EEB
European Environmental Bureau

THE BUILDINGS CHALLENGE: POLICY, NOT TECHNOLOGY

A path to carbon-neutral dwellings

The Buildings Challenge: Policy, Not Technology

A Paris Agreement-compatible (PAC) pathway to carbon-neutral dwellings

Executive Summary

Europe's buildings hold the key to achieving climate neutrality, and science shows the way forward. The Paris Agreement Compatible (PAC) Scenario, developed by CAN Europe and the European Environmental Bureau with modelling by CLIMACT, provides a credible, science-based roadmap for decarbonising the building sector by 2040. This pathway is clear: energy efficiency combined with electrification.

The PAC Scenario demonstrates that **the decarbonisation of heating and cooling is technically feasible and socially acceptable, requiring no radical behavioural changes**. By accelerating deep renovations, improving building performance, and deploying heat pumps, renewable district heating, and rooftop solar, Europe can cut building energy demand by 50 percent by 2040 compared to 2015 levels. By 2030, electrification will meet over half of buildings' energy needs, while efficiency measures will deliver a 67 percent reduction in emissions—putting Europe firmly on track to meet its climate targets.

Technology is not the barrier; policy is. Markets are ready: heat pumps, solar thermal systems, and renewable district heating are proven, cost-effective solutions. Yet flawed policies and regulatory gaps are slowing progress. Current national plans often over-rely on biomass, which undermines air quality goals, and fail to provide adequate incentives for clean heating technologies. Electricity pricing structures still disadvantage heat pumps compared to fossil fuel systems, while subsidies for fossil fuels persist.

To unlock the full potential of energy efficiency and electrification, urgent policy action is needed. The EU and its Member States must reform market rules and phase out fossil fuel heating through ecodesign regulations, reduce the electricity-to-gas price ratio to make heat pumps affordable, and expand subsidies and low-interest loans for renovations and clean heating technologies. Complementary measures such as streamlined permitting, dynamic tariffs, and support for energy communities will further accelerate adoption.

Fixing these policy bottlenecks will unleash a renovation and electrification boom, enabling Europe to deliver a fully renewable, zero-emissions building sector by 2040. The PAC Scenario proves that this transformation is credible, cost-effective, and aligned with the Paris Agreement. The challenge now lies in governance and ambition. Policymakers must act decisively to turn this vision into reality—because the technology is ready, and the time for action is now.

