Scientific advice for amending the European Climate Law

Setting climate goals to strengthen EU strategic priorities

European Scientific Advisory Board on Climate Change

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About the European Scientific Advisory Board on Climate Change

The European Scientific Advisory Board on Climate Change (hereafter 'the Advisory Board') is an independent scientific advisory body that provides the EU with scientific knowledge, expertise and advice relating to climate change. The Advisory Board identifies actions and opportunities to achieve the EU's climate neutrality target by 2050. The Advisory Board was established by the European Climate Law of 2021, with a mandate to serve as a point of reference for the EU on scientific knowledge relating to climate change by virtue of its independence and scientific and technical expertise.

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The Advisory Board is supported in the execution of its tasks by a secretariat, hosted by the European Environment Agency.

Summary and recommendations

This advice forms part of the Advisory Board's mandate to assess the coherence of EU climate targets with the European Climate Law and the EU's international commitments under the Paris Agreement. It aims to support the EU in aligning its long-term climate ambition with strategic opportunities to boost resilience, competitiveness and sustainability. Building on this foundation, the current report reaffirms the Advisory Board's 2023 recommendation, consolidates its 2024 and 2025 advice on policy opportunities to support EU climate targets, and introduces a new, dedicated recommendation on climate adaptation.

Amidst accelerating global warming, the EU prepares to set its 2040 climate target

Climate change remains an existential threat, with global temperatures already 1.3–1.4 °C above pre-industrial levels. In 2024, the hottest year ever recorded worldwide and in Europe, the continent endured record-breaking heat stress and an unprecedented number of frost-free days. As the fastest warming continent, Europe is already facing mounting human and economic losses from extreme heat, catastrophic floods and disruptions to critical infrastructure. These escalating impacts are driven by rising concentrations of greenhouse gases in the atmosphere, underscoring the urgent need for rapid and sustained global emission reductions, combined with a substantial scale-up of carbon dioxide removals.

As part of the global response to climate change, the European Union has committed to achieving net-zero greenhouse gas emissions by 2050 and net-negative emissions thereafter, as enshrined in the European Climate Law. To reach climate neutrality, the law sets a binding intermediary target of a 55 % net reduction in greenhouse gas emissions by 2030. To meet this target, the EU has adopted a comprehensive package of legislation. This target is within reach, as illustrated by recent emission trends, including a 9 % decline in EU emissions in 2023 – the largest annual reduction ever recorded in Europe. Sustained progress will require continued implementation across all Member States, ensuring that adopted policies are fully delivered on the ground.

The European Climate Law requires that the EU set a further intermediary target for 2040, to ensure progress towards the 2050 climate neutrality. In 2023, the Advisory Board recommended a domestic net greenhouse gas emission reduction target of 90–95 % below 1990 levels by 2040. This recommendation is based on modelled emission pathways consistent with the EU's climate neutrality commitment and the Paris Agreement temperature goal. In 2024, the European Commission recommended a 2040 target of a 90 % net emission reduction, consistent with the Advisory Board's scientific advice and supported by its own impact assessment. A formal legislative proposal to enshrine the 2040 target in the European Climate Law is expected in 2025 and will guide the preparation of the EU's next contribution under the Paris Agreement.

Climate action must remain a priority to address multiple EU challenges

Alongside the worsening climate crisis, the EU faces a growing set of interlinked challenges. Russia's war of aggression in Ukraine has disrupted fossil fuel supply chains and underscored Europe's vulnerabilities. Geopolitical tensions, inflation and rising public debt are increasing economic strain, while global competition on clean technologies intensifies. Yet, many of the needed responses are already in motion. Recent progress shows that, with the right policies, some of the necessary transformations across society and the economy are not only possible but underway. A faster deployment of renewable energy, modernisation of electricity grids and electrification of energy end-users, supported by reductions in the use of energy and materials, have already contributed to reducing the EU's dependency on fossil fuels, enhancing strategic autonomy and supporting price stability, while delivering on climate goals. Beyond

the energy system, climate action supports healthier environments, more resilient infrastructure, sustainable agriculture and improved quality of life across Europe.

Three landmark policy reports published in 2024 by three European leaders – Enrico Letta, Mario Draghi and Sauli Niinistö – identify key strategic challenges for the EU's future and underscore, in line with scientific evidence, that climate action should be central to the EU's long-term strategy. They highlight the need to strengthen the EU single market for clean technologies, increase investment in the green transition to restore competitiveness, and treat climate resilience as a pillar of European security. Echoing these strategic priorities, recent European Commission initiatives reflect a more integrated approach to climate policy. The Clean Industrial Deal links decarbonisation to industrial competitiveness and leadership, while the European Preparedness Union Strategy places climate adaptation at the core of the EU's approach to risk management, resilience and security. To be effective, these strategies need to be anchored in a predictable and science-based policy framework, especially regarding the EU's climate ambition.

Pursuing a 90–95 % domestic target for 2040 remains feasible and credible towards climate neutrality

As EU lawmakers prepare to debate the proposed 2040 target, the Advisory Board has reviewed its 2023 recommendation in light of evolving priorities and the latest scientific evidence. It concludes that achieving a 2040 emission reduction of 90–95 % domestically remains both feasible and would keep the EU on a credible path to climate neutrality by 2050. Aiming for a lower target would not only jeopardise the EU's progress towards this goal, but also undermine its sustainability, long-term competitiveness and energy security in a time of geopolitical uncertainty.

Reaching the recommended 2040 target requires deep emission reductions across the economy. At the same time, the EU should accelerate the development and deployment of carbon dioxide removals, which will be critical to counterbalancing residual emissions and achieving net-zero and net-negative emissions. To support this, the Advisory Board recommends setting separate 2040 targets for gross emission reductions, permanent carbon dioxide removals and temporary carbon dioxide removals.

Recent trends provide reassurance about the feasibility of a 90–95 % domestic target. Sustained emission reductions and strong progress in renewable deployment, with wind and solar roll-out in line with scenarios consistent with a 90–95 % reduction, demonstrate what is possible with the right support. While progress in other sectors has been more uneven, including a slowdown in the uptake of electric vehicles and heat pumps in some Member States, these are largely the result of short-term market uncertainty and policy adjustments. The EU's climate policy framework remains robust, but maintaining momentum will require renewed political commitment, stable investment signals and coordinated action across sectors. With these in place, the EU can stay firmly on track towards a 90–95 % reduction by 2040.

The 90–95 % emission reduction target recommended by the Advisory Board is expressed in domestic terms, as it is intended to place the EU on a feasible, credible and cost-efficient trajectory towards achieving climate neutrality by 2050, and to increase the fairness of the EU's contribution to global mitigation. While not fully aligned with what would constitute a fair share of global mitigation efforts, this level of ambition helps to bridge the gap between the EU's feasible pathway and its broader responsibility under the Paris Agreement. Achieving this target through domestic action will also reinforce the EU's long-term competitiveness by accelerating clean technology innovation, reducing fossil fuel dependency and driving investment in future-oriented sectors.

Using international carbon credits to meet this target, even partially, could undermine domestic value creation by diverting resources from the necessary transformation of the EU's economy, including

investments in infrastructure, skills and innovation. International credits might appear cost-effective from a global perspective, but they entail significant risks to carbon markets and environmental integrity, including concerns about additionality, emissions being displaced to other regions (leakage) as well as robust monitoring, reporting and verification. For these reasons, the Advisory Board does not recommend using international carbon credits to replace domestic emission reductions when meeting the 2040 target.

At the same time, the EU also has a responsibility to support global climate action beyond its borders. A fair and equitable contribution to global mitigation entails complementing strong domestic action with robust international support, provided it delivers genuine additional mitigation benefits and upholds environmental integrity. This can include mechanisms to support climate action abroad without substituting for domestic efforts or relying on the acquisition of carbon credits, in line with the EU's responsibilities under the Paris Agreement. The potential contribution of high-quality international credits from carbon dioxide removal towards the EU's achievement of net-negative emissions, after reaching climate neutrality domestically, should be further explored.

Cutting emissions and adapting to climate impacts must go hand in hand

While ambitious domestic mitigation efforts are essential for the EU to respect its global climate commitments, the parallel urgency of enhancing resilience to climate-related risks must be acknowledged. Adaptation protects against present and future climate impacts, safeguarding infrastructure, economies and livelihoods. However, without adaptation metrics and goals, progress remains difficult to track, and risks remain unmitigated. It is therefore imperative to establish clear, measurable objectives not only for emission reductions but also for adaptation, to ensure that policies are both effective and accountable. Strengthening the EU's legal framework and governance for adaptation will be essential to improve coordination, ensure accountability and deliver on the commitments under the Paris Agreement.

* * *

Based on the review of its 2023 scientific advice on an EU 2040 target, in light of evolving context and the latest scientific evidence, the Advisory Board makes the following recommendations.

Recommendation 1. To fulfil its commitments under the Paris Agreement and the European Climate Law, the EU should adopt a net domestic greenhouse gas emission reduction target for 2040 in the range of 90–95 % relative to 1990 levels.

- A 90–95% emissions reduction on EU territory for 2040 would keep the EU on a feasible and credible trajectory towards achieving climate neutrality by 2050, while enhancing the fairness of its contribution to global mitigation, in line with the commitments under the Paris Agreement and the European Climate Law. This level of ambition is underpinned by robust pathways that consider technological feasibility, environmental risks, and cost-efficiency. While not fully reflecting what would constitute a fair share of global mitigation efforts, it helps to bridge the gap between what is feasible within the EU and what is equitable in the context of the Paris Agreement.
- Achieving this target is within reach, as shown by the recent acceleration of EU emission reductions, the growing availability of clean technologies, and the adoption of supportive fit for 55 policies. These should be fully implemented and reinforced in the post-2030 framework.

- By increasing policy certainty, a 90–95 % domestic reduction target offers strategic benefits for the EU and the transformation of its economy, such as boosting clean technology innovation and reducing dependence on fossil fuel imports.
- Speed matters. Early domestic action is critical to achieving the 2040 target, minimising cumulative emissions, avoiding abrupt reductions later, and accelerating innovation and cost reductions.
- Post-2030 policies should build on robust socioeconomic impact assessments and be designed to minimise negative effects. This includes cost-effective measures such as emissions trading, targeted innovation support and investment in power infrastructure. A just transition should be supported through redistributive measures and structural funding, including from redirected fossil fuel subsidies and emissions trading revenues.

Recommendation 2. To ensure that both temporary and permanent removals contribute effectively to climate goals without deterring emission reductions, the EU should set three separate 2040 targets for gross emission reductions, permanent carbon dioxide removals and temporary carbon dioxide removals.

- Domestic carbon dioxide removals can contribute to the EU's 2040 target by counterbalancing residual emissions from activities that currently have no or limited mitigation alternatives.
- Public institutions need to manage removals, invest in them and support viable business models for their rapid, sustainable scale-up. This is essential to counterbalance residual emissions and enable net-negative emissions after 2050.
- Separate targets for gross emissions, permanent removals and temporary removals will help prevent mitigation deterrence – that is, delays in either emission reduction or removal efforts – and avoid the diversion of investments from emission reductions. The targets should also reflect the distinct features of permanent and temporary removals. These targets should be set in the European Climate law or subsequent legislation and form part of a broader EU carbon dioxide removal framework that ensures high-quality removals, supports the restoration of the land sink, fosters innovation and enables infrastructure development. The framework should also include effective pricing tools, such as the gradual integration of permanent removals into the EU ETS and the introduction of extended emitter responsibility.

Recommendation 3. To comply with the Paris Agreement and contribute to limiting global warming to 1.5 °C, the EU should strengthen support, cooperation and partnerships that advance climate action beyond its borders.

- International cooperation and climate diplomacy strengthen fairness, support greenhouse gas emission reductions across all sectors, help manage carbon leakage and align efforts on net-negative emissions and adaptation strategies.
- Even a 95 % domestic reduction by 2040 still leaves a gap between the EU's contribution and its fair share of global mitigation efforts. In parallel, the EU is committed under its treaties and the Paris Agreement to supporting climate action in developing economies. Expanding international support can therefore help reduce the fairness gap while advancing global progress towards the Paris Agreement goal.
- EU external action should include alliances on carbon pricing, strategic investments in clean technologies, technology cooperation and increased climate finance. This could be pursued through mechanisms under Article 6 of the Paris Agreement, including international credits,

provided these are not counted towards the EU 2040 or 2035 domestic emission reduction targets.

- The potential contribution of high-quality international credits from carbon dioxide removal towards the EU's achievement of net-negative emissions, after reaching climate neutrality domestically, should be further explored.

Recommendation 4. To prepare for intensifying climate hazards, the EU should strengthen its climate adaptation framework by clarifying its vision for climate resilience and preparedness, and supporting it with effective governance and a solid legal foundation.

- Climate risks are intensifying, threatening ecosystems, infrastructure, public health and the EU's financial system. Effective adaptation, including transformational measures that involve fundamental shifts in land use, infrastructure and governance, can reduce these risks and deliver broad social and economic benefits.
- Under the Paris Agreement's global goal on adaptation, measurable global targets are expected to be set at the 30th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP30) in 2025. The EU legal framework should be revised to reflect and implement the outcomes of this process.
- The current EU adaptation framework lacks a clear vision, measurable objectives and a strong legal basis. Efforts at both the EU and national levels remain fragmented and lag behind the pace and scale of climate impacts.
- The European Climate Law – or subsequent legislation should establish measurable EU-level adaptation targets and indicators aligned with the Paris Agreement, support monitoring, evaluation and learning, and strengthen governance to improve coordination across EU institutions and Member States.

