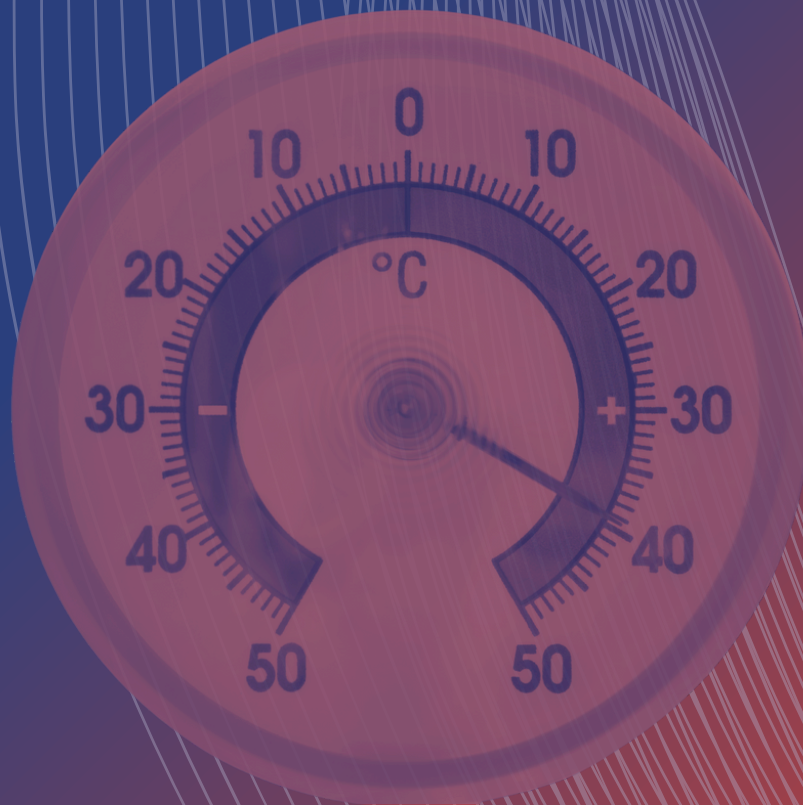


FAHRENHEIT 2040:

heating and cooling in the EU

Pathways for the clean heat transition



Commissioned by

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Outdoor thermometer shows hot summer temperature, Dmitry Naumov.

This document does not necessarily reflect the views of our advisory members.

BRUSSELS, MAY 2024



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Index of abbreviations

BPIE	BUILDINGS PERFORMANCE INSTITUTE EUROPE
CF	COHESION FUND
CLEVER	COLLABORATIVE LOW ENERGY VISION FOR THE EUROPEAN REGION
CO2	CARBON DIOXIDE
DNSH	DO NO SIGNIFICANT HARM
EEA	EUROPEAN ENVIRONMENTAL AGENCY
EED	ENERGY EFFICIENCY DIRECTIVE
ENER	ENERGY
EPBD	ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE
ERDF	EUROPEAN REGIONAL AND DEVELOPMENT FUND
ESF+	EUROPEAN SOCIAL FUND PLUS
ETS	EMISSIONS TRADING SYSTEM
EU	EUROPEAN UNION
FEC	FINAL ENERGY CONSUMPTION
FW	FRAMEWORK
GHG	GREENHOUSE GASES
H&C	HEATING AND COOLING
JTF	JUST TRANSITION FUND
LIFE	L'INSTRUMENT FINANCIER POUR L'ENVIRONNEMENT
MEPS	MINIMUM ENERGY PERFORMANCE STANDARDS
MS	MEMBER STATES
Mt	MEGATONNE
NBRP	NATIONAL BUILDING RENOVATION PLAN
NECP	NATIONAL ENERGY AND CLIMATE PLAN
NZEB	NEARLY ZERO-ENERGY BUILDING
PAC	PARIS AGREEMENT COMPATIBLE
pp	PERCENTAGE POINT
RED	RENEWABLE ENERGY DIRECTIVE
RES	RENEWABLE ENERGY SOURCE
SCF	SOCIAL CLIMATE FUND
t	TONNE
WAM	WITH ADDITIONAL MEASURES
WEM	WITH EXISTING MEASURES
ZEB	ZERO-ENERGY BUILDING

Summary

The transition to a decarbonised heating and cooling sector is crucial for the European Union (EU): to meet the Green Deal's target of net-zero greenhouse gas emissions by 2050, and to tackle a range of pressing socio-economic, security and environmental issues. The buildings sector is central to the heating and cooling transition, given its substantial impact on the EU's total carbon emissions. In the residential sector, space heating makes up for about two-thirds of final energy consumption, water heating for another 15 percent and cooling for around 0.5 percent. More than half of the energy use for residential space and water heating is based on fossil fuels¹. In the commercial and public services sector, space and water heating make up for about half of the total energy consumption².

The Fit for 55 legislative package is a crucial part of the EU's plan to reduce greenhouse gas emissions by 55% by 2030. The package includes significant actions aimed at decarbonising the buildings sector. However, the spread of these actions across various directives and regulations within the package makes it challenging to apply them in a unified manner, and important gaps towards full decarbonisation remain.

Against this background, the study addresses the following questions:

- Is the EU on track to decarbonise heating and cooling in buildings?

- Is the adopted framework for 2030 aligned with the goal of economy-wide full decarbonisation by 2050?
- What gaps need to be addressed with regard to the 2040 framework?

Is the EU on track to decarbonise heating and cooling in buildings?

With current policies and measures, the EU is far from reaching the goal of full decarbonisation of heating and cooling in buildings by 2050. Figure 1 shows that – despite a clear downward trend in greenhouse gas emissions in the buildings sector – a gap to full decarbonisation by 2050 of more than 300 Mt CO₂e (with existing measures) and around 250 Mt CO₂e (with additional measures) remains. To decarbonise the sector by 2040, the gap is about 350 Mt (with existing measures) and about 280 Mt (with additional measures).

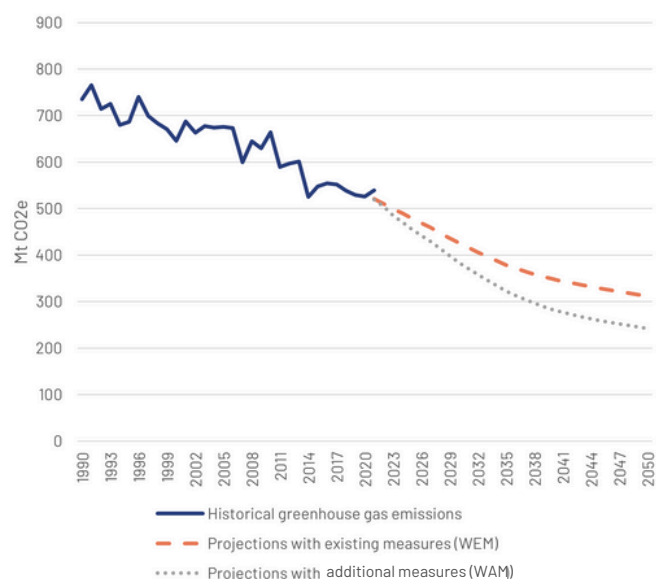


Figure 1: Projected GHG emissions in the buildings sector with existing and additional measures

Source: EEA (2023): Trends and projections in Europe 2023

Is the adopted framework for 2030 aligned with the goal of economy-wide full decarbonisation by 2050?