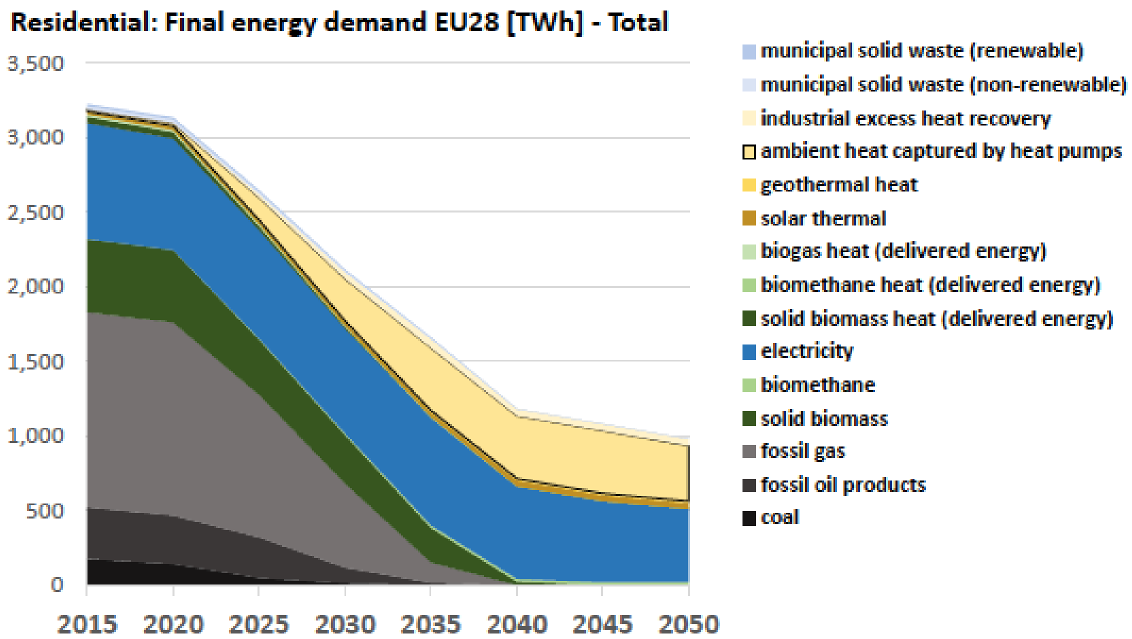
What is PAC-Scenario

The Paris Agreement Compatible (PAC) scenario, developed by CAN Europe and the EEB with modelling by CLIMACT, is a bottom-up, data-driven, real-technology scenario that outlines how the EU can reduce greenhouse gas emissions by at least 65% by 2030, setting a course toward a fully renewable energy system and achieving net-zero emissions by 2040. **This scenario provides a science-based vision for Europe's energy future, aligned with the Paris Agreement and the 1.5°C target.**

Between 2018 and 2020, an aggregated PAC scenario was prepared for the EU28 to illustrate an accelerated energy transition across the continent. Its development involved tens of stakeholders' meetings at EU and national levels, and hundreds of contributions from the European civil society, gathered both online and in person.

The scenario projects the evolution of energy demand and supply across key sectors -industry, buildings, transport, and agriculture- through 2050, alongside an overview of emission reductions. As a result, since its publication**, it has become the reference scenario for CAN-E, EEB and their members**, as well as other civil society organisations to benchmark both EU and Member State ambitions.

In 2020, responding to CAN Europe members' requests, **the scenario was updated to reflect the EU27,** using a more recent baseline year (2015). It was also disaggregated to produce detailed, country-specific PAC scenarios for each EU Member State. These national scenarios were developed to explicitly help national CSOs to benchmark the ambition in National Climate and Energy Plans (NECPs) and support efforts to strengthen ambition during NECP revision processes (see chapter 4).



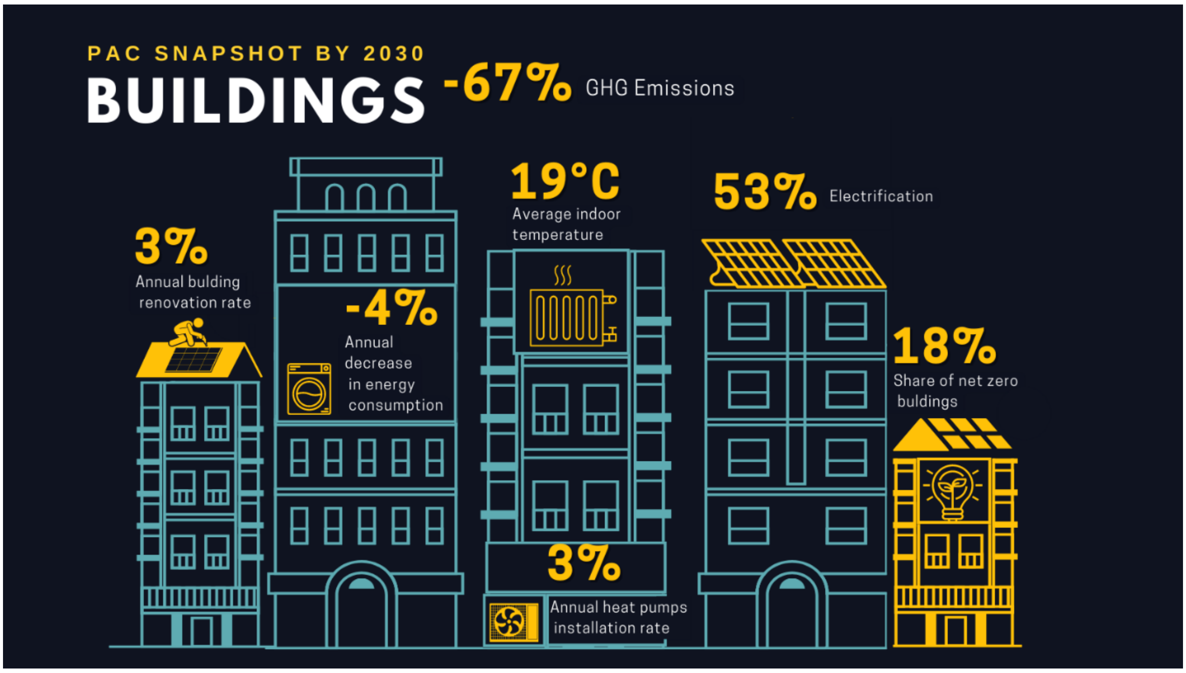
The PAC scenario relies on behavioural optimisations and accelerated deployment of existing technologies, without assuming radical changes to citizens behaviour such as those that would follow catastrophic events like pandemics or wars. Other scenarios may assume quicker uptakes of behavioural changes, in particular in relation to energy sufficiency and efficiency, but PAC focuses on what is achievable today.