1. Introduction

Considering the upcoming amendment to the European Climate Law, the European Scientific Advisory Board on Climate Change (hereafter 'the Advisory Board') reiterates its earlier recommendations and brings forward updated scientific insights to inform EU policymakers.

The Advisory Board's input responds to the explicit mandate in the European Climate Law tasking it with providing scientific advice on existing and proposed EU measures, climate targets and indicative greenhouse gas budgets, and their coherence with the objectives of the European Climate Law and the EU's international commitments under the Paris Agreement (EU, 2021a).

The Advisory Board has not yet issued a specific report dedicated to adaptation, though related recommendations have been included in previous publications (Advisory Board, 2022, 2023b, 2024b, 2025). With several key policy developments underway and the risk that low ambition could become locked in, leading to increased climate impacts, the Advisory Board finds it necessary to outline a guiding framework to support the preparation of a strong adaptation policy package.

Chapter 2 reiterates the case for climate action by linking the climate crisis with other major challenges facing Europe and emphasising the role of the European Climate Law. The Advisory Board reviews the latest physical science of climate change, drawing on reports from the Intergovernmental Panel on Climate Change (IPCC), the European Environment Agency (EEA) and the World Meteorological Organization (WMO). It also considers the broader geopolitical and economic context shaping the EU's response, and points to the key EU policies addressing these challenges, including the proposed 2040 target and emerging post-2030 legislation.

Chapter 3 revisits and updates the Advisory Board's recommendation for a 2040 greenhouse gas reduction target of 90–95 %. It builds on findings from the 2023 report *Scientific advice for the determination of an EU-wide 2040 climate target and a greenhouse gas budget for 2030–2050*, which was informed by a review of fair and feasible emission pathways from the scientific literature. The chapter incorporates recent evidence on technology development and deployment from scientific, industry and institutional sources. Drawing also on the Advisory Board's reports *Towards EU Climate Neutrality – Progress, policy gaps and opportunities* (2024) and *Scaling up Carbon Dioxide Removals – Recommendations for navigating opportunities and risks in the EU* (2025), it outlines the key elements of the post-2030 climate policy framework and discusses flexible and pragmatic approaches to implementing the 2040 target.

Chapter 4 provides a high-level rationale and guidance for strengthening the EU's climate adaptation policy framework. Based on academic research and EU institutional analysis, the Advisory Board assesses adaptation policy needs, gaps and opportunities, offering initial recommendations to strengthen its climate adaptation framework and coherence in the post-2030 context.

2. Why climate action remains an EU strategic priority

Climate change is a defining threat to EU prosperity. Global temperatures have risen to 1.3–1.4 °C above pre-industrial levels, driving more frequent and severe climate extremes. The resulting human and economic losses both in Europe and globally are increasing fast, while natural and human systems are pushed towards irreversible changes. To halt and reverse global warming, global efforts need to maintain and accelerate cutting greenhouse gas emissions while simultaneously removing carbon dioxide (CO_2) from the atmosphere through capture and durable storage. Through the Paris Agreement, the EU and its Member States are committed to pursuing efforts to limit the global temperature increase to 1.5 °C, strengthening its adaptation efforts and providing finance, technology and capacity-building support to less developed economies.

Europe's challenges of security, competitiveness and cost-of-living are intertwined with climate change. Climate risks are interlinked with Europe's other major challenges – geopolitical tensions, rising costs of living and declining competitiveness – requiring integrated and coherent policy responses. Curbing fossil fuel demand and accelerating electrification can at the same time reduce CO_2 emissions, lower energy prices for households and businesses and improve the strategic autonomy of the EU. Further efforts developing, making and deploying clean technologies can advance the EU's industrial competitiveness. Climate policy measures also bring health co-benefits, with adaptation efforts safeguarding lives, infrastructure and livelihoods. Hence, the climate transition presents an opportunity to boost the EU's long-term productivity and competitiveness while enhancing security and the overall well-being of Europeans.

The revision of the European Climate Law is an opportunity to confirm the EU's domestic and international climate commitments while actively addressing threats to European prosperity. The European Climate Law enshrines the Paris Agreement commitment into EU law. The European Commission is about to propose a formal amendment to the European Climate Law putting forward a 2040 target, which will be discussed in the European Parliament and the Council of the European Union. The upcoming amendment is an opportunity for the EU to provide policy certainty that supports investment and innovation towards climate neutrality, preparedness and resilience, while reaffirming its ongoing commitment to a rules-based international order.

2.1. Scientific basis and policy framework for EU climate action

2.1.1. Observed and projected warming trends

Average global temperatures are at 1.3–1.4 °C above pre-industrial averages, and continued greenhouse gas emissions move the world towards higher temperatures and greater climate impacts.

Globally, 2023 and 2024 were the warmest years on record. The long-term temperature average has already reached 1.3–1.4 °C above pre-industrial levels (WMO, 2025), with every increment of warming increasing the frequency and magnitude of climate extremes and heightening climate-related impacts and risks ([1]) (Pelz et al., 2025). Global warming is already affecting the Earth systems' core functions, and warming above 1.5 °C will result in further irreversible adverse impacts on certain ecosystems with low

([1]) The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather/climate events), exposure and vulnerability. Impacts generally refer to effects on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services (including ecosystem services) and infrastructure (IPCC, 2023).

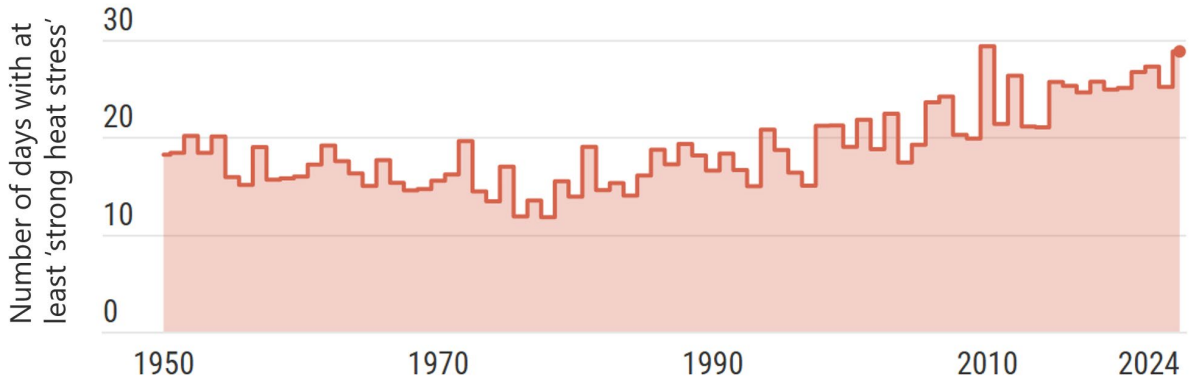
resilience, such as polar, mountain and coastal ecosystems, impacted by ice-sheet melt, glacier melt or by accelerating and higher committed sea level rise (IPCC, 2023a). Vulnerable groups, including low-income households, children and elderly people, are projected to be affected most, with a significantly higher likelihood of facing extreme exposures to heatwaves, crop failures, floods, droughts and wildfires over their lifetime (Grant et al., 2025).

2.1.2. Rising climate impacts in Europe and cost of inaction

The human life and economic losses exacerbated by climate change in Europe are at a record high and growing.

Europe is the fastest warming continent (EEA, 2024), with rising temperatures threatening the health of populations across the continent and leading to unnecessary loss of life (Van Daalen et al., 2024). Record-breaking heatwaves (see Figure 1) for chart showing the increase in strong heat stress), often combined with droughts and wildfires, have become a near-annual occurrence in the past decade, with the 2022 summer heatwaves alone linked to 60 000 to 70 000 premature deaths in Europe (EEA, 2024). Increasing heavy rainfall trends in other areas have contributed to numerous devastating flash and river floods (EEA, 2024). Measured economic losses from extreme weather events since 1980 amount to EUR 738 billion, with over EUR 162 billion, more than one-fifth of the total, incurred in just the last three years (EEA, 2025a).

Figure 1 The number of heat stress days is increasing in Europe



Source: WMO and the Copernicus Climate Change Service, 2025, supplementary Figure 4.3

Note: Annual average number of days with at least 'strong heat stress', defined as a day that has a 'feels like temperature' at least 32°C based on the Universal Thermal Climate Index.

Climate risks threaten Europe's health, ecosystems, economy and supply chains, and amplify sharply under higher global warming scenarios.

The European Climate Risk Assessment projects that climatic risks are increasing in all regions of Europe (see Figure 2), and impacts caused by climate change will continue to escalate if global emissions and temperatures continue to rise. While subject to high regional disparities, temperature-related mortality risk in Europe is substantial and continues to increase due to the effects of climate change and an ageing population, with impacts rising exponentially with each degree of warming (García-León et al., 2024; Masselot et al., 2025).

Figure 2 Key climatic risk drivers are on the rise in different European regions

Land regions	Northern Europe			Western Europe			Central-eastern Europe			Southern Europe		
	Past	Future		Past	Future		Past	Future		Past	Future	
		Low	High		Low	High		Low	High		Low	High
Mean temperature	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗
Heatwave days	□(*)	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗
Total precipitation	↗	↗	↗	↗	/	↘	↗	↗	/	↘	↘	↘
Heavy precipitation	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗
Drought	↗	↘	↘	↗	/	↗	↗	/	↗	↗	↗	↗

Source: European Climate Risk Assessment (EEA, 2024), based on data from the Copernicus Climate Change Service.

Note: Underlying climate variables are heatwaves (days with maximum temperatures above 35 °C), heavy precipitation (maximum one-day precipitation) and drought (using a standardised precipitation evapotranspiration index over six months (SPEI-6, Hargreaves' method)). Time periods and scenarios are past (1952–2021); future until the end of the century (2081–2100 relative to 1995–2014); low scenario (SSP1-2.6); and high scenario (SSP3-7.0). Greyed arrows indicate that there is limited agreement between models, datasets or indices. /' indicates there is a low level of confidence in the direction of change. For past heatwave days in Northern Europe, the square indicates there was no change though it should be noted other indices show an increase.

Economic projections show rising climate costs globally, despite persistent uncertainty.

Despite inherent uncertainty in long-term economic projections, the literature consistently points to a high cost to inaction. Estimates of climate-related economic impacts vary widely across countries, regions and sectors, and can reflect diverse, but still not-fully-understood, risk transmission channels such as income loss and property damage or socioeconomic disruptions due to conflict and migration (Network for Greening the Financial System - NGFS, 2024). Recent studies generally report higher projected economic losses from climate change compared with earlier research (Bilal and Känzig, 2024, 2025; Neal et al., 2025; NGFS, 2024; Tol, 2023). At the upper end of these estimates, Bilal and Känzig (2024) find that, under moderate warming scenarios (3 °C to 4 °C), global welfare losses could reach 25 % in present value terms, with the social cost of carbon exceeding EUR 1 000 per tonne.

Climate change affects the EU economy through direct damages, productivity losses and global trade disruptions.

The economic impacts for the EU manifest through a range of direct and indirect channels, including damage to critical industrial, energy and transport infrastructure (Forzieri et al., 2018); lower labour productivity due to heatwaves (García-León et al., 2021; Szewczyk et al., 2021); the effects of droughts on agricultural outputs (EEA, 2024); and losses from river and coastal flooding (EEA, 2024). Beyond these direct impacts, the EU economy is also highly exposed to global climate risks, such as through its trade and supply chains. Consistent with global studies, recent studies that account for the effects of these global risks often show significantly higher economic costs for the EU (Neal et al., 2025; Fahr et al., 2024; Bilal and Känzig, 2025). For instance, Fahr et al. (2024) show that euro-area GDP losses could average 11 % by 2050 (and rise to up to 22 %) under a high warming scenario, when global impacts and trade interdependencies are explicitly considered.

Estimating costs and benefits of climate action is not straightforward, but the global benefits of halting climate change exceed the costs of the transition.

Any cost estimates must be interpreted with caution. As Stern et al. (2021) highlight, the projected costs of climate impacts depend heavily on:

- the scale of risks tied to varying greenhouse gas concentrations;
- ethical considerations regarding the burden placed on future generations; and
- deep uncertainties involved.

Consistent with this, the IPCC (2023) finds that cost–benefit analyses have limitations in representing all damages from climate change, and all benefits of mitigation including significant health co-benefits. Even without quantifying all avoided harms, limiting global warming is shown to yield global economic and social benefits that exceed mitigation costs (IPCC, 2023b).

2.1.3. The urgency of mitigation and adaptation

To halt and reverse global warming, global efforts need to drastically cut greenhouse gas emissions while simultaneously removing carbon dioxide from the atmosphere through capture and durable storage.

Limiting global warming to 1.5 °C requires total global greenhouse emissions to stay within the remaining carbon budget: that is, the **physical limit** to the total volume of CO_2 that can be emitted while keeping warming below the temperature goal. The larger the temperature goal exceedance, the greater the impacts, and the more net-negative CO_2 emissions are needed to return to the 1.5 °C warming level (IPCC, 2023c).

Stabilising global warming at any level relies on at least net-zero global CO_2 emissions alongside significant and sustained reductions in other greenhouse gas emissions (IPCC, 2023c). The remaining global carbon budget consistent with 1.5 °C is very limited and will continue to shrink rapidly without a significant and sustained reduction of greenhouse gas emissions and scaling up of carbon dioxide removals in the coming decade (Forster et al., 2024).