Figure 2 shows the current approach to decarbonising building heating is comprised of measures dispersed across different pieces of legislation.

‘With current policies and measures, the EU is far from reaching the goal of full decarbonisation of heating and cooling in buildings by 2050.’

Reducing energy demand for H&C	Phasing out fossil fuels	Planning, data and information	Social aspects	Financing and energy pricing
<p>EED</p> <ul style="list-style-type: none"> Art. 4 - Collective reduction of FEC by 11.7% by 2030 Art. 5 - All public bodies combined must reduce their FEC by 1.9% annually compared to 2021 Art. 6 - Renovate 3% of total floor area of heated & cooled public body buildings each year to NZEB or ZEB Art. 8 - Cumulative end-use savings obligation annually 	<p>RED</p> <ul style="list-style-type: none"> Art. 23 - Target for annual increase of RES-H&C share (0.8% until 2025 and 1.1% 2026-2030) Art. 23 - Long-term decarbonisation strategies to increase RES in H&C & MS to inform owners/tenants and SMEs on cost-effective measures, and financial instruments on RES in H&C Art. 15a - Target and framework for mainstreaming RES in buildings Art. 24 - Target for renewables in district heating 	<p>EPBD</p> <ul style="list-style-type: none"> Art. 3 - National building renovation plan Art. 10 - Renovation passport Art. 13 - Smart readiness of buildings Art. 14 - Data exchange Art. 14 - Financial incentives, skills and market barriers Art. 15a - One-stop-shops for energy performance of buildings Art. 16-19 - Requirements for Energy Performance Certificates Art. 20-21 - Inspections Art. 22-23 - Requirements for building professionals Art. 26 - Information and awareness-raising campaigns 	<p>SCF</p> <ul style="list-style-type: none"> Art. 1 - Focus on households in energy poverty Art. 2(1) - Legal definition of energy poverty Art. 6 - Vulnerable households mapping in SCPs Art. 7 - Financial support to reduce energy poverty Art. 9 - Pass-on of benefits to households and micro-enterprises Art. 24 - Monitoring MS performance in tackling energy poverty via SCP 	<p>EU Taxonomy</p> <ul style="list-style-type: none"> Art. 9-15 EU-Tax Reg - Contribution to one of six environmental objectives Art. 17 EU-Tax Reg. - DNSH-Criteria Art. 18 EU-Tax Reg. - Minimum safeguard EU-Tax Annex - Criteria under which H&C related economic activities are labeled as sustainable are listed under Items 4.15. to 4.25. Adjacent are further items of section 4 (Energy) and 7 (Construction and real estate activities).
<p>EPBD</p> <ul style="list-style-type: none"> Art. 5-8 - Minimum requirements for new buildings and existing buildings that undergo major renovation Art. 9 - Minimum energy performance standards and trajectories for progressive renovation Art. 11 - Technical building system (efficiency requirements) 	<p>EED</p> <ul style="list-style-type: none"> Art. 26 - Criteria for efficient district H&C 	<p>EED</p> <ul style="list-style-type: none"> Art. 3 - Energy efficiency first principle Art. 13-20 - Metering and billing Art. 22 - Information and awareness raising Art. 25 - Heating and cooling assessment and planning 	<p>EED</p> <ul style="list-style-type: none"> Art. 8(3) - The proportion of cumulative end-use energy savings that benefits people in energy poverty shall at least be equal to the proportion of people that are affected by energy poverty Art. 24 - Empowering and protecting vulnerable customers and alleviating energy poverty 	<p>ETS 2</p> <ul style="list-style-type: none"> ETS 2 for buildings, road transport and additional sectors Art. 30c - Declining Union-wide quantity of allowances
				<p>EED</p> <ul style="list-style-type: none"> Art. 7 - Public procurement obligated to adhere to high energy efficiency
				<p>EPBD</p> <ul style="list-style-type: none"> Art. 14 - Financial incentives, skills and market barriers

Figure 2: Overview of legislation addressing heating in buildings

While the legislative framework provides several important contributions, binding rules towards full decarbonisation of heating in buildings are insufficient. Figure 3 (below) shows that for moving towards a 2040 framework aligned with the goal of full decarbonisation, the annual increase in the share of renewables in heating and cooling must accelerate, compared to the target values for 2030. To reach full decarbonisation by 2050, an average annual increase of 3.4 percentage points (ppt) is needed – provided that the 2030 target is achieved. In order to reach full decarbonisation by 2040, the average annual increase must rise to 6.8 ppt.

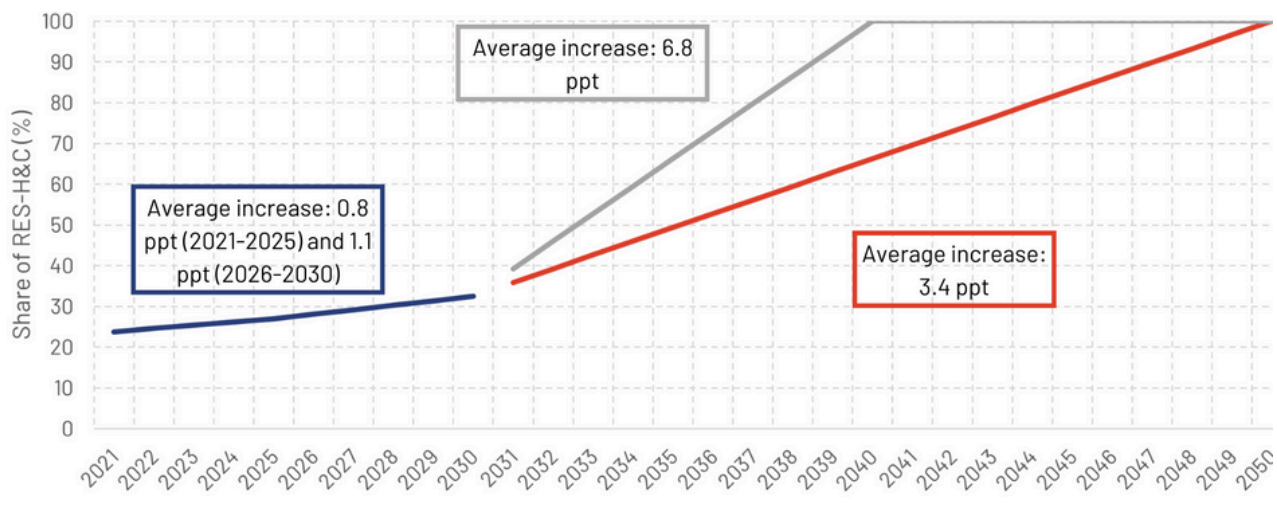


Figure 3: Annual increase of the share of renewable energy in heating and cooling under different pathways

What gaps need to be addressed with regard to the 2040 framework?

The 2040 framework provides the opportunity to close the remaining gap and move towards full decarbonisation of heating and cooling. Our analysis of gaps in the current framework and modelled pathways towards decarbonising heating and cooling in buildings identifies the following gaps.