In short, the PAC scenario shows a credible path to a 100% renewable future for Europe: ambitious, grounded in reality, and fully aligned with the Paris Agreement.

What does PAC Scenario include for buildings?

When developing a scenario for the building sector, the PAC-Scenario community and modelists considered both the high complexity of prompting change to tens of millions of households and the wide availability of technological solutions, which have only continued to improve. The result is an ambitious scenario that **assumes renovations will gradually increase, reaching a steady pace (3%)** and an improved performance of deep renovations by 2030. This is projected to **bring down energy demand by 50% by 2040** compared to the 2015 benchmark scenario (from 64.8kWh/m² to 48kWh/m²). Achieving this result requires an equally ambitious deployment of heat pumps, district heating and rooftop solar.

By 2030, the scenario envisages that, through deep renovation and prompt application of the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive, around 20% of the EU building stock would qualify as zero-emissions buildings. Electrification would meet 53% of buildings' energy demand, while overall energy demand would fall by 4% every year. In total, 20% of the buildings would undergo deep renovation, while the remaining stock would still see important renovations (reducing energy demand by 70%) to ensure they can be comfortably warmed and cooled using renewable energy (mostly via heat pumps).



Behavioural adjustments are also part of the scenario: the average indoor temperature would go down to 19°C thanks to a mix of energy sufficiency measures and increased efficiency of the dwellings. The scenario assumes that the average living space per capita does not increase, reflecting the growing urbanisation of the EU population, where space is not abundant, and dwellings tend to be smaller. At the same time, renovations in high-rise buildings often tend to redistribute space in view of increasing the number of available units.

Since renovation would start from the least performing buildings, these measures are projected to cut GHG emissions by 67% by 2030 already. Inefficient buildings that cannot be renovated would be demolished at an increased rate compared to the current one (from 0.1% to 0.2%).

It goes without saying that these results come with a social impact that must be considered and prevented as much as possible. Adequate planning and targeted spending of the Social Climate Fund (SCF) are essential to limit the effects of carbon pricing (ETS2) on lower income households. National support for renovations must also be strengthened across the board to leave no one behind.

Deep dive on Heating & Cooling assumptions for 2040 carbon neutrality

Buildings are a sector that can be almost **entirely decarbonised by 2040.**

Both on site and in the grids, fossil fuels for heating are phased out by 2050, with remaining emissions only coming from a small amount of biomethane (locally sourced and used) and solid biofuels.

District heating will play a major role in future urban environments: the increasing availability of cascade heat (i.e. from data centres, sewage and industrial production) and improved efficiency and availability of renewable heating solutions (low temperature district heating, solar heating, seasonal storage, among others) are expected to support a development that should hit 30% of the overall heating and cooling demand by 2050.

One of the most important underlying assumptions in the scenario stems from the acknowledgment that **biomass combustion** is already the number one contributor to air pollution in urban areas in the EU and is no longer compatible with the European objectives of the Air Quality Directive: for this reason, **we envisage a sharp drop of biomass heating from 21.5% to 4.3%. Similarly, hot water from biomass would drop from 14.03% to zero**. The precondition for this is a clear commitment from member states to phase out biomass technology support over the years, to comply with the air quality standards, and promote at the same time support policies for alternatives, particularly for low-income households and rural communities. Another such precondition is the development of ambitious ecodesign and energy labelling regulations that will adopt the best available technologies (i.e., electrostatic filters) for newly produced biomass stoves and boilers, thus aligning their price with that of the least emitting technologies (i.e., heat pumps).

