, time-of-replacement rules for the worst systems, and the connection & timeline requirements in district-heating zones, to create predictable demand. To address the execution and payback risks of full works, pair finance with performance guarantees and public re-insurance, so installers and district-heating developers face lower transaction and warranty risk.

3 Cut electricity VAT to 5% for heat-pump users to narrow the spark gap.

Cut electricity VAT to 5% for heat-pump users, provided the installation meets EU energy-label standards and is carried out by certified professionals (as already required in housing renovation and in air-conditioning regulation in regions such as Guadeloupe). As of 1 August 2025, France applies the full 20 % VAT rate to both the fixed subscription and the kWh component of household electricity bills, after scrapping the 5.5 % reduced rate that had applied only to the subscription. Lowering France's electricity VAT to 5 % for qualifying heat-pump users would narrow the running-cost gap between heat pumps and gas boilers while reinforcing quality standards, and follows precedents set by Portugal, Spain and Poland when they needed to soften price shocks while accelerating electrification.

With these types of public sector developments in place, this will unlock the private finance needed to fill the financing gap. The next page looks at how the private sector can play its role in providing households with solutions for more affordable clean H&C.

France - Private sector's role in provision of finance

As per the model, the private sector needs to provide an additional €4bn per year to fulfil its role in filling the 2050 funding gap. To succeed in this will require two elements to be achieved, 1) companies need to have access to the finance and 2) households need to be able to access the funds from the companies. Outlined below are examples of how both of these elements can be achieved.

Element 1: High potential for companies to raise finance*

French companies have been one of the most popular issuers of green bonds, with companies that will be involved in the H&C transition receiving €165bn from investors since 2012, and the majority of this since 2020. If future raisings by these companies are of a similar scale, this would comfortably cover the €5bn needed per year, not even accounting for the possibility that companies also opt to use reinvested profits or issue equity as funding. Here, we provide a few examples of types of business that, in combination with the public policy recommendations on page 46, can drive the financing to decarbonise residential H&C in France:

- **Engie** is one of the leading companies in the developing market of geothermal district heating. The €22bn in finance it has accessed through the green bond market is evidence of the huge investor base it has and shows its potential to drive district heating development.
- **Covivio**, the real estate business that includes residential properties in its estate, has raised over €3bn in green bonds. Further issuance of this type could enable it to decarbonise the H&C of its estates.
- **Societe Generale**, as one of the major banks in France, can play a key role in providing straightforward and efficient finance to its customers. It has already raised close to €5bn in green bonds; further issuance can provide its customers with the ability to install decarbonised H&C in their homes.

Element 2: Growing number of finance options for households

Example 1

- BNP Paribas** in partnership with IZI by EDF is providing a seamless service to customers to organise the decarbonisation of their heating system.
- IZI by EDF offers guidance on heat pump installation and renovations, including connecting customers with certified professionals/trained installers. (There is also a public service for energy renovation that households can use).
- The public support, e.g. MaPrimeRénov, is deducted from the estimate by IZI, with BNP Paribas providing the remaining finance required with a low-interest rate loan ranging from 0% to 2.82%.

**BNP Paribas has set itself a target of supporting 400,000 energy renovation projects across Europe in 2025 and 2026.

Example 2

- La Banque Postale provides green personal loans for renovation work, insulation and installation of clean H&C equipment.
- The interest rate of 5.36% is fixed, with the term typically 5 years.
- La Banque Postale also makes larger sums available to local authorities, starting at €300k which can enable them to transition their estates.

*For clarity, the figures provided are historic raisings and will have been used for various elements of the transition, not exclusively on H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition

Case Study – Multiplier effect of policy on the private sector

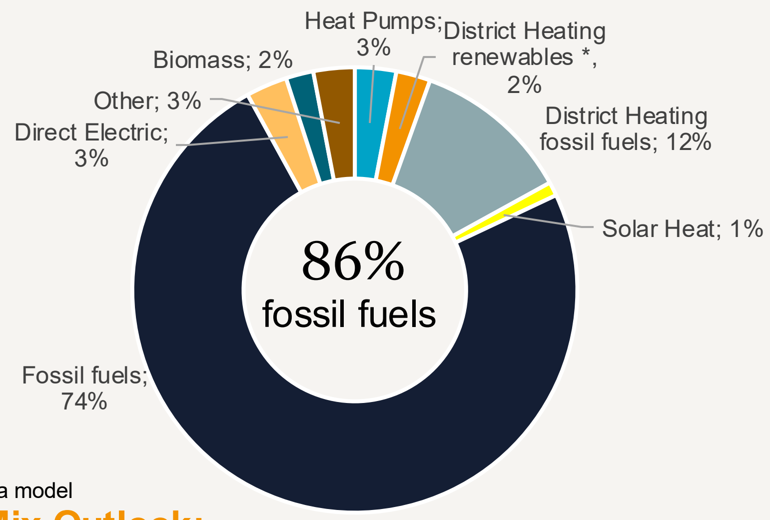
The multiplier effect of public policy on private finance

France introduced the éco-prêt à taux zéro in 2009, which provided 0% interest loans for energy renovation projects. These loans could be up to €30,000 and were available for owners and landlords of residential buildings that were built pre-1990 (the year we have used for renovation requirements in the model).

- In total 20 banks participated in the programme, providing customers with 0% loans for up to 15 years.
- The loans have been used to insulate and install new windows, elements that are potentially required for certain properties installing a heat pump.
- In 2015, €480m of finance was taken up by households using this scheme and yet the French state only spent €40m, which resulted in the impressive multiplier effect that for every €1 of state money, €12 of private finance was provided.
- Whilst not every scheme should be expected to have this level of multiplier, it is an illustration of just how effective a policy can be in sparking the demand of the household and how the private sector will successfully provide the finance for this demand. Here it was particularly effective because it used the efficient processing framework that already existed in the private market to implement public policy.

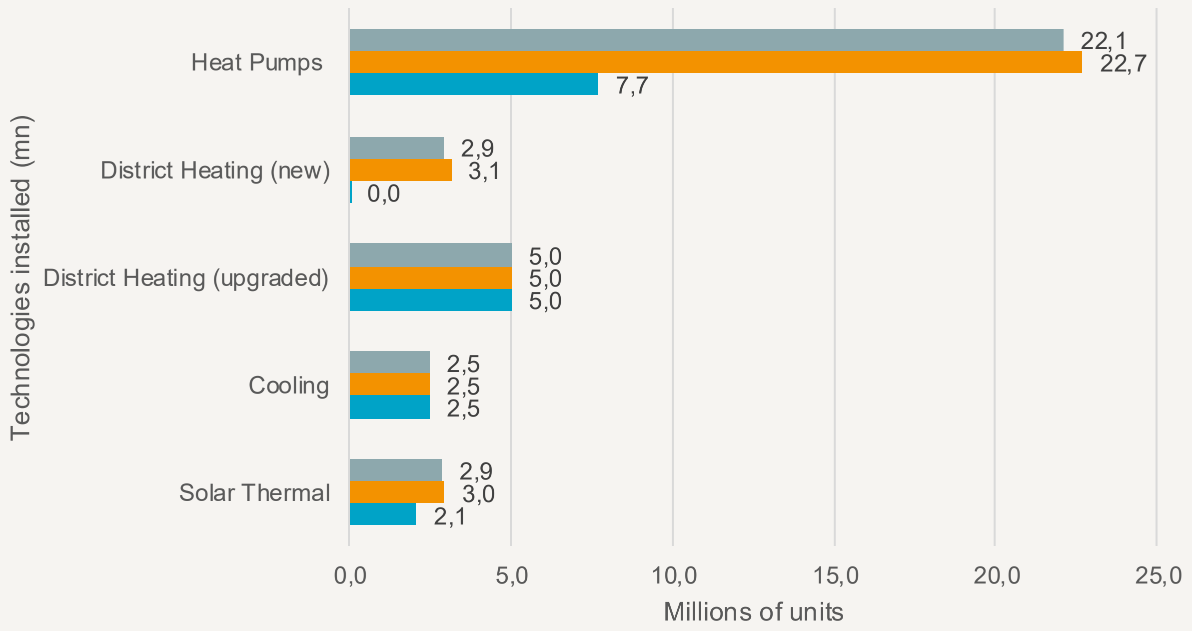
Germany – technologies needed for decarbonising residential H&C

Chart 32: Current heating mix



Source: LCP Delta model

Chart 33: Number of new individual installations under the three scenarios



Source: LCP Delta model

2050 Decarbonisation Scenario 2040 Decarbonisation Scenario Current Trajectory

Heating Mix Outlook:

Germany's current trajectory would leave the country with over half of its residential heating system still reliant on fossil fuels. A meaningful step up in clean technology growth rates is required to avoid this outcome.

- Heat pumps play a significant role in a decarbonised Germany and to reach the number of installations required for decarbonisation in 2040 will need an annual growth rate of over 20%, amongst the highest in the MS studied in this study. The level of growth for 2050 is also amongst the highest, at ~12%.
- Due to the high share of heat pumps in the decarbonised scenarios, district heating networks are projected to grow at a slower rate. Additionally, the decarbonisation of existing networks, such those in Berlin, will be required.

Table 9: Compound annual growth rate (CAGR) required for each technology

	Heat Pump	District Heating	Solar Thermal
Current Trajectory	8%	0%	7.7%
Decarbonised by 2040	21.4%	2.8%	15.4%
Decarbonised by 2050	12.2%	1.6%	8.9%

Source: LCP Delta model

*includes biomass

Germany – Cost of decarbonising residential H&C

Achieving a decarbonised heating system in Germany by 2050 will demand €665 billion (NPV €415bn), or roughly €25 billion per year.

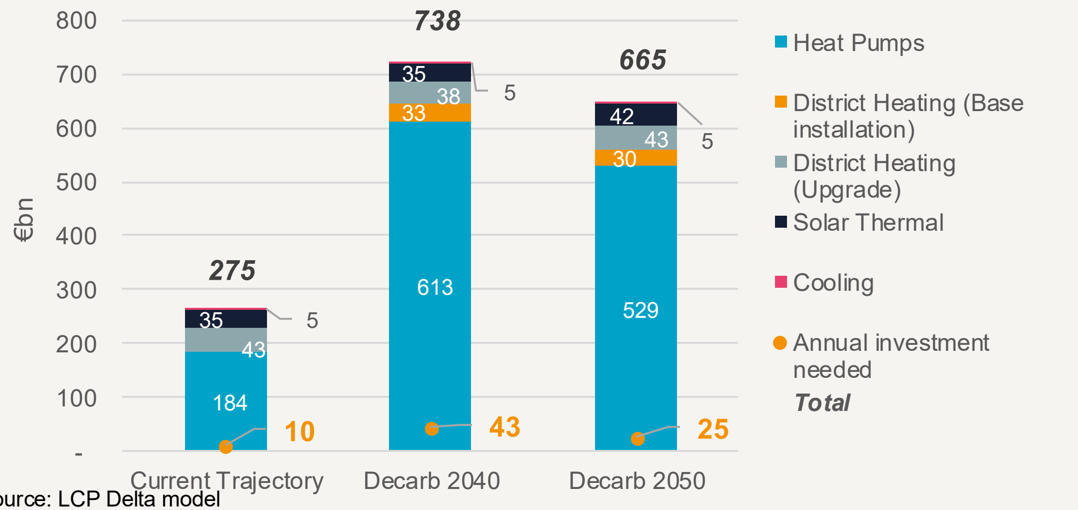
Germany's transition is expected to be by far the most expensive among the MS analysed, driven largely by high heat pump installation costs, which account for around 80% of projected transition costs for 2040 and 2050.

- Heat pumps dominate both decarbonisation scenarios, not only due to their large share in the future heating mix of 2040/2050 but also the costs of the technology that is detailed below.
- The significant cost difference between the Current Trajectory Scenario and Decarb 2040/2050 is explained by the high share of fossil fuel-based heating in the first scenario, as 54% of the heating mix in Germany would still rely on fossil fuels.
- It is worth highlighting that even if the transition was not required, replacing gas boilers that would break up until 2050 would cost €194bn (NPV €141bn).

Exceptionally high upfront installation costs for heat pumps are a major barrier to making the transition more affordable in Germany.

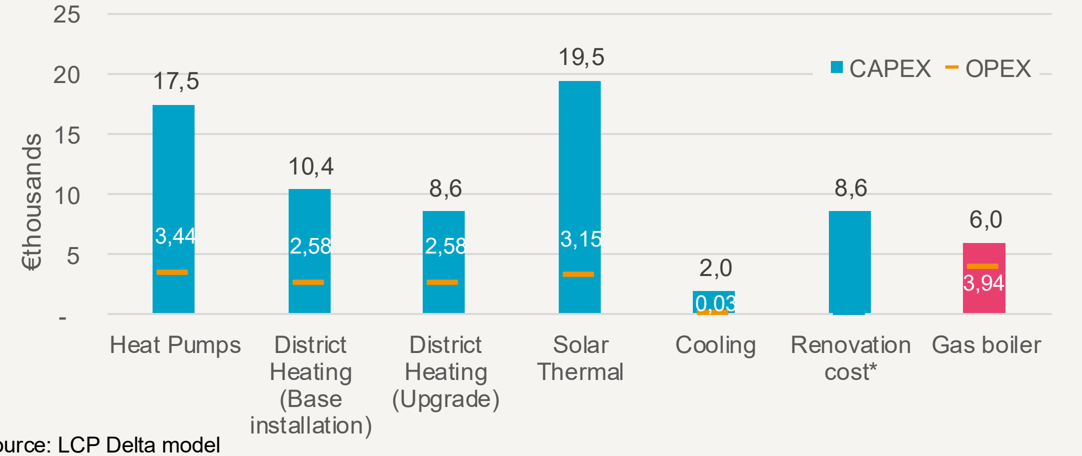
- Installing a monobloc HP of 8kW in Germany (~€30k**) is twice as expensive as in other EU MS (~€12.5k in Italy and France), there are a number of factors in this, including high installation costs, partly driven by more complex installation requirements. These include technical and safety standards that are stricter. Also, the full 19% VAT applies to the technology.
- Germany's high electricity prices further weaken the economic case for heat pumps. Among the seven MS studied, in 2024 Germany has the highest rate, 18% above the next most expensive, Italy.
- The high CAPEX costs and high electricity costs mean that Germany by 2050, does not reach the point where the lower running costs offset the CAPEX costs as they do in France. They do however lower the NPV to €204bn.

Chart 34: Total and Annual Investment Costs by Scenario and Technology (€bn)



Source: LCP Delta model

Chart 35: CAPEX and Annual OPEX by Technology, Including Renovation Costs (€k)



Source: LCP Delta model

*Renovation costs apply to the share of the building stock constructed before 1990 and requiring heat pumps. **Price before subsidies.

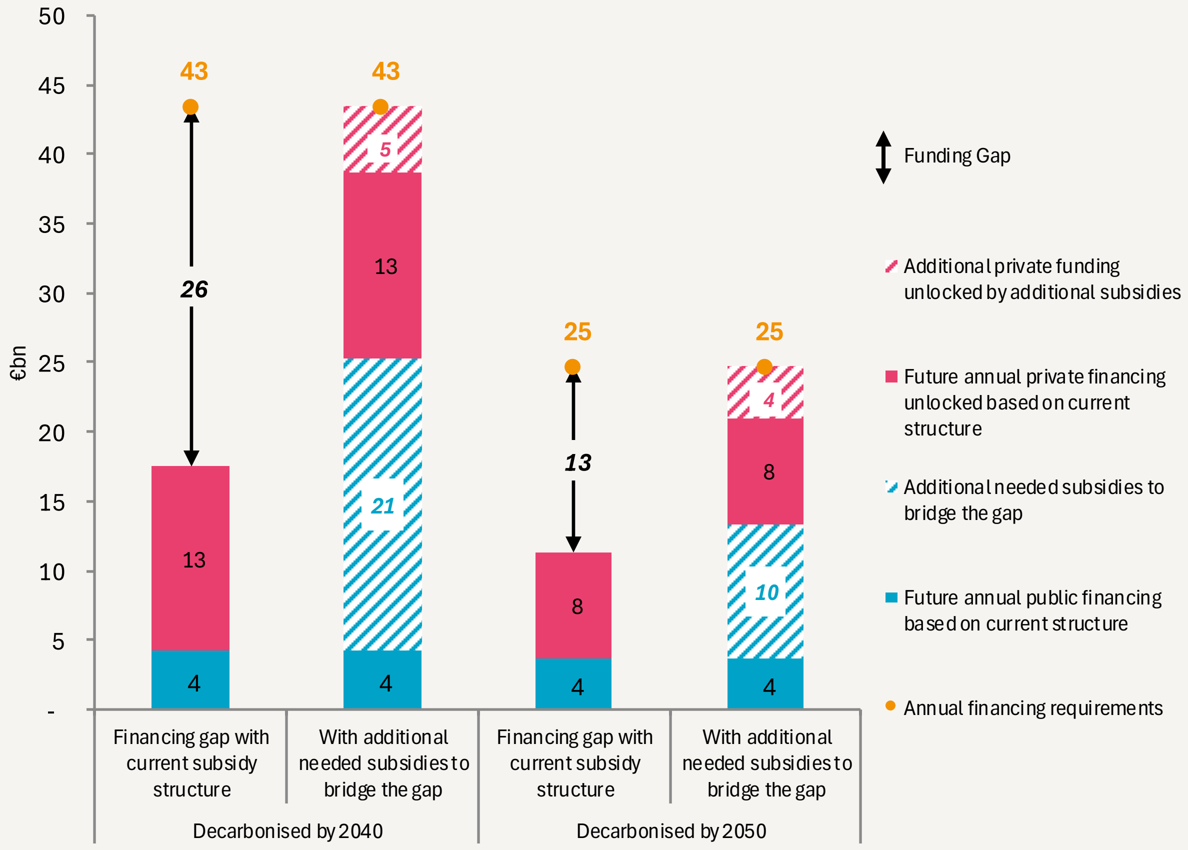
Germany – Cost of decarbonising residential H&C

€13 billion in annual investment needed to close the gap and decarbonise heating in Germany by 2050.

Germany's available financing capabilities fall €13 billion short of the €25 billion needed for the 2050 scenario.

- In the **2050 scenario**, the model calculates that private financing reaches €8bn per year, based upon €4bn of public financing. This falls €13bn short of the finance that is required for clean H&C. In the model, a further €10bn of public financing is needed to unlock the €4bn of private finance that will fill the gap.
- In the **2040 scenario**, the model calculates that private financing reaches €13bn per year, a strong multiple of the €4bn of public finance. However, given the more ambitious timeline, the shortfall stands at €26bn a year. A further €21bn of public finance would be needed to unlock €5bn of private funding to meet the 2040 target.
- Whilst Germany has the largest financing gap in the study, largely caused by the higher costs of heat pump installations, it also has the largest amount of annual **fossil fuel subsidies,** which in 2023 stood at €41bn. Even allowing for a decline in this subsidy level towards the 2015 figure cited in chart 12 of €16.5bn, if this were redirected to supporting H&C it would be sufficient to close the public financing gap needed for 2050.
- The next pages look at existing policies and consider further recommendations that could be used by Germany to channel the finance to households to install clean H&C systems.

Chart 36: Current Annual Financing Capacity vs. Required Annual Financing Capacity per Scenario in Germany (€bn)



Source: LCP Delta model

Germany - Selection of policies

LCPDelta

Germany's aim to decarbonise its heating by 2045 is spearheaded by policies that cover funding for efficient buildings and funding for efficient heating networks.

Table 10

Policy	Summary	Timeline	Amount	Positive	Negative
Federal funding for efficient buildings (BEG)	The Efficient Buildings programme (BEG) has a tiered structure that backs energy-saving and renewable-heat upgrades via covering 5 %-40 % of eligible costs for items like insulation, new windows, ventilation, and heating, offered as grants or subsidised loans, with extra bonuses for replacing oil boilers and an income bonus can increase support for those on lower incomes.	2021 - ongoing	Up to 40 % of eligible costs	• Generous sizing of subsidy for households • The 20% climate speed bonus	• The subsidies available for landlords and tenants are not as generous • The payments are made post completion, requiring households to still source the original finance.
Federal funding for efficient heating networks (BEW)	The policy is designed to support the decarbonisation of district heating. It supports both the upgrade of existing networks and the development of new networks.	2022 - ongoing	~€1bn per year	• Breadth of organisations that can access it, vital given broad range of parties involved in district heating	• The documentation and planning requirements are burdensome and can slow the process
Energy consulting and public relations - Energy consulting for residential buildings (EBW)	Part of the broader BEG policy, grants are available to associations, individuals, and businesses, covering up to 80 % of the costs for energy consulting on new builds, renovations, efficiency upgrades, and renewable-energy projects.	2020 - ongoing	Up to 80 % of the costs for energy consulting	• Using online portal, processing times have been shown to be ~2 weeks which makes it relatively efficient compared to other policies (though still slower than private sector processes)	• Payment made upfront before claiming back
Heat pump regulations and technical standards	The regulations and technical standards for installing heat pumps in Germany are more onerous than other MS in the EU	n/a	n/a		• As detailed in the Octopus report, there are a number of factors that increase the cost of heat pumps in Germany.
Building Energy Act (GEG)	Approved in September 2023, the GEG act introduced the requirement for using at least 65% renewable energy in new heating systems. It also includes the creation of Municipal Heating Plans by each municipality with details needed for areas of over 100k inhabitants by 2026 and those under 100k inhabitants by 2028.	2024-	n/a	• The 65% of renewable energy requirement for new heating systems is a strong driver of decarbonising heat.	• It has involved significant political tension

Germany - Recommendations

1. Encourage efficiencies within the heat pump market.

This study shows the significantly higher costs that exist within the German heat pump market compared to its EU peers. Policies that can bring efficiencies to the market and drive down these costs towards parity with countries such as the Netherlands and France would accelerate the H&C transition in Germany. Types of policy that could enable lower costs include: i) an adjustment of subsidy design that discourages increased costs of installation; ii) increased training of new installers to develop greater competition; iii) a clean heat market instrument (Agora)which incentivises manufacturers to increase the sales of heat pumps and therefore encourages attractive pricing for customers.