Clear framework for phasing out of fossil fuels for heating: While several elements of the Fit for 55 framework address the reduction of the use of fossil fuels, no binding pathway towards a full phase-out is included.

Support for renewable heating: All scenarios show a strong increase in the diffusion of renewable heating technologies. This requires an adequate support framework to ensure a socially just transition.

Reducing energy demand: The energy demand reductions achieved in the scenarios require at least a doubling of the retrofit rate. A study by BPIE³ estimates

that an even more ambitious annual deep renovation rate of 3% is required to achieve the 2030 targets. Extending minimum energy performance standards (MEPS) to residential buildings can contribute to achieving this.

Framework for limiting the role of biomass for heating: The framework needs to account for the limited availability of sustainable biomass resources, strengthening the requirements in the recast Renewable Energy Directive (RED II).

Ambitious implementation of the 2030 framework: An ambitious implementation of the requirements of the 2030 is key for any efforts towards full decarbonisation.

To summarise, beyond 2030, future policy frameworks must take a more holistic approach to the low-carbon transition of heating and cooling systems. This strategy would simplify the implementation process and enhance the effectiveness of decarbonising heating and cooling, thereby supporting the EU's climate goals.

Background and objectives

01

The decarbonisation of the European Union's (EU) heating and cooling sector is essential for achieving the objectives set forth in the Green Deal—specifically, attaining net-zero greenhouse gas emissions by 2050—and also for addressing various interconnected socio-economic, security, and environmental challenges. The buildings sector occupies a central role due to its significant contribution to the EU's overall carbon footprint.

The decarbonisation endeavour is critically associated with the issues of energy security and dependency on imported fossil fuels. The EU's dependence on external energy sources not only jeopardises its energy security but also exposes the bloc to geopolitical unpredictability and market fluctuations. An expedited shift towards renewable heating and cooling technologies offers a pathway to diminish this dependency, thereby enhancing the EU's resilience and autonomy.

Moreover, this transition could ameliorate energy poverty and elevate living standards. A substantial segment of the European population currently experiences energy poverty, with people unable to afford the necessary energy for adequate heating or cooling of their homes. The decarbonisation of the heating and cooling sector promises the development of sustainable energy soluti-

ons that are both economically feasible and widely accessible, consequently improving well-being and health outcomes for millions.

The Fit for 55 package represents a key element of EU efforts to cut greenhouse gas emissions by 55% by 2030, and includes important measures for the decarbonisation of the building sector. However, the distribution of these measures across different directives and regulations within the package poses a challenge for implementation.

To reach full decarbonisation by 2050, setting the framework for the year 2040 is of key importance. The 2040 target and policy framework are especially critical for the buildings sector. Given the long lifetimes of building components, buildings must be largely decarbonised by 2040 to meet the 2050 full decarbonisation goal.

Against this background, the study addresses the following questions:

- **Is the EU on track towards decarbonising heating and cooling in buildings?**
- **Is the adopted framework for 2030 aligned with the goal of economy-wide full decarbonisation by 2050?**
- **What gaps need to be addressed in view of the 2040 framework?**

Is the EU on track to decarbonise heating and cooling in buildings?

02

To answer the first question, Figure 4 shows modelling results provided by Member States in the context of their projections submitted under the framework of the Governance of the Energy Union and Climate Action ((EU) 2018/1999). These projections reflect the evolution of greenhouse gas emissions taking into account existing and additional measures. The data were submitted by Member States in March 2023, i.e. prior to the implementation of the provisions in the Fit for 55 framework.

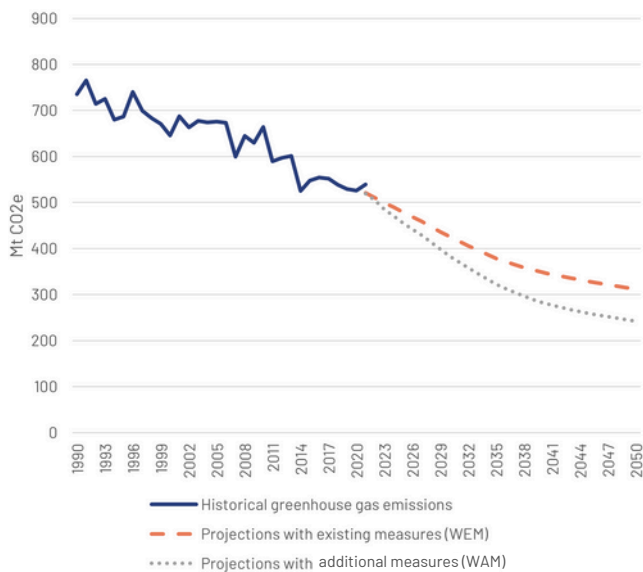


Figure 4: Projected greenhouse gas emissions with existing and additional measures

Source: EEA (2023): Trends and projections in Europe 2023

The projections reveal a considerable gap towards full decarbonisation of heating in buildings by 2050 and thus show that the EU is currently not on track. The projected greenhouse gas emissions in the 'with existing measures' (WEM) and 'with additio-

nal measures'⁴ (WAM) scenarios show remaining greenhouse gas emissions of more than 300 Mt CO₂e (WEM) and around 250 Mt CO₂e (WAM) in the sector by 2050. To decarbonise the sector by 2040, the gap is about 350 Mt (with existing measures) and about 280 Mt (with additional measures).

‘The projections reveal a considerable gap towards full decarbonisation of heating in buildings by 2050 and thus show that the EU is currently not on track.’

Is the adopted framework for 2030 aligned with the goal of full economy-wide decarbonisation by 2050?



3.1 Key elements of the 2030 framework for heating and cooling

Within the framework of the EU Green Deal, the Fit for 55 package, and RepowerEU, several important legislative files have been revised and adopted, with the objective to reduce greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, and to make Europe the first climate-neutral continent by 2050.

The reduction of energy demand is a main priority of the Energy Efficiency Directive (EED), containing various provisions that directly and indirectly affect heating and cooling. In addition, the Energy Performance of Buildings Directive (EPBD) contains key provisions addressing the energy efficiency of the building envelope as well as technical building systems.