Mitigation must be accompanied by early and effective adaptation to reduce climate risks and costs.

Early and effective climate adaptation reduces human and system vulnerability to climate-induced extreme events (IPCC, 2022a). Adaptation can significantly reduce climate damages, with studies showing the benefits of adaptation initiatives can substantially outweigh the costs, depending on the context (Watkiss, 2022; WRI, 2022). It can also contribute to mitigation: for example, by reducing the contribution of climate-related extremes (e.g. from wildfires) to the decline of the land carbon sink (EEA, 2024). However, adaptation cannot make up for failing to cut greenhouse gas emissions: it cannot fully eliminate loss and damages ([2]), while the accelerating impacts at higher temperatures can push many natural and human systems beyond their limits to adapt (IPCC, 2022a).

2.1.4. Translating global commitments into EU law

The parties to the Paris Agreement, including the EU and its Member States, are committed to pursuing efforts to limit the global temperature increase to 1.5 °C, strengthening adaptation efforts and providing finance, technology and capacity-building support to less-developed economies.

In 2015, at the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21) in Paris, the EU and its Member States joined over 190 jurisdictions in signing a landmark agreement to combat climate change. Part of the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement's central aim is to strengthen the global

([2]) Loss and damage understood broadly as economic or non-economic harm from observed impacts and projected risks (IPCC, 2022a).

response to the threat of climate change by keeping a global temperature rise this century well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 °C. Additionally, the agreement aims to increase the ability of countries to prevent risks and deal with the impacts of climate change, and at making finance flows consistent with a climate-resilient pathway with low greenhouse gas emissions (UNFCCC, 2015).

The Paris Agreement enables voluntary cooperation among countries through market and non-market mechanisms (Art. 6) to raise climate ambition while ensuring environmental integrity and transparency (see Chapter 3, Section 3.6). It establishes a global goal on adaptation (Art. 7), calling for enhanced resilience and support, especially for developing economies (see Chapter 4), and recognises the need to address loss and damage (Art. 8). It also strengthens support for developing economies (Arts 9–11) through climate finance, technology transfer and capacity-building, and promotes education, public awareness and participation (Art. 12) .

The European Climate Law enshrines the Paris Agreement commitment into EU law and is the cornerstone of EU climate policy for the coming decades.

At the EU level, the Paris Agreement commitment is enshrined in the European Climate Law, which binds the EU to domestically achieving net-zero greenhouse gas emissions by 2050 and pursuing net-negative emissions beyond 2050 (EU, 2021). It requires this transition to be guided by two interim targets. The first interim target consists of reducing net greenhouse gas emissions domestically by at least 55 % compared with 1990 levels by 2030. The second interim target, for 2040, is about to be set. Medium- and long-term targets guide climate policy development, enhance legal certainty, and help ensure fair distribution of the global carbon budget (Kulovesi et al., 2024).

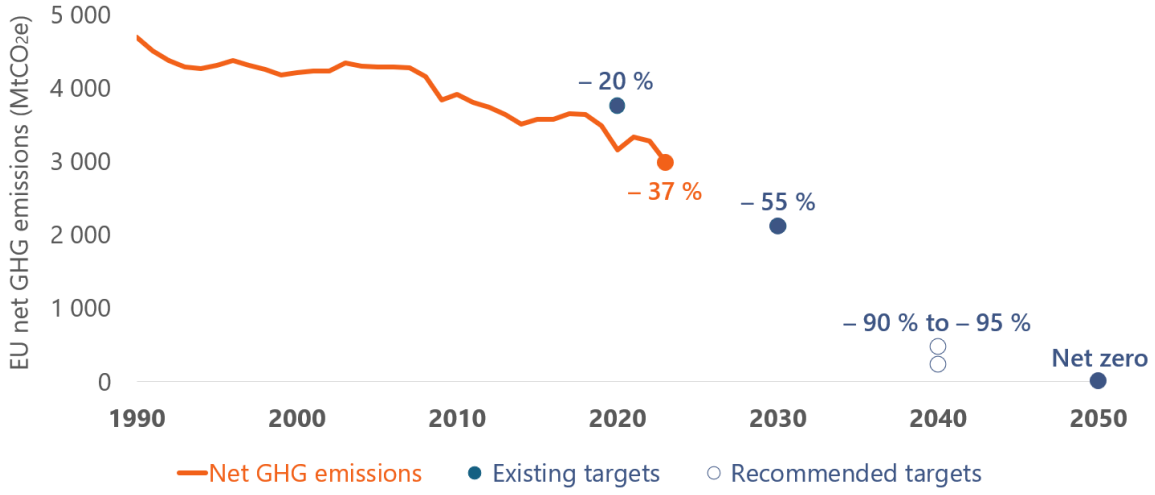
The European Climate Law also provides a basis for the EU's climate adaptation policy, requiring continuous progress from the EU and Member States in enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change. Apart from the pursuit of progress, it does not set any adaptation targets. It requires Member States to prepare national adaptation strategies and plans following EU guidance (EU, 2021).

2.1.5. The 2030 target and EU policy framework

The EU has consistently delivered on its climate targets so far, and is well positioned to achieve its 2030 target.

As shown in Figure 3, the EU has made substantial progress in reducing its greenhouse gas emissions since 1990, and the pace of reductions has accelerated in the last five years. The EU has surpassed its greenhouse gas emission reduction goal from 2008–2012: in this period, EU-15 emissions decreased by 11.7 %, surpassing the 8 % below 1990 levels commitment made under the Kyoto Protocol (EC, 2015). By 2020, greenhouse gas emissions fell 32 % below 1990 levels, resulting in a substantial overachievement of the original 20 % reduction target (EEA, 2022). While emissions in that year were also lower due to the COVID-19 pandemic, the reduction trend has continued in subsequent years due to progress across several sectors, in particular, the transition in the energy sector.

Figure 3 The EU has made steady progress in reducing emissions, putting the 2030 target within reach



Source: Data from the EU's greenhouse gas inventory (EEA, 2025b).

In 2023, emissions were already 37 % below 1990 levels, bringing them close to the original 40 % reduction target for 2030 as agreed under the original 2030 climate and energy framework. A record 9 % reduction was achieved between 2022 and 2023 alone. If the pace of reductions as observed since 2018 (on average 128 $MtCO_2e$ reductions per year) can be maintained, EU emissions would be almost 57 % below 1990 levels by 2030, allowing the EU to achieve its 55 % reduction target under the European Green Deal. Whereas full emission data for 2024 is not yet available, available data for some sectors give encouraging signals, while others highlight the need for continued policy support.

- Emissions from stationary installations under the EU emissions trading system (ETS) have continued their downward trend, with a 5 % decrease between 2023 and 2024. This was primarily driven by a shift from fossil fuels to renewable and nuclear electricity generation (EC, 2025a).
- The industrial sector is under pressure, although emerging net-zero technologies are under development and, in 2024, the sector showed a significant interest in the EU's Innovation Fund, with the demand surpassing the available budget by more than nine times (EC, 2025b).
- In the transport sector, the share of electric passenger cars in total EU sales (20 %) stagnated in 2024 compared with 2023, largely attributed to the phasing out of supportive policy measures in key EU markets. However, there was a sharp rebound in the first quarter of 2025, a trend that can be expected to continue as carmakers are planning the release of more affordable electric models in 2025 and beyond, in response to the EU CO_2 standards. At the same time, electrified vehicles are also increasing their market shares in the heavy-duty vehicle segment (IEA, 2025).
- In the building sector, early data from late 2024 shows a rebound in demand for heat pumps, after a nearly 50 % drop in EU sales in the first semester of 2024 (IEA, 2025).
- In the agriculture sector, after a relative stagnation in emissions between 2005 and 2022, the last two years have seen a decreasing trend (3.35 % and 0.74 % year-to-year decrease) (EEA, 2025b).
- The EU's net LULUCF sink has seen a sharp decline in 2017 and 2018 (16 % and 24 % year-to-year sink decrease), but the newest greenhouse gas inventory data suggests that the sink has been stabilising in recent years (between 1 % decrease and 8 % increase) (EEA, 2025b).

The EU has adopted a comprehensive policy package – fit for 55 – that puts achievement of the 2030 target within reach.

These trends have been driven by rapid progress in the EU's energy transition, enabled by technological advances, and policies developed under the fit for 55 policy framework (EEA, 2025c). This past record and the recent acceleration of progress have put the achievement of the EU's 2030 target well within its reach, and the fit for 55 policy framework needs to guide and maintain this pace of emission reductions ([3]). This requires additional efforts in all sectors, especially in buildings and transport, along with the land use, land use change and forestry (LULUCF) sector, where the carbon sink has decreased sharply since 2015 (Advisory Board, 2024). Achieving the 2030 target depends therefore on the rapid, robust and effective implementation of the fit for 55 package, in particular at the national level: central elements of the package, such as the Effort Sharing Regulation, the LULUCF Regulation, the Renewable Energy Directive and the Energy Efficiency Directive, set out general objectives, whose achievement primarily relies on national policies and measures (Advisory Board, 2024).

Based on Member States' projections, the Commission estimates a 54% reduction in total net greenhouse gas emissions by 2030 compared to 1990 levels, indicating that the EU is on track to meet its 2030 target - provided all existing and planned national and EU policies are fully implemented (EC, 2025c).

2.2. Climate action at the core of the EU response to security, economic and energy challenges

2.2.1. Europe's overlapping crises and their link to climate

In parallel with climate impacts, the EU faces rising geopolitical tensions, war at its border, hybrid threats, cyberattacks and foreign interference. **Wars and trade conflicts erode the rules-based international order.**

Since the beginning of this decade, Europe has dealt with several acute crises: the COVID-19 pandemic exposed deep vulnerabilities, Russia's unprovoked and unjustified invasion of Ukraine shattered assumptions about peace and strength, and escalating climate impacts are forcing an urgent reflection on present-day resilience, not just future risks. Wars and trade conflicts, including recent United States (US) tariff policy, are increasingly undermining the principles of a rules-based international order, posing risks to the foundation of the EU's external relations and policy framework (Letta, 2024) and creating new uncertainty for businesses (EMBER, 2025).

These crises come atop several longer-term challenges that have since emerged as key strategic priorities for the EU, as highlighted in three landmark reports published in 2024. The report by Mario Draghi (Draghi, 2024) identifies challenges in maintaining the EU's global competitiveness (particularly with the US and China), including a growing productivity gap, higher energy costs and insecurity, and challenges in maintaining leadership in innovative technologies. Enrico Letta (Letta, 2024) highlights the importance of the single market to maintaining the EU's economic prosperity and competitiveness, yet identified significant barriers that are hindering integration and economic growth, such as in capital and energy markets. Sauli Niinistö (Niinistö, 2024) highlights security and preparedness as foundational

([3]) Achieving the 2030 target requires average annual net emission reductions of 141 $MtCO_2e$ per year in 2022–2030, more than twice the average rate over 2005–2022 (Advisory Board, 2024). Data for 2023 show that the EU's greenhouse gas net emissions were reduced by 285 $MtCO_2e$ (– 9 %) and are currently in line with a linear reduction path to the EU's 2030 target of reducing greenhouse gas emissions by at least 55 % compared with 1990 levels (EC, 2024a; EEA, 2025c).

public goods that underpin continued economic prosperity, societal stability and democratic governance, something that has been largely neglected and suffered underinvestment until now. However, as climate change is a defining threat to EU and global security, prosperity and well-being, all three reports underscore, in line with scientific evidence, that climate action should be a central part to the EU's long-term strategy. They and the literature also highlight many examples where well-managed climate transitions can deliver wider economic and social benefits, and where an integrated policy response can address combined climate, security and competitiveness challenges.

2.2.2. The strategic and economic costs of fossil fuel dependency

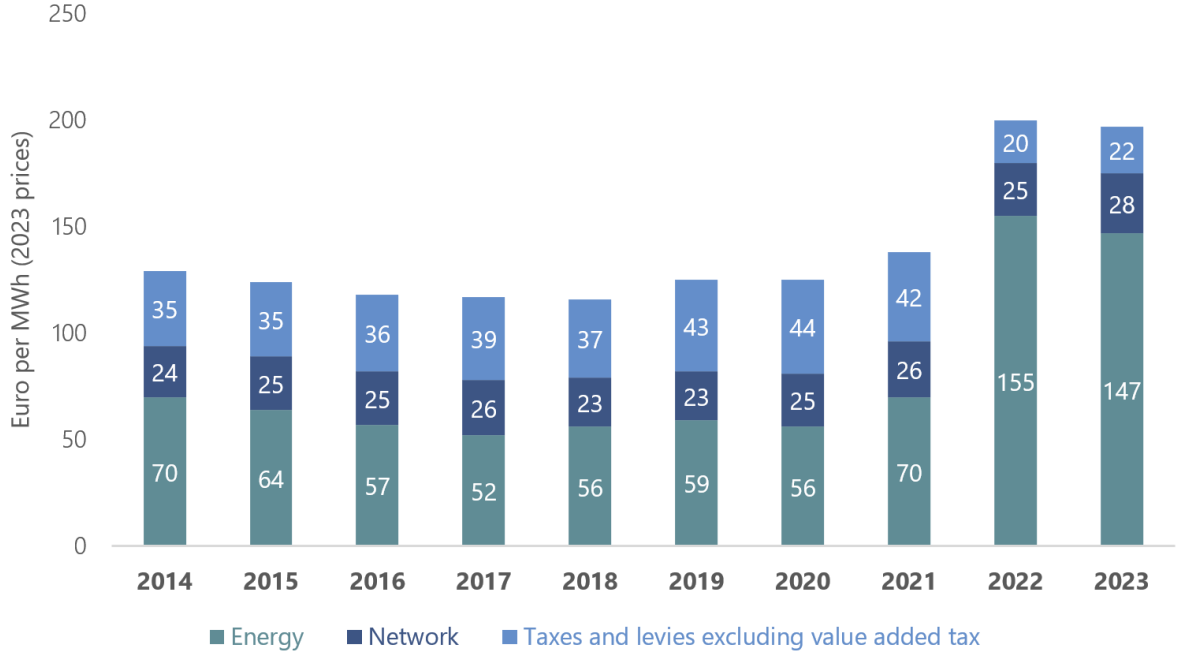
The EU's fossil fuel dependence contributes to climate change, and is a root cause of the energy crisis that has weakened the EU's strategic autonomy, competitiveness and economic prosperity.