2. Tenant/landlord balance is crucial.

With a high percentage of the population in rented homes, German policy in driving the decarbonisation of heating is made more complex. As a result, there are differences driven by this, which can lead to a lower amount of subsidies being available to landlords than homeowners. Monitoring the pace of decarbonisation in these two different markets will be vital to assessing if the policies are balanced correctly and therefore being equally effective in both areas of the housing market. This monitoring should be assessed within a short timeframe to allow changes to be made if it is becoming clear that one area of the market is being left behind.

3. Reallocate Germany's fossil-fuel subsidies to narrow the spark gap and support for vulnerable households transitioning to low-carbon heating.

Redirect a portion of Germany's fossil-fuel subsidies, €41 billion in 2023 alone, toward targeted support for energy-poor households to finance the roll out of clean H&C technologies, thereby weakening fossil-fuel competitiveness and accelerating a fair clean heat transition.

4. Lower VAT on the technologies.

Germany does not provide the incentive of lower VAT on the technologies, unlike France. Consideration should be given to lowering the rate of VAT on all the technologies involved in decarbonising H&C to make them more affordable for households.

With these types of public sector developments in place, this will unlock the private finance needed to fill the financing gap. The next page looks at how the private sector can play its role in providing households with solutions for more affordable clean H&C.

Germany – Private sector's role in provision of finance

As per the model, the private sector needs to provide an additional €4bn per year to fulfil its role in filling the 2050 funding gap. To succeed in this will require two elements to be achieved, 1) companies need to have access to the finance and 2) households need to be able to access the funds from the companies. Outlined below are examples of how both of these elements can be achieved.

Element 1: High potential for companies to raise finance*

German companies are well established issuers in the green bond market, with sectors that will be involved in clean H&C receiving €152bn from investors since 2017. Given the additional €4bn per year that is needed from the private sector, these green bonds are a powerful source of funding, alongside the additional options of raising equity or reinvesting profits. Here, we provide a few examples of types of business that, in combination with the public policy recommendations on page 53, can drive the financing of decarbonising residential H&C in Germany:

- **Deutsche Bank** is the largest bank in Germany and as such has a huge role to play in providing the finance needed for its customers to decarbonise their homes. To date, Deutsche Bank has raised €33bn from investors.
- **Siemens energy,** the German technology company, has raised nearly €1.5bn in finance to enable its customers to move towards decarbonisation through its technological advances. Siemens is set to play a strong role in decarbonising district heating, which this type of finance can enable.
- **E.ON,** a major utility company in Germany and Europe, has accessed €12bn in funds from the green bond market. The ability for it to support its customers with their decarbonisation journey is evident given the high demand from investors.
- **AOC Die Stadtentwickler,** a German property developer has raised €30m in green bonds. Further similar issuance can be used to provide the private finance needed to move the residential sector to a clean H&C future.

Element 2: Growing number of finance options for households/municipalities

Example 1

- **KfW,** a state-owned investment and development bank, is a key provider of finance in Germany and this includes to municipalities looking to develop district heating networks.
- For example, through Credit No. 208, KfW can provide loans of up to €150m for 30 years at an interest rate of 3.31%.
- Importantly, KfW looks to limit the percentage of the project that it finances, to avoid crowding out the private market. Its presence in the market gives confidence to private finance providers to fill the financing gap.

Example 2

- **Munich RE**, the insurer, provides insurance for geothermal exploration by operators looking to develop the technology for district heating.
- The focus of this study has been on public and bank finance and how it can fund clean H&C. However, given the risks and upfront costs involved, the insurance sector will also play a crucial role in enabling the development of the district heating market. This example of how Munich RE provides risk reduction, which in turn enables investment into the sector is another piece of the puzzle to complete the transition to clean H&C.

*For clarity, the figures provided are historic raisings and will have been used for various elements of the transition, not exclusively on H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition

Case Study – Thermondo: helped and hindered

Thermondo Flex - helped

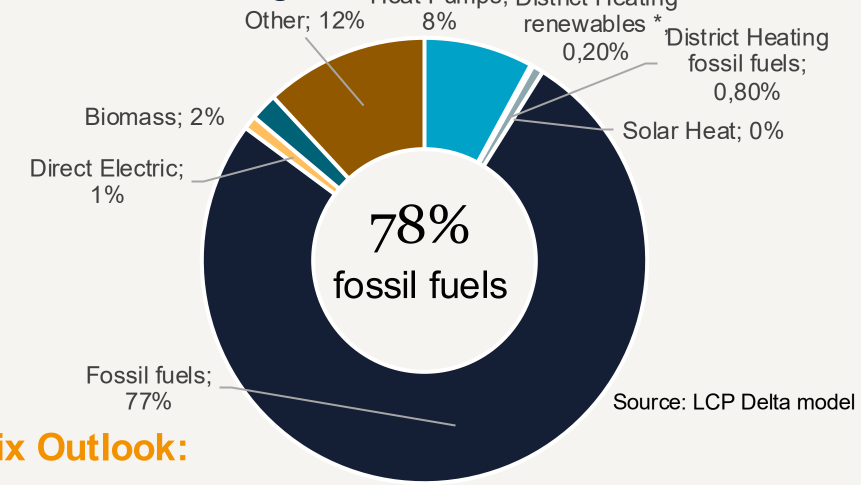
- Thermondo's Flex product enables households to spread the cost of a heat pump across 15 years, with an annual interest rate of 6%. This significantly reduces the required upfront capital expenditure.
- The monthly fee starts at €76, including the 70% government subsidy. Beneficially, Thermondo supports the household with the subsidy application, making it as straightforward as possible for them.
- Without the subsidy, the average monthly rate would be close to €300.
- Thermondo has partnered with a bank to secure financing that enables it to be able to offer this product, raising €50m in July 2025.
- This is an example of how the public and private sector can work well together to provide households with affordable clean H&C offerings. The public sector provides the subsidy which makes it attractive to the household, whilst the private sector, through a partnership between the heat pump company and the bank, organises the remaining finance needed by the household.
- These types of collaborative offerings can accelerate the rollout of clean H&C across the EU.

Thermondo Easy Heat Pump - hindered

- Thermondo launched their rental (Heat as a Service/HaaS) offer in Germany in the summer of 2022. This enabled households to lease a heat pump on a fixed term of 2, 10 or 15 years.
- Households paid a fixed monthly fee, which included the installation of the heat pump, radiators and hot water tank, as well as the servicing and warranty.
- The offer benefitted from subsidies which meant that the monthly fees could be €159, therefore significantly more affordable than the upfront costs of purchasing a heat pump.
- However, due to changes in the BEG subsidies policy, which made HaaS/rental propositions ineligible for full heat pump subsidies, Thermondo had to pause the product in early 2024 and has ultimately removed it from its offerings.
- This is an example of how inconsistency from policy causes a negative impact on the private sector, which leads to understandable caution from companies and therefore offerings are removed from the market, restricting households' options and ultimately slowing the transition to clean H&C.

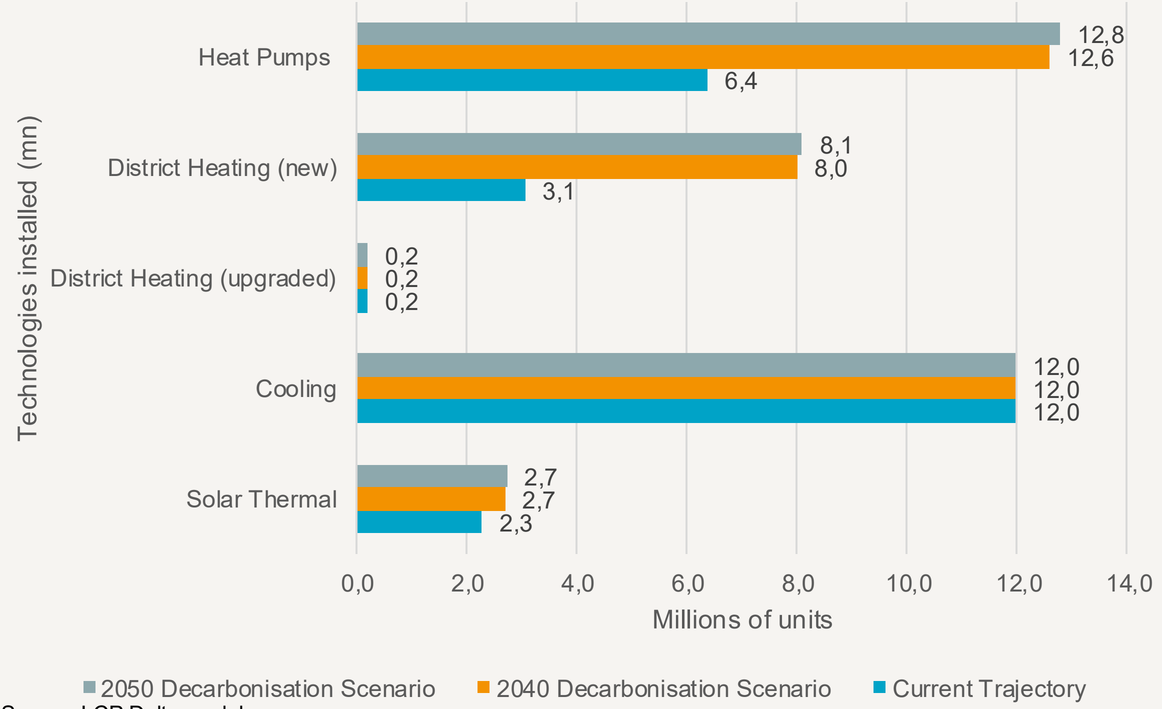
Italy – technologies needed for decarbonising residential H&C

Chart 37: Current heating mix



Source: LCP Delta model

Chart 38: Number of new individual installations under the three scenarios



Source: LCP Delta model

Heating Mix Outlook:

On its current course, Italy looks set to still have nearly half of its heating provided by fossil fuels by 2050. With strong growth rates in a number of technologies, this can be avoided with the residential sector transitioning to being served by clean energy.

- In the past five years, heat pumps benefitted from the growth under the Superbonus policy, however even allowing for this, double-digit growth of over 14% is still needed in this technology to achieve decarbonisation by 2040.
- As detailed in the Milan case study shows, district heating is already progressing in the country and can play a significant role in the cleaning of the H&C sector. A combination of public and private entities can co-ordinate their efforts to maximise the resources available for this key technology.
- Solar thermal is suited to Italy's climate and there is an expectation that it will add ~2.7m installations in the two decarbonised scenarios, but the technology does need to be paired with other technologies which has cost implications.
- As with Spain, cooling is expected to grow strongly in Italy as the climate changes.

Table 11: Compound annual growth rate (CAGR) required for each technology

	Heat Pump	District Heating	Solar Thermal
Current Trajectory	5.8%	11%	13.6%
Decarbonised by 2040	14.0%	26.0%	24.9%
Decarbonised by 2050	8.2%	14.9%	14.4%

Source: LCP Delta model

*includes biomass

Italy – Cost of decarbonising residential H&C

Achieving a decarbonised heating system in Italy by 2050 will demand €350 billion (NPV €200bn), or approximately €13 billion per year.

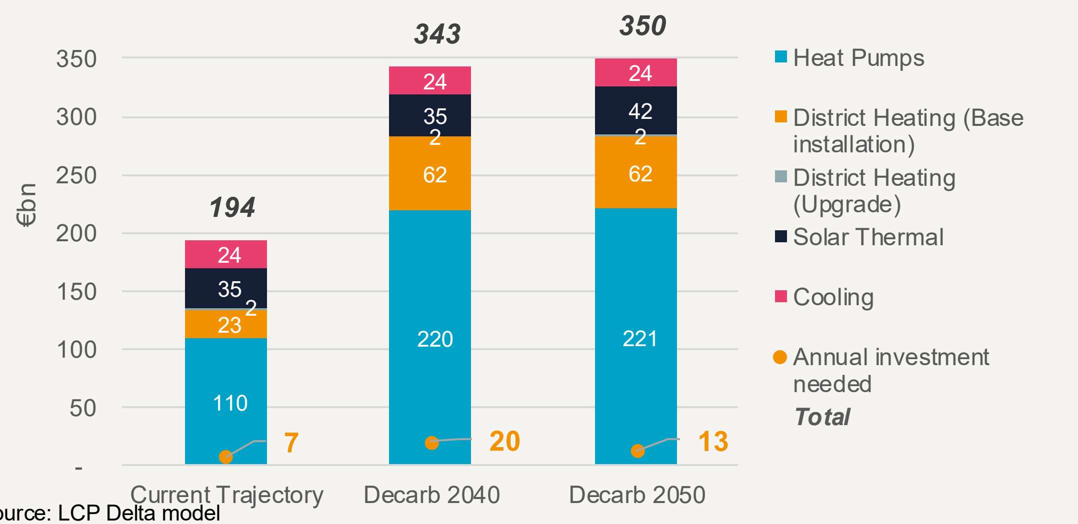
Italy's H&C shift will primarily involve phasing out gas boilers and replacing them with low-carbon alternatives.

- As in many other MS, heat pumps dominate the projected mix in Italy (63%). However, solar thermal also holds a notable share (12%) due to the country's strong solar exposure. Cooling technologies are also widely used, and their demand is expected to increase. Nevertheless, they contribute less to overall costs because of their relatively low capital expenditure.
- It is worth highlighting that even if the transition was not required, replacing gas boilers that would break between now and 2050 would cost €118bn (NPV €86bn).

High electricity prices and unfavourable spark gap leads to unattractive payback times for heat pumps (~16 years).

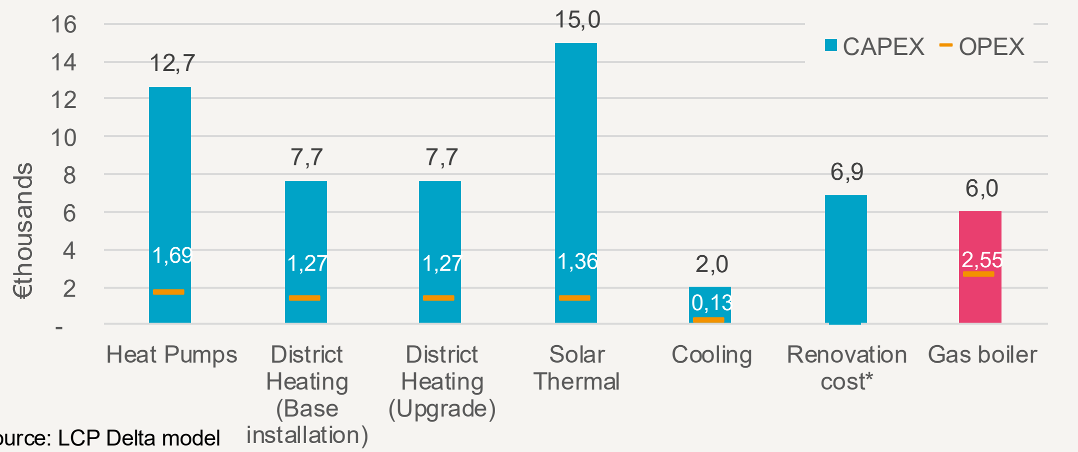
- Electricity prices in Italy are expected to remain high, as coal power is phased out and replaced by upgraded and newly built gas-fired plants, which are prone to the volatility of international fossil fuel prices. This has negative implications for households looking at clean H&C options.
- However, despite the relatively negative heat pump economics, on an NPV basis, Italy could be €10bn better off by 2050 even including the significant upfront CAPEX required.

Chart 39: Total and Annual Investment Costs by Scenario and Technology (€bn)



Source: LCP Delta model

Chart 40: CAPEX and Annual OPEX by Technology, Including Renovation Costs (€k)



Source: LCP Delta model

**Renovation costs apply to the share of the building stock constructed before 1990 and requiring heat pumps.*

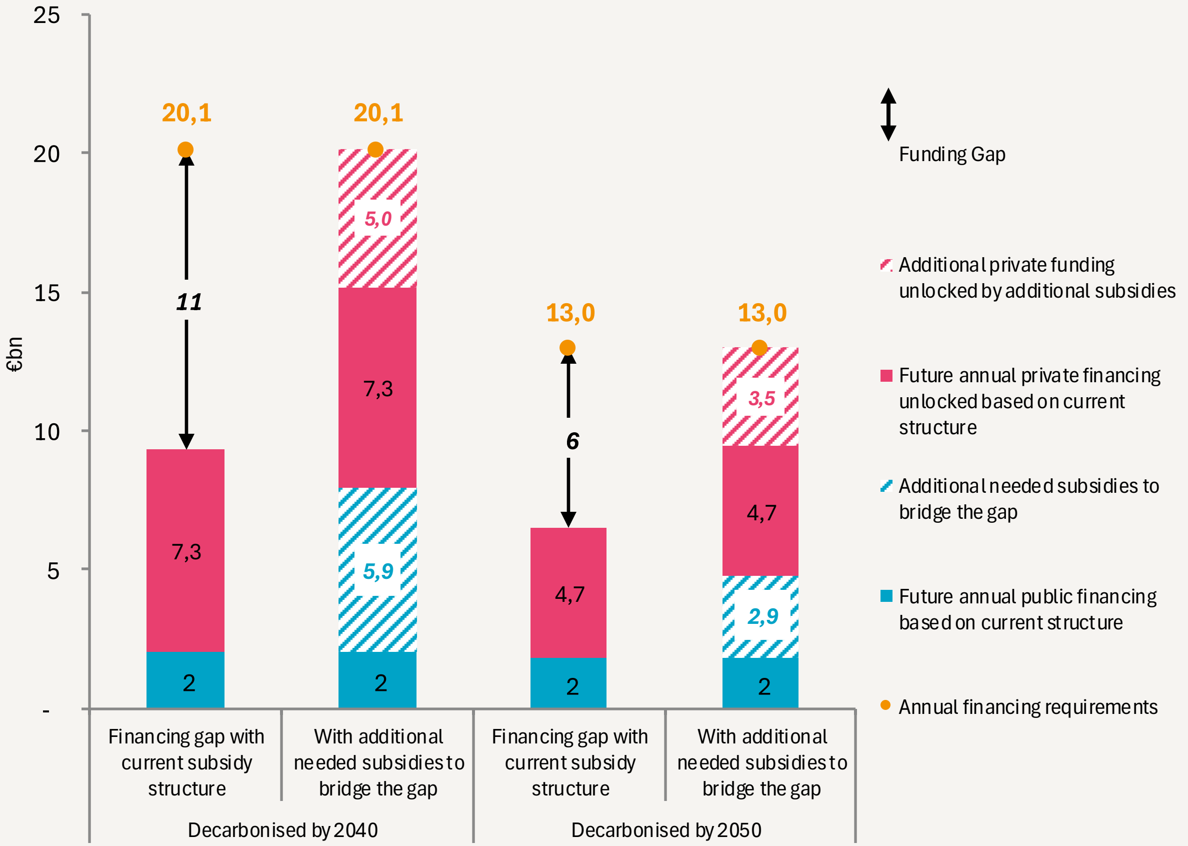
Italy – Financing the decarbonisation of residential H&C

€6 billion in annual investment needed to close the gap and decarbonise heating in Italy by 2050.

Decarbonising Italy's gas-boiler dominated heating market will require a further €6bn in annual investment to provide households with the affordable solutions.

- Italy currently demonstrates a relatively **stronger financing capacity** than other MS, supported by higher average incomes. Upper income deciles of the population can afford to cover the cost of replacing H&C systems.
- The **2050 scenario**, using the current structure, results in €4.7bn of private finance being achieved through only €2bn of public funding. As with all MS, there is a gap between this and what is needed, €6bn in Italy's case. This can be filled through €2.9bn of further public funding leading to the unlocking of €3.5bn of private finance.
- Under the **2040 scenario**, the shortfall is predictably larger at €11bn and would need an additional ~€6bn of public financing, combined with €5bn of private financing to meet the €20bn total per year needed.
- The additional ~€3bn of public financing needed for the 2050 target could be achieved through the redirection of the ~€6bn of annual **fossil fuel subsidies** that were provided in the country in 2015 and 2023 as cited in chart 12.
- The next pages look at existing policies and consider further recommendations that could be used by Italy to channel finance to households to install clean H&C systems.

Chart 41: Current Annual Financing Capacity vs. Required Annual Financing Capacity per Scenario in Italy (€bn)



Source: LCP Delta model

Italy - Selection of policies

With a target of 2050, Italy is enabling the rollout of clean H&C through a combination of grants and tax incentives.

Table 12

Policy	Summary	Timeline	Amount	Positive	Negative
Energy Efficiency and Renewable Energy Refurbishment tax reduction (Superbonus)	Funding is available as a tax deduction of 65% on energy-efficiency upgrades in multi-apartment buildings (e.g. condominiums)—a measure introduced after the phase-out of the Superbonus 110%/90% schemes for residential construction.	2020 - 2025	Tax relief of up to 65% work amount	• Historically the Superbonus proved to be highly effective at spurring households into action	• The subsidy was too costly and fueled inflation. • The 110% Superbonus was unsustainable due to oversized compensation.
Home (Renovation) Bonus and Ecobonus	Funding is available through tax deductions for renovation and energy efficiency improvements in residential and other buildings.	2008 - ongoing	Tax relief of up to 50% work amount	• Breadth of eligibility from homeowners to tenants • Can be combined with other incentives • Subsidy active for 17 years	• The percentage is being reduced from 50% to 36% to 30% between now and 2028 • The payment is in the form of a tax reduction over ten years increasing upfront payment needs
Energy efficiency obligation scheme (White certificates)	White Certificates are tradable assets that certify verified energy savings resulting from specific projects or measures. Each certificate corresponds to a saving of one Ton of Oil Equivalent (TOE).	2005 - ongoing	N/A	• Energy Service Companies deal with the paperwork and claim certificates, whilst potentially providing discounts on their products to households	• Cannot be combined with national incentives (though regional/EU are allowed)
Conto Termico 2.0/3.0	Conto Termico 3.0 is the 2025 version of the original policy set up in 2013. It is still to be ratified but it promotes the production of renewable energy and access to energy efficient building works and installations. It improves the efficiency through insulation and windows as well as the replacement of heating systems.	2025 - ongoing	€900m	• Payments under €5000 are paid directly to the householder as a lump sum payment, aiding the upfront costs. Larger payments are in two or 5 annual instalments • Energy Service Companies can handle the process for household	• It cannot be combined with the Ecobonus • Applications face tight deadlines
PNRR - Efficient District Heating	Funding is provided under Italy's National Recovery and Resilience Plan (PNRR), allocating €200 million to develop, expand, or upgrade efficient district H&C networks.	2022 - 2026	€200m	• The emphasis of projects on densely populated areas makes it more likely to showcase the effectiveness of district heating and enable its growth	• The final 2026 date places limitations on how effective it can be to transform the district heating market in Italy

Italy - Recommendations

1

Long term, sustainable policy.