The provisions addressing the components of the building envelope mainly address

Reducing energy demand for H&C	Phasing out fossil fuels	Planning, data and information	Social aspects	Financing and energy pricing
<p>EED</p> <ul style="list-style-type: none"> Art. 4 - Collective reduction of FEC by 11.7% by 2030 Art. 5 - All public bodies combined must reduce their FEC by 1.9% annually compared to 2021 Art. 6 - Renovate 3% of total floor area of heated & cooled public body buildings each year to NZEB or ZEB Art. 8 - Cumulative end-use savings obligation annually 	<p>RED</p> <ul style="list-style-type: none"> Art. 23 - Target for annual increase of RES-H&C share (0.8% until 2025 and 1.1% 2026-2030) Art. 23 - Long-term decarbonisation strategies to increase RES in H&C & MS to inform owners/tenants and SMEs on cost-effective measures, and financial instruments on RES in H&C Art. 15a - Target and framework for mainstreaming RES in buildings Art. 24 - Target for renewables in district heating 	<p>EPBD</p> <ul style="list-style-type: none"> Art. 3 - National building renovation plan Art. 10 - Renovation passport Art. 13 - Smart readiness of buildings Art. 14 - Data exchange Art. 14 - Financial incentives, skills and market barriers Art. 15a - One-stop-shops for energy performance of buildings Art. 16-19 - Requirements for Energy Performance Certificates Art. 20-21 - Inspections Art. 22-23 - Requirements for building professionals Art. 26 - Information and awareness-raising campaigns 	<p>SCF</p> <ul style="list-style-type: none"> Art. 1 - Focus on households in energy poverty Art. 2(1) - Legal definition of energy poverty Art. 6 - Vulnerable households mapping in SCPs Art. 7 - Financial support to reduce energy poverty Art. 9 - Pass-on of benefits to households and micro-enterprises Art. 24 - Monitoring MS performance in tackling energy poverty via SCP 	<p>EU Taxonomy</p> <ul style="list-style-type: none"> Art. 9-15 EU-Tax Reg - Contribution to one of six environmental objectives Art. 17 EU-Tax Reg. - DNSH-Criteria Art. 18 EU-Tax Reg. - Minimum safeguard EU-Tax Annex - Criteria under which H&C related economic activities are labeled as sustainable are listed under items 4.15. to 4.25. Adjacent are further items of section 4 (Energy) and 7 (Construction and real estate activities).
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	<p>EPBD</p> <ul style="list-style-type: none"> Art. 9b - Definition of ZEB Art. 11 - Technical building system (strive to replace stand-alone boilers powered by fossil fuels in existing buildings to be in line with the national phase-out plans) 			<p>EED</p> <ul style="list-style-type: none"> Art. 7 - Public procurement obligated to adhere to high energy efficiency
				<p>EPBD</p> <ul style="list-style-type: none"> Art. 14 - Financial incentives, skills and market barriers

Figure 5: Overview of legislative elements addressing heating in buildings

Across these files, numerous important provisions for decarbonising heating in buildings are defined (Figure 5). As Figure 5 shows, the decarbonisation of heating in buildings is addressed through a variety of provisions scattered across different legislation. The next chapter analyses how these provisions help to meet the target of full decarbonisation and identifies key gaps and policy needs.

new buildings and buildings under major renovation, with minimum energy performance standards (MEPS) for existing buildings only addressing non-residential buildings.

The phase-out of fossil fuels for heating is addressed in the RED in the overall target in Art. 23, in addition to several provisions addressing renewables in buildings and district heating. In addition, the EPBD sets requirements for Member States to establish national building renovation plans, with one element of the plan being measures addressing the phase-out of fossil fuels in heating and cooling. The EED contributes to the decarbonisation of district heating by formulating a definition and requirements for efficient district heating.

The need for planning, data and information focused on heating and cooling in buildings is acknowledged in the EED as well as the EPBD. The latter establishes a support framework for building retrofit measures, including, among others, the provision of information on the energy performance of buildings, provisions to support building owners through one-stop shops as well as measures addressing the quality of workforce in the built environment.

Several provisions in the 2030 framework acknowledge that focusing on the social aspects of decarbonising buildings is crucial for ensuring that the process is equitable and beneficial for all. Key provisions in the Social Climate Fund, the Energy Efficiency Directive, and the Energy Performance of Buildings Directive collectively address the challenge of energy poverty while promoting energy efficiency and decarbonisation. The Social Climate Fund offers financial assistance to lower-income households for energy-efficient renovations and renewable energy integration, aiming to alleviate energy bills and improve living conditions.

The EED mandates Member States to identify vulnerable consumers and prioritise them in energy efficiency programmes, directly addressing energy poverty by reducing energy expenditure for low-income households. Meanwhile, the EPBD requires consideration of vulnerable groups in renovation requirements and promotes access to funding for energy-efficient retrofits.

Energy pricing and financing are addressed by several provisions. The ETS 2 is a key element for levelling the playing field between fossil fuels and renewable heating technologies by pricing carbon emissions in the buildings sector (among others). The alignment of the taxation of energy products with EU energy and climate policies is also the objective of the ongoing revision of the Energy Taxation Directive. With respect to the financial sector, the EU Taxonomy defines a framework for classifying economic activities that are aligned with a net-zero trajectory by 2050 and the broader environmental goals other than climate. In addition, several financing mechanisms are available at the EU level, encompassing broad programmes that allocate funds for various initiatives, with the specifics of the fund utilisation being determined by the Member States.

This includes the Recovery and Resilience Facility (a temporary fund running until 2026 established in reaction to the COVID-19 pandemic and the subsequent energy crisis), the funds within the Cohesion Policy framework, including the European Regional and Development Fund (ERDF), the Cohesion Fund (CF), the European Social Fund Plus (ESF+), and the Just Transition Fund (JTF).

Furthermore, Member States accrue substantial revenue through the Emissions Trading System (ETS), which is frequently directed towards energy efficiency projects and the adoption of renewable energy sources. In addition, the Social Climate Fund is set to be implemented to aid Member States in mitigating the extra financial strains on households due to the imposition of carbon pricing on transportation and heating fuels under ETS 2. However, it is likely that the volume of the fund is insufficient and further support is needed⁵.

3.2 Contribution to the goal of full decarbonisation

An important element of the 2030 framework for the heating and cooling sector is the target for increasing the share

of renewable energy in heating and cooling set out in Article 23 of the RED, mandating an average increase of the renewable share by 0.8 percentage points per year for the years until 2025 and 1.1 percentage points for the years 2026-2030.

Figure 6 shows that for moving towards a 2040 framework aligned with the goal of full decarbonisation, the annual increase needs to increase significantly as compared to the target values for 2030. To reach full decarbonisation by 2050, an average annual increase of 3.4 percentage points is needed – provided that the 2030 target is achieved. To fully decarbonise heating and cooling by 2040, an average increase by 6.8 percentage points would be needed.

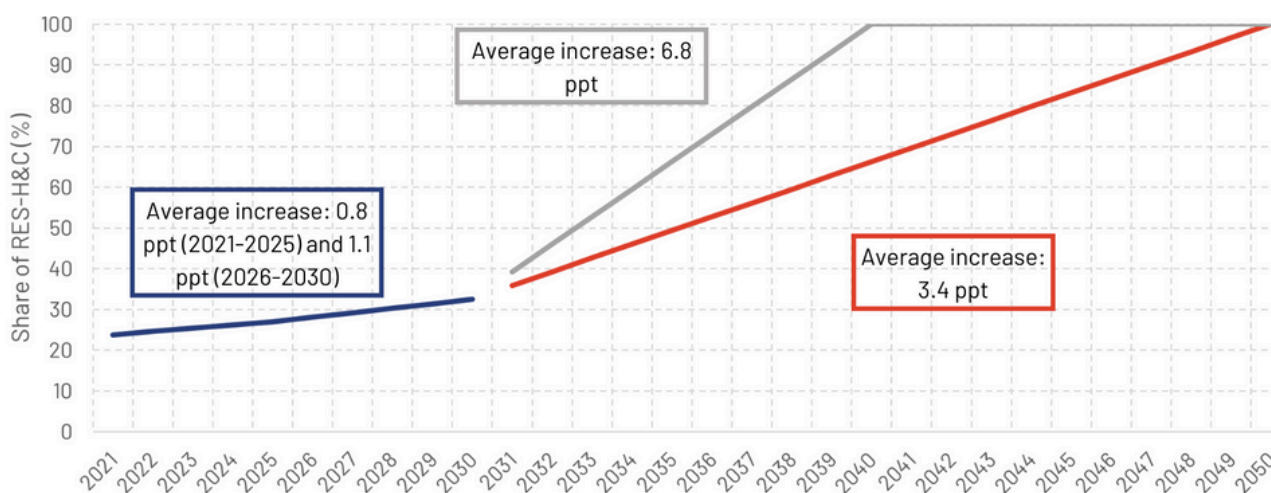


Figure 6: Annual increase of the share of renewable energy in heating and cooling under different pathways

Which gaps need to be addressed with regard to the 2040 framework?