Heat pumps follow a similar trend to mid- to deep renovations and deep renovations. In practice, all renovations should include the switch from fossil fuels to heat pumps.

These changes are rendered in the PAC-Scenarios through an online tool, **the pathways explorer**, which works with levers whose values range from 1 (business as usual scenario) to 4 (maximisation of both behavioural and technological change), with increments of 0.1 points. The overall assessment of the sector assigns an overall ambition of 2.5 points to the buildings sector, **with a more ambitious 3.1 score for low carbon heating and cooling in the residential sector.**

This figure is a combination of different factors: as mentioned, district heating and cooling is set to grow from the current 11.75% in 2021 to 30% in 2030, which translates in a grade 3 ambition for this subsector. Secondly biomass ambition is set to 1.4: this is due to biomass cooking going down to 1% in 2050 from the current 3.58%, heating from 24.6% to 8.66% and DHW from 10% to 0%**.** **Cooking electrification is set to an ambitious 3.8, which results from gas cooking going down from 23,69% to zero** -possibly the most audacious policy assumption- thus direct use of electricity, typically with induction hobs and similar technologies, raises from 62.36% in 2021 to 100%. Lastly, **electrification of space and water heating via heat pumps and other electrified technologies enjoys the highest ambition score**. This, in turn, is the result of increased direct electricity use in space heating (from 7% to 15%) thanks to infrared technologies and improved, smart-managed electric heaters in buildings with limited insulation, increased deployment of heat pumps from 15% to 80% and a tenfold growth of solar thermal from 0.5% to 5%. Domestic hot water follows similar trends, with a larger use of direct electricity (playing a role as a storage option for excess renewable electricity) that grows from 27.96% to 30%, **a sharp increase of heat pumps from 0.5% to 47% and a twofold increase of solar thermal, from 11.3% to 23%,** potentially also in combination with heat pumps.

Are we on track with these assumptions?

Analysing how member states are doing with heating and cooling is not an easy job, not only because, despite the National Energy and Climate Plans, information remains patchy, but also because a lot of the work relates to anecdotal analysis of **a narrative that has become more and more politicised every year.** We can, for instance, judge positively policies in place in a country but then find out that the Energy Minister of that country has made declarations that create insecurity in the renewable heating market and might have impact on installations: how to evaluate that is, therefore, a matter of choices and points of view.

Besides the methodological issues, another issue is coming in the way of analysing policies that age rapidly: **technology has advanced**. Typically, markets are much quicker than regulation and the heating and cooling market is no exception. In the last three years, while member states were drafting their plans and the EU Institutions finalised discussions around the EED and EPBD – among other files- technologies have evolved fast and new products have made technically and/or economically viable what seemed out of reach just a few years ago, **thus making it easier to reach the targets and potentially making those targets no longer in line with potential.**

NECPs presented by Member States following the revision of the Effort Sharing Regulations vary in completeness, quality and scope: the Commission has made an analysis of such plans and has drawn the conclusions that, unlike the energy efficiency target that is challenged, **the plans are in line with the requested Renewable Energy target of 42.5%, though a small 1.5% gap remains**. Despite the fact that the EU Commission does not mention their names, it also declares **that 22**

Member States have included in their NECPs a 2030 heating and cooling target that is in line with 2030 targets, as set out in the 2023/2413 RED III directive. Unfortunately, many of these plans include **national targets for biofuels production and use**, which from the perspective of the EEB is not making any sense and is not in line with the assumptions we make in the PAC-Scenarios. Besides, steps are taken to promote renewable heating and cooling, including via district heating, but the EC recognised that more needs to be done to plan and implement the relevant policies.

If we take a closer look at the plans, we see that they diverge significantly from the plotted chart of the PAC-scenario in several points: one of this point **is the continued – and increasing- role of biomass in the renewable heating and cooling mix**. Looking at these plans, it appears very clear that a risk is there in some countries to switch from fossil heating to biomass heating. It is the case of **Portugal**, that foresees and increase of such use, and **Spain** with includes both an increase in consumption and imports of such energy vector. On a positive note, Denmark, Finland, Lithuania, Portugal and Sweden are on track to exceed 60% renewable heating and cooling by 2030. **Denmark, Lithuania and Sweden** are expected to reach 80%.