The impact of the Superbonus in recent years is evidence that households have the ambition and desire to install clean H&C in their homes. However, the generosity of the policy, whilst arguably part of the reason for this success, proved to be unsustainable. For the private sector to be able to optimise its own long-term, sustainable momentum it will require a government policy that is in place for the long-term.

2

Simplicity can be a highly effective key to unlocking the market.

The individual policies that exist within Italy all have elements of strength. However, the potential overlap between these and whether they can be combined or not can create confusion for households looking to install clean H&C technology. Whilst the energy companies can aid the household in this, ideally the eligibility would be clear to the household without the need for the external guidance. The simplicity that the private sector provides for its offerings (e.g. ENI heat pump fixed monthly payment, A2A CLIMA2A) should be used as a blueprint for public policy.

3

District heating will need significant support.

District heating has huge potential as a solution to clean H&C in Italy. As the Milan case study shows there are an increasing number of examples of how effective it can be, if the public and private sector collaborate. However, it remains a small component of the overall market and to enable the transformational growth to happen will require long term policies and funding to be put in place, that encourage the development of the technology.

4

Reintroduction of the Cessione del Credito to low-income households and tenants to overcome the landlord-tenant dilemma.

The Cessione del Credito overcame the challenge posed by delayed tax credits, which previously required households to cover upfront installation costs. By allowing households to transfer their tax credits to banks, they could access the necessary financing for those initial expenses. The reintroduction of this process would be an enabler for low-income households to finance new installations.

With these types of public sector developments in place, this will unlock the private finance needed to fill the financing gap. The next page looks at how the private sector can play its role in providing households with solutions for more affordable clean H&C.

Italy – Private sector’s role in provision of finance

As per the model, the private sector needs to provide an additional €3.5bn per year to fulfil its role in filling the 2050 funding gap. To succeed in this will require two elements to be achieved, 1) companies need to have access to the finance and 2) households need to be able to access the funds from the companies. Outlined below are examples of how both of these elements can be achieved.

Element 1: High potential for companies to raise finance*

Italian companies are well established issuers in the green bonds market, with companies in the sectors likely to be involved in the H&C transition having raised €73bn from investors since 2017. Evidence of such strong issuance potential, alongside the options of equity raising and reinvesting profits should lead to confidence that the finance is there for companies to fund €4bn extra per year to the H&C transition. Here, we provide a few examples of types of business that, in combination with the public policy recommendations on page 60, can drive the financing to decarbonise residential H&C in Italy:

- **Intesa Sanpaolo,** Italy’s largest bank with a market share of 23%, through the provision of fast and efficient finance to its customers can accelerate the cleaning of Italy’s H&C sector. With over €8bn of finance raised in the green bond market historically, it has the access to huge amounts of financing.
- **Iren** has a breadth of operations in Italy, engaged in the sector of electricity and thermal energy for district heating. Iren is set to play a significant role in district heating and it has already shown strong demand from its investors, raising over €3bn in finance.
- **A2A,** has historically raised close to €5bn in finance for its operations. A2A, already a presence in Italy’s district heating market, can play a huge role in the development of this element of Italy’s clean H&C future.
- **Alerion,** the Italian company focused on wind and solar energy that enables heating to be decarbonised, has strong demand from investors, who have historically provided €900m of finance to it.

Element 2: Growing number of finance options for households

Example 1

- **Intesa Sanpaolo** offers Domus Green Mortgage products for households looking to renovate their home to become more energy efficient.
- The product provides flexibility to the household, where they can choose either a fixed or variable rate and over different terms. The rates are at preferential levels compared to standard mortgages.
- The products eligible for the funding include solar thermal which is set to be a growing technology in Italy.

Example 2

- **Unicredit One4Planet** loans are focused on businesses and are available to those looking to invest in energy saving solutions for properties.
- The finance can be used for the construction of new properties or the renovation of existing buildings, with the duration ranging from 2-15 years.
- This type of finance is beneficial for the companies that operate in the space between individual ownership and the larger businesses who can access the green bond market.

*For clarity, the figures provided are historic raisings and will have been used for various elements of the transition, not exclusively on H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition

Case Study – Effective financing structure for district heating

Effective combination of private and public sectors:

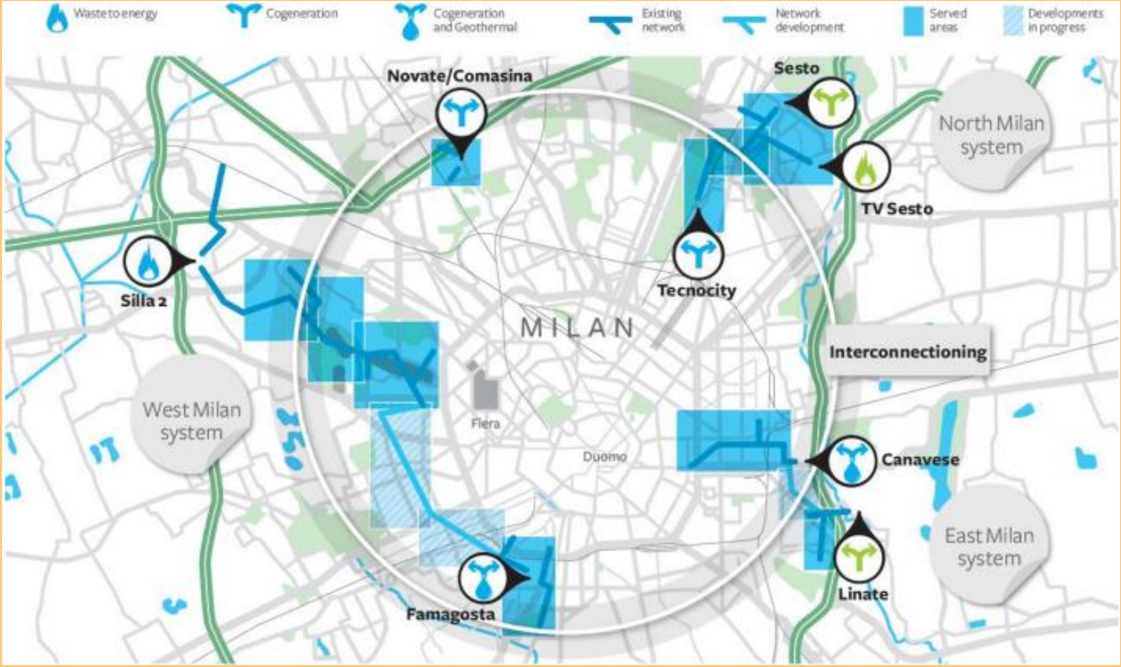
The district heating network of Milan is a good example of how the public and private sector are working together to deliver affordable, decarbonised heating for the city. Here we outline the parties involved:

A2A: In 2016 won the 30-year contract to run the district heating network in Milan. A2A is responsible for the significant capital expenditure required for the system but due to the long-term contract, it is able to plan and organise its finance accordingly.

Comune di Milano: Milan owns a stake in A2A Spa and this fosters alignment between public and private objectives. For example, Milan has enabled A2A to invest in groundwater heat pumps by allowing A2A free use of Milan's extraction wells. In addition, Milan takes responsibility for the pricing of the district heating to the customer, providing the balance between the private funding needed for the upfront development and the importance of affordability for the customer.

European Investment Bank: As well as having access to the green bond market as detailed earlier, A2A has been able to access funds from the EIB to develop the district heating network in Milan.

Further plans: A2A is currently developing plans to add geothermal energy to Milan's district heating network, as well as using the recovered heat from data centres.

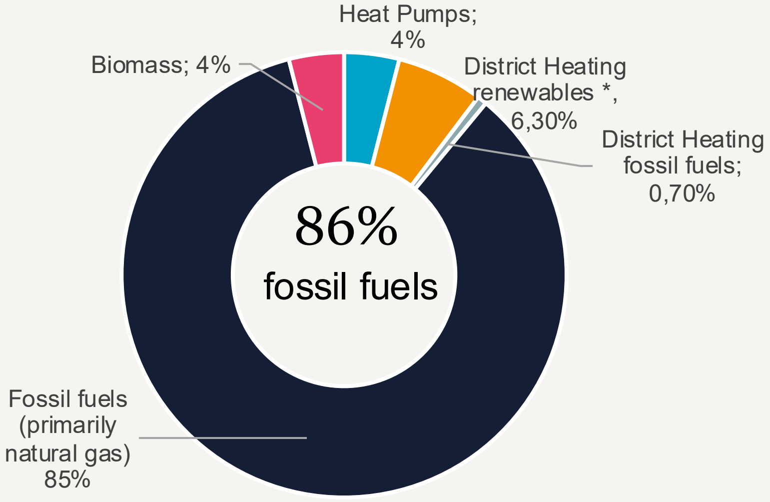


Development of three wide DH systems in Milan/Sesto San Giovanni area

Source: [Description of Milan DH System]

The Netherlands – technologies needed for decarbonising residential H&C

Chart 42: Current heating mix



Source: LCP Delta model

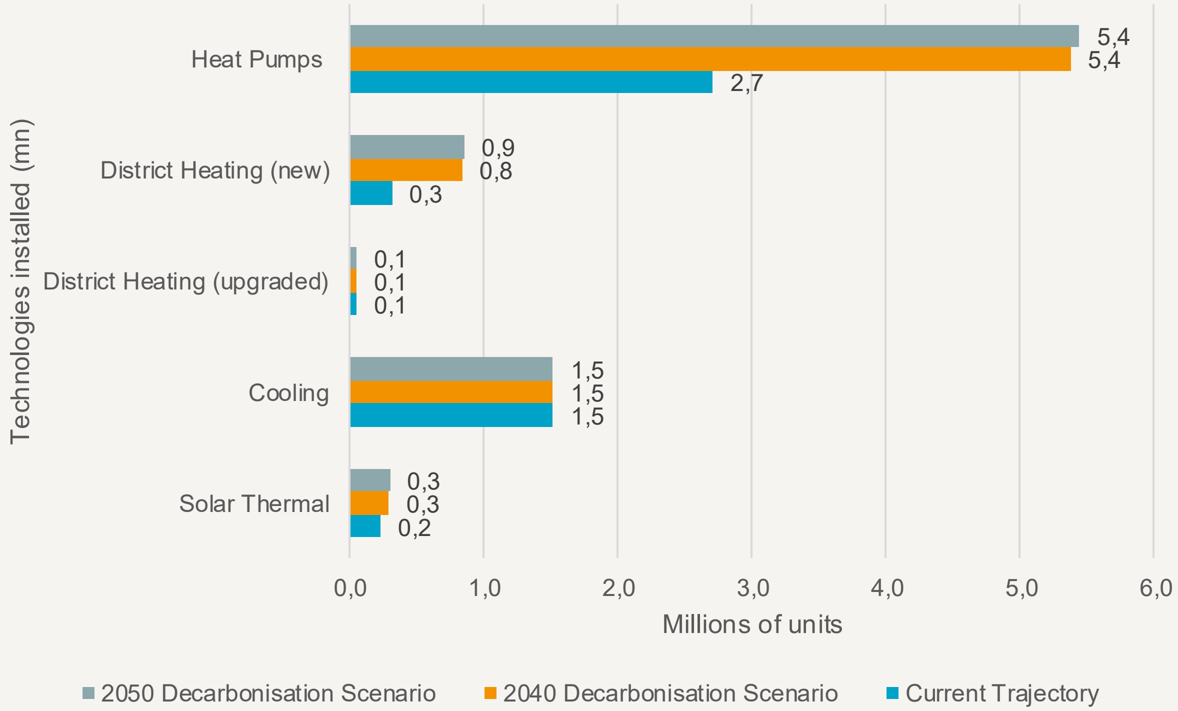
Heating Mix Outlook:

As detailed in chart 42, the Netherlands currently has a very high reliance on heating based on natural gas and unless the current trajectory is changed, the country will still have half of its residential heating from fossil fuels in 2050.

- Achieving a decarbonised H&C system will require significantly scaling up heat pump installations to over 5 million units.
- District heating is currently focused on renewables and a growth in these types of development at a mid single digit growth rate can be part of successfully cleaning the H&C sector.

*includes biomass

Chart 43: Number of new individual installations under the three scenarios



Source: LCP Delta model

Table 13: Compound annual growth rate (CAGR) required for each technology

	Heat Pump	District Heating	Solar Thermal
Current Trajectory	9.4%	2%	8.0%
Decarbonised by 2040	21.1%	6.3%	15.3%
Decarbonised by 2050	12.3%	3.8%	9.0%

Source: LCP Delta model

The Netherlands – Cost of decarbonising residential H&C

Achieving a decarbonised heating system in the Netherlands by 2050 will demand €105 billion (NPV €61bn), or roughly €4 billion per year.

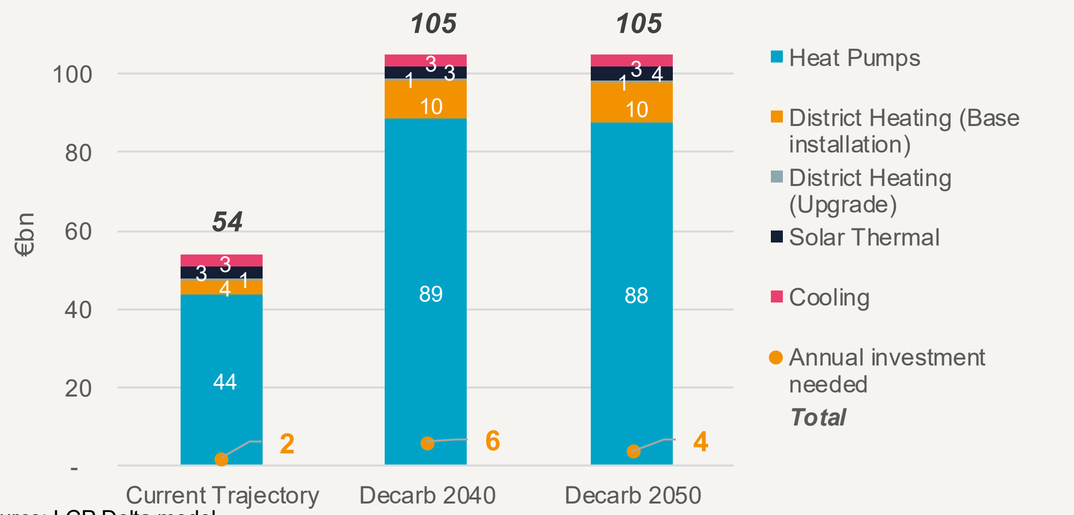
More than in any other MS, heat pumps dominate the transition in the Netherlands, accounting for 84% of the total cost. District heating follows far behind, making up only 10% of the total investment.

- The dominance of heat pumps is driven by efforts to replace the existing stock of natural gas boilers, which currently make up 85% of all heating systems. In the short term, hybrid solutions (not included in the model) are preferred for retrofits by customers, as they have a lower upfront cost than all-electric HPs.
- It is worth highlighting that even if the transition was not required, replacing existing gas boilers that would break between now and 2050 would cost €41bn (NPV €30bn).

Running costs play an important role, since gas boilers become less attractive over time as rising gas prices make their operation increasingly expensive.

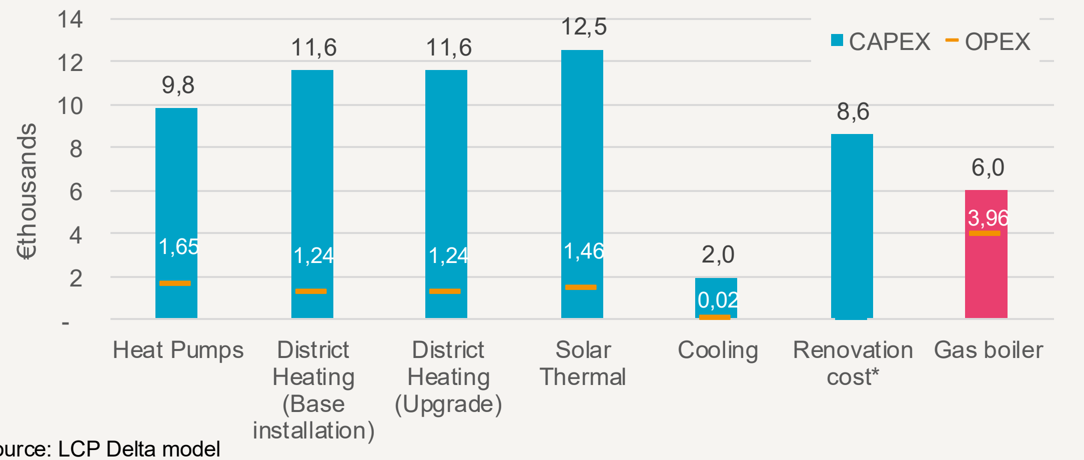
- The Netherlands is projected to have one of the highest gas prices in Europe by 2050 (25 c€/kWh), significantly boosting the attractiveness of electricity-based alternatives.
- The lower running costs could be so advantageous that on an NPV basis, the Netherlands could be €57bn better off by 2050 even including the significant upfront CAPEX required.

Chart 44: Total and Annual Investment Costs by Scenario and Technology (€bn)



Source: LCP Delta model

Chart 45: CAPEX and Annual OPEX by Technology, Including Renovation Costs (€k)



Source: LCP Delta model

*Renovation costs apply to the share of the building stock constructed before 1990 and requiring heat pumps.

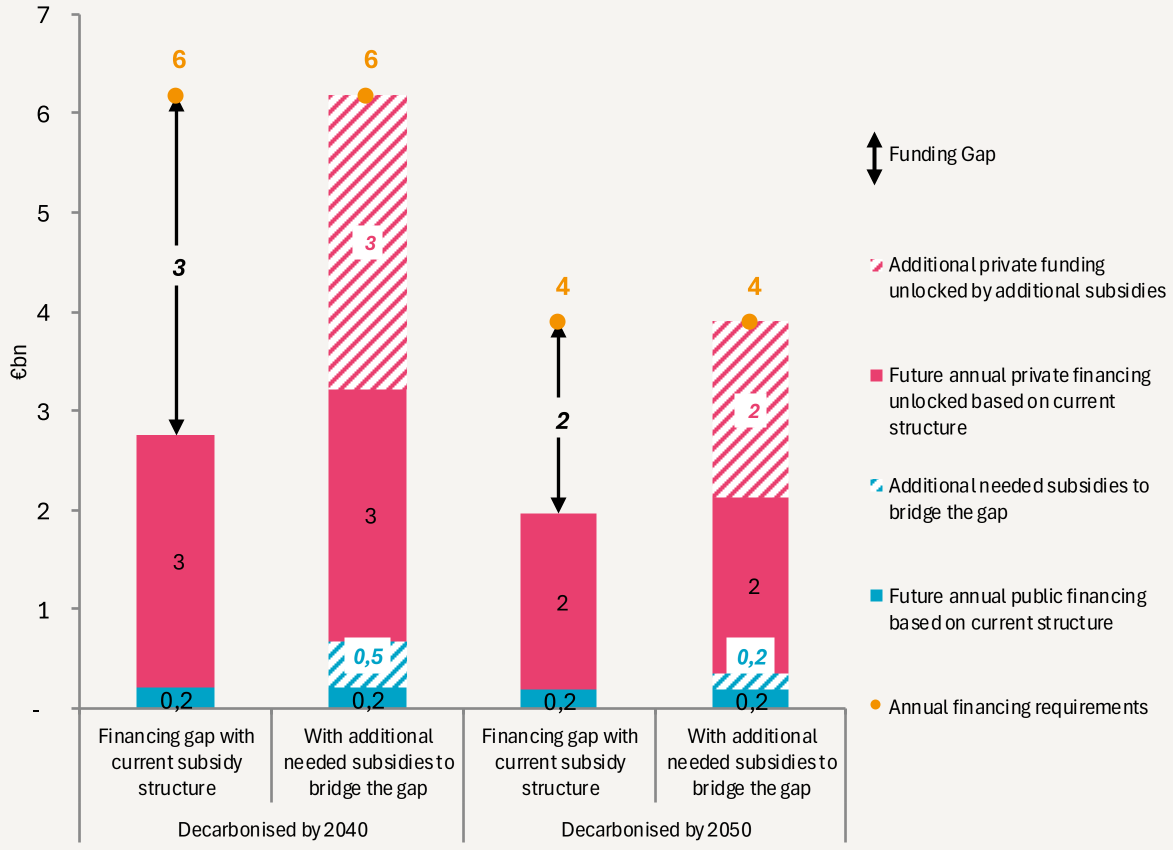
The Netherlands – Financing the decarbonisation of residential H&C

€2 billion in annual investment needed to close the gap and decarbonise heating in the Netherlands by 2050.

The Netherlands demonstrate one of the most favourable income to asset price ratio. As a result, households have strong capacity to finance the required investments.

- The Netherlands currently have about half of their total investment needs already covered, primarily due to strong household financing capabilities. This strength is largely driven by the fact that renewable heating systems are highly competitive compared to fossil fuel alternatives, making private investment more attractive.
- In the **2050 scenario**, the model details that only €0.2bn of public finance is required to achieve €2bn of private finance, with the same ratio being in evidence that can close the €2bn gap.
- In the **2040 scenario**, the gap of €3bn that exists between the current structure and the €6bn needed can be filled through €0.5bn of public funding, releasing €3bn of private finance.
- The 2050 €0.2bn extra public finance needed is covered nearly 15x by the **fossil fuel subsidies** figure of €2.9bn in 2023. A redirection of a small portion of these subsidies would be all that is required to unlock the finance needed to achieve the 2040 and 2050 scenarios. Even the lower 2015 fossil fuel subsidy figure of €0.6bn would cover the additional public funding requirement for both scenarios
- The next pages look at existing policies and consider further recommendations that could be used by the Netherlands to channel the finance to households to install clean H&C systems.