04

To discuss key gaps that need to be addressed in the framework for decarbonising heating and cooling, we compare four recent scenario studies that project pathways towards a full decarbonisation in 2040 or 2050. The four scenarios are:

- The scenarios S1, S2, S3 and LIFE included in the Commission recommendation for a 2040 emissions reduction target to set the path to climate neutrality in 2050⁶.
- The PAC scenario⁷, developed in the PAC project – ‘Paris Agreement Compatible Scenarios for Energy Infrastructure’ – aiming at net-zero greenhouse gas emissions and 100% renewables by 2040. The PAC scenarios represent Paris Agreement-compatible scenarios for Europe’s energy system. These scenarios have been established by civil society organisations to guide European energy infrastructure planning and help to ensure that Europe is planning and building the infrastructure necessary for a future renewables-based energy system guided by three goals: a 65% reduction in greenhouse gas emissions by 2030; net-zero greenhouse gas emissions by 2040; and, 100% renewables in Europe by 2040 in all sectors.
- The CLEVER (Collaborative Low Energy Vision for the European Region) scenario⁸, aiming to reach carbon neutrality at the European level by 2050 at the very latest, together with a 100% renewable mix. This scenario has been developed through a bottom-up approach that starts with the national trajectories constructed by 26 national partners from the academic world, research, or civil society. The scenario presents a pathway that reconciles the long-term climate and sustainability imperatives with the short-term energy security constraints and practical feasibility of such a transformation. It evaluates the potential of energy demand reduction (sufficiency and efficiency) and renewable energy development at the national and European level, with the aim to reach carbon neutrality at the European level by 2050 at the very latest, together with a 100% renewable mix.
- The scenarios developed in the project ‘Renewable space heating under the revised Renewable Energy Directive’⁹, comparing different pathways towards full decarbonisation of heating and cooling by 2050. It is one of the most comprehensive studies addressing detailed pathways for decarbonising the buildings sector.

In Section 4.1 we compare the different pathways for phasing out fossil fuels and discuss the needs to develop a comprehensive framework across the different legislations.

Section 4.2 focusses on the role of different renewable energy technologies for decarbonising heating and cooling, while Section 4.3 focusses on the reduction of energy demand. The role of biomass is discussed in Section 4.4 and the implementation of the 2030 framework is considered in Section 4.4.

4.1 Phasing out fossil fuels for heating and cooling

An important gap that needs to be closed is the development of a clear framework for phasing out fossil fuels. Figure 7 shows different pathways for reducing fossil fuel use for heating and cooling¹⁰ in residential buildings compared to their 2020/2021 base value.

- The PAC scenario is the most ambitious, where the residential sec-

tor is decarbonised by 2040 through a fast and steep reduction of fossil fuel use in the coming years.

- The scenarios in the recommendation for the EU 2040 framework (EU FW) provide for an initial sharp reduction in gas¹¹, but only until the year 2030. The focus then shifts to a steep and almost complete reduction of the use of oil and coal in the years 2030 to 2040. Gas, on the other hand, is only reduced by 5-10% between 2030 and 2040 (see graphs for S1, S2, S3 and LIFE). The remaining share of gas use in the residential H&C sector is then to be reduced in the last decade in order to achieve the climate targets.
- The CLEVER scenario ranks roughly in the middle with a constant and almost linear reduction in fossil fuels over the years and a slight weighting of the oil reduction by 2035.

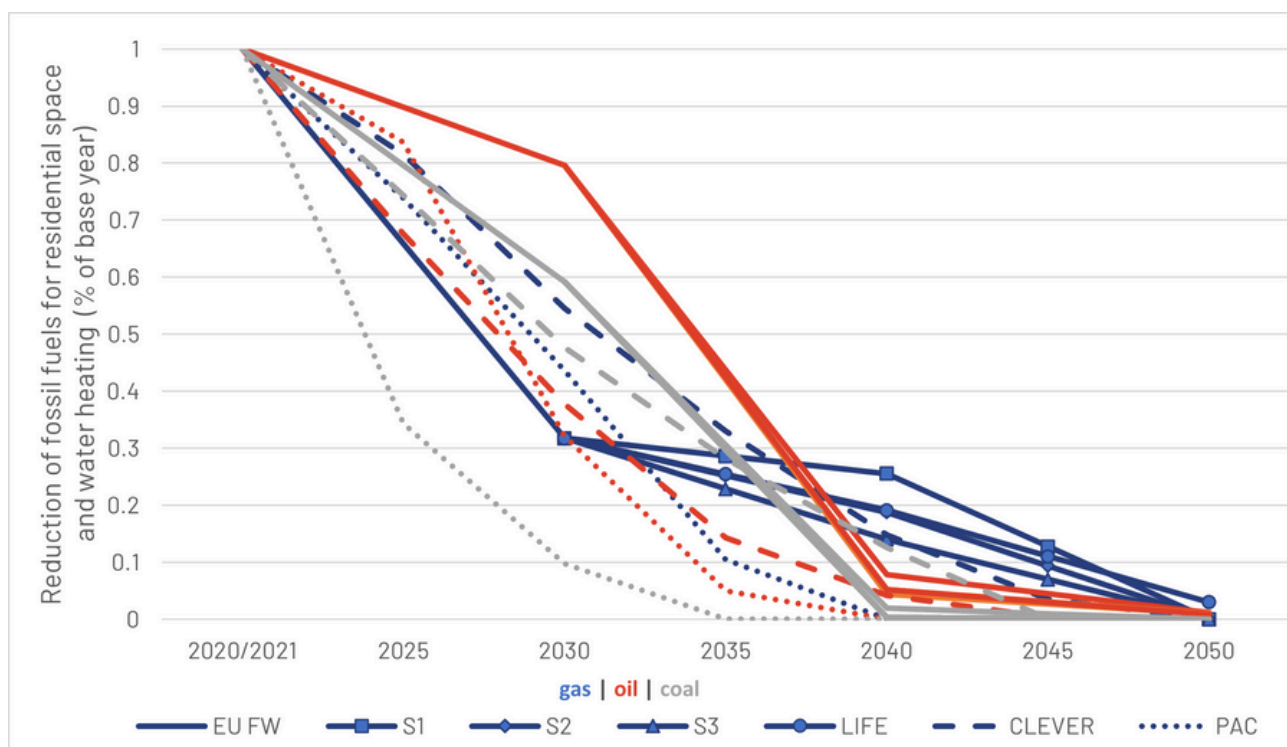


Figure 7: Comparison of different modelling results towards full decarbonisation of heating¹² in residential buildings. The figure shows the percentage reduction of fossil fuels used for residential space and water heating based on 2020 (CLEVER and PAC), 2021 resp. (S1, S2, S3, LIFE). *CLEVER Scenario does not include geothermal heat.