Russia's invasion of Ukraine highlighted the interaction between climate and other strategic priorities most acutely, where cuts in fossil gas supplies from Russia created volatility and spikes in European energy and food prices ([4]), resulting in inflationary impacts that spiralled through the EU economy (Advisory Board, 2023a). This weaponisation of gas supplies created excess energy costs of EUR 500–800 billion in 2021 and 2022, requiring governments to mobilise additional spending of almost EUR 1 trillion to shield households and businesses from the acute price impacts (Colgan et al., 2023). While the acute supply shock has subsided, persistent levels of inflation observed since then have contributed to an ongoing cost-of-living crisis: around 10 % of EU citizens cannot afford to heat or cool their homes properly, with a disproportionate impact on vulnerable groups and strong correlation with unhealthy living conditions (Advisory Board, 2024). It has also undermined the international competitiveness of EU businesses, notably in energy-intensive sectors. Nominal electricity prices have almost doubled in recent years: for a medium-sized industrial consumer, prices in 2023 remained 97 % above their 2014–2020 average (EC, 2025d). EU businesses face higher energy and electricity prices to their Chinese, Japanese or US counterparts, and this gap has widened since the energy crisis (Draghi, 2024).

The EU's continued fossil fuel dependence is a root cause of these challenges and is likely to continue unless the EU shakes off its reliance on fossil fuels. EU electricity prices remain particularly exposed to short-term fluctuations in global fossil fuel markets, especially fossil gas (Navia Simon and Diaz Anadon, 2025; Zakeri et al., 2023; Maneejuk et al., 2024). In contrast, network charges and levies recovering support schemes for renewables and reserve generation costs have remained stable (Bruegel, 2024, see also Figure 4 below), although constraints in grid infrastructure, energy system integration and system flexibility also hold back the full integration and benefits of renewable energy sources (EC, 2025b; Advisory Board, 2024a).

([4]) Food price inflation was driven by the rising costs of both energy and fertiliser (produced in energy-intensive industrial processes, some using natural gas as feedstock) inputs to food production, along with weather extremes.

Figure 4 Increases in EU industry electricity prices reflect the increases in wholesale natural gas prices due to European electricity price formation mechanisms



Source: European Commission (2025e) based on data from Eurostat (2025) (dataset nrg_pc_205).

Note: Presented data is for non-household consumers in band ID (i.e. consumption of 2 000 MWh to 19 999 MWh).

Reducing fossil fuel dependencies can enhance EU and global security.

Beyond undermining the EU's own energy security, the role of fossil fuels in driving and funding conflicts (Colgan, 2013; San-Akca et al., 2020) can contribute to EU and global insecurity. A recent study by the Kiel Institute for the World Economy (2025) highlights that curbing fossil fuel demand significantly reduces export revenues for resource-rich autocracies – many of which channel substantial funds into military expenditure. For Europe, it indicates concrete benefits of reducing fossil fuel demand in the form of a 'peace dividend', from easing geopolitical and security pressures as a strategic co-benefit. While it is difficult to quantify this co-benefit precisely, the Kiel Institute study shows that each euro spent on oil in the EU generates geopolitical costs of around EUR 0.37 (0.01–4.7) related to Russia's unprovoked and unjustified invasion of Ukraine.

Since the outbreak of Russia's war of aggression at the EU's borders in 2022, the EU has increased its renewables output (Eurostat, 2025). This loosened the EU gas demand–supply balance, reduced instances of natural gas setting marginal prices in the electricity markets system and, coupled with demand-side measures, contributed to energy efficiency gains (European Union Agency for the Cooperation of Energy Regulators, 2025).

Diversification of supply, supported by a reduction in energy and material consumption, can reduce risks, but as long as the EU maintains a high primary energy dependency on imported fossil fuels, it remains exposed to future geopolitical risks and market volatility. EU climate action that reduces oil and natural gas consumption is therefore recognised as a key pillar of European security, complementing military investments, diplomatic initiatives and sustained support for Ukraine (EC, 2025f; Kuzemko et al., 2022).

2.2.3. Delivering a cost-effective and flexible energy system

Accelerating, electrification, renewables deployment, and improving electricity system integration and flexibility can help to stabilise and drive down EU energy prices.

Enhancing EU energy security is also central to the EU's economic strategies. The cost of clean energy technologies like solar, wind and batteries have fallen exponentially in recent decades, by around 10 % per year, and at consistently faster rates than predicted by most energy models and forecasts, which has enabled higher levels of climate ambition (Way et al., 2022) (see Chapter 3, Section 3.2). Falling capital costs, lower operational costs and higher efficiency have made renewable and electrified technologies cost-competitive in comparison to their more-polluting counterparts in many applications (IEA, 2025c, 2024; George et al., 2024). Accelerating the deployment and integration of renewables also reduces the exposure of EU electricity prices to fluctuations in global fossil fuel markets, and resulting price volatility (Navia Simon and Diaz Anadon, 2025; Zakeri et al., 2023; Maneejuk et al., 2024). For example, whereas currently every euro increase in fossil gas prices per MWh causes average EU electricity prices to increase by EUR 1.40, deploying sufficient renewables to achieve objectives in national climate and energy plans would reduce this price effect to EUR 1, and even more if Member States over achieve on their renewable objectives (Navia Simon and Diaz Anadon, 2025).

However, fully exploiting these advantages requires strengthening and integrating the EU's electricity market. This includes interconnection, grid investments and flexibility solutions (e.g. batteries, demand-side response) to enable a higher penetration of renewables and displace fossil fuels, while increasing the cost-effectiveness and resilience of the energy system. However, progress has been slower here, and one study has estimated that electricity congestion costs could increase from approximately EUR 4 billion today to EUR 103 billion in 2040 if electricity market integration does not progress (Joint Research Centre, 2024). In addition to being a climate priority, these investments have been identified as central to the EU's long-term competitiveness and energy affordability – ensuring that clean energy deployment is cost-efficient, resilient and strategically aligned with the single market (Draghi, 2024; Letta, 2024; EC, 2025). The literature highlights that energy transitions can pay off as combining electrification, renewables, and a more integrated and flexible electricity system can reduce costs, stabilise energy prices (Child et al., 2019; Way et al., 2022; IEA, 2024; Navia Simon and Diaz Anadon, 2025; Maneejuk et al., 2024; Way et al., 2022; Luderer et al., 2025) and enhance the EU's resilience to external shocks and actors.

2.2.4. Capitalising on innovation and clean technology opportunities

Scaling up clean technology innovation, manufacturing and deployment can strengthen EU competitiveness while driving industrial transformation through decarbonisation.

The clean energy transition is an opportunity for the EU to boost competitiveness. Stabilising global temperatures depends on accelerating investment and innovation in clean technologies, including both emission reduction and removal technologies (Advisory Board, 2024, 2025; IEA, 2025). Continued innovation is necessary to reduce the costs of emerging clean technologies and enable their wider deployment – particularly for emerging solutions such as carbon dioxide removals, green hydrogen and alternative fuels. Past efforts have demonstrated the success of innovation and early deployment: as noted above, solar and wind, once costly, are now the cheapest sources of electricity on average (IRENA, 2024), thanks to 'a virtuous circle of innovation, accelerated deployment, economies of scale and policy support' (IEA, 2024, p. 14). Some demand-side technologies have also made a lot of progress in terms of efficiency and cost over the past two decades. Solid state lighting, for instance, has become much more efficient and come down dramatically in cost since the early 2000s thanks to research and development, technology spillovers, and economies of scale and learning by doing from large scale manufacturing (Weinold et al., 2025).

Clean technology development and innovation can also drive economic development: for instance, in 2023, clean technologies were the largest driver of China's economic expansion, accounting for 40 % of its growth in GDP (Draghi, 2024), while energy innovation has historically resulted in wider economic benefits in both energy and non-energy sectors (IEA, 2025d). However, Europe's recent slump in research and development investment (IEA, 2025d) risks undermining these opportunities – making renewed focus on innovation a strategic priority for both climate and competitiveness.

As one of the world's largest markets for clean technologies, the EU has also been an early mover in developing manufacturing bases for innovative clean technologies, and retains a competitive edge and strong capacity in key emerging technologies like wind, electrolysers and carbon capture technologies (Draghi, 2024; EC and Ecorys, 2025). However, as with wider challenges in capitalising on innovative technologies, the EU has not always been successful in retaining these early advantages: it remains a net importer of clean technologies overall, and has lost early advantages once held in some technologies, such as solar, to China and the US (Draghi, 2024). Some of these opportunities and challenges can be addressed through dedicated climate and industrial policies to ensure stable demand, create long-term investment certainty and support manufacturing capacity. However, they also intersect with the EU's broader challenges in maintaining competitiveness (Draghi, 2024) and fully integrating and leveraging its single market (Letta, 2024), highlighting the need for an integrated policy response to drive industrial transformation through electrification and decarbonisation.

Navigating and reducing other dependencies in critical minerals and materials forms a common response to climate, security and competitiveness challenges.

While reducing fossil fuel dependence significantly enhances the EU's energy security, other potential dependencies may pose new challenges – particularly the reliance on imported critical minerals, materials and certain green technologies. Unlike fossil fuels, where fuel supply disruptions can cause immediate and widespread impacts, interruptions in the supply of materials or technologies tend to unfold more gradually, offering time to adapt and respond (Krane and Idel, 2021). The EU also has viable options to address these dependencies and increase resilience in its critical mineral supply chains; for example, through increased domestic sourcing; improved circular economy, resource and design efficiency; and strategic partnerships and diplomacy (Draghi, 2024). A secure supply of critical minerals and materials is crucial not only to the EU's energy transition, but also to the EU's strategic priorities in digital innovation, artificial intelligence, defence and space (Draghi, 2024; Niinistö, 2024). A review conducted by Calderon et al. (2020) highlights that while physical scarcity of materials is not a major constraint for the energy transition, environmental, social and geopolitical barriers pose challenges. It further points out that achieving climate goals will require proactive policy measures to ensure material security, sustainable extraction and strategic resource development.

2.2.5. Improving air quality and health

Phasing out fossil fuels improves air quality and reduces health burdens.

Despite improvements in recent decades, air pollution from energy, industry and transport continues to pose a significant threat to EU health and well-being. Air pollution was estimated to cause around 350 000 premature deaths each year (EEA, 2025d), increased morbidities and health burdens, and economic costs worth hundreds of billions of euro each year. Policies to phase out fossil fuels also significantly reduce emissions of many common non-greenhouse gas pollutants that are harmful to human health, with benefits of reduced mortality and morbidities often the largest direct co-benefit of climate mitigation policies (Advisory Board, 2023b; IPCC, 2022b; Karlsson et al., 2020; Pisoni et al., 2023; Schucht et al., 2015). For example, the European Commission's impact assessment estimates that achieving the 90–95 % target could reduce the economic costs of non-greenhouse gas pollutants by

EUR 382–1 051 billion per year by 2040 (compared with EUR 686–1 724 billion per year in 2015) (EC, 2024b). In some cases, these co-benefits can be of a similar magnitude to the costs of mitigation, for example Karlsson et al. (2020) estimates that air quality co-benefits alone could reach 75 % of mitigation costs (globally, on average).

2.2.6. Ensuring healthy and resilient ecosystems

Protecting and restoring ecosystems strengthens the EU's climate resilience, food security and financial stability by safeguarding vital natural services and carbon sinks.

The EU's land sink and ecosystems are currently the only major source of carbon removals and storage, but are increasingly threatened by both deliberate human action and growing climate impacts (wildfires, pests, temperature events, etc.). Policies and initiatives to protect, restore and improve the resilience of ecosystems not only contribute to climate goals, but are also crucial to preserving many of the other vital ecosystem services on which EU citizens and businesses rely, such as pollination, flood protection, erosion control, air and water quality. The loss of healthy ecosystems directly undermines the EU's food security: 84 % of crops at least partially depend on pollinators, whose populations have declined; while soil depredation, with 60–70 % of EU soils being considered degraded, threatens production and increases exposure of crops to climate extremes (EEA, 2023). These ecological risks also translate into financial risks, with up to 75 % of EU corporate loans held by businesses that directly or indirectly depend on ecosystem services – underscoring repeated warnings from the European Central Bank about the systemic economic threats posed by nature loss (Ceglar et al., 2024; Parker, 2023).