Chart 46: Current Annual Financing Capacity vs. Required Annual Financing Capacity per Scenario in the Netherlands (€bn)



Source: LCP Delta model

The Netherlands - Selection of policies

The Netherlands' heat transition is supported by a mature mix of grants, zero-interest loans, and strong multi-level coordination, but progress is hindered by administrative complexity, uneven access, and policy volatility.

Table 14

Policy	Summary	Timeline	Amount	Positive	Negative
Investment subsidy for sustainable energy and energy saving (ISDE)	The ISDE scheme provides subsidies to homeowners and businesses for energy-saving and sustainable technologies. Homeowners can receive support for insulation, heat pumps, solar boilers, district heating connections. The programme became stricter in 2024 but is funded annually and runs through 2030.	2019 - ongoing	Up to €17,200	• Broad technology coverage • long-running national scheme with transparent RVO process	• Higher-income households take up heat-pump subsidies more than low-income groups • Policy uncertainty around the 2026 hybrid-HP obligation dampened confidence
National heat fund Energy savings loan	Soft loans are available to homeowners and housing associations to support energy-saving upgrades in residential buildings. Eligible measures include heat pumps, district heating connections, solar panel, etc.	2015 - ongoing	Up to €28,000	• Public loan with 0% • Small minimum ticket • Supports single and bundled measures	• Standard owner-occupier cap (€28k) can be insufficient for deep retrofit/electrification • Credit checks can exclude the most vulnerable
Sustainability subsidy scheme for owners' associations (SVVE)	Funding is offered in the form of subsidies by the SVVE for sustainability measures and research. The subsidies cover: energy-saving insulation measures, installation of central heat pumps, solar boilers, or connections to heating networks. Additionally, subsidies are available for sustainability research and advice, including studies on optimal measures for energy savings and application for this advice.	2022- ongoing	15% of costs	• Supports insulation, heat pumps, solar thermal and DH connections	• Percentage support (≈15% single insulation; ≈30% packages/clean heat) leaves co-financing gap
Energy performance payment (EPV)	Tenants of highly energy-efficient rental homes can receive monthly compensation from landlords, known as EPV, for improved comfort and lower energy bills. This payment is separate from rent and service charges and does not impact eligibility for housing allowances. The amount is determined by criteria in the EPV table.	2023 - ongoing	N/A	• Predictable revenue stream to recover deep-retrofit costs • Independent verification and annual tenant reporting	• Complex compliance • Tenant affordability risk if performance lags • Admin burden to document heat demand/production
Subsidy Scheme for Sustainability and Maintenance of Rental Properties (SVOH)	Funding is offered in the form of a subsidy by the SVOH scheme to landlords of one or more existing or monumental rental properties for energy-saving works. Eligible measures include energy-saving improvements, sustainable heat options, and energy advice. The work must be carried out through a construction/installation company.	2021 - ongoing	Up to €15,000 for a solar water heater or heat pump	• Per-dwelling cap raised to €10k or €15k with HP/solar boiler • Landlord cap removed	• Even with higher caps, deep renovation costs can exceed support • Admin burden for small landlords • Deep packages can require higher investment than standard caps/loans.

The Netherlands - Recommendations

1 **Reintroduce a national standard supporting heat pump adoption in the Netherlands.**

In May 2022 the Dutch cabinet announced that every gas boiler replaced from 2026 must be paired with a hybrid heat pump. However, the caretaker coalition paused this obligation in May 2024, citing consumer-cost concerns and installer shortages. A phased, flexible reinstatement of the heat-pump mandate standard, paired with stable subsidies, zero-interest finance, and installer-training scale-up, would restore market confidence and accelerate the H&C transition.

2 **Dedicate part of the Netherlands' ETS2 gas-related revenues to a Clean Heat Transition Fund that directly finances household moves away from gas heating.**

From 2027, the EU's new ETS2 will place a carbon price on heating fuels, including natural gas, with part of the revenues returned to MS through the SCF. In the Netherlands, dedicating a fixed share of these gas-related ETS2 revenues to a Clean Heat Transition Fund would create an additional stable, long-term resource for helping households overcome the financial and technical barriers of replacing gas heating.

3 **Require all major renovations in district-heating priority zones to include low-temperature heat distribution and pre-piping for future network connection.**

In DH-priority zones defined in municipal heat plans, require that any major renovation must leave the building "DH-ready", with low-temperature heat distribution and pre-piping for future network connection. The objective is to ensure that every building in an area where district heating is planned or available can connect easily and cheaply when the network reaches it. Adding DH connection piping during renovation is significantly cheaper than retrofitting later.

4 **Introduce binding minimum energy performance and clean-heat standards for all rental properties.**

The "split incentive" in the Dutch rental sector slows the adoption of insulation and low-carbon heating: tenants benefit from lower bills, but landlords bear the costs. Current policies, while promoting hybrids and rewarding better labels in rent setting, lack binding minimum standards for existing rental stock.

With these types of public sector developments in place, this will unlock the private finance needed to fill the financing gap. The next page looks at how the private sector can play its role in providing households with solutions for more affordable clean H&C.

The Netherlands – Private sector's role in provision of finance

As per the model, the private sector needs to provide an additional €2bn per year to fulfil its role in filling the 2050 funding gap. To succeed in this will require two elements to be achieved, 1) companies need to have access to the finance and 2) households need to be able to access the funds from the companies. Outlined below are examples of how both of these elements can be achieved.

Element 1: High potential for companies to raise finance*

Dutch companies are well established issuers in the green bond market, with companies within the sectors that will be involved in the H&C transition raising €146bn since 2015. The scale of this compared to the €2bn required annually from the sector to meet its role to reach 2050 is vast, providing great confidence that the finance is there to be sourced from pension funds and other investors. Here, we provide a few examples of types of business that, in combination with the public policy recommendations on page 67, can drive the financing to decarbonise residential H&C in the Netherlands:

- **ING, Rabobank and ABN amro,** the three largest banks in the Netherlands have approximately 75% market share between them and collectively they have raised nearly €27bn in green bond finance. This scale of finance that is available to them and their market breadth indicates the huge impact they can have on financing the decarbonisation of the residential H&C sector.
- **Alliander,** the Dutch network business, has a significant role in the transition and its subsidiary, Firan, will be key to developing its heat and cooling networks. Alliander has already successfully raised over €3bn in green finance which provides confidence that it can continue to raise funds to develop the Netherland's clean H&C sector.
- **Vesteda finance,** is a residential property owner with 98% of its estate at ABC energy efficiency. The €1.5bn it has raised has aided with the high quality of the estate and there is reason to expect that this type of finance can help Vesteda and other similar companies to green the H&C of estates in the Netherlands.

Element 2: Growing number of finance options for households

Example 1

- **Green Lion,** is a financing structure by ING that enables it to raise significant funds from its investors. This structure is used by ING to develop its green mortgage product for households looking to decarbonise their homes through offering lower interest rates than their standard mortgages.
- The Green Lion structure has issued ~€2bn of finance to date and there is good reason to expect this type of structure to be used by banks across Europe and be a material part of the solution to funding the decarbonising of the residential H&C sector.

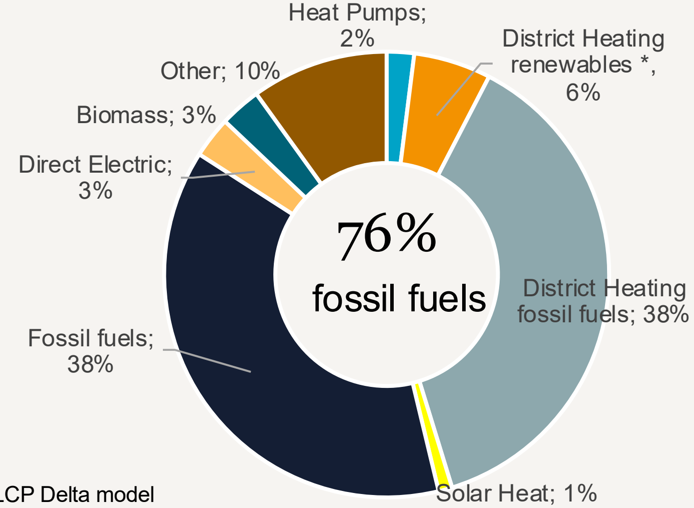
Example 2

- **ABN Amro's** sustainable home mortgage is available to households looking to improve the energy efficiency of their home, from insulation to clean heating systems. The interest rates on these mortgages are lower than their standard mortgages.
- The household can take out the mortgage and have up to 2 years to install the new energy measures (or 3 years for a new build). This ability to have the upfront finance available in advance enables the household to plan its works more effectively and with greater confidence.
- The interest rates available depend on the term of the loan, ranging from 3.32% for 5 years or 4.17% for 20 years.

*For clarity, the figures provided are historic raisings and will have been used for various elements of the transition, not exclusively H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition.

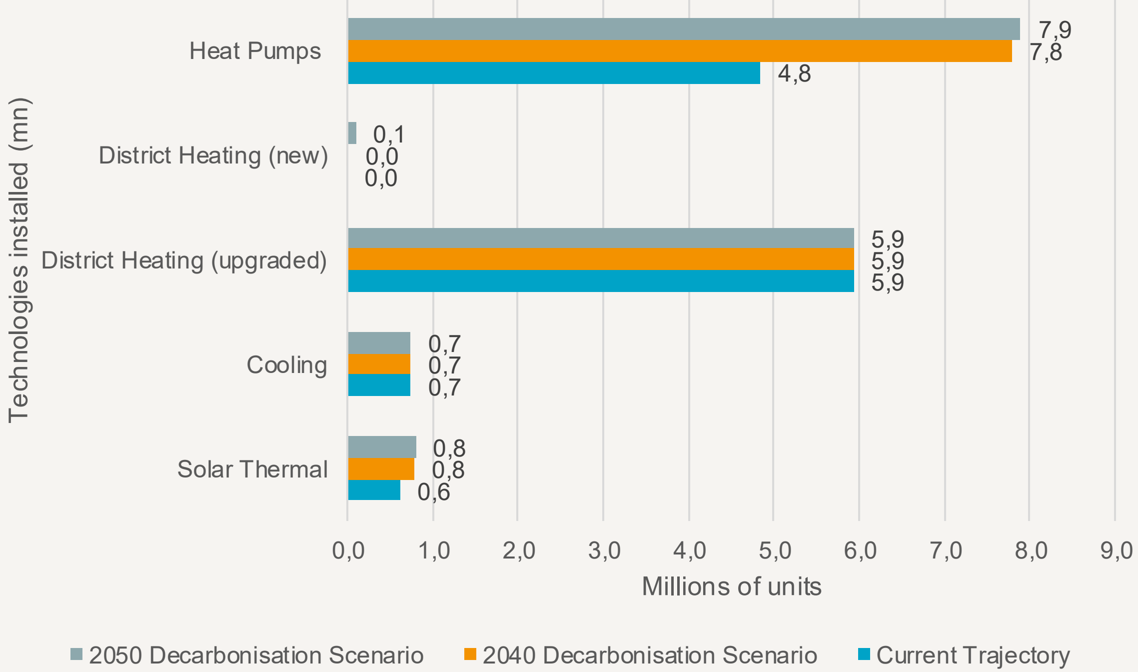
Poland – technologies needed for decarbonising residential H&C

Chart 47: Current heating mix



Source: LCP Delta model

Chart 48: Number of new individual installations under the three scenarios



Source: LCP Delta model

Heating Mix Outlook:

Historically, Poland has developed a large number of district heating networks, leading to over 40% of the population using this solution. Poland's strategy for decarbonising its existing district heating (see below link) will lead to a steady decline in fossil fuel usage by 2050. However, it could still be left with ~20% reliance on fossil fuels unless the following growth rates are achieved:

- Heat pumps require the highest annual growth rate analysed in this study, at over 24% for the 2040 target to be achieved and just under 14% for a decarbonised 2050 target to be met.
- As with Czechia, the large existing fossil fuel district heating networks need to be decarbonised and there is a strategy in place to achieve this, including geothermal and large-scale heat pumps (PTEC Report 2024).

*includes biomass

Table 15: Compound annual growth rate (CAGR) required for each technology

	Heat Pump	District Heating	Solar Thermal
Current Trajectory	11.8%	0%	7.7%
Decarbonised by 2040	24.2%	0%	14.7%
Decarbonised by 2050	13.9%	0.1%	8.6%

Source: LCP Delta model

Poland – Cost of decarbonising residential H&C

Achieving a decarbonised heating system in Poland by 2050 will demand €192 billion (NPV €111bn), or roughly €7 billion per year.

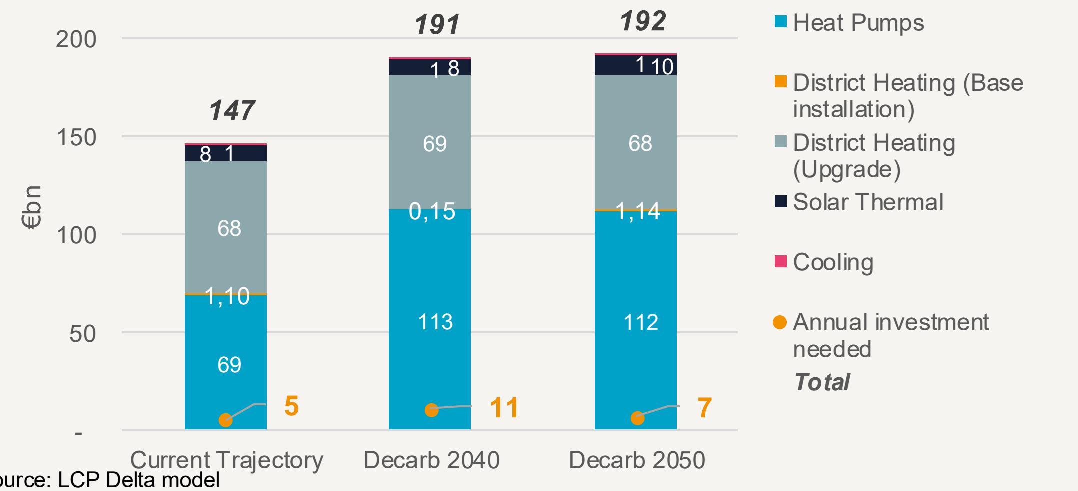
Similar to Czechia, Poland will leverage its existing large district heating network to achieve its H&C transition.

- District heating will represent 35% of the transition cost. Like Czechia, Poland has a large share of residents in high-rise blocks, where space constraints limit the installation of individual hot-water cylinders or outdoor heat-pump units. This is the case in both MS because they share a legacy of dense urban housing and widespread centralised heating infrastructure.
- It is worth highlighting that even if the transition was not required, replacing gas boilers that would break between now and 2050 would cost €36bn (NPV €26bn).
- N.B. The total transition cost is lower than the cost estimate in the National Building Renovation Plan, as that plan applies a broader scope (see annex for details).

Poland is one of the worst MS for the competitiveness of heat pumps, especially until 2030, although it does improve afterwards.

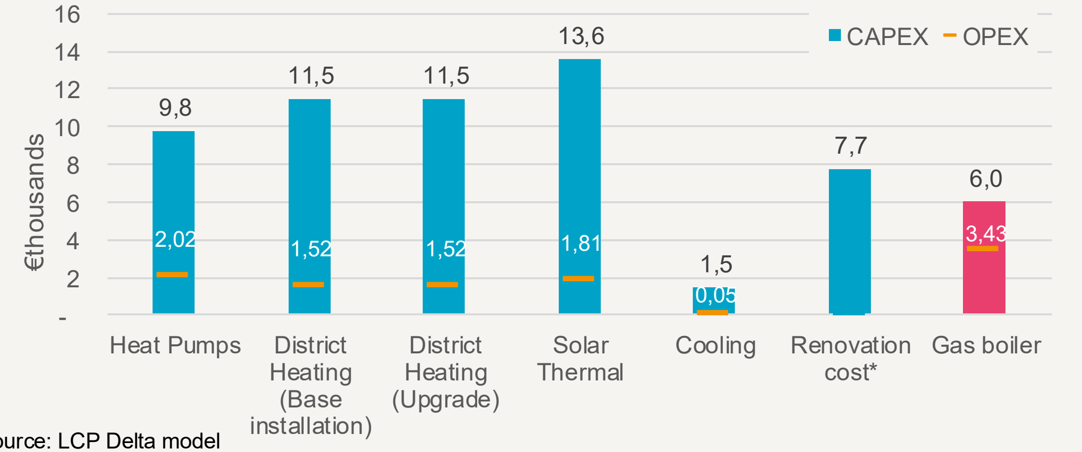
- In our analysis, Poland is the only MS where, in the first year, operating a gas boiler costs less than operating a heat pump, on average (€138/€145). In 2025, Poland spark gap ranked 6th out of the 7 countries studied. This is due to an unfavourable electricity to gas price ratio.
- Despite the difficult start, lower projected running costs, driven by rising gas prices, could make heat pumps cost-effective on an NPV basis, Poland could be €110bn better off by 2050 even including the significant upfront CAPEX required.

Chart 49: Total and Annual Investment Costs by Scenario and Technology (€bn)



Source: LCP Delta model

Chart 50: CAPEX and Annual OPEX by Technology, Including Renovation Costs (€k)



Source: LCP Delta model

Renovation costs apply to the share of the building stock constructed before 1990 and requiring heat pumps.

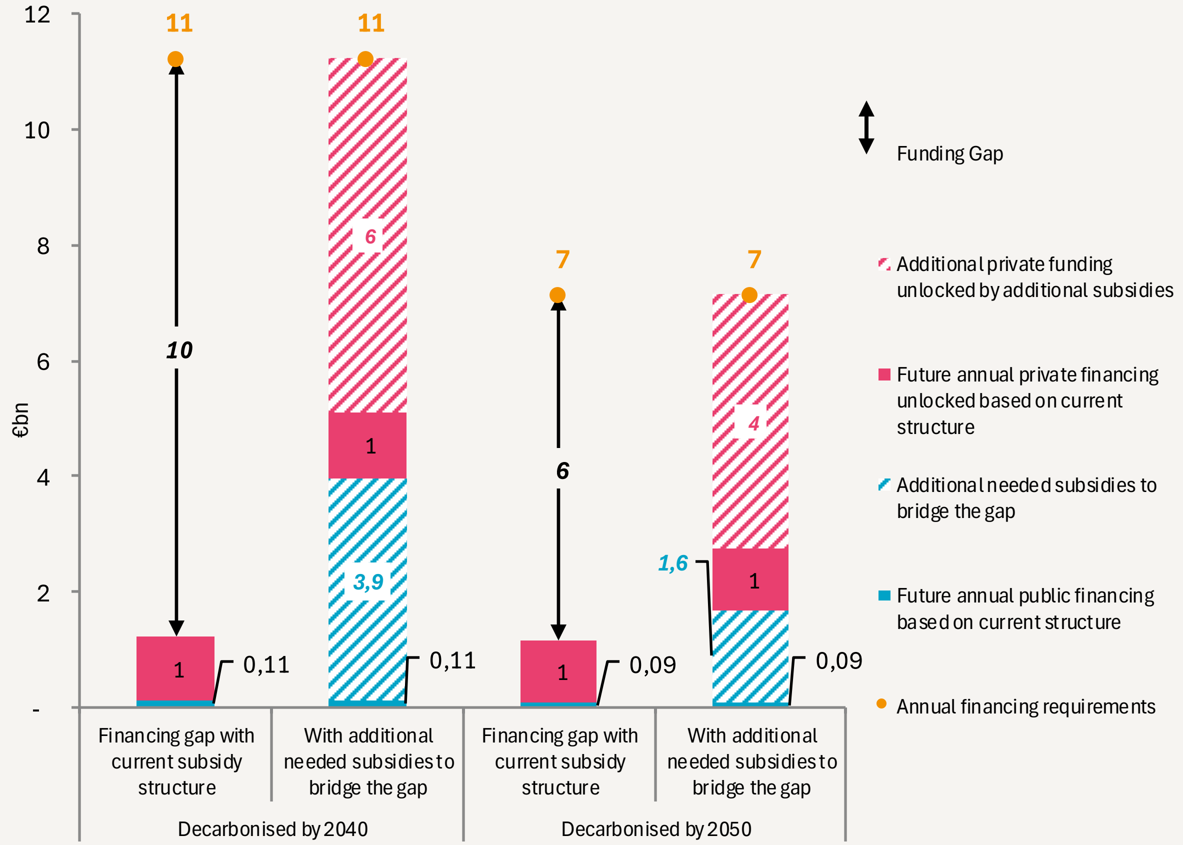
Poland – Financing decarbonisation of residential H&C

€6 billion in annual investment needed to close the gap and decarbonise heating in Poland by 2050.

Poland currently invests only about one eleventh of the level needed to meet its 2050 targets, largely due to the weak economic case for electricity-based heating systems.

- **For 2050**, with an assessed financing capacity of only €1 billion, Poland falls furthest behind its required investment levels, with an additional €6 billion per year in combined public and private funding needed to close the gap. The potential for the private sector to provide the lion's share of this is strong, with €1.6bn of further public finance resulting in €4bn of private funds.
- **For 2040**, the shortfall is in stark contrast to the existing capacity, with €10bn extra needed on the existing €1bn. Again, the private sector is capable of providing the largest share of this, with €6bn unlocked by €3.9bn of further public financing.
- Poland had one of the largest levels of **fossil fuel subsidies** in 2023, at €15.7bn. It would need only ~10% of these to be redirected to meet the additional €1.6bn public finance modelled to achieve the 2050 decarbonisation scenario. Even the lower fossil fuel subsidy from 2015 of €1.9bn would be sufficient for 2050.
- The next pages look at existing policies and consider further recommendations that could be used by Poland to channel the finance to households to install clean H&C systems.

Chart 51: Current Annual Financing Capacity vs. Required Annual Financing Capacity per Scenario in Poland (€bn)



Source: LCP Delta model

Poland - Selection of policies

Poland's clean-heat transition is powered by a large-scale household retrofit grant, and renewable district-heating conversions, yet momentum is weakened by stop-start rule changes and electricity-price uncertainty.