From the comparison of the scenarios, the following conclusions can be drawn:

- Fossil fuels are nearly phased out in all scenarios by 2040, except for gas in the scenarios S1, S2, S3.
- For these scenarios, it seems unclear how the highly ambitious achievements by 2030 are supported and why the ambition decreases rapidly between 2030 and 2035.
- Concluding, a framework for (nearly) phasing out fossil fuels by 2040 is needed to support the developments shown in the scenarios.

At the EU level, the phase-out of fossil fuels for heating and cooling needs to be addressed consistently across all relevant legislations, and remaining gaps in the 2030 framework need to be addressed. This may include a strengthening of the provisions in the revised **EPBD**, including concrete measures to ensure the transformation of the EU building stock into a zero-emission building stock by 2050, or preferably 2040. Currently, phasing out fossil fuels is mainly addressed in the EPBD by passing the responsibility to the Member States by requiring them to establish national building renovation plans (NBRP), containing an obligation to include policies and measures addressing the phase-out of fossil fuels in heating and cooling with a 'view to a complete phase-out of fossil fuel boilers by 2040'.

Phasing out fossil fuel heating can further be supported by the **Ecodesign** implementing regulations for heating systems, where a phase-out of mono-fuel fossil heating systems could be introduced

by defining minimum thresholds for the efficiency of heating systems that exceed 100%. The approach was first proposed in the EU Save Energy Communication¹³ and offers the advantage of a harmonised framework for phasing out fossil fuels at EU level. However it faces the risk that the ambition of the legislation would be set at a low level to adapt to the needs of the most affected countries and regions and therefore needs to be integrated and aligned with the provisions in other directives.

In the **Renewable Energy Directive**, the requirement to introduce minimum renewable shares in buildings according to Art. 15(4) provides a direct link to national phase-out legislation by means of a use obligation. Strengthening the requirements of Art. 15(4) by adding a quantitative minimum share thus provides an opportunity to support the phase-out of fossil fuels for heating at the EU level. In addition, implementation of the RED could support the phase-out of fossil fuels for heating and cooling by aligning the target of Article 23 for increasing the renewable share with the pathways towards full decarbonisation.

The **Energy Efficiency Directive (EED)**, while not being the core directive for phasing out fossil fuel boilers, can contribute to the framework through the requirements on public buildings and by encouraging the use of heat pumps for achieving final energy savings.

The analysis concludes that an ambitious approach for phasing out fossil fuels for heating in the EU would benefit from introducing an integrated approach for the

2040 framework. This would require a clear action plan with timelines for phasing out fossil fuels for heating and cooling, as well as a coherent approach for translating the timelines into clear requirements across the directives discussed above.

4.2 Support for renewable heating

The year 2040 is critical for achieving full decarbonisation in 2050. Figure 8 shows the residential and tertiary heating and cooling demand and describes different pathways for meeting full decarbonisation in heating and cooling by 2050.

To achieve the required rollout of renewable heating, a comprehensive strategy and action plans are needed to support the diffusion of these technologies. In view of the long lifetimes of heating appliances and the resulting low replacement rates, achieving the necessary diffusion of heat pumps and other renewable heating technologies requires a strong support framework. As the modelling results displayed in Figure 8 consider full decarbonisation by 2050, meeting the objective of full decarbonisation by 2040 demands a significantly increased effort and accelerated diffusion of the technologies.

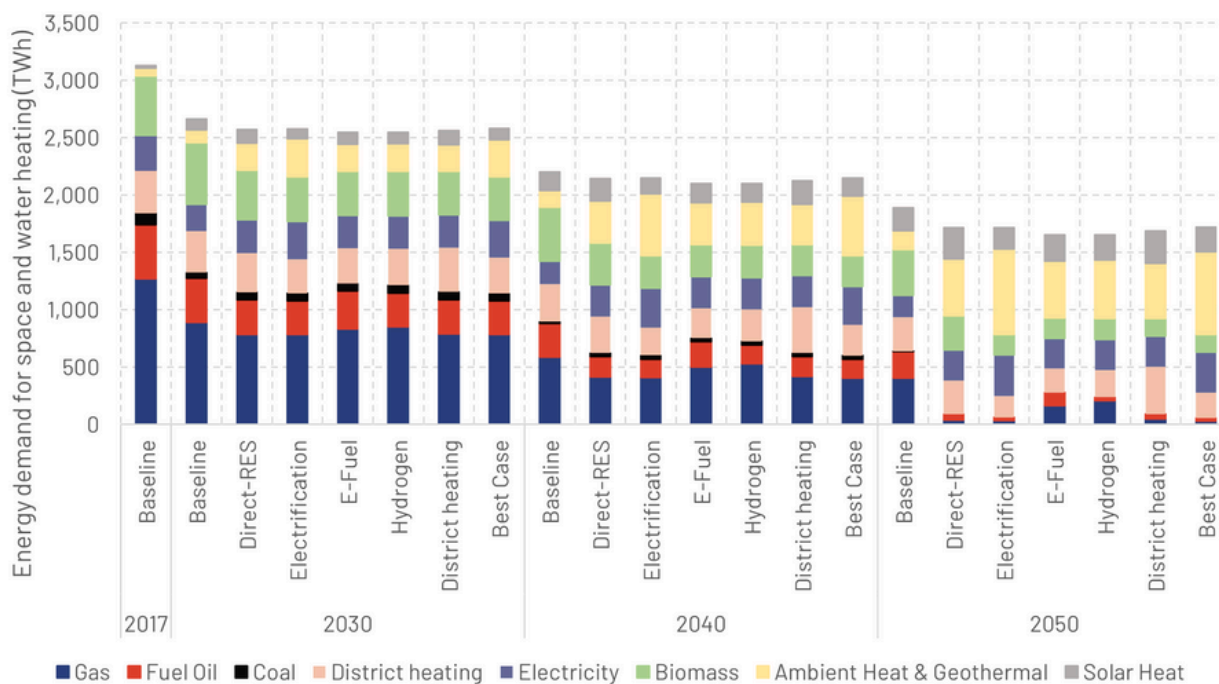


Figure 8: Comparison of different modelling results towards full decarbonisation of the buildings sector.

Source: ENER/C1/2018-494 – Renewable space heating under the revised Renewable Energy Directive.

The figure shows that across all scenarios, the use of heat pumps strongly increases by 2030 and throughout the development until 2050. This is reflected in the strong increase in ambient heat and geothermal. In addition, solar heat and district heating gain importance across all scenarios. The development of biomass for heating declines¹⁴.

4.3 Reducing energy demand

To achieve full decarbonisation of heating and cooling by 2040/2050, all scenarios assume significant reductions of final energy demand (see Figures 8-9). To achieve these reductions, the retrofit rate needs to increase. For example, in the scenarios underlying the 2040 target recommendation (S1, S2, S3, LIFE), the renovation rate for residential buildings more than doubles by 2030 from less than 1% to 2.2/2.3% and for buildings in the service sector from 0.5% to 1.3/1.4%. A study by BPIE¹⁵ estimates that an even more ambitious annual deep renovation rate of 3% is required to achieve the 2030 targets.