2.2.7. Embedding distributional fairness in climate policies

Integrated policy approaches that embed fairness at their core can address social inequalities alongside environmental goals to build public support, and societal resilience.

Climate impacts are felt unevenly across social groups, sectors and regions. For example, lower-income households are more exposed to volatile food and water prices, and generally have lower financial capabilities to adapt to climate change. Older people are more vulnerable to the effects of heatwaves and cold waves (see also Chapter 2, Section 2.1). People working in sectors that are most directly exposed to climate hazards, like agriculture or construction, are more likely to experience income losses or increased health burdens (EEA, 2024). By exacerbating existing inequalities and insecurities, climate change can undermine societal resilience and cohesion, and the ability to cope with future crises.

While addressing climate change can deliver broad public benefits that outweigh the cost of inaction, climate policies can also lead to uneven impacts across households, sectors and regions if fairness is not embedded in policy design. For example, inequities may arise from carbon pricing, where low-income households are more vulnerable to energy and food price increases (Advisory Board, 2024; Peñasco et al., 2021). The perceived fairness of EU climate policies also influences their feasibility and successful implementation: despite widespread awareness of and support for the need for climate action, concerns or uncertainties regarding potential policy impacts on households (particularly for lower-income households) reduces support (Andre et al., 2024; Dechezleprêtre et al., 2025).

Since the perceived fairness of EU climate policies will determine whether they are implemented successfully, special attention is needed to address the regressive social impacts of climate policy measures, taking into account various dimensions of social inequalities, including location (e.g. rural, urban, remote), income, gender, ethnicity, race, age and (dis)ability. Policy packages combining multiple, well-targeted policy measures – such as green infrastructure programs, subsidies for low-carbon technologies, and carbon taxes with progressive use of revenues – can address climate and other objectives in parallel, and often command high public support (Dechezleprêtre et al., 2025; Vona, 2023). Research shows that such policy packages can often have a progressive effect, benefitting lower-income

households when carbon pricing revenues are recycled into targeted measures, and delivering non-financial gains (e.g. air quality and infrastructure) (Feindt et al., 2021; Fragkos et al., 2021; Känzig and Konradt, 2024).

2.2.8. Policy stability and international partnerships

Stability and predictability of demand are a fundamental driver for investment.

Addressing these parallel climate, competitiveness and security challenges requires significant public and private funding and investments. As energy and climate investments involve multi-decadal financial commitments, investors require policy certainty and a long-term outlook to signal investments are consistent with net-zero pathways, and to avoid investments that result in costly lock-ins of fossil fuel assets and systems. For example, while the specific dynamics vary by technology, stable and predictable demand conditions constitute a critical enabling factor for investment decisions across all clean technology sectors (Draghi, 2024). The EU needs a stable outlook and enabling conditions for sustained investment to maintain leadership and harness clean tech as both an economic and climate opportunity (Advisory Board, 2024; Draghi, 2024). Strong coordination for disaster preparedness and adaptation can further improve the outlook as it reduces the risk of business disruption by protecting core societal functions and smoothing recovery (EC and HR/VP, 2025).

Stability also depends on the EU's role as an international partner committed to upholding the rules-based international order and advancing global partnerships.

On the global scene, a stable climate commitment can benefit the EU's security and competitiveness. The EU combines open markets with strong social inclusion, low inequality and high standards in education, health and the rule of law. It has long upheld multilateralism, free trade and international cooperation as core principles, forming the foundation of its approach to global governance and economic strategy (Letta, 2024). It plays a pivotal role in safeguarding the rules-based international order and can tackle global challenges by further internal market integration and promoting partnerships rooted in shared norms and mutual resilience, for example through the Carbon Border Adjustment Mechanism and the common security and defence policy missions (Niinistö, 2024, see also Chapter 3, Section 3.6). The single market of 440 million consumers and 23 million companies, accounting for around 17 % of global GDP, gives the EU a powerful foundation upholding its values, driving innovation and enhancing competitiveness. But in today's shifting geopolitical landscape, this foundation requires further reinforcement (Draghi, 2024; Letta, 2024). One key lever is the EU's solidarity principle (i.e. joint action by Member States in times of crisis), which has recently strengthened both the energy sovereignty and the EU's position in external relations (LaBelle, 2024).

2.3. Emerging EU strategies for competitiveness, resilience and clean investment

2.3.1. A new policy direction anchored in climate and economic renewal

The security, industry and competitiveness strategies published by the European Commission in 2025 continue to put energy and climate investment at the centre of future EU policy.

Recently published strategies from the European Commission underscore the interlinkage between the climate and the other challenges. As a response to the increasing challenges faced by the EU, in early 2025 the European Commission has laid out four strategic documents: the Competitiveness Compass (EC, 2025g), the Clean Industrial Deal, the Affordable Energy Action Plan (EC, 2025e) and the European Preparedness Union Strategy (EC and HR/VP, 2025). All of them lay out what is needed for the EU to

'play to its strengths and quickly harness its own pathway to innovation-based productivity growth towards a climate-neutral future' (EC, 2025g). This approach recognises the key levers to tackling EU challenges and rightly puts the net-zero transition at the core of the EU's economic renewal. They reaffirm the EU's commitment to staying the course on mitigation, including through the intermediate 2040 target of 90 % net greenhouse gas emission reduction, in line with the Advisory Board's advice (Advisory Board, 2023a).

2.3.2. The Clean Industrial Deal and the Competitiveness Compass

The Clean Industrial Deal and the Competitiveness Compass commit the EU to decarbonisation, reindustrialisation and innovation, with focus on the business case for carbon dioxide removals.

The Clean Industrial Deal focuses on supporting:

- energy-intensive industries so that they become decarbonised, electrified and shielded from high energy costs, unfair global competition and complex regulations;
- the clean-tech sector as the pillar of industrial transformation, circularity and decarbonisation.

Both areas are linked in the Clean Industrial Deal and the Competitiveness Compass to the EU's 2050 net-zero objective including carbon dioxide removals and climate adaptation, notably water resilience. It reinforces the EU's commitment to creating a business case for permanent removals to compensate for residual emissions, including in the context of the review of the ETS Directive in 2026. This is a welcome policy direction, as previously highlighted by the Advisory Board (2025).

2.3.3. The Affordable Energy Action Plan

The 2025 Affordable Energy Action Plan aims to cut energy bills, strengthen energy systems and support the 2040 target through structural reforms and new legislative initiatives.

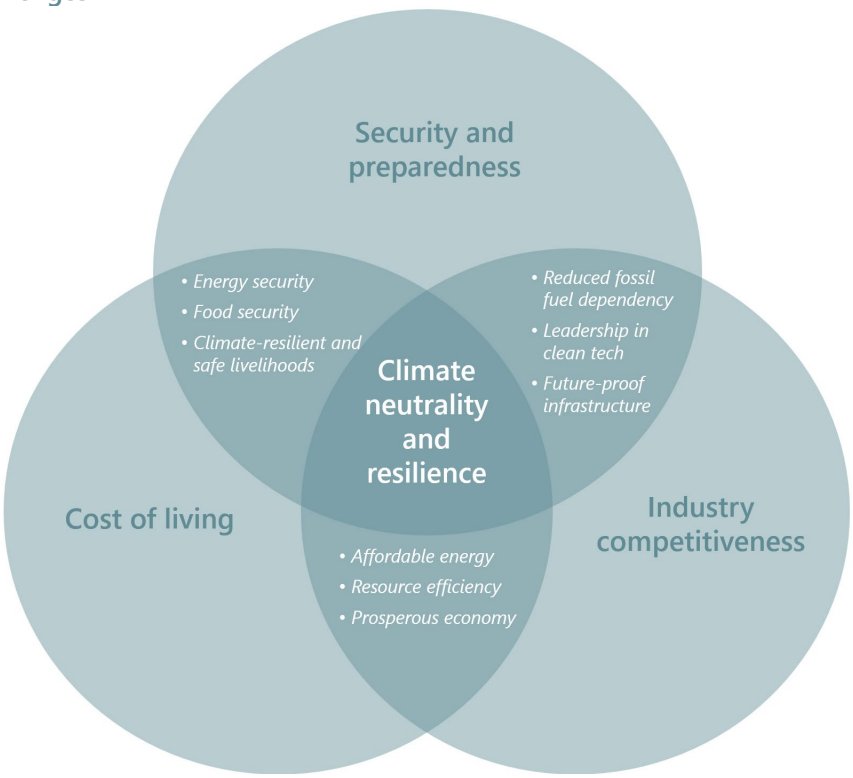
Responding to high energy costs, and as part of the Clean Industrial Deal, the European Commission has put forward the Affordable Energy Action Plan (EC, 2025e), presenting measures to lower energy bills in the short term, while accelerating cost-saving structural reforms and strengthening EU energy systems to mitigate future price shocks. It aims at delivering 'competitiveness, security, decarbonisation and a just transition, passing on to end users the benefits of cheaper energy.' (EC, 2025e). Among the presented measures is the European grid package aiming at making the trans-European energy networks (Trans-European Networks for Energy Regulation, EU, 2022) fit for further roll-outs of renewables and energy system integration (EC, 2025e). The package announces other legislative initiatives that will become part of the post-2030 policy framework and enable the 2040 target achievement (see Figure 5).

2.3.4. The European Preparedness Union Strategy and climate-security links

The 2025 European Preparedness Union Strategy highlights climate-security links and tasks the European Commission with developing a European climate adaptation plan to strengthen EU-wide resilience.

In March 2025, the European Commission and High Representative launched the European Preparedness Union Strategy to support Member States and enhance the EU's capability to prevent and respond to emerging threats (EC and HR/VP, 2025). The strategy includes 30 key initiatives and an action plan to advance the preparedness union's objectives. The strategy gives particular attention to climate and environment, recognising their strong interlinkages with security (EC and HR/VP, 2025). It tasks the European Commission with the preparation of the European climate adaptation plan to support Member States in preparing for climate risks and strengthening the resilience of the EU as a whole.

Figure 5 Climate neutrality and resilience are at the core of the EU's response to security, economic and energy challenges



Source: Advisory Board.

2.4. Role of the European Climate Law

2.4.1. Translating climate ambition into binding EU targets

Binding EU climate targets are essential for turning Paris Agreement goals into concrete EU policies, providing long-term direction and stability for post-2030 climate action.

Binding EU targets provide a way to translate the objectives of the Paris Agreement into EU domestic goals and policies that provide predictability for economic stakeholders and ensure a gradual and irreversible transition. The upcoming European Climate Law amendment and post-2030 framework preparation is a critical opportunity for the EU to adopt climate targets that are commensurate with the scale of the challenges. The amendment provides a stable guiding post for the post-2030 EU policies, including the reform of the EU ETS, and the EU's climate adaptation legislation. Finally, the amended European Climate Law will need to be reflected in the EU (nationally determined contribution) NDC for the submission to the UNFCCC ahead of COP30 later in 2025.

Clear targets provide stability and predictability for economic stakeholders and ensure a gradual and irreversible transition.

A binding net emission reduction target for 2040 and clear adaptation targets can guide policies addressing the EU's strategic challenges, as outlined in Chapter 2, Section 2.2, by providing policy stability and increasing investor certainty through post-2030 policy outlook at the EU and national levels. The targets can enable well-designed and well-targeted climate policies in which the synergies and trade-offs of the transition can be managed (Peñasco et al., 2021). The European Climate Law describes the 2040 target as a tool:

'to provide predictability and confidence for all economic actors, including businesses, workers, investors and consumers, to ensure a gradual reduction of greenhouse gas emissions over time and that the transition towards climate neutrality is irreversible.' (European Climate Law, recital 30, EU, 2021a).

2.4.2. The 2040 target and carbon budget requirement

Setting of the 2040 target is required in the European Climate Law.

The European Climate Law requires the European Commission to publish a proposal for an intermediate climate target for 2040 and an indicative carbon budget for 2030–2050 associated with the target proposal, setting out the cumulative volume of CO_2 that is expected to be emitted without putting at risk the EU's Paris Agreement commitment. The proposal is required to be informed by the advice of the Advisory Board, which has recommended a 2040-target of 90–95 % advice (Advisory Board, 2023a) as further elaborated in Chapter 3. This recommendation is in line with the 'highest possible ambition' standard which informs the due diligence obligations arising under the UNFCCC (Mayer, 2024; Rajamani, 2020; Voigt and Ferreira, 2016).

The legislative proposal for the 2040 target is required to build on a robust impact assessment (EC, 2021a). In February 2024, the European Commission published its impact assessment and recommendation for reducing the EU's net greenhouse gas emissions by 90 % by 2040 relative to 1990 (EC, 2024c), which is in line with the advice of the Advisory Board (see Chapter 3).

2.4.3. The adaptation gap in the current legal framework

While the European Climate Law aims to enhance EU resilience to climate change, it lacks a framework to measure progress towards adaptation goals.

The implementation of the national adaptation strategies and plans has been weak so far, and the European Commission's assessment warns that 'the EU's and the Member States' climate adaptation policies and measures are not keeping pace with the rapidly growing risks and impacts' (EC, 2024a). The European Commission has scheduled a new policy initiative, the European climate adaptation plan for 2026, expected to build on the *European Climate Risk Assessment*, introduce common climate reference scenarios and embed 'preparedness by design' across relevant EU sector policies and investments, and strengthen proactive climate, environment and water risk management across the EU (EC and HR/VP, 2025). It is yet unclear if the plan will be a legislative proposal.