Italy, France, Greece, Ireland and **Bulgaria** are lagging, with the last country failing to reach the minimum target fixed by the RED III altogether.

What could be done differently at the national level?

At the national level for those countries that are lagging, a few policy options are available and should be taken into account.

1. Accelerate energy efficiency and renovation

All countries must prioritize energy efficiency to reduce overall energy consumption. Key measures should include:

- **Accelerating energy renovations:** Renovation rates are currently below EU targets, and certainly below what the PAC-Scenario requires to remain within the limits of the Paris Agreement, necessitating stronger policies.
- **Implementing stricter building regulations** to limit energy consumption.
- **Introducing financial incentives** such as subsidies, low or zero-interest loans, leasing schemes for energy renovations, and particularly for the decarbonisation of heating and cooling.
- **Establishing bans on renting poorly insulated homes**, by, for instance, including an obligation of renovation linked with subsidies and support schemes for those owners that are not in the position to access private finance.
- **Ensuring improved energy efficiency** in buildings plays an important role in reducing energy consumption, aligning with the Energy Efficiency Directive (EED) targets.

2. Boost clean heating technologies and limit biomass reliance

To meet the 2030 renewable energy targets, MS must focus on shifting away from fossil fuels and increasing the uptake of high-efficiency renewable sources, particularly moving beyond unsustainable biomass consumption.

- **Promoting ambient heat (heat pumps) and solar energy:** Countries lagging must shift to renewable sources beyond biomass, specifically promoting ambient heat (via heat pumps) and solar energy.
- **Limiting biomass reliance:** Heavy reliance on biomass (especially imports, noted in countries like Bulgaria, France, Greece, Ireland, and Italy) is deemed unsustainable. Countries must reduce use, avoid imports, and prioritize the truly sustainable biomass sector.
- **Mandating bans on fossil fuel appliances**: Countries must adopt bans on new oil and gas boilers to accelerate decarbonisation. The report encourages more countries to follow the lead of the Netherlands and Austria, which have already implemented such bans.
- **Promoting renewable district heating**: Policies should promote the expansion of renewable district heating, including extending networks and increasing the use of renewables such as heat pumps and solar thermal energy within these systems

3. Reform economic and market instruments

To make clean heating solutions economically viable for consumers, market distortions related to taxation must be addressed.

- **Reducing the electricity-to-gas price ratio**: In most countries, electricity remains too expensive compared to gas, making heat pumps less cost-effective. Only a few countries, such as the Netherlands and the Flanders region in Belgium have announced measures to counter this problem. This ratio should be reduced by:
    - Lowering electricity taxes and levies for consumers.
    - Cutting subsidies to fossil fuels such as reduced VAT for heating oil in mountainous areas, or gas heating bonuses for large consumers.
- **Providing financial support for heat pumps**: Policy support is needed to make the switch viable, especially since heat pump operation is often more expensive due to high electricity taxes. Subsidies are necessary for heat pump installations to replace fossil-fuelled boilers and old biomass boilers. For instance, countries like Czechia, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Romania, and Spain need to subsidise heat pumps more given the current electricity-to-gas price ratio.

4. Improve governance, planning, and social equity:

Addressing implementation challenges and ensuring a just transition are critical components of the energy transition. In particular member states should be:

- **Integrating additional measures:** Most National Energy and Climate Plans (NECPs) should formally incorporate their proposed 'With Additional Measures' (WAM) scenarios into official plans. It seems as if Member States are expecting a time where public European spending will be higher and will trigger further, more ambitious measures that they for now postpone. An incomprehensible attitude given the unprecedented amount of funds made available by the Recovery and Resilience Fund and the upcoming ETS2.

- **Clarifying funding:** Countries must provide transparent documentation of funding for policies and measures to ensure stable and predictable climate policy implementation.

- **Local implementation and consumer support:** Member States should establish one-stop shops to help households reduce energy consumption and transition to renewable heating (Bulgaria, Greece, Hungary, and Sweden currently lack these). Local policies and measures for sectoral decarbonisation are improving in most countries.