Table 16

Policy	Summary	Timeline	Amount	Positive	Negative
Clean Air Program	Non-refundable subsidies are available for comprehensive thermal upgrades of buildings and for replacing outdated solid fuel heating systems with modern, high-efficiency alternatives.	2018 - 2029	Up to PLN 136,200* (€32,000)	• Huge budget (€22B) and long horizon	• 2024 pause and frequent rule tweaks continue to dent market confidence
My Heat	Subsidies of up to 30% or 45% of eligible costs, are available for the purchase and installation of heat pumps in new single-family homes. This subsidy is supported by the European Funds for Infrastructure, Climate and Environment (FENIKS), under the 2021-2027 multiannual financial framework.	2022 - 2027	Up to PLN 21,000 (€5,000)	• Grants for HPs in new homes up to PLN 21 k • Multi-year budget gives predictability	• Strictly new-build, doesn't speed coal/biomass phase-out in existing stock • Grant covers limited share of total HP cost
Energy efficiency obligation scheme (White certificates)	The programme requires energy efficiency improvements in all sectors, focusing on electricity, gas, and district heating. Eligible actions cover building insulation, heating systems, appliances, lighting, and waste heat recovery.	2013 - ongoing	N/A	• Market-based mechanism with tradable certificates • Covers wide range of measures	• High transaction costs and complexity deter SMEs • Certificate price volatility complicates compliance and project finance
Renewable energy sources – heat source for heating (źródło ciepła dla ciepłownictwa)	Loans of up to PLN 1.43 billion and grants of up to PLN 570 million are available to support renewable heat production projects. Eligible investments include building or upgrading heat sources with a minimum capacity of 2 MWth and may also cover network connections and energy storage integration.	2021 - 2030	Grants of up to PLN 570 million (€130M)	• Targets heat pumps, solar thermal, geothermal • ≥ 70 % heat to public network ensures impact	• Size threshold excludes building-scale clusters
Thermal modernization bonus and grant (ulga termomodernizacyjna)	A thermal modernization bonus is available to owners or managers of residential buildings, public facilities, collective housing, and local heating systems to support energy upgrades. The bonus covers 26% of project costs, increasing to 31% if combined with a renewable energy component.	1999 - ongoing	Up to 31% of project costs	• Clear subsidy rates • Works for single- and multi-family plus public buildings	• Only repays a small part of loans. Projects financed from own funds are ineligible • Heavy documentation; stacking with other aid can be complex

*Strategic assumption, as the Program currently relies on patchwork funding and its budget through 2029 remains uncertain.

Poland - Recommendations

1
Enable all energy and income poor households, to obtain public funding without own contribution.

In March 2025, Poland reformed the Clean Air Programme to provide higher grants for low-income households, but many energy-poor families, particularly in dense urban areas, remain ineligible for full support due to restrictive technical and income thresholds. Expanding eligibility to ensure all genuinely energy-poor households can access full funding without any personal financial contribution, would remove key participation barriers and accelerate the roll-out of clean heating. This must be paired with stronger oversight and adviser support, as these households are especially vulnerable to dishonest installers.

2
Amend the Construction Law to obligate connection of eligible new and renovated buildings to district heating networks.

In 2020 Poland introduced a legal obligation requiring investors to confirm whether a new building can be connected to district heating if technical and economic conditions allow. This is part of the building permit process. However, this requirement does not extend to buildings undergoing major renovations, leaving a significant policy gap.

3
Establish a coordinated investment strategy for next-generation district heating

Modern district heating systems require integrated investments across the value chain. This includes deeper building retrofits to enable low-temperature supply, distributed heat sources, and upgrades to system components such as oversized or unregulated heat exchangers and radiators. Adapting system parameters and managing consumer expectations around delivered temperatures are also critical. Lowering network temperatures is essential to enable integration with low-carbon technologies like heat pumps and thermal storage while retaining conventional backup capacity for peak winter demand.

4
Narrowing the technologies under the Clean Air Programme to renewables.

The reduction in available technologies under the Clean Air Programme, excluding biomass boiler from support would remove the possibility to continue using fuels that are not suitable for the transition.

With these types of public sector developments in place, this will unlock the private finance needed to fill the financing gap. The next page looks at how the private sector can play its role in providing households with solutions for more affordable clean H&C.

Recommendation 1 is based on [Clean heat 2030 | Strategy for heating - Forum Energii](#)

Poland – Private sector's role in provision of finance

As per the model, the private sector needs to provide an additional €4bn per year to fulfil its role in filling the 2050 funding gap. To succeed in this will require two elements to be achieved, 1) companies need to have access to the finance and 2) households need to be able to access the funds from the companies. Outlined below are examples of how both of these elements can be achieved.

Element 1: High potential for companies to raise finance*

Polish companies are developing an increasing presence in the green bond market, with companies in the sectors that will be involved in the H&C transition, raising €5.3bn from investors since 2019. Whilst this is at the lower end of the countries in this study, the market now has a proof of concept, from which companies and investors can gain confidence, combined with the reinvestment of profits and funding raised from equity issuance. Here, we provide a few examples of types of business that, in combination with the public policy recommendations on page 73, can drive the financing to decarbonise residential H&C in Poland:

- **PKO and Bank Polska,** with a combined market share of ~30% have raised €1.7bn from green bonds. This type of future issuance could accelerate cleaning the residential H&C sector by providing their customer base with affordable, efficient finance.
- **Ghelamco,** a European property business, has a number of different types of property within Poland, including residential. The €143m it raised from green bond investors highlights the potential for companies to source the private funding required for a clean H&C sector.
- **Polenergia**, the private energy group, that provides energy through its wind and solar farms, has raised €200m in green bonds, illustrating the potential for transition focused businesses to raise finance.
- **7R SA**, the Polish warehouse business, has raised over €30m in green bonds to fund the decarbonisation of its portfolio of warehouses. 7R's success in the market shows the demand is there for property businesses in Poland to raise the monies required to decarbonisation the sector.

Element 2: Growing number of finance options for households

Example 1

- **Bank Pekao,** one Poland's largest bank, provides a European Funds for the Modern Economy ecological loan (*Fundusze Europejskie dla Nowoczesnej Gospodarki*), which can be used on the modernisation of buildings and structures.
- The loan is available to medium size businesses and could be a component of the finance required for companies involved in decarbonising existing district heating and building out new district heating.
- The loan can be combined with a number of different subsidies, such as the *Krajowy Plan Odbudowy*, to cover up to 80% of eligible costs.

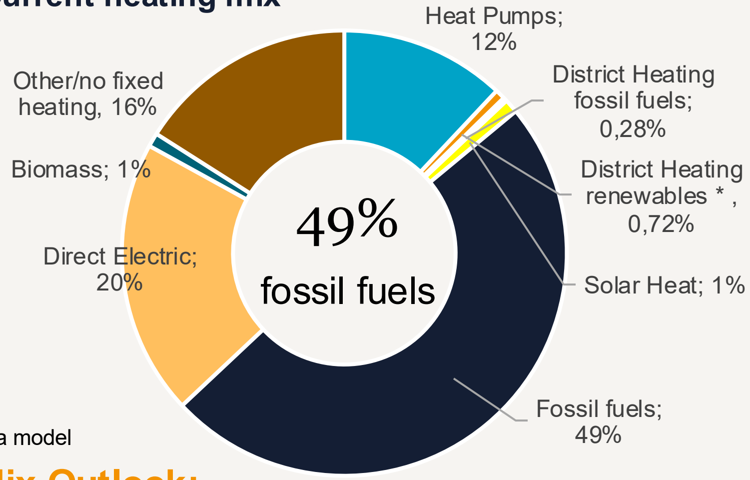
Example 2

- **BOS Bank** offers ecological mortgages, that can finance the renovation of the property to include clean H&C, with attractive interest rates up to 0.5% lower than its standard mortgages.
- The product has a range of interest rates available and a term of up to 35 years.
- The loan is available for single or multi-family houses, which need to meet conditions on the ecological status of the home such as whether it has been designed in accordance with certificates such as LEED or BREEAM.

*For clarity, the figures provided are historic raisings and will have been used for various elements of the transition, not exclusively on H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition

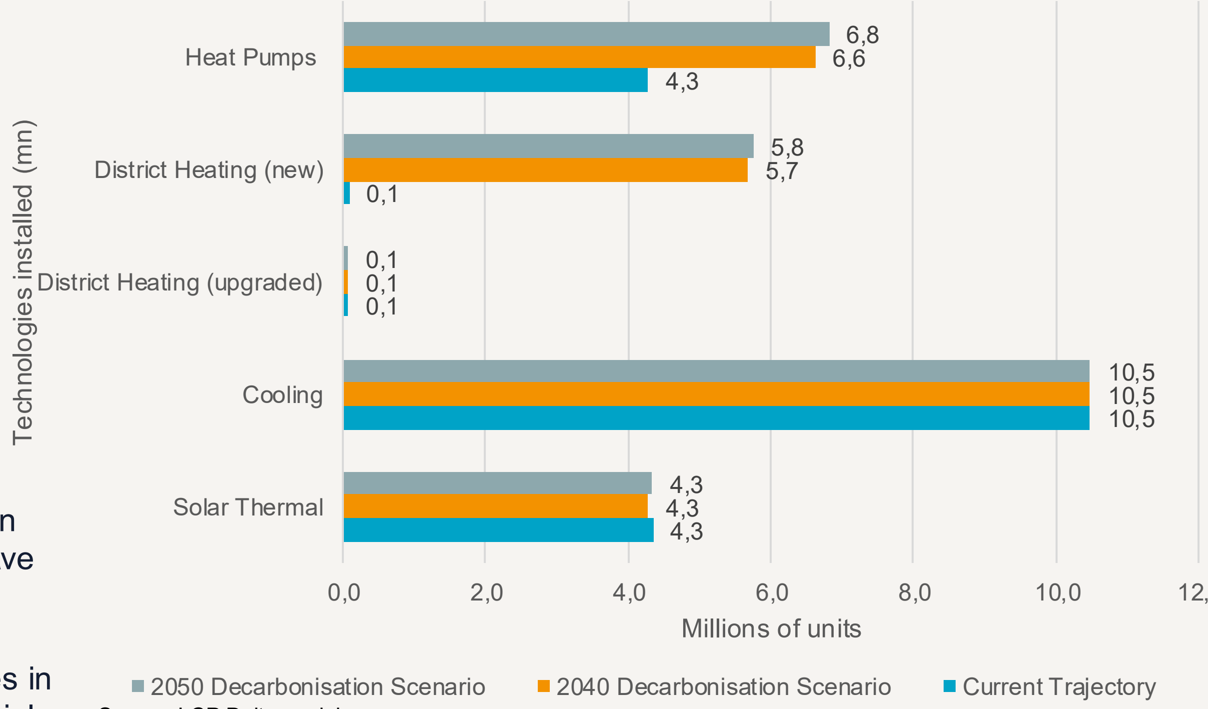
Spain – technologies needed for decarbonising residential H&C

Chart 52: Current heating mix



Source: LCP Delta model

Chart 53: Number of new individual installations under the three scenarios



Source: LCP Delta model

Heating Mix Outlook:

Although Spain is starting from a relatively strong starting point of having less than half of its heating from fossil fuels, unless the transition gathers pace it will still have over a third of heating from fossil fuels in 2050.

- Heat pumps can be an effective heating solution for over half of the residences in Spain, with a mid single digit annual growth rate required to realise this potential.
- District heating has the potential to provide heat to 20% of households and needs a strong growth rate to achieve this.
- The climate of Spain is well suited to solar thermal growing strongly in the coming decades, but the technology does need to be paired with other technologies, which has cost implications.
- Whilst all MS analysed are expected to see increasing demand for cooling equipment as the climate changes, Spain is expected to see amongst the largest growth in the EU.

*includes biomass

Table 17: Compound annual growth rate (CAGR) required for each technology

	Heat Pump	District Heating	Solar Thermal
Current Trajectory	3.4%	1%	10.8%
Decarbonised by 2040	7.7%	22.9%	18.5%
Decarbonised by 2050	4.6%	13.2%	10.8%

Source: LCP Delta model

Spain – Cost of decarbonising residential H&C

Achieving a decarbonised heating system in Spain by 2050 will demand €212 billion (NPV €121bn), or roughly €8 billion per year.

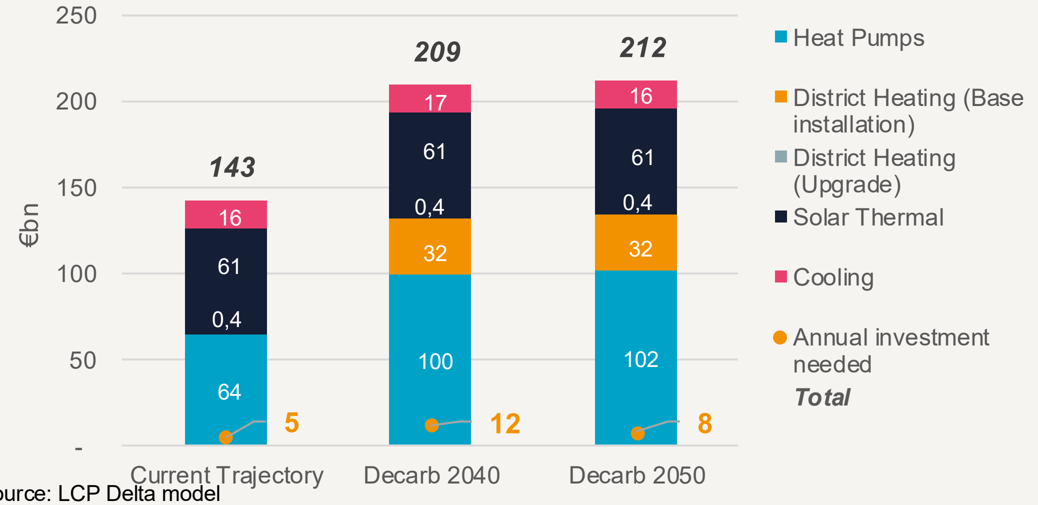
Spain has the highest share of solar thermal energy among all the MS studied, thanks to high solar exposure, accounting for ~30% of the costs under the 2050 scenario.

- Despite a strong potential, dense urban living conditions do pose a constraint on the roll-out of heat pumps in Spain. ~ 70% of Spaniards live in apartment buildings, where limited space often restricts the installation of conventional HPs. On top of this, some autonomous communities prohibit placing outdoor heat pump units on balconies, further complicating deployment.
- It is worth highlighting that even if the transition was not required, replacing gas boilers that would break between now and 2050 would cost €79bn (NPV €57bn).

Although long-term electricity price trends are positive, the spark gap still gives gas a competitive advantage.

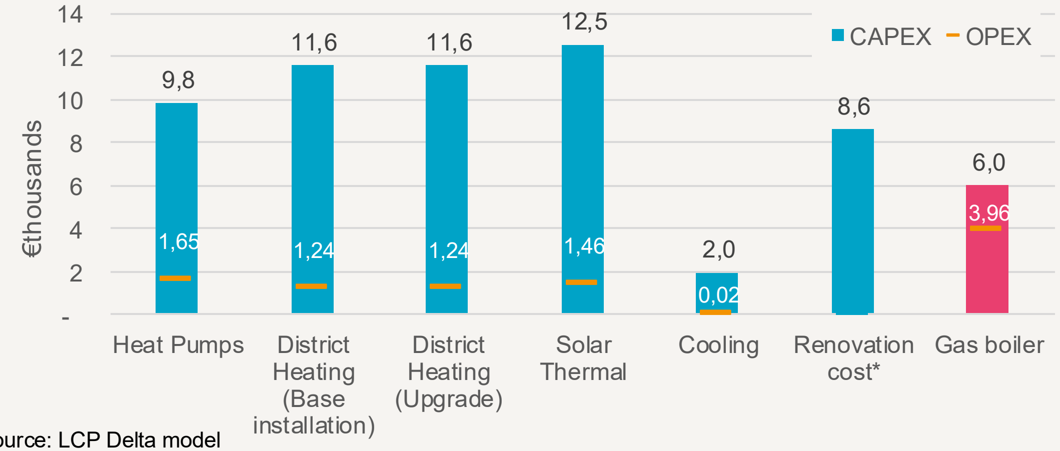
- Spain's growing share of renewables in the electricity mix is strengthening security of supply and reducing dependence on energy imports. Over time, this shift should help stabilise or lower electricity prices, which will favour renewable heating systems.
- The combination of high upfront investment costs and high electricity prices means that the savings from lower running costs do not fully offset the initial capital expenditure by 2050. They do however lower the NPV to €69bn.

Chart 54: Total and Annual Investment Costs by Scenario and Technology (€bn)



Source: LCP Delta model

Chart 55: CAPEX and Annual OPEX by Technology, Including Renovation Costs (€k)



Source: LCP Delta model

Renovation costs apply to the share of the building stock constructed before 1990 and requiring heat pumps.

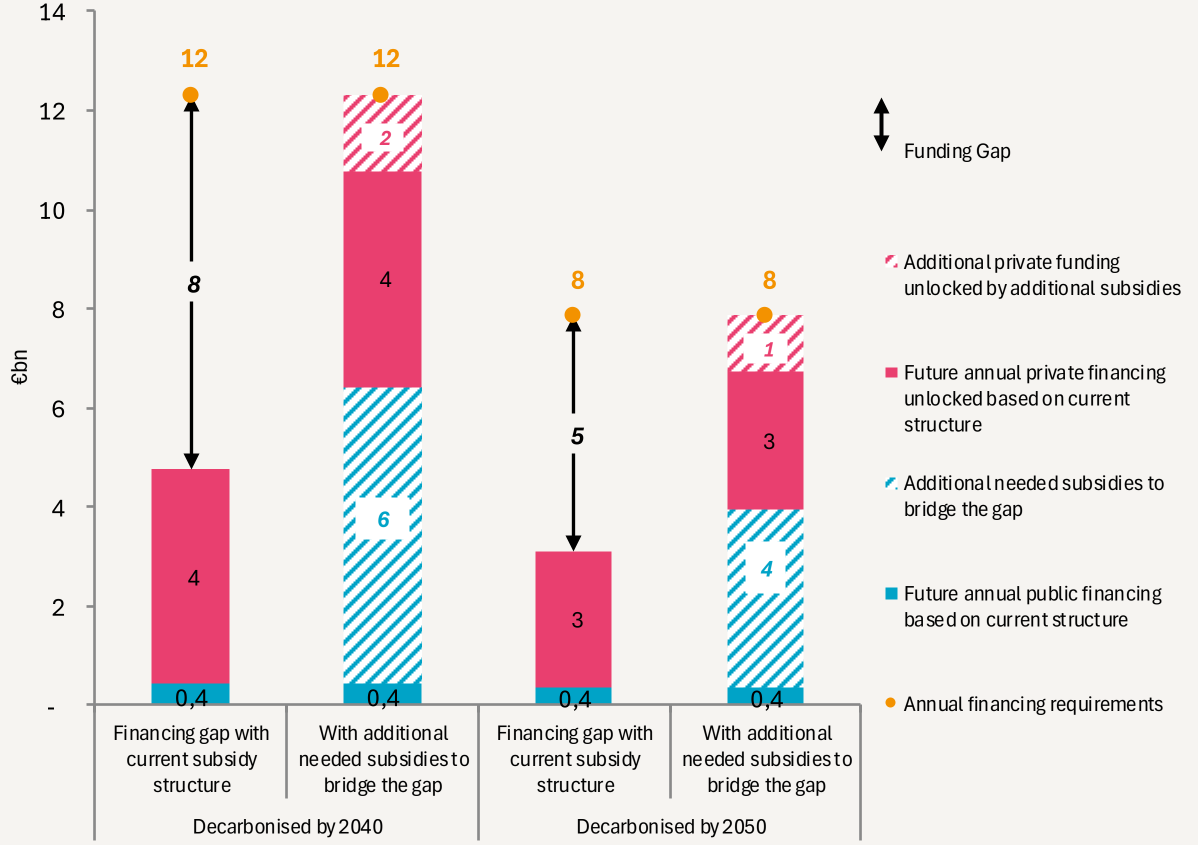
Spain – Financing decarbonisation of residential H&C

€5 billion in annual investment needed to close the gap and decarbonise heating in Spain by 2050.

Spain is currently not on track to finance its H&C cooling transition to 2050, as approximately only a third of annual investment needs are being met.

- For the **2050 scenario**, €3.4bn of finance is achievable given the current structure, which falls €5bn short of the figure that is needed to meet the target. Public finance needs to increase by €4bn in order to unlock the €1bn of private finance that can fill the gap.
- With the current subsidy structure, Spain is capable of financing €4.4 billion out of the €12 billion required annually for the **2040 decarbonised scenario**. Of this, 90% comes from the private sector, amounting to around €4 billion each year. To help close the funding gap, a public financing increase of €6bn is needed.
- Spain's annual **fossil fuel subsidies** of €6.4bn in 2023 would be sufficient to fund the public financing required to close the gap, both for the 2050 scenario and also the 2040 scenario. The 2015 lower level cited in chart 12 of €4.7bn would more than cover the additional public funding needs for the 2050 scenario.
- The next pages look at existing policies and consider further recommendations that could be used by Spain to channel the finance to households to install clean H&C systems.

Chart 56: Current Annual Financing Capacity vs. Required Annual Financing Capacity per Scenario in Spain (€bn)



Source: LCP Delta model

Spain - Selection of policies

Spain's heat-transition is based on a freshly launched white-certificate market and EU-funded programmes onto crisis-era energy-security measures, yet uptake is slowed by regional fragmentation and modest protection for the most vulnerable.