However, the provisions in the current framework at EU level do not even seem sufficient to support a doubling of renovation rates, never mind a tripling. With the introduction of minimum energy performance standards (MEPS) being limited to non-residential buildings, there remains a gap for effectively addressing the retrofit rate for residential buildings in the policy framework.

Closing this gap and providing a framework in particular for addressing the renovation of the worst-performing buildings is an important element to move towards full decarbonisation of heating and cooling in the EU building stock.

4.4 Framework for limiting the role of biomass for renewable heating

The renewable share of heating and cooling in the EU currently relies heavily (80%) on biomass. The predominant form

of biomass used for heating is solid biomass, accounting for 95% of all biomass heating in 2019, followed by biogas at 4%, and bioliquids at 1%.¹⁶ Several authors have pointed out constraints on the potential contribution of biomass to achieving climate neutrality^{5,17}. Given the finite nature of biomass resources, their utilization should be prioritised for durable, high-value applications, such as in the production of wood-based products¹⁸.

The scenarios shown in Figure 8 show that despite the strong decline in the use of fossil fuels, the use of biomass also decreases. In order to ensure that the decrease of fossil fuels is not compensated by an increase in biomass use, the resource availability constraints for sustainable biomass must be clearly reflected in a future framework for the decarbonisation of heating and cooling in the EU. This could include, among others, constraints on the share of biomass allowed as a contribution to meet the targets for heating and cooling specified in Article 23 of the Renewable Energy Directive¹⁹.

4.5 Ambitious implementation of the 2030 framework

The framework for 2040 depends critically on the achievements until the year 2030. To pave the way towards full decarbonisation, it is essential that the framework for 2030 (see Figure 5) is fully implemented by Member States.

For the **reduction of energy** demand, meeting the targets set in Article 4 of the EED requires significant additional effort by Member States, where the buildings

sector will play an important role.

However, with the EPBD taking an incremental approach towards residential buildings, the responsibility to define and implement actual policy instruments that lead to reduced energy demand is up to the Member States. The Commission should develop strong, simple and clear guidance for Member States on how to approach implementation ambitiously and ensure that the necessary financial support is available.

For **increasing the share of renewable energy in H&C**, Figure 9 shows that even meeting the (relatively unambitious) targets for increasing renewable heating and cooling until 2030 requires significant additional efforts in many Member States. Almost half of the countries currently fall below meeting the target set for the years 2021-2025 and about two-thirds of the countries are currently below the target set for 2026-2030, among them countries with highest absolute energy demands for heating and cooling, such as Germany and Italy.

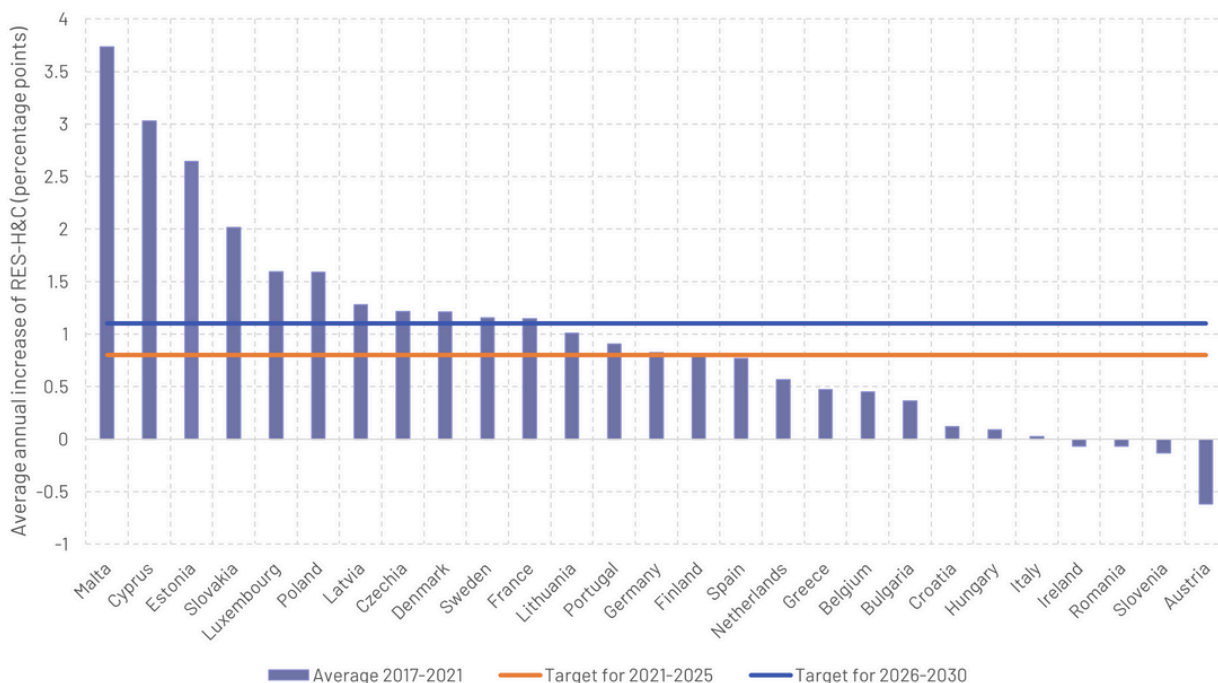


Figure 9: Average increase of the share of RES-H&C in the years between 2017-2021 and targets until 2030 in RES-Directive

Given the fact that the targets specified until the year 2030 are an insufficient contribution to the full decarbonisation of heating and cooling and would multiply the needed efforts for achieving full decarbonisation by 2040 or 2050 (see Figure 6), Member States should aim at overachieving the targets. Figure 10 shows the gap between the current annual increase rates needed to meet full decarbonisation by 2040.

In addition to the target for increasing renewables in H&C, the responsibility for designing the framework to support the

phase-out of fossil fuels for heating up to 2030 lies mainly with the Member States. Phasing out fossil fuels by 2040 is stated as a non-binding objective in the EPBD, and Member States have to provide details on the 'transformation of existing buildings into zero-emission buildings by 2050' in their national building renovation plans. It is therefore essential that Member States provide plans that are consistent with the objective of full decarbonisation by 2050 or preferably 2040.