- **Addressing energy poverty**: All countries should tackle energy poverty by using tools like the upcoming Social Climate Fund to provide income support, subsidised energy bills, and funding for energy renovations. Specifically, **Bulgaria**, **Czechia**, and **Italy** lack dedicated plans for supporting vulnerable consumers.

- **Alignment with local plans:** NECP policies and measures should align with municipal heating and cooling plans to ensure coherent implementation. Several MS, including **Hungary**, **Ireland**, **Italy**, **Lithuania**, and **Romania**, provide no information on these local plans in their NECPs.

What could be done differently at the EU level?

At the EU level further steps to accelerate the decarbonisation of heating and cooling could be taken:

While no longer a viable political option promoted by the EU Commission, **the phase out of placing on the market of combustion fossil fuels boilers** through the Ecodesign regulations remains a very important step to take to really send a signal to both consumers and industry alike that the combustion heating era is over. Considering that all relevant analysts, including those hired by the EU Commission rule out any relevant role of H2 in heating, it is evident that keeping gas and oil boilers on the market would only prolong the use of fossil fuels, hampering the update of clean solutions. The measure would reduce emissions by roughly 72Mteq.

Parallel to this file, other heating-related ecodesign and energy labelling files should be approved in such a way that all combustion technologies, including biomass stoves and boilers, internalise the current social and environmental damage they cause, and are obliged to adopt the best available technologies for filters and efficiency. This, combined with a labelling promoting zero emissions technologies, would contribute to nudging consumers towards renewable technologies such as heat pumps and solar.

A **clean heating mechanism is another possible tool** that the EU could consider, building on the experience the UK is having of this measure. The Mechanism would promote **a bonus malus scheme for producers**, that would be prompted to either sell a growing share of zero emissions heating technology or compelled to lower the average emissions factor of the units they sell annually: both solutions would lead to producers selling more heat pumps and solar technologies. Producers falling short of such targets would need to buy emissions credits, while those surpassing them would be benefitting from such credits, which they could sell to those industries that are lagging. Similarly to the ETS market, the overall number of annual emissions would be decreasing every year and no phase-out obligation would be placed on the market. This mechanism so far has not been endorsed by major industry stakeholders but could be seen as a market mechanism and be supported by a larger political majority in the EU parliament.

Since the upfront cost of switching to heat pumps can be a serious obstacle for many, another important problem that should be tackled at the EU level is **the availability of low to zero interest loans for renovations, for all EU Citizens:** not only the cost of borrowing in some countries can be a serious obstacle to make the business case for the switch, but many Europeans -including those belonging to middle class- might also not be eligible for such credits because their credit rating is not good enough. That is, credit rating makes no distinction between a loan to buy a fancy new car and a loan to install a technology that saves a lot of money on energy bills and pays back quickly.

On top of the existing subsidies at the national level and the upcoming support of the Social Climate Fund, **a European Lending Facility for Renovations should be made available** to the EU banks via the European Investment Bank. Ideally this fund would reach the end consumer with low to zero interest, depending on the economic conditions of the beneficiary, and some added criteria such as the obligation to not raise the rent of the apartment more than the inflation rate for a certain number of years, in order to prevent *renovictions*.

In parallel, it’s worth noting that the heat pump market could receive **a significant boost from the Social Climate Fund (SCF) and revenues from the Emissions Trading Scheme (ETS2)** -provided these funds are spent in a way that complements existing subsidy schemes.

If 34% of both SCF and ETS2 revenues were allocated to heat pumps, vulnerable families across almost every EU country could access decarbonised heating and cooling solutions, combining solar thermal and heat pumps. This allocation would also enable the EU to meet its target of 60 million heat pumps installed by 2030. Achieving this **would drastically cut remaining emissions from heating and cooling in all Member States,** with reductions ranging from 4% in Hungary to 100% in Lithuania and Sweden, depending on each country’s technology mix.

Lastly, a recurrent issue across the EU is **the lack of flexibility services in the market.** With the remarkable exception of the Netherlands, the situation is quite patchy across the EU when it comes to **time-of-use contracts, flexible tariffs or dedicated heat pumps tariffs**. Also, **the possibility of self-consuming off-side energy produced within energy communities** is not yet there in many member states. These difficulties mirror those of the DSOs, that are struggling to bear the costs of the transformation of the grid from centralised to distributed. The fact that the definition of energy communities has been left largely to the member states has created 27 different definitions that at the local level have encountered several obstacles.