Table 18

Policy	Summary	Timeline	Amount	Positive	Negative
Energy efficiency obligation scheme (White certificates)	The Energy Efficiency Certificate System, implemented by the Royal Decree 36/2023, mandates energy efficiency improvements across all sectors, requiring obligated parties (companies) to carry out validated actions that deliver measurable final energy savings in kWh per year.	2023 - ongoing	N/A	• Market-based mechanism aligned with EU EED, first auctions opened 2023–24 • Covers all fuels and sectors	• New market: low liquidity & price volatility • Regional energy agencies flag limited staff to validate projects on time
Program to enhance energy efficiency and sustainability	Grants are available for energy efficiency and sustainability upgrades in single-family homes and multi-unit residential buildings.	2022 - 2025	N/A	• Rural strand (PREE 5000) targets towns < 5 000 inhabitants, tackling depopulation & energy poverty	• Co-financing still high for low-income owners • Long payment lags reported
Thermal renovation of buildings for municipalities	The Energy Rehabilitation Program provides funding for energy upgrades in existing buildings located in municipalities with up to 5,000 residents. The programme supports energy efficiency and renewable energy adoption in areas facing demographic challenges.	2019 - 2024	N/A	• Fund up to 100 % of municipal building retrofits, incl. RES HVAC	• Limited technical assistance means many municipalities skip applications
Household Heating Subsidy (Bono Social Térmico)	The Bono Social Térmico provides annual financial aid of €35 to €373 to vulnerable households for heating and hot water.	2018 - ongoing	Up to €373	• Automatic annual payment to all electricity-social-tariff holders • Climate-zone weighting	• Excludes households without an electricity contract (e.g., bottled-gas users)
More Energy Security Plan (+SE)	The More Energy Security Plan (+SE), launched in 2022, aims to cut gas use by 5.1%-13.5%, promote renewable energy, and enhance efficiency. It includes 73 measures, tax cuts, and financial aid for vulnerable households.	2022 - ongoing	N/A	• Strengthens protection for vulnerable consumers • Rapid impact public-sector actions (temperature limits, building efficiency plan)	• Limited dedicated budget for building-sector decarbonisation
Royal Decree 114/2021	Royal Decree 114/2021 allocated up to €500 million in grants for low carbon heating in industries, agriculture, and public infrastructure, supporting technologies like heat pumps, biomass, and solar thermal systems. It was stopped in 2023.	ended	Unknown	• Broad accessibility • Allocated funds via regions, allowing tailored implementation	• Lacked targeted guarantees for low-income

Spain - Recommendations

1

Cut electricity VAT to 5% for heat-pump households to close the electricity–gas price gap and boost heat-pump economics.

As of January 1, 2025, Spain applies the full 21% standard VAT rate to household electricity bills. Although VAT for heat-pump equipment may be reduced to 10% under some conditions, electricity VAT remains high, weakening the economic case for heat pumps. Cutting electricity VAT to 5% for heat-pump users, consistent with EU legislation that enables minimum 5% VAT rates for green energy solutions, would narrow the spark-gap between heat pumps and gas boilers.

2

Address regulatory barriers limiting heat pump deployment on building façades.

In Madrid, the Urban Development Plan caps the projection of HVAC equipment on façades at 30cm, measured perpendicular to the façade plane, meaning that no part of the unit may stick out more than 30cm beyond the façade. Visible systems also require an architectural integration study. Together, these provisions hinder wider heat-pump adoption in Spain.

3

Require all major renovations in district-heating priority zones to include low-temperature heat distribution and pre-piping for future network connection.

Spain's major renovation subsidies, including PREE 5000, should require buildings in district-heating priority zones to be "DH-ready", with low-temperature heat distribution and pre-piping or space for a heat-exchanger. This low-cost measure during renovation would future-proof buildings, reduce future connection costs by up to 70 %, and strengthen the viability of renewable and waste-heat district-heating projects.

4

Reintroduce and upscale the Royal Decree 1124/2021-style subsidy scheme.

Reintroduce and upscale the Royal Decree 1124/2021-style subsidy scheme with a larger annual funding (> €150M) , providing grants for renewable thermal installations, particularly for low-income and public recipients, to ensure continuity, and alignment with clean heating transition targets.

With these types of public sector developments in place, this will unlock the private finance needed to fill the financing gap. The next page looks at how the private sector can play its role in providing households with solutions for more affordable clean H&C.

Spain – Private sector's role in provision of finance

As per the model, the private sector needs to provide an additional €1bn per year to fulfil its role in filling the 2050 funding gap. To succeed in this will require two elements to be achieved, 1) companies need to have access to the finance and 2) households need to be able to access the funds from the companies. Outlined below are examples of how both of these elements can be achieved.

Element 1: High potential for companies to raise finance*

Spain is host to some of the largest utilities and banks in the world, as a result it has a well-developed green bond market, with companies in sectors that will drive the H&C transition, raising €70bn from investors since 2014. Given the scale of this demand from investors and the annual €1bn required from the private sector to close the finance gap and achieve the 2050 target, the strength of the private sector's finances is clear. Here, we provide a few examples of types of business that, in combination with the public policy recommendations on page 79, can drive the financing to decarbonise the residential H&C in Spain:

- **Acciona**, amongst its business lines, includes residential real estate with a focus on sustainable projects. Having already raised €2bn in green bonds, it has evidenced the demand from investors and the potential for it to be one of the private sector's solutions to the clean residential H&C system.
- **Santander**, **Caixa** and **BBVA**, as Spain's three largest banks, have a combined market share of 72%. Between them, they have raised over €16bn in green bond finance. As Spain moves towards a clean residential H&C sector, these three banks can use their access to finance and market share to drive this transition.
- **Iberdrola**, one of the global leading energy utilities, has issued over €12bn in green bonds, this size of access makes it one of the key enablers of decarbonising residential H&C in Spain.
- **Redeia**, the transmission network has raised nearly €3bn to develop the electrical network in Spain, the upgrading of this will be crucial to the H&C transition and Redeia has shown its ability to fund the transition.

Element 2: Growing number of finance options for households

Households can now access a wider variety of financing solutions.

Example 1

- **Banco Santander** has a turnkey energy efficiency service, including H&C systems, for homes. The service includes a simulator for the efficiency improvements that can be made on the home, which provides estimates for the renovations required and grants available.
- Santander works with Iberdrola, Effic and Reformanerr to provide detailed quotes, with these providers managing the subsidies and grants.
- Santander then provides the loan for the remaining finance at a fixed rate of 4% over seven years, including a grace period of 12 months.

Example 2

- **Ibercaja's** Vivienda + Sostenible loan products enable households to finance the installation of boiler replacements with heat pumps and solar thermal.
- A deposit is not required, with the finance available to fund 100% of the project. The loan can be used for primary and second homes.
- The typical loan has an interest rate of 4.9% and can be taken for up to 8 years.
- Ibercaja highlight the agility and simplicity that it is able to offer with its processing. As has been stated throughout this study, this simplicity is vital to the speed of the transition.

*For clarity, the figures provided are historic raisings and will have been used for various elements of the transition, not exclusively on H&C. The purpose of the figures is to show the significant ability that exists to raise the sums required for the H&C transition

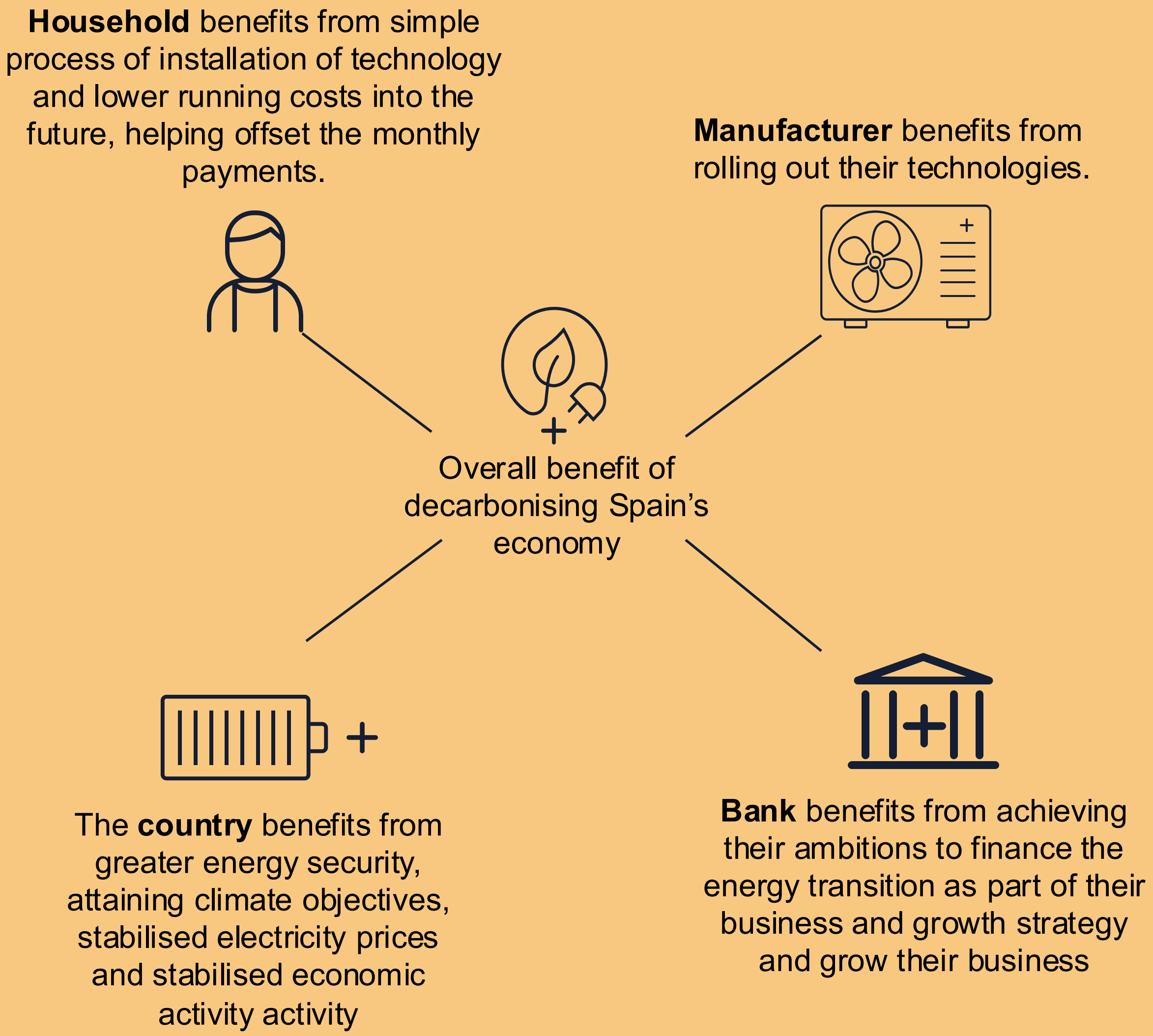
Case Study – Partnerships within the private sector

Private sector combination

In Spain, Vaillant and Caixabank have partnered to provide a straightforward journey for the household looking to install a heat pump:

- The household can either use their own installer or arrange it through Vaillant.
- Whichever installer is chosen, will then guide the household through the whole process of the installation and the financing.
- The financing can be taken from 1 year through to 10 years, with an interest rate of 5.06%. This compares favourably to finance available for non-eco products such as petrol cars with a ~9% interest rate.
- This partnership with Vailliant is part of Caixabank's wider ambitions to help drive the overall transition.
- Between 2022-24, Caixabank put over €70bn towards the energy transition, including clean H&C, and has set an even higher ambition for the period of 2025-27 of €100bn.
- Caixabank has specified decarbonising residential real estate as one of the focuses of its strategy.

Benefits for the whole economy



Conclusion

- Clean H&C transition will result in savings
- Finance chain needs to be strengthened to achieve success
- Summary of finance levels required and policy recommendations to achieve success

Monetary savings are the ultimate outcome of transitioning to clean H&C

To achieve the savings though, substantial upfront costs are required. With effective policies in place the financing of upfront costs can be easily achieved.

1) Households could see savings and a cheaper future

- The study finds that by 2050, households in five of the seven Member States (MS) analysed will save money from transitioning to clean residential H&C. Households in the remaining two MS will save money if the right policies are put in place.
- The monetary savings result from the lower running costs of clean technologies, because of the energy efficiency of technologies such as heat pumps.

2) But households require support in the present

- To capture the ultimate savings from lower running costs, the sizeable upfront costs of installing the equipment needs to be funded.
- Currently, partly due to the incomplete pricing of the externalities of air pollution, health costs and climate change impacts, upfront costs of clean technologies can be twice as much as the incumbent technology. Consequently, households need support to transition their H&C systems, to be able to enjoy the lower running costs.

3) Support can come from the public and private sectors

- Public policy can provide support to households through a number of instruments, including subsidies, grants, tax incentives, guarantees to provide lower interest rate costs, and adjustments to the pricing mechanisms to reduce electricity prices.
- The private sector can support households by providing affordable finance solutions that remove the upfront cost and replace it with manageable and consumer-friendly monthly payments.

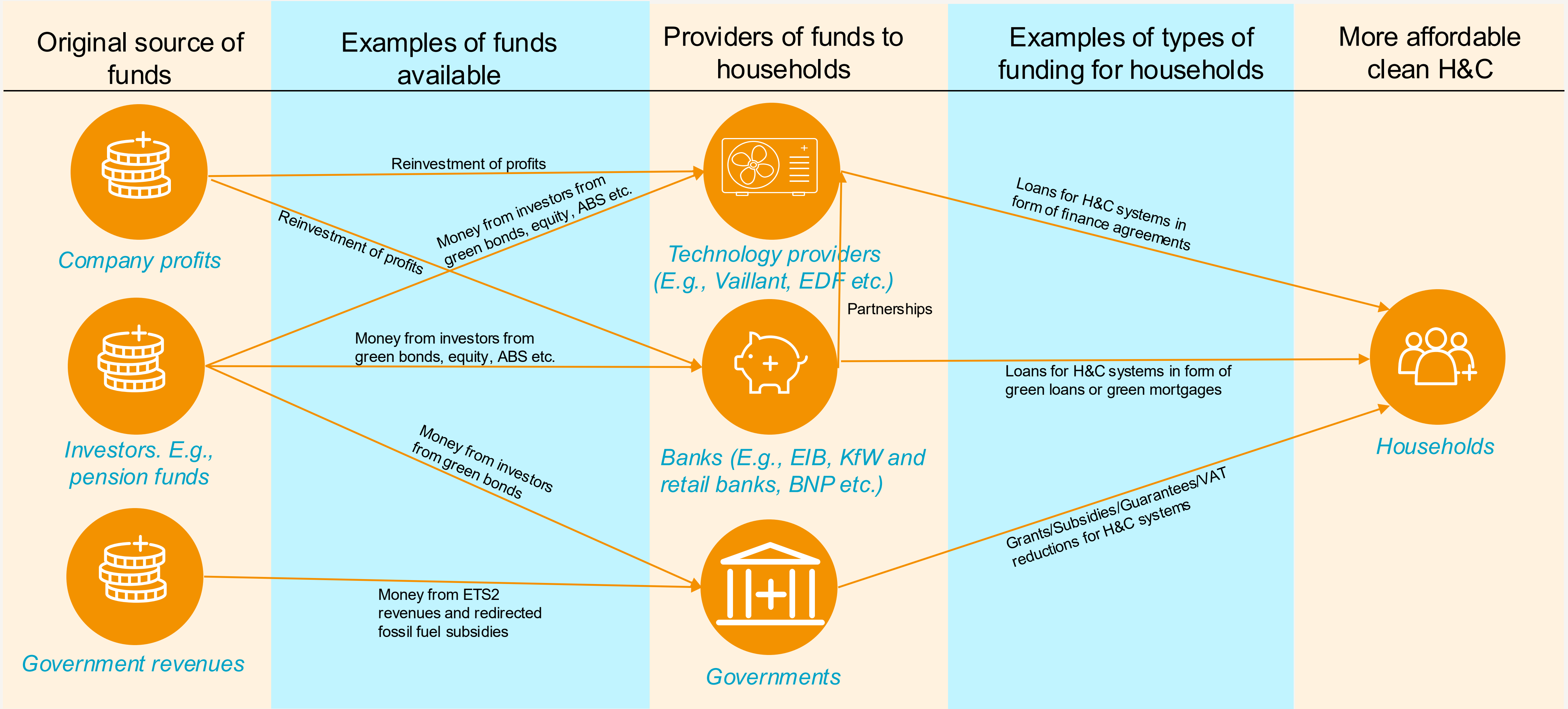
4) Required finance for the support is available

- Finance to fund public policy can be sourced through a mixture of redirecting existing fossil fuel subsidies and mechanisms such as the Emissions Trading System 2 (ETS2).
- Finance to enable the private sector to provide households with attractive finance offerings can be sourced through a mixture of the reinvestment of profits and equity raising.
- Finance for both public and private sectors can be raised from the global bond market in the form of green bonds.

Finance chain to close financing gap

The various players and instruments required to provide affordable financing to households already exist. Effective policies will enable them to gather the necessary scale for households to transition to clean H&C.

Diagram 1: Finance chain to enable more affordable H&C systems for households



Summary of finance needed + policies to strengthen finance chain

LCPDelta

	Overall investment required (€)	Finance gap (€)	% share public/private to fill finance gap	Annual finance gap to fill (€)	Upfront NPV (€)	Net Upfront NPV (adjusting for boiler replacement costs that would happen anyway)	Total NPV (once lower running costs included)	Summary of policy recommendations
Czechia	€50bn	€40bn	61% / 39%	€1.5bn	€29bn	€20bn	€5bn savings	• Monitor 2025 simplifications for effectiveness • Long term policies to support clean district H&C • Build a financing platform • Cut VAT to close spark gap
France	€329bn	€160bn	37% / 63%	€6.6bn	€188bn	€115bn	€178bn savings	• Consistency of policy following recent pause • Combine private-sector best practices with regulation • Cut VAT to close spark gap
Germany	€665bn	€360bn	73% / 27%	€13.2bn	€415bn	€274bn	€63bn cost	• Encourage efficiencies within the heat pump market • Monitor balance between tenant/landlord/homeowner • Close spark gap by reallocating subsidies • Lower VAT on clean technologies
Italy	€350bn	€174bn	46% / 54%	€6.5bn	€200bn	€114bn	€97bn savings	• Ensure policies have long term sustainability • Increase simplicity of support for households • Increase support for clean district H&C • Reintroduce the *cessione del credito*
The Netherlands	€105bn	€52bn	9% / 91%	€1.9bn	€61bn	€31bn	€87bn savings	• Reintroduce upgrades as mandatory heat pump adoption • Dedicate finance to a Clean Heat Transition Fund • Encourage efficiency within clean district H&C • Clean heat standards for rental properties
Poland	€192bn	€161bn	27% / 73%	€6bn	€111bn	€85bn	€136bn savings	• Enable full support for those on lower incomes • Construction law to increase clean district H&C • Investment strategy for next generation district H&C • Narrowing the technologies under Clean Air Program
Spain	€212bn	€128bn	76% / 24%	€4.7bn	€121bn	€64bn	€12bn cost	• Reduce regulatory barriers for heat pumps • Encourage efficiency within clean district H&C • Reintroduce *Real Decreto* • Cut VAT to close spark gap
EU	€3670bn	€2107bn	Not in scope of study	€78bn	€2112bn	€1331bn	€461bn cost	• Scale up support through 2028-34 MFF • Apply tripartite agreement to clean H&C • Reallocate fossil fuel subsidies

Table 1 Source: LCP Delta model

Appendices

Methodology, assumptions & sources

What approach does the study use to address the core research question?

To assess the financing gap, a three-step approach was developed:

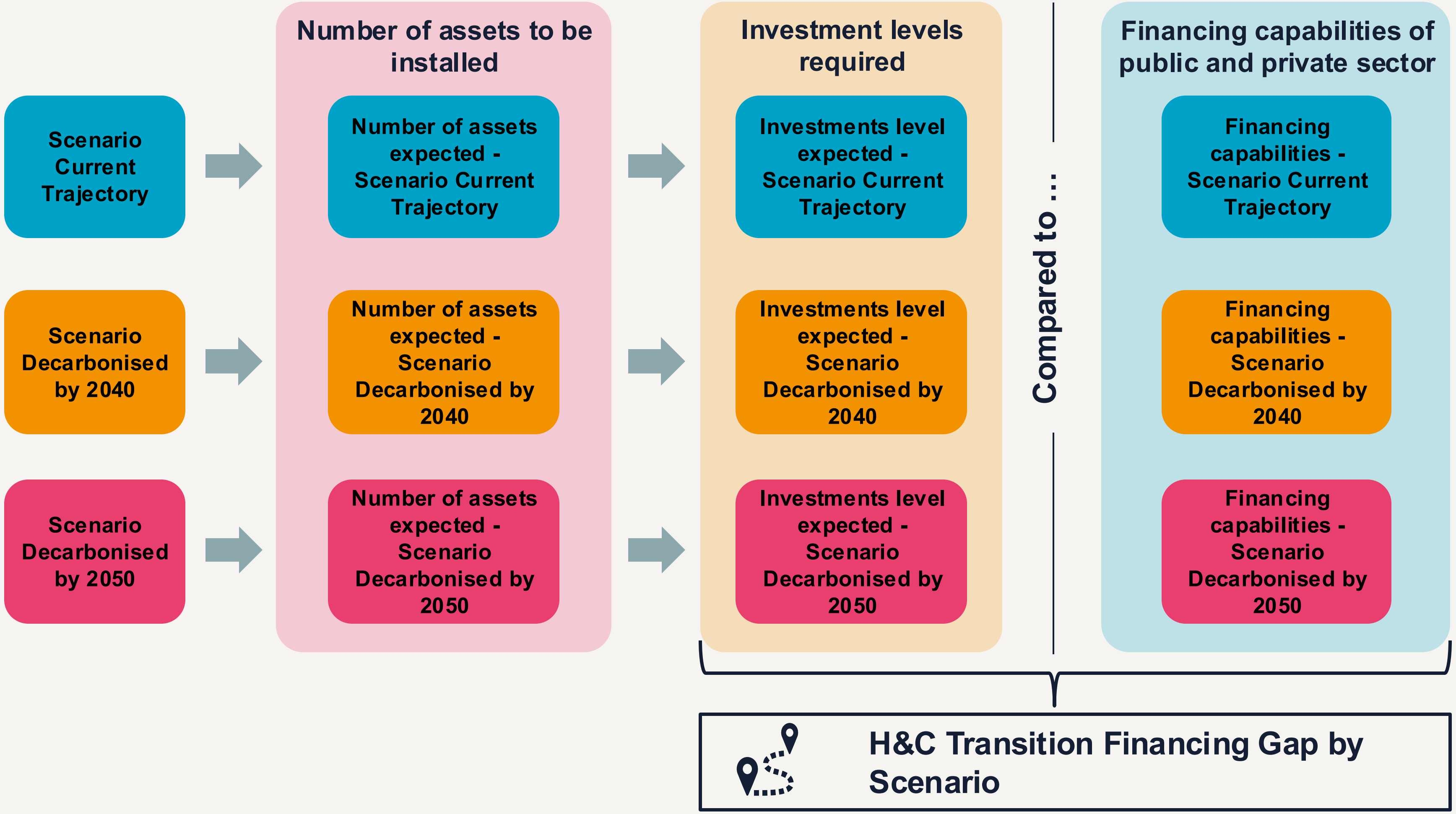
1. **Scenario-based asset rollout** – Using three scenarios, the number of H&C assets to be installed annually was calculated.