The EU's 2040 target and adaptation objectives need to rise to the multiple challenges that Europe is facing.

This chapter underscores that climate change remains a defining threat for Europe and needs consistent and immediate attention. While the EU faces other monumental challenges that are linked to climate, fossil fuel demand reduction and the scaling up of renewable energy can benefit multiple dimensions. The revision of the European Climate Law is an opportunity to reinforce the EU's climate commitments, while coping with the other threats to European prosperity.

3. Setting a robust, science-based 2040 climate target

The EU should set a domestic net greenhouse gas reduction target of 90–95 % below 1990 levels by 2040, as recommended by the Advisory Board. This range is based on assessments of feasibility, fairness and consistency with EU and global climate commitments and corresponds to a 2030–2050 greenhouse gas budget of 11–14 Gt CO_2e, aligned with the 1.5 °C goal of the Paris Agreement. It is a critical milestone on the path to climate neutrality by 2050.

The EU's progress in cutting emissions and advancing its energy transition supports this level of ambition. Considering environmental risks and the pace of technology deployment, achieving a 90–95 % reduction is feasible, as shown by the Advisory Board's 2023 assessments and ongoing progress.

To reach net zero and move towards net-negative emissions, a rapid and sustainable scale-up of carbon dioxide removals is essential. All EU scenarios show a need for carbon dioxide removals to meet the 2040 target. Dedicated EU targets for both temporary and permanent removals, including minimum levels and a cap on their contribution, can drive investment and deployment while safeguarding gross emission reductions.

The year 2035 is a key milestone on the path to 2040, needed to ensure that the 2040 target can be reached within the remaining five years. Aligning the 2035 goal with the 2040 target, scenarios indicate feasible net reductions of 71–80 % by 2035, which ensures steady progress, supports innovation and helps limit EU contributions to global warming.

Alongside domestic action, the EU should enhance reduction and removal efforts beyond its borders, consistent with the Paris Agreement, to provide a fair and equitable contribution to global mitigation and advance international cooperation. This includes technology transfer, investment, capacity-building, alliances and climate finance, potentially under Article 6, including international credits. Carbon dioxide removal credits from outside the EU could help the EU to achieve net-negative emissions after reaching net zero – provided their high quality is ensured through robust governance.

A cost-effective, fair and well-paced transition remains essential to meeting EU climate goals and requires a robust post-2030 climate policy framework. The Advisory Board has provided detailed guidance on this in its previous reports (Advisory Board, 2025, 2024).

3.1. The EU target of 90–95 % is rooted in domestic and international commitments

3.1.1. Identifying a feasible and fair 2040 pathway through scenario analysis

To determine an adequate 2040 climate target for the EU, the Advisory Board had considered both feasibility and fairness. Over 1 000 scenarios had been analysed in terms of their consistency with the physical science, environmental risks and short-term technological feasibility.

To inform its advice on a fair and feasible 2040 climate target for the EU, the Advisory Board (2023b) analysed over 1 000 EU emission pathways from the scientific literature. Scenarios were first screened for consistency with:

- limiting warming to 1.5 °C with no or limited overshoot;
- alignment with the EU's 2030 and 2050 goals; and
- feasibility thresholds (e.g. for geological storage, energy demand or technology scale-up).

This initial filtering yielded 36 scenarios. The Advisory Board then assessed feasible domestic emission reduction levels for the EU, namely by analysing how scenarios compared against several environmental risks (i.e. heavy reliance on bioenergy, land-based removals and carbon capture) and short-term technological scale-up challenges (i.e. for wind, solar and hydrogen). Among scenarios that are consistent with the EU's 2050 target and Paris Agreement 1.5 °C goal, the analysis identified five scenarios that met all feasibility criteria, showing emission reductions of 88–92 % by 2040 (relative to 1990 levels with all but one of these scenarios showing net emission reductions of at least 90%). These scenarios are derived from integrated assessment models which are designed to find the most efficient solutions in terms of costs (Baumstark et al., 2021). Scenarios below this range indicated fundamental risks for the EU, generally relying on bioenergy, or on compensating delayed action with removals, to an extent that exceeded environmental risk thresholds.

Additional scenarios were identified that achieved higher domestic emission reductions through a more rapid deployment of renewable energy technologies. While these were associated with short-term technological scale-up challenges, overcoming these deployment barriers would make it feasible to achieve emission reductions of up to 95 % by 2040.

To complement this feasibility assessment, the Advisory Board compared cumulative emissions from these scenarios to 'fair share' estimates of the EU's share of the global carbon budget in 2030–2050 under different equity principles. However, cumulative emissions from even the most ambitious feasible pathways exceeded the fair share budgets, underscoring a gap between what is feasible and what is fair.

3.1.2. A domestic target of 90–95 %, complemented by international cooperation

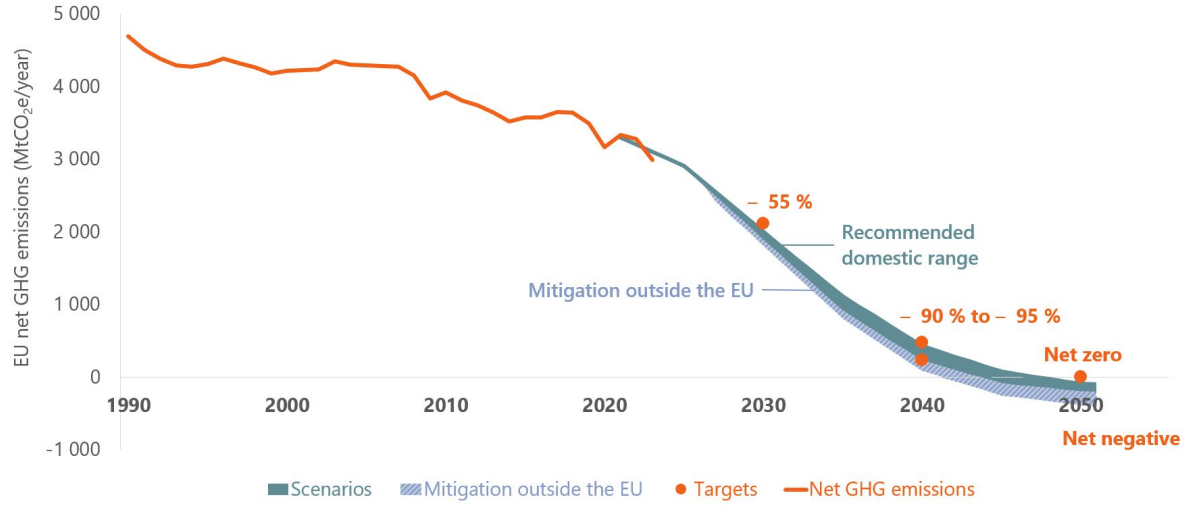
The Advisory Board recommended that the EU set a domestic net emission reduction target in the range of 90–95 % by 2040. Complementing the highest level of domestic ambition, with support for further efforts outside the EU, can ensure a fair contribution to climate change.

Considering both the feasibility and fairness assessments, the Advisory Board recommended that the EU set a domestic target in the range of 90–95 % for 2040, corresponding to a 2030–2050 greenhouse gas budget for the EU of 11–14 $GtCO_2e$. In particular, taking the quantification of an EU fair share into account, the Advisory Board considered that the minimum reduction for 2040 should be 90 %.

In light of the identified shortfall between the feasibility and fairness estimates, and to maximise the EU's contribution to global efforts to reduce climate change, the Advisory Board recommended that the EU:

- aim for the **highest feasible level of ambition** in domestic emission reductions and carbon dioxide removals;
- contribute to **complementary mitigation efforts outside the EU** through support, partnerships and international cooperation;
- pursue **net-negative emissions after 2050**, through a rapid and sustainable scale-up of carbon dioxide removals (see Figure 6).

Figure 6 A domestic net emission reduction target of 90–95 % by 2040, complemented with international mitigation efforts, is feasible and fair on the pathway to climate neutrality



Source: Advisory Board.

3.1.3. European Commission proposal and alignment with scientific advice

The European Commission has recommended that the EU set a target of 90 % for 2040.

In 2024, the European Commission released its impact assessment of options for the 2040 climate target (EC, 2024c), which will underpin its forthcoming formal proposal. It analysed three scenarios, each representing a different target level for 2040, including one scenario that achieves net emission reductions within the 90–95 % range recommended by the Advisory Board.

A target in the range of 90–95 % was identified as the preferred option in the impact assessment, with the impact assessment highlighting how this target:

- has the lowest emissions in 2030–2050, making it most aligned with EU and global climate goals;
- delivers the highest net benefits from avoided climate damages and air pollution in relation to the mitigation cost;
- more quickly reduces the EU's fossil fuel dependencies and improves strategic autonomy;
- requires an earlier investment push, but similar overall investment needs to other options;
- creates opportunities for EU competitiveness through innovation in clean technologies; and
- has minor additional trade-offs in comparison to other options, which can be managed.

This assessment underpinned the European Commission's communication (EC, 2024d), where it recommended that the EU set a target of 90 % in 2040, at the lower end of the range recommended by the Advisory Board.

3.2. Recent progress in overcoming feasibility challenges

3.2.1. EU progress towards 2020 and 2030 targets

Achievement of the EU's 2020 target, and encouraging progress towards the 2030 target, reinforce the possibility of achieving ambitious domestic emission reductions.

As highlighted in Chapter 2, the EU has achieved past greenhouse gas emission reduction targets, and the recent acceleration in the pace of emission reductions means that it is making encouraging progress

towards the 2030 target. This target is an important milestone, with all scenarios in the Advisory Board's assessment underpinning the 2040 advice, showing how reducing net emissions by at least 55 % by 2030 is crucial to enabling the subsequent 90–95 % 2040 target advice (Advisory Board, 2023a). Maintaining the pace of emission reductions seen in recent years, and ensuring the full implementation of the existing EU climate policy framework, would put the EU on track to achieving its 2030 target and enabling ambitious targets for 2040 (EC, 2024a; EEA, 2025c).

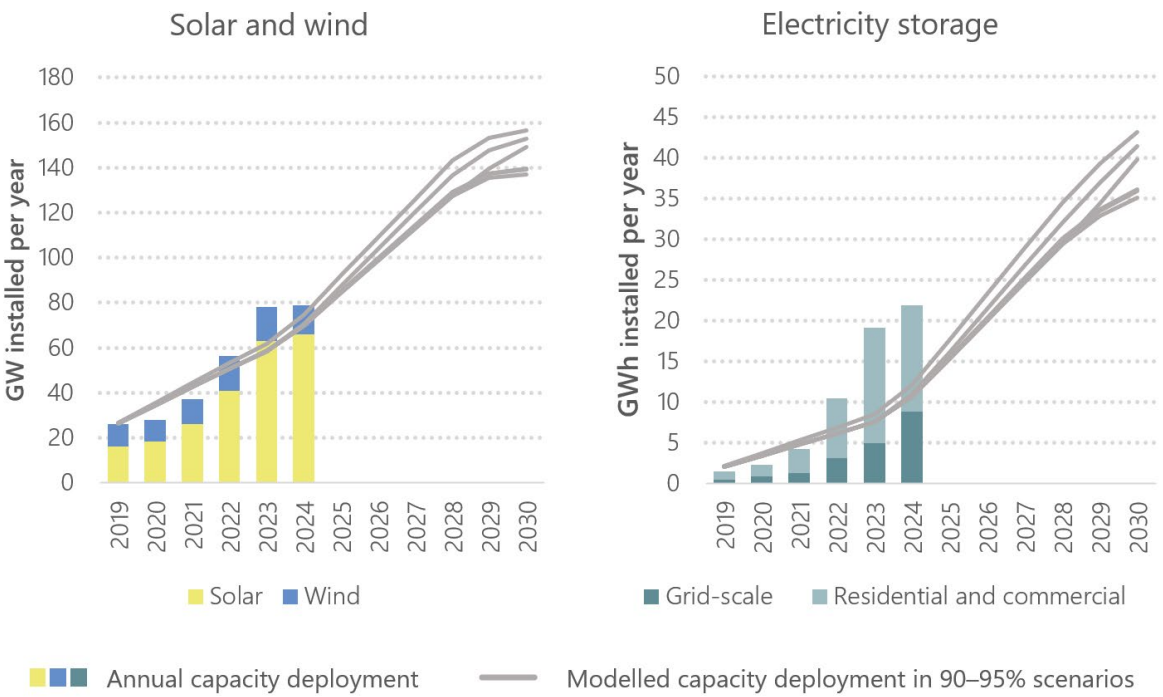
3.2.2. Progress and opportunities for overcoming feasibility challenges

Recent growth rates in renewable energy deployment are in line with the rates seen in 90–95 % scenarios, even where these were considered to present technological deployment challenges.

All 2040 scenarios analysed by the Advisory Board rely on a deep and rapid energy transition in the EU, including a near-to-complete decarbonisation of the power sector by 2040, substantial reductions in fossil fuel use and imports, and greater electrification and efficiency.

As highlighted previously, the recent acceleration in emission reductions has been driven largely by the energy sector, where the EU and global energy transition has demonstrated the possibility of overcoming key technological deployment challenges. In particular, projections have consistently underestimated the speed and scale of cost reductions for solar, wind and battery technologies from endogenous learning effects, and the real-world rate of renewable energy deployment often grows faster than predicted by most models (Vatankhah Ghadim et al., 2025; Way et al., 2022; Nijsse et al., 2023). Similar trends have been seen in the EU: in the most recent data, combined wind and solar annual deployment rates are on track with the levels in the 90–95 % scenarios, including those at the upper end of this range, for which short-term technological scale-up challenges were identified, while battery deployment shows a similar acceleration (see Figure 7). Increased renewable energy deployment and production contributed to displacing coal and gas from the EU's electricity grid, driving EU power emissions to a record low in 2023 (EEA, 2025c; EC, 2024e).