When things work out for the best, though, **these flexibility options reward the consumer** and contribute to cut electricity costs. For instance, a preliminary experiment in Rome shows the possibility to save the equivalent of one monthly bill for those consumers willing to increase their consumption on demand (i.e. turning on the heat pump) to absorb extra power: this would greatly favour the expansion of electrified renewable heating.

Conclusions

The European Commission has found that overall the decarbonisation of the EU economy is on track to achieve its 2030 climate targets and on track to achieve its 2050 targets provided a 2040 mid-target is added. At the EEB, though, we believe that to remain within the commitments the EU took in the Paris Agreement, such objectives should be attained by 2040.

In this sense, progress in the heating and cooling decarbonisation policies at the national level is slow, as the implementation of current policies is either lacking or less effective and less ambitious than they should be to achieve the planned target, as shown in the analysis of the NECPs.

Moreover, the delay in the implementation of ETS2 will have a direct and indirect impact, both through an increased amount of available emissions in 2028 and through a reduced positive effect on the decarbonisation of heating and cooling.

Nevertheless, as mentioned, a series of complementary and non-disruptive measures could be put in place (that would bring a total of roughly 110 MTep savings for the boiler ban and DSF measures alone) and hence help balance the slow implementation.

European Union

The EEB reviews the findings outlined above and urges the European Commission to take targeted actions on decarbonisation.

The EEB calls on the Commission to:

1. **Prompt Member States to expand support** for decarbonising heating and cooling technologies, including demand-side flexibility (DSF). In the Electrification Action Plan and the Heating and Cooling Strategy, the European Commission should encourage Member States to establish streamlined permitting procedures and broad support for low-carbon heating and cooling technologies - especially those enabling electrification via heat pumps. A mix of grants and loans will ensure low-income households can access these support schemes, while the Social Climate Fund (SCF) and Emissions Trading System 2 (ETS2) funding streams are allocated accordingly.

2. **Draw lessons from the United Kingdom's Clean Heat Market Mechanism** experience and develop a similar proposal for the EU market. Paired with ETS2, this could powerfully accelerate adoption of clean heating and cooling technologies, though complementary demand-side measures remain essential to create a viable market for producers.

3. **Phase out fossil fuel technologies through Ecodesign regulations**, including a swift revision to incorporate recommendations from the International Energy Agency (IEA) and the Joint Research Centre (JRC). Although most Member States currently lack political will for EU-level action, rising heat pump installations, ongoing performance improvements, expanded product scopes, and growing consumer acceptance could shift this dynamic by the late 2020s, thus enabling implementation before 2030. Adopt a two-tier approach in the Ecodesign Regulation, starting with short-term updates to minimum efficiency standards.

National Governments

The EEB also urges national governments to **define detailed roadmaps for phasing out fossil fuels in homes, including an eventual ban**, integrated into National Heating and Cooling Plans alongside national energy and climate plans, national social climate plans, and municipal heating and cooling plans.

We also call on national governments to:

1. **Curb upfront costs for decarbonising and electrifying heating and cooling** by reducing or eliminating value-added tax (VAT) on heat pumps and related technologies, while simplifying permitting and installation to shorten timelines.

2. **Promote "Independence Kits" -bundled non-combustion renewables and efficient technologies** that bolster heat pump deployment by enhancing business cases or easing grid connections. These include building insulation, photovoltaics, solar thermal and hybrid solar photovoltaic-thermal (PVT) systems, domestic energy storage, smart meters, and demand-side smart controls, plus low-enthalpy geothermal.

3. **Lower electricity costs and narrow the electricity-gas price gap** by shifting taxes and levies away from electricity toward fossil fuels like methane, liquefied natural gas (LNG), liquefied petroleum gas (LPG), and gasoil, targeting a maximum 1:2:5 ratio to strengthen heat pump economics. **Complement this by promoting dynamic tariffs**, enabling consumers to operate heat pumps when renewable energy is abundant and inexpensive.

We are Europe's largest network of environmental citizens' organisations.
We bring together 180 civil society organisations from 38 countries. Together, we work for a better future where people and nature thrive together.

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