2. **Investment cost estimate** – Based on projected CAPEX trends, the annual investment needs were calculated for each scenario and EU MS.

3. **Financing capacity assessment** – The financing capabilities of both the public and private sectors were evaluated to allow for comparison with the investment needs.

The difference between projected investment needs and available financing, defines the financing gap.

Chart 57: Overall study approach



What approach does the study use to estimate asset installation needs?

Scope of the study

As part of the study, seven EU MS are analysed alongside an **EU-wide perspective**. The seven MS are **Czechia, France, Germany, Italy, Spain, the Netherlands, Poland.**

To assess installation needs, the study draws on renewable energy pathways and uses a simplified representation of national building stocks.

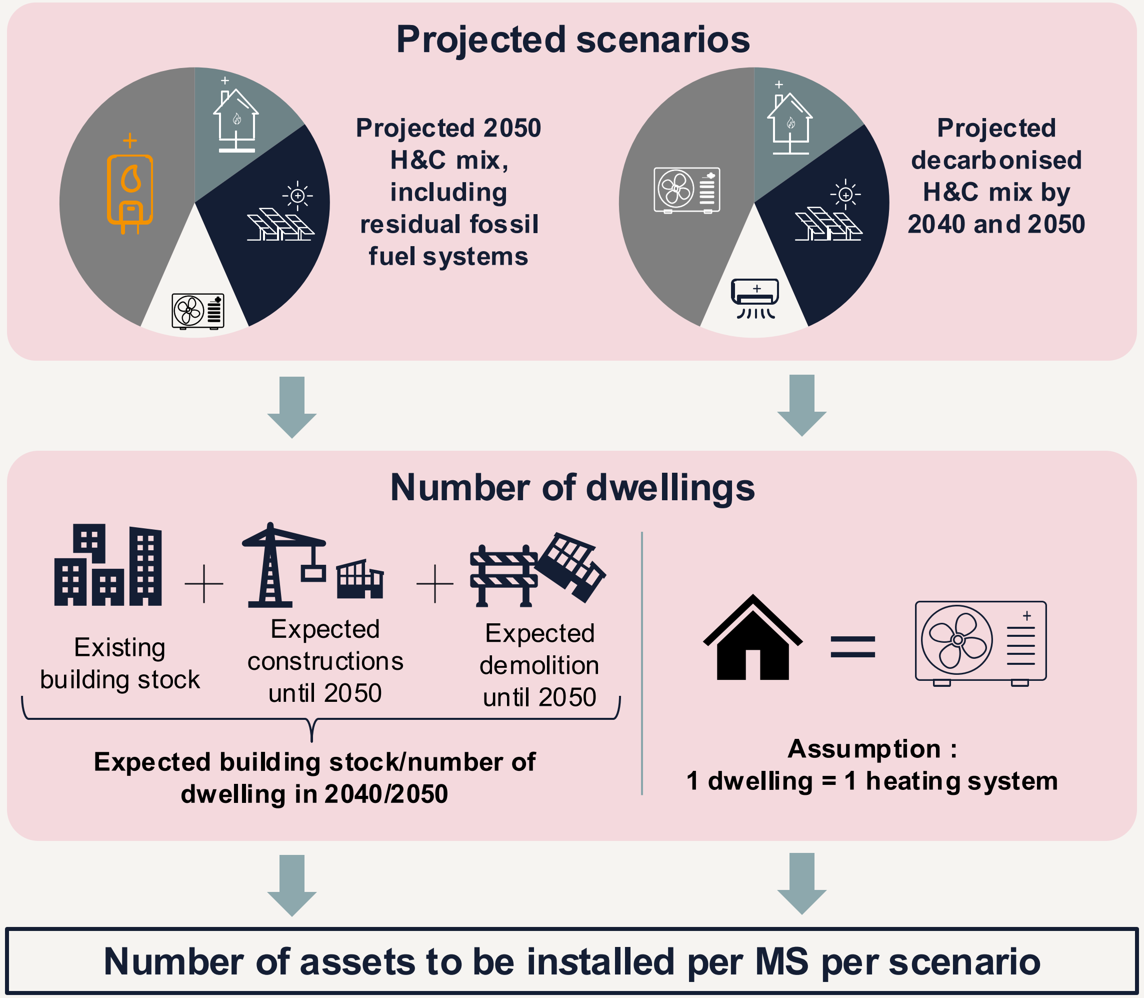
The renewable pathways are based on a 2023 report focused on decarbonising the residential and tertiary H&C sectors. These scenarios account for renewable energy availability, infrastructure, building performance, industrial structure, policies, and climate conditions at all territorial levels. The study treats the entire Clean-Energy Package, i.e. the revised Renewable Energy Directive, the Energy-Performance-of-Buildings Directive and the Governance Regulation, as “current policy”. **The original scenarios were adapted as needed for this study**, for instance, they specified energy carriers but not technologies (details in the appendix). This approach enabled the construction of a projected decarbonised H&C mix for 2050, which also serves as the basis for estimating the 2040 scenario.

The analysis focuses on **four technologies**: heat pumps, district heating (primarily powered by heat pumps through new installations and network upgrades*), solar thermal, and Precision Air Cooling (PAC) systems for cooling (more information in the technology overview section).

To calculate the number of assets required, the study applies a simplified building stock model for 2050, using a single representative figure for the number of dwellings.

This offers a high-level estimate of annual asset installations, based on a linear growth trajectory.

Chart 58: Approach to assess installation needs



*Although most current district heating systems are not powered by heat pumps, the study assumes heat pumps will be the primary technology adopted in future developments.

What approach is used to calculate transition costs under each scenario?

To estimate transition costs, the study calculates annual CAPEX by multiplying the unit cost of each technology by the number of assets to be installed each year.

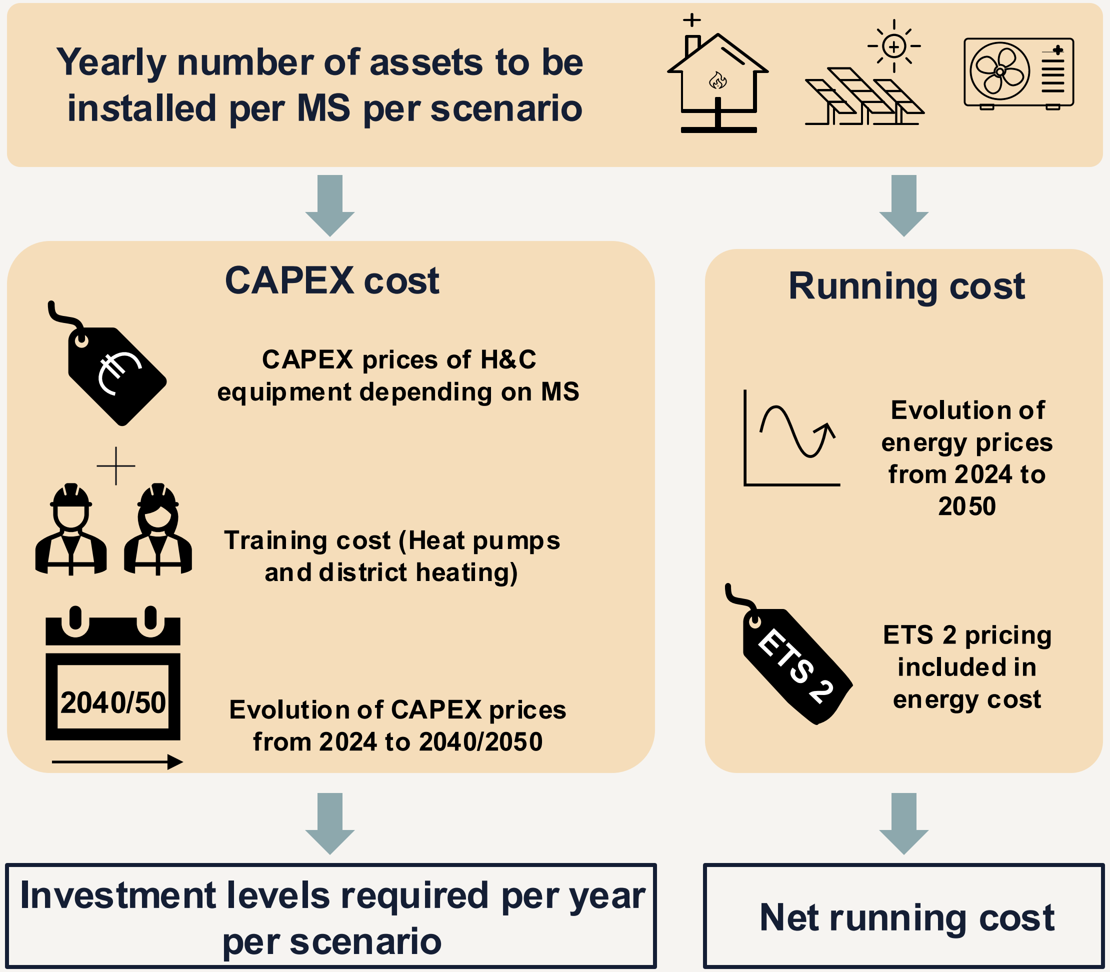
To reflect heat pump compatibility issues, renovation costs are included for buildings constructed before 1990, assuming upgrades are needed to enable efficient heat pump operation. These renovation costs are added to the CAPEX for heat pump installations in this segment of the building stock.

For solar thermal systems, the total cost includes both the solar installation and a complementary heat pump. Additionally, high-level training costs are factored in for heat pump and district heating technologies to account for workforce development needs.

Running costs are also calculated but not included in the financing part.

Running costs are also calculated but are not directly included in the assessment of required investment levels. Net running costs are estimated by comparing the operational expenses of each renewable heating technology to those of a standard gas boiler.

Chart 59: Approach to yearly investment cost



How does the study assess the financing capabilities of the private sector ?

For the assessment of current financing capabilities, households must pass an "affordability test" to be considered able to finance their H&C transition. This test is applied at the scenario level, for each MS, year, income decile, and technology.

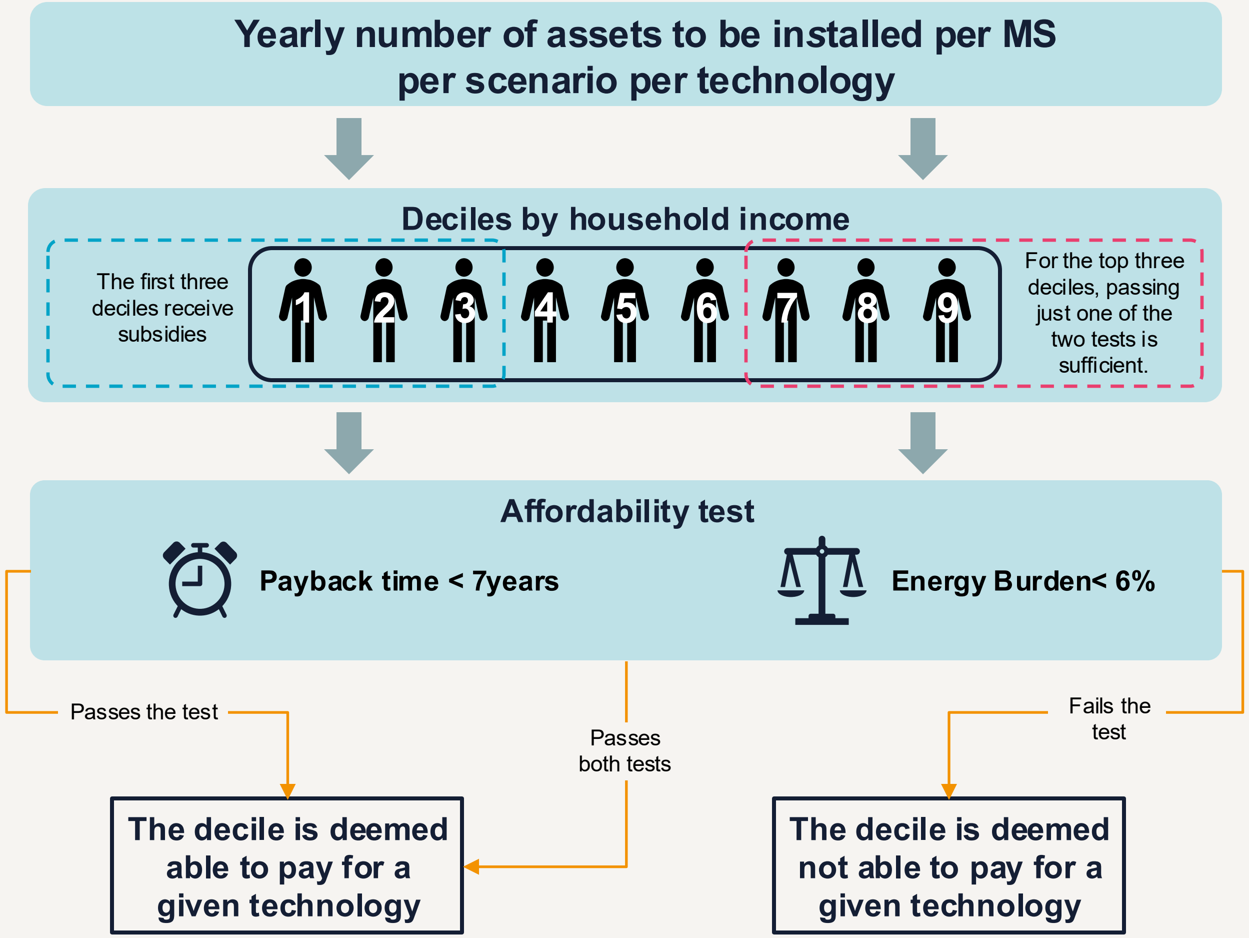
The affordability test has two criteria, and a household decile must meet both criteria to be considered able to invest, except for the top three deciles:

1. Payback period under 7 years
2. Energy burden below 6% of disposable income

Although each decile must pass both tests, the conditions and criteria to pass the affordability test vary by income group:

- For the first three deciles, subsidies are allocated to reduce the effective CAPEX, though this is modelled in a simplified way that does not fully replicate real-world subsidy schemes. They must meet both tests. As part of our model, the subsidies are modelled as an upfront subsidy that is given to the household. This subsidy reduces the total investment needed. It is this new amount that is considered for the "affordability test". The amount is equally divided between technologies.
- The middle deciles must meet both tests without subsidies, unless residual funding remains from fully covering the lower-income groups.
- For the top three deciles (highest incomes), passing just one of the two tests is sufficient, based on the assumption that these households are unlikely to receive public subsidies.

Chart 60: Approach to assess the financing capabilities of the private sector



How does the study estimate the financial gap and the role of subsidies in bridging it?

To estimate the additional support needed to bridge the gap, financing needs are calculated based on the amount each income decile needs to meet both affordability criteria. Meeting these criteria unlocks private financing.

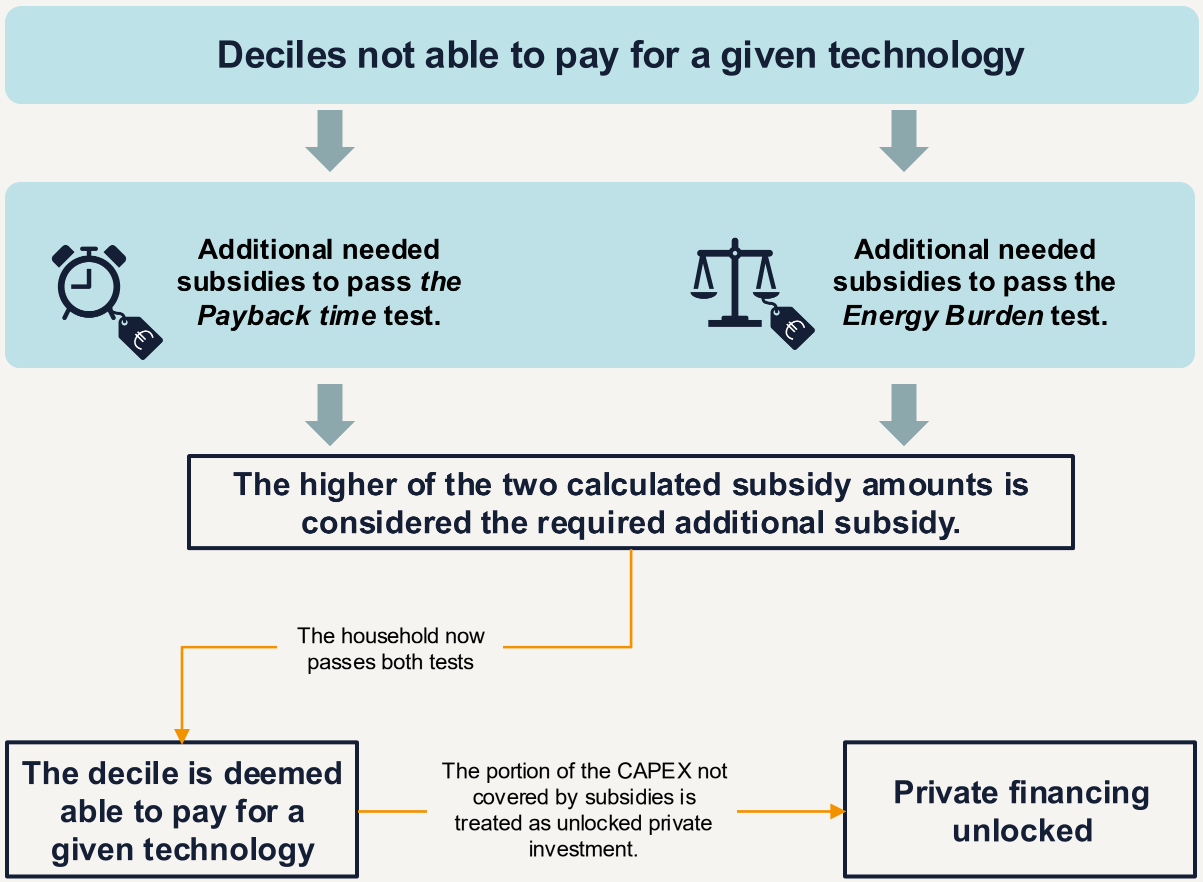
The required subsidies for each decile to pass both tests are determined and treated as the additional financing support needed.

Once a decile meets these thresholds, it is assumed that households can cover the remaining CAPEX themselves, this is considered "unlocked" private investment.

This approach enables the study to estimate the level of public subsidies needed to close the overall financing gap.

The model does assume that households' willingness to pay and that, once there is no longer any financial barrier to pursue the investment, the demand will be met.

Chart 61: Approach to assess the additional subsidies needed to bridge the gap



Assumptions & Sources – (1/5)

Section of the analysis	Assumptions	Sources (when applicable)
General	Prices are expressed in 2025 current values, with no adjustment for inflation.	
General	The cost associated with the potential upgrade of the grid due to the increasing electrification of residential heating has not been considered in this study.	
General	To calculate the annual averages from 2024 to 2050, we divide the total 2050 requirement by 27 years. The divisor reflects the full period from 2024 through 2050 (inclusive) and assumes that the 2050 value represents the cumulative growth over that span.	
General	The ETS2 charge is assumed at €45/tCO_2 from 2027 to 2030, followed by a linear increase to €100/tCO_2 by 2035, based on the medium scenario in Agora Energiewende's A New Emissions Trading System for the EU Building Sector (2022). Beyond 2035, projections follow Montel's EU Energy Outlook 2050, which sets ETS2 charges at approximately €160/tCO_2 by 2050.	
General	The National Building Renovation Plan provides a comprehensive assessment of Poland's building stock, classifying dwellings into energy performance bands based on primary energy consumption. It then models a pathway to move buildings into higher efficiency bands through deep renovation measures, including insulation of the building envelope (walls, roofs, windows), replacement of heating and hot water systems, and the integration of renewable energy technologies such as solar PV and solar thermal. The resulting cost estimates are exhaustive, covering the full spectrum of building modernisation. By contrast, this study study adopts a narrower scope: it focuses on equipment replacement and heating system upgrades, with deep renovation considered only in the case of heat pumps and does not account for envelope performance improvements or the integration of renewables. This explains why our investment estimates are lower than those reported in the National Building Renovation Plan.	