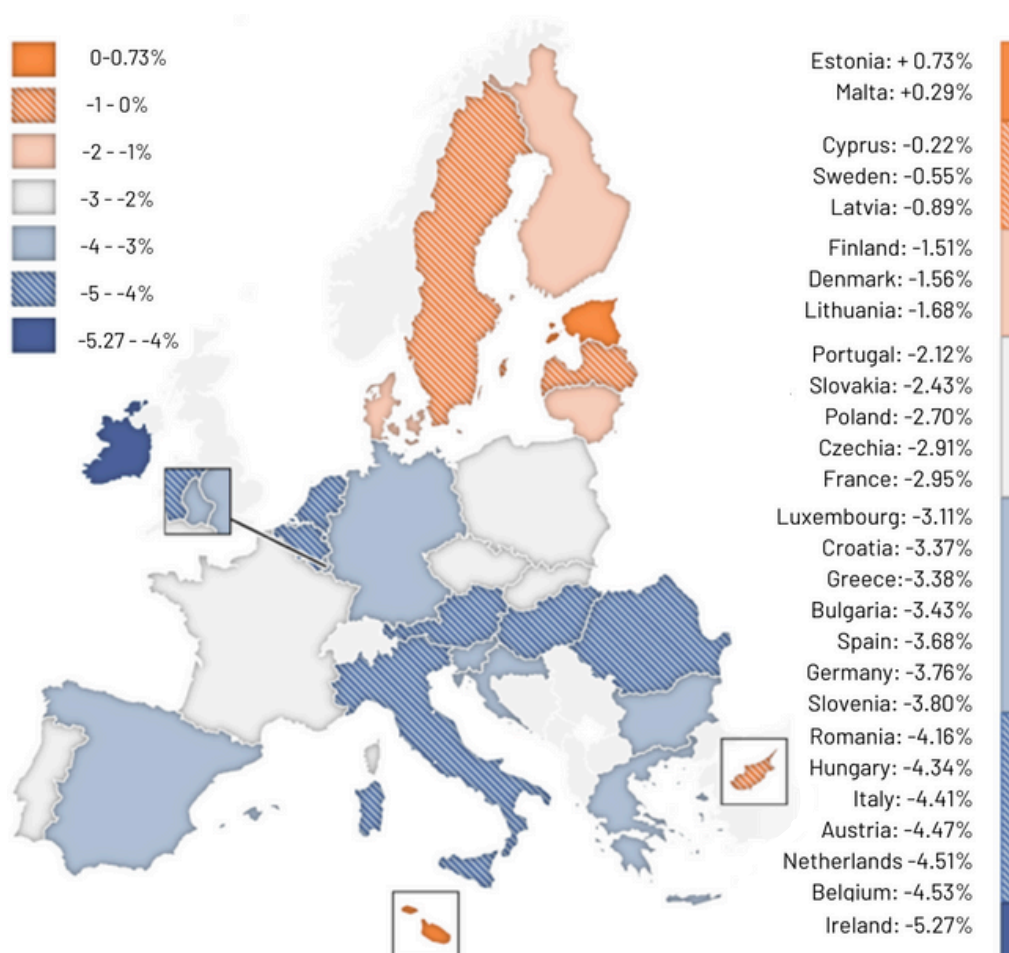


Figure 10: Gap towards meeting targets for full decarbonisation of heating and cooling in 2040 by country

Conclusions

05

The study shows that the transition of heating and cooling is currently not on track towards full decarbonisation – neither by 2040 nor by 2050. The EU energy and climate framework for the year 2030 contains important elements for the transition of heating and cooling, however several gaps remain.

To close these gaps, the decarbonisation of heating and cooling requires a comprehensive and integrated strong framework that addresses the reduction of energy demand in buildings and the phase-out of fossil fuels, while taking into account the differing needs of those owning and occupying the buildings. To achieve coherence between the provisions scattered across the directives, an integrated strategy that develops the key goals and milestones and connects these to key provisions in the directives would be beneficial.

Our analysis of gaps in the current framework and modelled pathways towards decarbonising heating and cooling in buildings identifies the following recommendations:

Clear framework for phasing out of fossil fuels for heating: While several elements of the Fit for 55 framework address the reduction of the use of fossil fuels, no binding pathway towards a full phase-out is included. Previous estimates²⁰ conclude

that the implementation of a ban for installing fossil boilers starting from January 2025 would make up for 10% of the greenhouse gas emissions reduction target at EU level for 2030. In addition, the reduction of gas consumption by 2030 induced by this measure is estimated to be equivalent to 8% of total gas imports (21% of imports from Russia).

Support for renewable heating: All scenarios show a strong increase in the diffusion of renewable heating technologies. This requires an adequate support framework to ensure a socially just transition. The Social Climate Fund has the potential to specifically support vulnerable households in participating in a socially-just energy transition through decarbonising their homes. However, it is likely that the volume of the fund is insufficient and further support is needed.

Reducing energy demand: The energy demand reductions achieved in the scenarios require at least a doubling of the retrofit rate. Extending minimum energy performance standards (MEPS) to residential buildings can contribute to achieving this. Previous estimates by Climact and BPIE²¹ show the strong potential of MEPS to contribute to reducing greenhouse gas emissions, showing that MEPS with an ambitious design could potentially reduce greenhouse gas emissions by 21%,

contributing to achieving one-third of the building sector target for 2030, with residential buildings accounting for a large share of the savings.

Framework for limiting the role of biomass for heating: The framework needs to account for the limited availability of sustainable biomass resources, strengthening the requirements in the RED.

Ambitious implementation of the 2030 framework: An ambitious implementation of the requirements of the 2030 legislative framework is key for any efforts towards full decarbonisation.

‘It is crucial that the requirements set in the 2030 target framework are fully implemented and that the targets and objectives are met or overachieved to pave the way towards decarbonising heating and cooling.’

In summary, looking beyond 2030, future policy frameworks should seize the opportunity to address the transition of heating and cooling in a more integrated manner. Such a strategic shift would streamline the implementation process, ensuring that the decarbonisation of heating and cooling can more effectively contribute to the EU's climate objectives, facilitating the transition towards energy-efficient, fossil fuel free buildings, and marking a significant step forward in the EU's path to sustainability and climate resilience as well as energy and geopolitical security.

References

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- 3 BPIE (2022): Report on the evolution of the European regulatory framework for buildings efficiency
- 4 These scenarios include all measures that had been planned by the Member States by the time of developing the projections and thus do not reflect full implementation of the Fit for 55 framework.
- 5 See e.g. Delors Institute (2024) Make the Social Climate Fund a game changer to tackle energy poverty; Agora Energiewende (2022): Delivering RePowerEU: A solidarity-based financing proposal; I4CE (2024): European Climate Investment Deficit report
- 6 The description of the proposal as well as the documentation for the scenarios found at: https://ec.europa.eu/commission/presscorner/detail/en/ip_24_588
- 7 More information on the PAC scenario is found here: <https://www.pac-scenarios.eu/>
- 8 More information on the CLEVER scenario is found here: <https://clever-energy-scenario.eu/>
- 9 More information on the scenarios is found here: <https://op.europa.eu/en/publication-detail/-/publication/16710ac3-eac0-11ec-a534-01aa75ed71a1/language-en>
- 10 Note that cooling is largely based on electricity and thus does not directly use fossil fuels.
- 11 The report does not elaborate on the measures that drive the steep reduction of gas demand up to 2030.
- 12 Space cooling is not displayed as the (direct) use of fossil fuels for space cooling is negligible.
- 13 European Commission (2022): EU 'Save Energy'. COM(2022) 240
- 14 The category biomass shows all biomass used for individual heating of buildings and does not show the use of biomass in district heating.
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- 20 Oeko-Institut (2022): Impact of a ban of fossil heating technologies on NECPs and national energy dependency.
- 21 Climact and BPIE (2022): Impact assessment of the MEPS under discussion in the context of the EPBD revision.

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