Figure 7 Annual rates of wind and solar deployment since 2019 are largely on track with the scenarios used to support the Advisory Board's recommended 90–95 % target



Sources: Data from Advisory Board scenarios (Advisory Board, 2023), EMBER (2025b), SolarPower Europe (2024, 2025) and WindEurope (2025)

Note: The figures show the annual deployment levels of wind, solar and electricity storage capacity in the EU in the scenarios within the recommended 90–95 %, range and compares this to actual data since 2019 (the base year of the scenarios). Wind and solar deployment rates for 2019–2023 come from EMBER, while 2024 deployment rates come from WindEurope and SolarPower Europe, respectively. Battery storage data for 2019–2024 come from SolarPower Europe. In the Advisory Board's scenarios, electricity storage capacity relates to electricity storage that is used/needed by the electricity grid. This is largely assumed to come from grid-scale storage, with residential and commercial storage predominantly being used by for on-site energy storage, although some (and increasingly with supportive policies) may contribute to providing grid storage services. The 2019–2024 period also excludes non-battery storage solutions (e.g. pumped hydro storage), which would further increase annual deployment rates beyond the levels shown.

Recent advances in batteries and electrification, and fully exploiting demand-side strategies offer the prospect to achieve larger, more cost-effective emission reductions, with higher co-benefits for society.

Beyond power supply, advances in direct electrification have made it possible to achieve an extensive, cost-effective electrification of much of the EU economy, notably in sectors where progress to date has been slower, like road transport and buildings (Advisory Board, 2023b, 2024).The efficiency of electrification, rapidly-falling battery costs ([5]) and supportive policies mean that key technologies like heat pumps and electric vehicles are quickly becoming (or have already become) cost-competitive with their fossil fuel counterparts in many applications (IEA, 2025c, 2024; George et al., 2024), contributing to other strategic goals highlighted earlier through lower energy costs and fossil fuel dependencies. As costs continue to fall, advances in electrification are opening up further potential cost-effective mitigation options even in activities where alternatives were previously considered to be more limited, such as in heavy duty transport and short-distance maritime activities (Kersey et al., 2022; Link et al., 2024).

([5]) On average, costs have declined exponentially by around 10 % per year (Way et al., 2022).

The Advisory Board also highlighted that there are different pathways to achieve climate neutrality, and while scenarios show common features, there are further choices for policymakers and sectors to achieve significant emission reductions. These include pathways that combine both supply- and demand-side measures (Advisory Board, 2023a). For example, research consistently shows how demand-side strategies – such as prioritising greater energy and resource efficiency, flexibility measures and behavioural shifts – can deliver substantial emission reductions but tend to be underrepresented in both policy modelling and implementation. Combined with the efficiency gains of electrification, these strategies tend to come at lower costs, reduce fossil fuel and resource dependencies, and deliver higher social and environmental co-benefits .

Exploiting the opportunities from electrification and demand management contributes to reducing bottlenecks in technologies that currently face greater scale-up challenges ([6]) (Odenweller and Ueckerdt, 2025; Edelenbosch et al., 2024), allowing them to be better prioritised to activities where there are truly no or limited mitigation alternatives and increasing the overall feasibility of achieving ambitious climate targets (Johnson et al., 2025). Decarbonisation options for different sectors like industry and agriculture are often wider than typically shown in scenarios, while continuing to invest in technological and social innovation can further expand the range of feasible mitigation outcomes, enable higher levels of domestic ambition and increase benefits to society from a rapid climate and energy transition (Advisory Board, 2023a).

3.3. Carbon dioxide removals can smooth the path towards the 2040 target

3.3.1. The role of carbon dioxide removals in achieving net-zero and net-negative emissions

Alongside deep gross emission reductions, a rapid and sustainable scale-up of removals can smooth the path towards the 2040 target and will be necessary to achieve net-zero and net-negative objectives.

The Advisory Board's 2040 advice, and most recent advice on carbon dioxide removals, highlights the need for a rapid and sustainable scale up of removals (Advisory Board, 2025, 2023b). If complementing deep, gross emission reductions, removals smoothen the path to EU climate targets by enabling a higher level of ambition in the short term. In scenarios analysed by the Advisory Board and the European Commission consistent with a 90–95 % target, temporary and permanent removals contribute between 390 and 500 $MtCO_2e$ towards net greenhouse emission reductions by 2040 (Advisory Board, 2025).

To achieve net zero, carbon dioxide removals will be necessary to counterbalance residual emissions from activities with no or limited mitigation alternatives. As noted previously, the future levels of residual emissions in the EU economy and required volumes of removals evolve dynamically, driven by technological and societal developments. Continuing to drive down residual emissions can allow removals to increasingly contribute to their second strategic function of delivering net-negative emissions, where removals exceed emissions. Achieving net-negative emissions, including both within the EU and supporting removals outside the EU beyond 2050, would further contribute to improving the fairness of the EU's contribution to climate mitigation (Advisory Board, 2025, 2023b).

Globally, net-negative emissions are essential to manage any overshoot of the global temperature limit, and to restore atmospheric greenhouse gas levels to within safer limits. However, any significant overshoot would require very large volumes of removals to stabilise temperatures, and to hedge against

([6]) For example, the cost-competitiveness of direct electrification has contributed to reducing needs for hydrogen in IEA scenarios, and is helping to close the hydrogen 'ambition gap' between future supply and expected demand (Odenweller and Ueckerdt, 2025).

future, high-risk climate outcomes, as net-negative emissions cannot reverse past climate impacts or undo the crossing of tipping points (Schleussner et al., 2024). Therefore, removals should complement deep, gross emission reductions, and a rapid and sustainable scale up is necessary to reach EU climate goals and reduce climate impacts.

3.3.2. Scale-up challenges for temporary and permanent removals

Both temporary and permanent carbon removals have roles in the EU's climate efforts but face significant scale-up challenges that need to be addressed.

Temporary removals (e.g. afforestation) and permanent removals (e.g. direct air carbon capture and storage) have different roles to play in the EU's climate efforts. While the availability of temporary removals means that they can more readily contribute to short-term mitigation efforts, their temporary nature and reversal risks means that they cannot deliver the same long-term mitigation impact as permanent removals.

Both temporary and permanent removal methods face significant feasibility and scale-up challenges. The EU's land carbon sink has declined by around one third over the last decade, and rapidly reversing the ongoing decline is essential to achieving EU climate goals. The current capacity of the EU to remove carbon permanently through emerging methods, such as bioenergy with carbon capture and storage and direct air carbon capture and storage, is miniscule, and needs significant support and investments to scale up sustainably (see Section 3.5) (Advisory Board, 2025).

3.3.3. Separate targets to scale removals and avoid mitigation deterrence

Setting separate targets for removals, including by defining a minimum target and maximum contribution of removals towards the 2040 target, can boost investment and innovation, and prevent mitigation deterrence.

As the foundations for a rapid and sustainable scale-up of removals in the EU, the Advisory Board (2025) recommended setting separate targets for gross emission reductions and for temporary and permanent carbon dioxide removals at the EU level.

The Advisory Board highlighted several important roles for removal targets. Targets can signal ambition and policy commitment, helping to mobilise the investment and innovation necessary to drive the scale-up. They can also act as a safeguard to avoid mitigation deterrence, by managing market and policy expectations regarding the role of removals. To balance these roles, the Advisory Board recommended a differentiated target structure. This includes setting both **minimum** targets for temporary and permanent removals, aimed at increasing ambition, and a **maximum contribution** of removals towards EU climate goals, aimed at ensuring continued gross emission reductions to avoid mitigation deterrence and that sustainability thresholds are not surpassed.

This target structure has precedence in EU policies for 2030, where the European Climate Law currently sets a maximum contribution of removals towards the EU's 2030 climate target of 225 $MtCO_2e$, while the LULUCF Regulation sets a separate target for net LULUCF removals of 310 $MtCO_2e$. The Advisory Board highlighted that this could be done in a similar manner, when revising the European Climate Law or when developing the post-2030 policy framework (Advisory Board, 2025).

3.4. The year 2035 is an important waypoint towards 2040

3.4.1. Why early action matters for achieving the 2040 target

The speed of the transition is critical to achieving the 2040 target, as early action limits the EU's contribution to global warming, avoids steeper future cuts, and drives faster innovation and cost reductions.

While the EU has a degree of flexibility between target years, the 2040 advice notes the importance of a rapid climate and energy transition. Speed is important for three main reasons.

- First, the recommended 2040 target stems from the physical realities imposed by the global carbon budget. The scenarios show the need to pursue a rapid transition towards the 2040 target to stay within the Advisory Board's recommended 2030–2050 budget, and to **limit the EU's contribution to global warming**.
- Second, pursuing a rapid transition avoids the need for even steeper cuts in later periods to **achieve the EU's climate goals**. Delaying emission reductions would increase the risk of missing EU targets, particularly if it also delays the policies and measures necessary to achieve these emission reductions, or increases the reliance on technologies where there are greater scale-up challenges or environmental concerns.
- Third, early deployment and investment is important to making ambitious climate targets more feasible, namely by **accelerating innovation and cost reductions** of clean technologies and preventing the lock-in of fossil fuel assets and infrastructure (Erickson et al., 2015; Way et al., 2022).

3.4.2. The EU NDC in line with the 2040 target range

The 2035 emission reduction commitment in the EU NDC is an important milestone on the path to 2040.

The EU is about to communicate its commitment for 2035 as part of its collective contribution under the Paris Agreement. Although in its previous advice the Advisory Board (2023b) did not provide a specific recommendation for a 2035 target, it highlighted the need to set the 2035 NDC target as a 'waypoint' that enables the achievement of the EU's 2040 target. Among the analysed feasible pathways, net emission reductions in 2035 were in the range of 71–80 %.

This range would be in line with the Paris Agreement requirement for the NDC to reflect Party's highest possible ambition (Advisory Board, 2023b) Setting a 2035 commitment aligned with the 2040 target pathway would provide a transparent benchmark for demonstrating the EU's fair and ambitious contribution to global mitigation efforts, as required under the Paris Agreement.

3.5. Post-2030 policies can enable a smooth transition

3.5.1. Building on the fit for 55 framework to reach 2040

The EU's emission cuts are driven by a robust climate policy framework, now set to evolve for the post-2030 decade.

The EU has been able to achieve significant progress in emission reductions so far, supported by a climate policy framework which has been significantly strengthened in recent years under the European Green Deal and the fit for 55 framework. Full implementation of these policies is crucial to achieving the 2030 target and providing a foundation for post-2030 climate goals (Advisory Board, 2024).

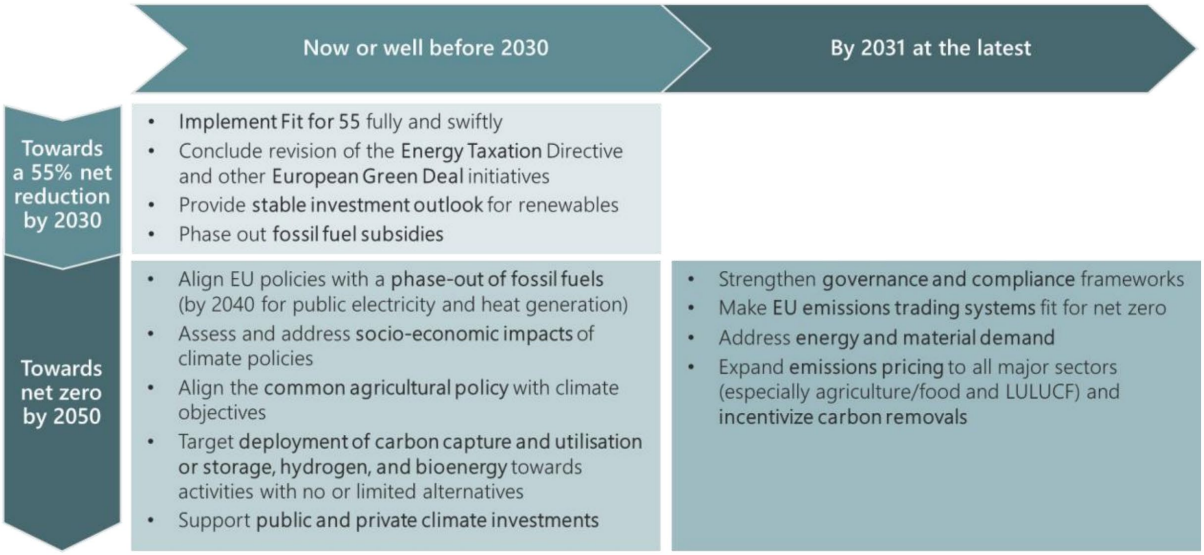
The 2040 target should build on this foundation through the development of the EU's post-2030 climate policy framework. The Advisory Board put forward its recommendations addressing the key features of this framework (Advisory Board, 2024, 2025) that can help the EU achieve the necessary emission reductions and scale-up of removals beyond 2030.

In 2024, the Advisory Board identified key policy priorities and opportunities for the post-2030 policy framework that would enable the achievement of the 2040 target.