Assumptions & Sources – (2/5)

LCPDelta

Section of the analysis	Assumptions	Sources (when applicable)
Scenarios	The scenario set is rooted in the 2022 EU-wide modelling exercise on renewable space-heating and cooling. Its key dimensions are: 1. **Policy baseline (to 2030)** • The study treats the entire Clean Energy Package, i.e. the revised Renewable Energy Directive (RED II), the Energy-Performance-of-Buildings Directive (EPBD) and the Governance Regulation, as "current policy". • Full transposition and *complete* achievement of the associated 2030 targets (renewables, energy efficiency and -55 % economy-wide GHG reduction under Fit-for-55) are taken as given for every Member State. • For electricity and district heating, a declining carbon budget consistent with the -55 % goal frames all supply-side assumptions. 2. **Post-2030 treatment** • The modelling treats the EU Clean-Energy Package as the "current-policies" world and assumes its 2030 targets are achieved. After 2030, the study does not just roll those policy trajectories forward. Instead, it switches to scenario-driven optimisation under extra constraints to reach climate-neutrality by 2050. • Instead, it adds an optimisation layer that drives the system towards (near-)climate-neutrality by 2050, subject to technology-specific constraints (deployment ceilings/floors, resource limits and the shrinking carbon budget). 3. **Key technology simplifications introduced for the present assessment** • **Biomass** : Solid biomass has been excluded from individual-building options due to significant environmental, economic, and health concerns associated with its use. The "freed" demand is reallocated primarily to electric heat pumps (with a residual share for biomethane in hybrid configurations). • **District heating** : Generation is represented exclusively by large-scale, low-temperature district heat pumps; other renewable or waste heat sources are not modelled separately. • **Cooling** : Space-cooling demand is covered solely by individual air-conditioning units; the equipment mix is assumed identical across scenarios. • **Direct electric :** It is assumed that its proportion within the heating mix remains constant. Notes : • The RED II directive has not yet been fully transposed into Polish law. While some provisions have been implemented, key areas such as permitting, and energy communities remain incomplete, and infringement proceedings are ongoing. • Our 'current trajectory' follows the Baseline scenario from the *Renewable Space Heating under the Revised Renewable Energy Directive* study, which represents current policies (Clean Energy Package targets assumed met by 2030). Annual installations are not extrapolated from recent sales. For each scenario, we convert the scenario energy-share outcome into an implied number of units and allocate the required additions evenly across years.	Renewable space heating under the revised Renewable Energy Directive - Publications Office of the EU Air Conditioners and Comfort Fans - European Commission

Assumptions & Sources – (3/5)

Section of the analysis	Assumptions	Sources (when applicable)
Scenario	To calculate the number of assets required, the study applies a simplified building stock model for 2050, using a single representative figure for the number of dwellings.	Dynamic building stock modelling: Application to 11 European countries to support the energy efficiency and retrofit ambitions of the EU – ScienceDirect EU Building Stock Observatory Green-Heat-for-All-2-Final.pdfGreen-Heat-for-All-2-Final.pdf Energy consumption in households - Statistics Explained - Eurostat
# of assets to be installed	For an asset to be considered “to be installed”, we only account for the replacement of fossil fuel – based heating systems. If a household already has a renewable-based heating device, the study considers that the household has already made its transition.	
# of assets to be installed	The study considers a simplified version of the building stock, where 1 household equals 1 dwelling and where 1 dwelling equals 1 heating device.	
# of assets to be installed	The study is based on general targets rather than past sales. For solar thermal installation numbers, external experts flagged that this does not reflect actual sales or market penetration. We acknowledge this but maintain consistency with our methodology.	

Assumptions & Sources – (4/5)

Section of the analysis	Assumptions	Sources (when applicable)
Cost of the transition	The number average life span per heating technology is based on estimates from the IEA.	Heating - IEA
Cost of the transition	Energy prices forecast used were provided by LCP Delta and included ETS2 prices up until 2035, derived from EUROSTAT. Source for 2035-2050 ETS2 were derived from MONTEL.	Montel - Blog - How Will the European Electricity Market Develop by 2052?
Cost of the transition	Heat pump prices forecast were provided by LCP Delta Heat Research Service.	LCP Delta
Cost of the transition	Save for the case of Heat pumps in Germany, the study does not assume falling CAPEX cost of clean heating and technologies, but rather a linear decrease.	LCP Delta
Cost of the transition	District heating connection costs vary significantly depending on local factors such as urban density, system design, and heating technologies. The cost estimates used here are based on a Polish study, which identifies an average connection cost of approximately €12,000. This value is used as a baseline. To estimate costs for other countries, the study adjusts this baseline using relative cost differences reported in an earlier study. While the absolute values in the earlier study are considered outdated and likely undervalued (according to interviewed industry experts), the relative differences between countries are assumed to remain broadly valid. The underlying assumption is that no major structural changes have occurred that would significantly alter these inter-country cost differentials.	Overview of heating and cooling - Publications Office of the EU OneDrive Carbon_Trust._Estimating_the_cost-reduction_impact_of_the_Heat_Network_Investment_Proj...pdf
Cost of the transition	The International Energy Agency's SHC Task 54 targets more than 30 % purchase-price reduction for solar-thermal kits by substituting copper with polymers, automating absorber/coating lines and shipping pre-assembled roof cassettes. The study assumes a conservative 20% overall price decrease between 2024 and 2050.	IEA SHC || Task 54 || Publications
Cost of the transition	Skill and training costs for heat pump and district heating have been accounted for and added to the total cost of the transition.	Igniting opportunities in the EU's built environment | McKinsey
Cost of the transition	To reflect heat pump compatibility issues, renovation costs are included for buildings constructed before 1990, assuming upgrades are needed to enable efficient heat pump operation. These renovation costs are added to the CAPEX for heat pump installations in this segment of the building stock.	Housing Europe
Cost of the transition	A sizeable margin of error should be applied when calculating training costs, as labour markets are likely to undergo dynamic changes driven by factors such as average wage growth and demographic shifts. This is particularly true in Poland.	

Assumptions & Sources – (5/5)

Section of the analysis	Assumptions	Sources (when applicable)
Financing capabilities	The financing capabilities of households are based on their annual gross income per household.	HFCS Statistical Tables - Wave 2021 - July 2023
Financing capabilities	The annual household income in the study is expected to remain constant (excluding inflation).	
Financing capabilities	Energy burden >6%.	energy-affordability.pdf
Financing capabilities	Payback time over 7 years.	Green-Heat-for-All-2-Final.pdfGreen-Heat-for-All-2-Final.pdf
Financing capabilities	The assessment of government public financing capabilities draws primarily on the linked report, except for Czechia and the Netherlands, where a combination of internal LCP Delta data and the EHPA subsidy report was used to estimate subsidy expenditures in 2022. The year 2022 was selected due to its exceptionally high heat pump sales, offering a benchmark for the level of government support achievable during periods of peak market activity.	mission-possible-full-report.pdf
Financing capabilities	Over the time of the study period, government support is expected to decrease.	
Financing capabilities	The ratio of additional subsidy required to unlock private household spending differs significantly from the investment “rules of thumb” often cited in EU reports—for example, the 1/5 public – 4/5 private split in the Draghi report. That figure is historical and economy-wide, describing the financing mix of productive investment (excluding residential sectors). It is not intended as a sector-specific or instrument-specific target. Our analysis, by contrast, examines a different concept: the subsidy share necessary to make residential heating systems affordable under an explicit household affordability test. This reflects a policy transfer calibrated to household budgets, not a macroeconomic composition of productive investment. Because the object (productive investment vs. household purchases), scope (excludes vs. includes residential), and purpose (macro financing mix vs. micro affordability support) differ fundamentally, the resulting ratios should not be expected to align.	

Technologies included in this study

Technology Overview (1/4): Heat Pumps

LCPDelta

What is it?

Heat pump technology is a core component of the transition to a clean H&C sector and is already widespread in many of the coldest parts of Europe, for example satisfying 60% of the heating needs of buildings in Norway. The technology's efficiency is one of its greatest strengths, providing 3-4 units of heat for each unit of electricity used. The heat pump technology covered in this study focuses on air/water and ground source as air-to-water heat pumps are more widely integrated into domestic hot water systems, which are the primary focus of most residential energy retrofit and decarbonisation policies.

The progress

The growing popularity of heat pumps as a residential heating solution is illustrated in the adjacent charts, with chart 62 detailing a steady increase in the heat pumps installed across the 21 MS in the EU covered by the European Heat Pump Association (EHPA), showing an acceleration in 2022 and 2023 due to the Energy Crisis.

The MS covered in detail in this study have a base of heat pumps as part of their residential heating shown in chart 63.

The challenges to overcome

Heat pumps need to become a significantly larger component of the H&C sector to meet Europe's decarbonisation targets and whilst the technology's effectiveness is proven, it is currently less affordable than it needs to be. This study looks at possible solutions to the high upfront costs.

Chart 62: Heat pump stock of EU 21 (m)

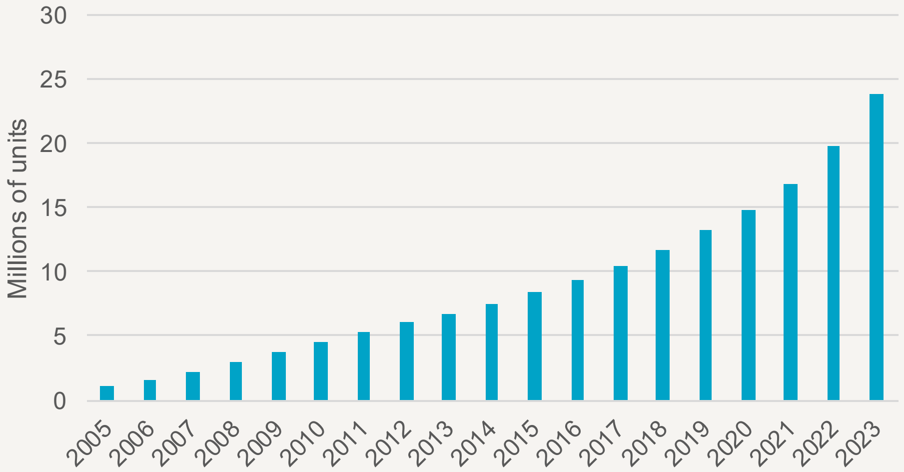
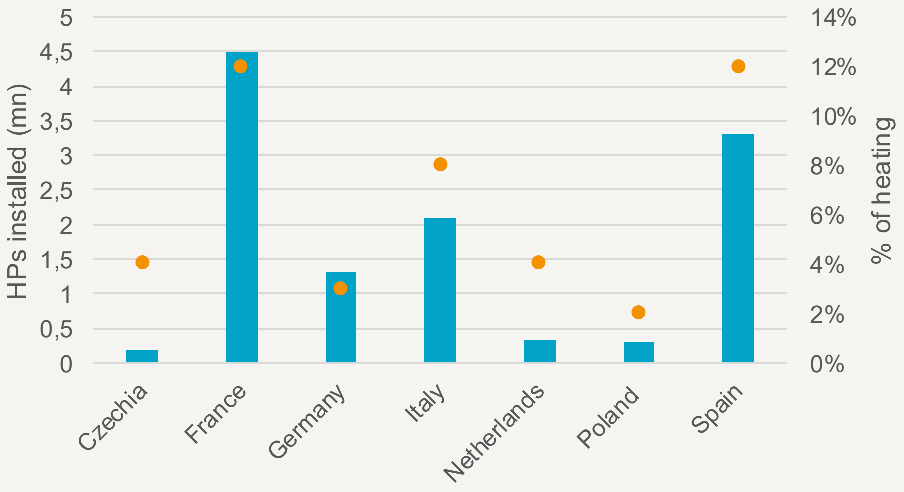


Chart 63: Heat pump stock by country (m)



Source: LCP Delta

Technology Overview (2/4): District Heating

What is it?

District heating networks use a central facility or facilities to produce the heat that is then utilised by the connected residences in the network via heat exchangers. The technology can enhance energy efficiency and has been in use for over 130 years, although arguably the concept has been around since Roman times.

The progress

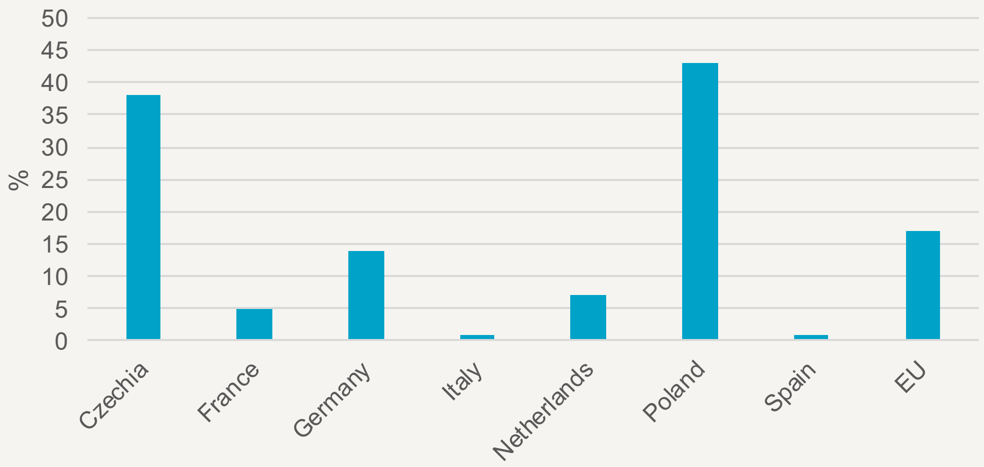
District heating is already firmly established in many MS across the EU, evidenced by the fact there are approximately 19,000 district heating networks, supplying heat to 77 million people across Europe, which equates to ~17% of the EU's population. The details for the MS that are the focus of this study can be seen in Chart 64.

The challenges to overcome

There are two main hurdles for district heating:

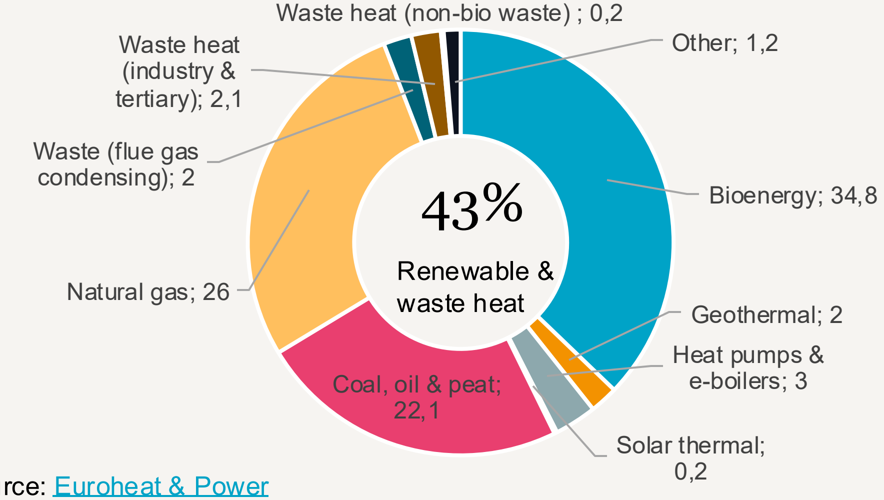
- As chart 65 shows, as of 2022, only 42.6% of district heating was supplied from renewable and waste heat resources. In this regard, there is the potential for geothermal, large heat pumps and solar thermal to play an increasingly important role in the transitioning of existing district heating systems. We detail an example of how district heating can develop in the Case Study on page 62.
- The upfront cost and co-ordination across the parties involved to build new district heating networks is another aspect that needs to be conquered in the move to a clean H&C sector. This study focuses on the solutions to the upfront cost.

Chart 64: Current % of population served by district heating



Source: IIF IIR + LCP Delta

Chart 65: Fuel mix of district heating in 2023



Source: Euroheat & Power

Technology Overview (3/4): Solar Thermal

LCPDelta

What is it?

Solar thermal technology harnesses solar energy to provide heat for space and water heating. 10 million rooftops in Europe are equipped with solar heat. Among its variants, flat plate collectors are the most common and ideal for residential applications. Germany accounts for the largest share of installed solar thermal capacity in the EU, with 15 GWth far ahead of any other member state (Chart 66).

Large-scale solar thermal systems are currently integrated into district heating networks in **282 European cities,** representing around 5% of all district heating systems and 0.2% of total heat supply. In EU energy policy, solar-thermal is classed as renewable heat and is complementary to heat pumps.

The progress

In 2023, solar thermal capacity in the EU grew by just 1.3 GWth, reaching a total of 41 GWth. This growth rate falls well short of the pace needed to triple capacity by 2030. In 2023, six new large-scale solar thermal systems integrated into district heating networks began operation, with nine additional projects either under construction or in advanced planning. As indicated by chart 66, 83% of newly installed water collector are used for domestic hot water systems.

The challenges to overcome

Economic viability still hinges on fossil-fuel price spreads; when gas is cheap, solar heat struggles to compete. Because the sun is intermittent, systems almost always need integration with back-up or storage technologies, adding design complexity. Competitive pressure also comes from rapidly scaling heat-pump fleets.

Chart 66: Breakdown of newly installed solar thermal water collector capacity in Europe in 2022, by application

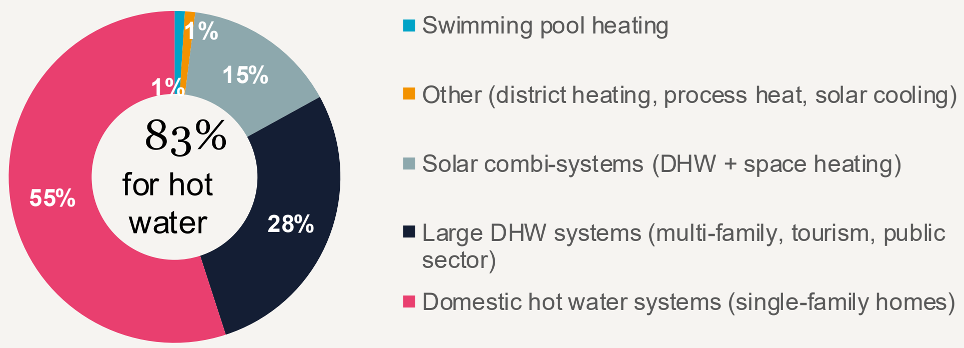
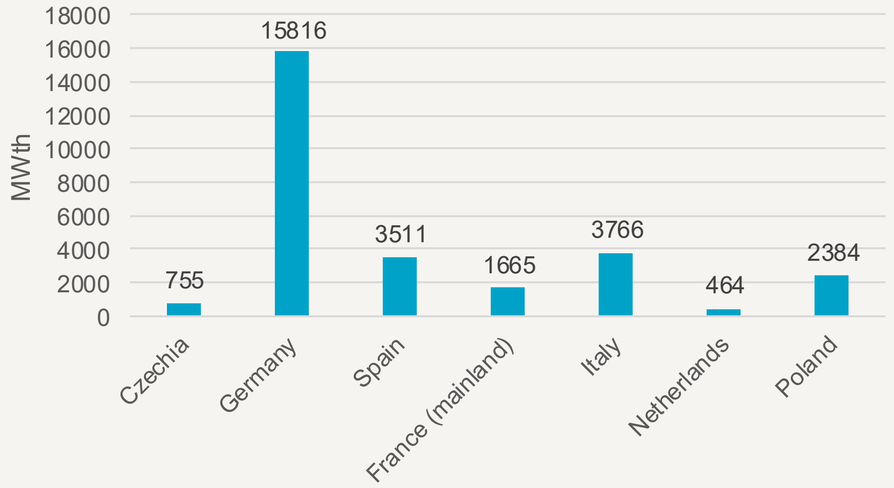


Chart 67: Total Solar Thermal Capacity In Operation In 2022, Air And Water Collectors (MWth)



Source: Solar Heat Worldwide

Technology Overview (4/4): Cooling solutions

What is it?

The technology assessed in this study is based upon a split system air conditioner because this is the most prevalent technology used today. The benefits of this technology are the relatively low cost and the simplicity of installation.

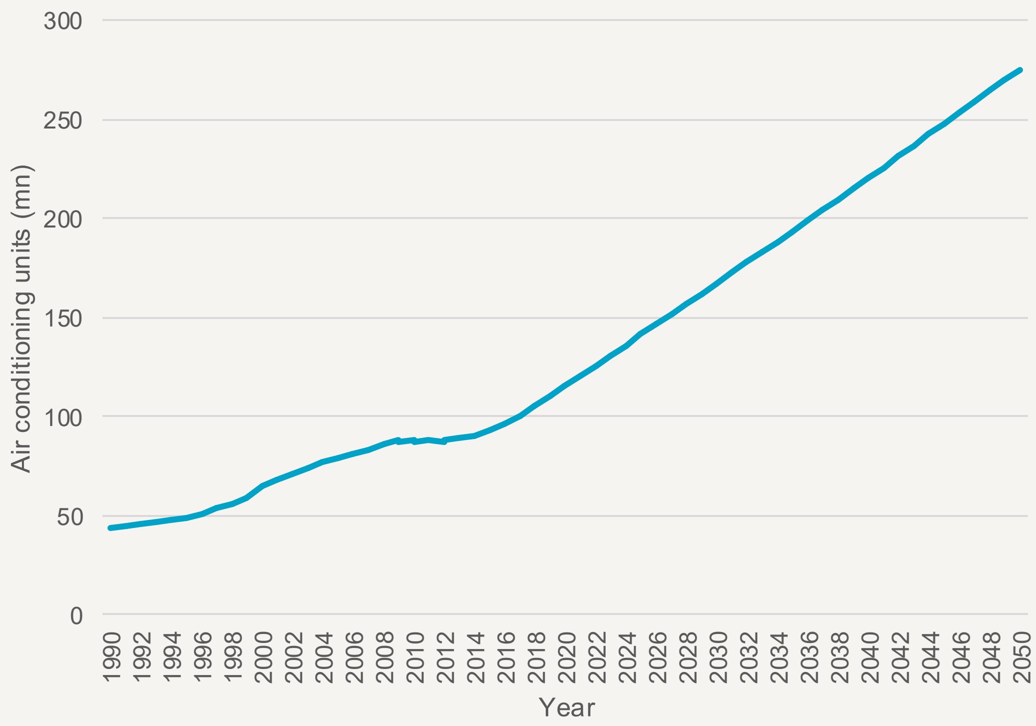
The progress

As detailed on page 18, cooling accounts for just 0.6% of a household's energy consumption. Of all the technologies covered in this study, cooling is at a relatively early stage of use by the residents of the EU. However, this is expected to change as climate change progresses, with demand for home cooling systems projected to increase significantly, as illustrated in chart 68.

The opportunities for the future

There is the potential for both district cooling and cooling via heat pumps to become a widespread solution as the technologies develop on the way to 2050. Depending on the nature of these developments, this could make the decarbonisation of residential H&C systems more straightforward, with households able to tackle both H&C elements in one installation.

Chart 68: Expected air conditioner stock in the EU



Source: IEA

Credits

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Glossary of terms

CAPEX (Capital Expenditure): Funds used by individuals or companies to acquire heating technologies.

Cessione del Credito: The ability for households to transfer their tax deduction to a third party, for example the installer or supplier, to enable the household to receive the full amount of the government tax deduction upfront, with the installer or supplier then receiving the tax deduction over time.

Decile: Splitting a group of data into 10 equal parts, where each part represents 1/10th of the population.

Green bond: A financial instrument used by governments and companies to borrow money from investors, the proceeds of which must be used for environmentally beneficial purposes. The interest rates for these instruments are often lower than if governments and companies used a standard bond framework for borrowing money.

Heat as a service: Where a company offers heating solutions to a household to provide it with heat, without the household being required to buy the heating equipment.

Net Present Value (NPV): Cost of transition that accounts for the time value of money.

Spark gap: Difference in cost between electricity and gas.

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