In 2024, the Advisory Board (2024) provided advice on progress, policy gaps and opportunities for the EU, and identified several policy priorities that can help the EU achieve the necessary emission reductions beyond 2030, as shown in Figure 8.

As noted previously, the fit for 55 package plays a crucial role in enabling the achievement of the 2030 and subsequent climate targets. This requires robust implementation, in particular at the national level, at the conclusion of outstanding initiatives and in addressing remaining policy inconsistencies. The Advisory Board also identified additional opportunities for the post-2030 policy framework by improving existing policy instruments and developing new ones, with recommendations on the EU's carbon pricing systems, funding and investment, innovation and governance mechanisms (Advisory Board, 2024).

Figure 8 Recommendations on policy gaps and opportunities for the EU



Source: Advisory Board, 2024.

3.5.2. Developing a robust EU policy framework for carbon dioxide removals

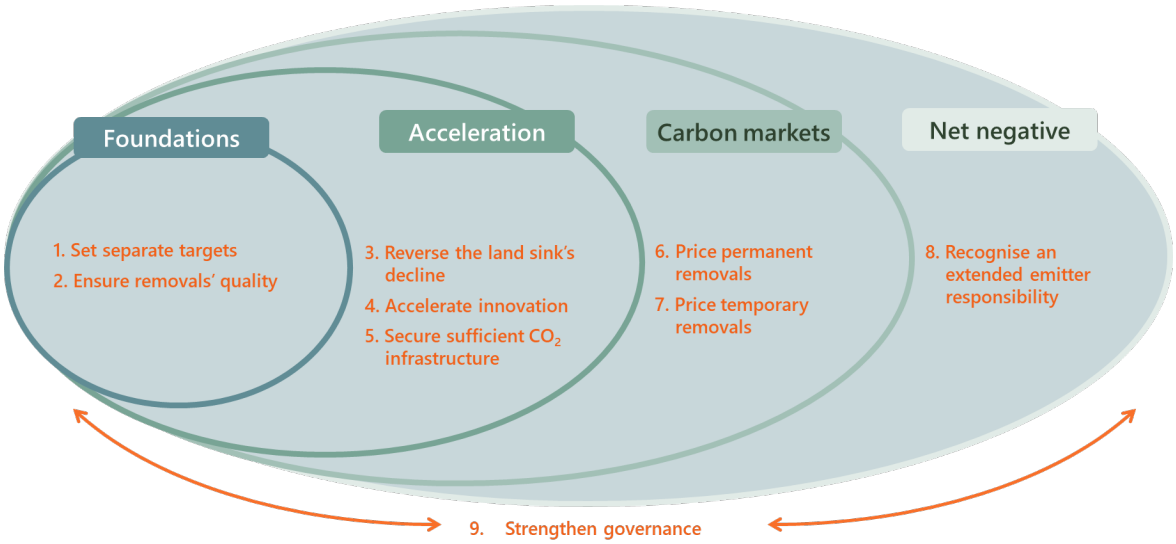
Developing the EU's policy framework for removals will support a rapid and sustainable scale-up, with policies to manage risks and scale-up challenges, provide cost-effective and fiscally sustainable incentives for deployment and achieve net-negative emissions.

Despite some recent initiatives, the EU's policy framework for carbon dioxide removals remains relatively underdeveloped compared with other climate policies. The Advisory Board identified several gaps, including the need for clearer targets for permanent and temporary removals; robust certification and monitoring; investments in innovation, infrastructure and ecosystems; a declining land sink due to poorly aligned land use policies; and a lack of clear incentives for removals (Advisory Board, 2025).

Given the important role of removals in the post-2030 target framework and the need for urgent action, the Advisory Board provided recommendations on policies to support a rapid and sustainable scale-up of removals, while managing risks and opportunities (see Figure 9). With separate targets and certification systems providing the foundations for EU removal policies, the advice specified a need for

policies to overcome scale-up challenges, provide cost-effective and fiscally sustainable incentives for deployment and enable the achievement of net-negative emissions. As the deployment of removals is a dynamic process, there is a need to introduce and adapt different policies over time to maximise benefits, reduce costs and mitigate risks as the scale-up of removals progresses (Advisory Board, 2025).

Figure 9 Recommendations on policies to support a rapid and sustainable scale-up of removals, while managing risks and opportunities



Source: Advisory Board, 2025.

In addition, horizontal considerations of cost-effectiveness and fairness, required in the context of setting the 2040 target under the European Climate Law (Art. 4, EU, 2021a), are essential conditions for sustaining public support and enhancing the feasibility of meeting the 90–95 % net emission reduction target by 2040 (Advisory Board, 2023, 2024, 2025; Vona, 2023).

3.5.3. Ensuring cost-effective and fair climate transitions

Emission pricing, public investment and innovation policies contribute to reducing the costs of the transition.

In both reports, the Advisory Board has highlighted the important role of carbon pricing, and the EU Emissions Trading System, in achieving flexible and cost-effective emission reductions in the EU. The European Climate Law provides economy-wide targets, and by placing a price on emissions and removals, carbon pricing provides incentives for all businesses and consumers to pursue emission reductions where it is most cost-effective to do so, reducing the cost of ambitious climate goals. However, emission pricing is currently incomplete in the EU, and the Advisory Board has made several recommendations that will expand the scope of the EU ETS. This includes the gradual, conditional integration of permanent removals into the EU ETS, the promotion of greater convergence between the EU ETS 1 and 2, and the expansion of pricing to agriculture and LULUCF (Advisory Board, 2025, 2024).

Carbon pricing is most effective when a part of a well-designed policy mix (Döbbeling-Hildebrandt et al., 2024) and needs to be complemented with policies to address market failures, and public investments in infrastructure and innovation. In particular, support for innovation and early deployment of novel technologies is also crucial to accelerating **dynamic** cost-effectiveness, reducing costs in the long-run through experience-based learning, and enhancing feasibility (Advisory Board, 2025, 2024).

Redirecting carbon pricing and fossil fuel subsidies to attenuate negative impacts on households and businesses plays an important role in bridging cost-effectiveness and fairness considerations.

As highlighted previously, cost-effective climate instruments also require special attention to be given to addressing potential negative distributional impacts, and to ensure continued public support for the transition. The EU has made important strides towards fairer climate policy in recent years, thanks to tools such as the Innovation Fund, Modernisation Fund, Just Transition Fund, and upcoming Social Climate Fund. The Social Climate Fund will be funded by and come into operation alongside the EU ETS 2 in 2027.

The Advisory Board has highlighted how broadening emission pricing and consistently applying the polluter pays principle across sectors is necessary to maintain cost-effective incentives to reduce emissions, while generating additional revenues for socially balanced climate action. Providing sufficient and secure funding for these will therefore be essential to enabling the EU's climate goals. The Advisory Board has also highlighted how significant public resources can be freed up by redirecting fossil fuel subsidies towards targeted measures to mitigate regressive impacts (Advisory Board, 2024). Fossil fuel subsidies within the EU have been estimated to reach around EUR 50 billion annually in the years preceding the energy crises, spiking to over EUR 100 billion in 2022 and 2023 (EC, 2025h).

3.5.4. Strengthening transparency, participation and democratic legitimacy

Legitimacy enabled by public participation, transparency and access to justice, as well as combatting climate disinformation are essential to effective climate policies.

Participation, transparency, and good communication and combating climate disinformation are essential to climate policy legitimacy, i.e. the belief or perception that authority is appropriately exercised (Dellmuth et al., 2019), and effective implementation with minimal climate-related public discontent (IPCC, 2022c). The EU post-2030 framework should strengthen the transparency and democratic legitimacy of EU policies by rigorous enforcement of the European Climate Law and the Governance Regulation. Relevant far-reaching acts, including the proposal for the European Climate Law amendment, should be based on meaningful impact assessments, including the climate neutrality consistency assessments required under European Climate Law (Art. 6, EU, 2021a). Transparent, inclusive and detailed impact assessments of future EU laws can:

- enable their alignment with the 2040 target and EU goals on adaptation (see Chapter 4);
- strengthen democratic legitimacy; and
- support the design of fair and effective redistributive tools to ensure a smooth and just transition (Advisory Board, 2024).

These can be supported by already existing, yet under-implemented governance tools at the national level, notably the permanent climate and energy dialogues and independent scientific climate advisory bodies (Advisory Board, 2024).

Access to credible knowledge alone cannot counter the rise of climate disinformation - the intentional spread of falsehoods about climate change and action (EC, 2025i; Lewandowsky, 2021). By eroding trust in science and democracy, such disinformation undermines public support for climate policy and its implementation (Lewandowsky, 2024). It is therefore encouraging that the European Commission is pursuing a mix of policy, digital, and communication measures to address this challenge (EC, 2024f).

3.6. Supporting mitigation outside the EU complements domestic ambition

3.6.1. Legal framework for EU climate action abroad

A fair and equitable EU contribution to global climate change mitigation necessitates both domestic action and support for mitigation efforts beyond the EU's borders.

The EU's climate targets for 2030 and 2050 are domestic, and the European Climate Law requires them to be achieved through emission reductions and removals within the EU. Similarly, the recommended 2040 target in the range of 90–95 % is limited to domestic emissions and removals, with all feasible and fair scenarios showing that meeting the EU's 2050 climate neutrality objective and Paris Agreement commitments requires significant domestic efforts in 2040. Furthermore, allowing credits from emission reduction and removals from outside the EU towards this domestic goal entails significant risks related to environmental and market integrity (see Box 1), and could undermine the EU incentives and investments necessary to achieve the EU's long-term climate neutrality goal. The potential contribution of high-quality international credits from carbon dioxide removals toward the EU's achievement of net-negative emissions, after reaching climate neutrality domestically, should be further explored.

The EU also has a responsibility to support global climate action beyond its borders, and the Advisory Board highlighted the need for support for international mitigation efforts to **complement** these domestic efforts. There are at least two key reasons why such external contributions are essential within the framework of the EU's responsibilities under the Paris Agreement.

- **Limitations of domestic ambitions.** As outlined in Section 3.1, there is a disparity between the emission reductions that are considered feasible within the EU and what would constitute the EU's fair share of global mitigation efforts. To address this shortfall, the Advisory Board recommends supplementing domestic reductions with international mitigation measures (Advisory Board, 2023b).
- **Enhanced responsibilities of developed economies.** Developed economies such as the EU have a responsibility to support climate action in other regions, notably in low- and middle-income countries (UNFCCC, 2015). Thus, an equitable EU contribution needs also to include active engagement in supporting mitigation and carbon removal efforts in non-EU countries.

Beyond legal and normative responsibilities, others have argued that the high costs of inaction and global climate change (see Chapter 2, Section 2.1) mean that it is in the EU's interest to support other countries in achieving their own climate goals (Bolton et al., 2025).

The EU may engage in international climate mitigation through mechanisms established under Article 6 of the Paris Agreement or through broader forms of support.

Mitigation efforts undertaken outside the EU can take various forms. One such pathway is to use Article 6 of the Paris Agreement, which provides a framework for voluntary international cooperation on mitigation between countries (see Box 1). Moreover, as the European Climate Law mandates the EU's climate targets be met through domestic action only, any mitigation outcomes or credits obtained via Article 6 mechanisms cannot substitute for domestic emission reductions and carbon removals.

In addition to Article 6, the Paris Agreement establishes further obligations for developed countries under Articles 9 to 11. These provisions call for the delivery of financial support, the mobilisation of climate finance, the enhancement of technology transfer and the promotion of capacity-building in developing countries. Although such forms of support are not always directly linked to quantifiable mitigation outcomes, they are nonetheless crucial for enabling developing countries to pursue ambitious

climate objectives and to strengthen their overall climate resilience. At the same time, enhanced global mitigation is in the EU's own interests.

Box 1: Overview of Article 6 of the Paris Agreement

Article 6 of the Paris Agreement provides a framework through which parties may engage in voluntary cooperation to achieve their NDCs (UNFCCC, 2025). This cooperation can take the form of both market-based mechanisms involving the transfer of mitigation outcomes, and non-market approaches that do not entail reciprocal exchanges. The most salient components of Article 6 are as follows.

- **Article 6.2** permits bilateral agreements in which a host country transfers emission reduction units, referred to as internationally transferred mitigation outcomes, to a buyer country in return for financial compensation. These internationally transferred mitigation outcomes may be counted towards the buyer country's NDC but are not eligible for inclusion in the host country's NDC.
- **Article 6.4** establishes a centralised carbon market under the authority of a UN supervisory body. This mechanism involves the issuance and registration of credits, known as Article 6.4 emission reductions, which may be purchased by countries, companies or individuals. When such credits are applied towards the buyer's NDC, the corresponding emission reductions or removals must be subtracted from the host country's NDC to prevent double counting.
- **Article 6.8** facilitates international cooperation through non-market-based approaches. Unlike Articles 6.2 and 6.4, it does not involve the transfer of quantified emission reductions or removals between countries, but rather supports broader climate efforts such as financial contributions, capacity-building and technology transfer.

3.6.2. Practical considerations linked to supporting mitigation outside the EU

The EU can leverage its climate diplomacy, trade policy and international partnerships to advance global climate action while simultaneously addressing its strategic objectives related to security and competitiveness.

Beyond the provision of assistance, the EU has the potential to strengthen its international climate engagement through diplomatic channels. Forming climate alliances focused on policy coordination and technological innovation can enhance the EU's strategic capacity and reaffirm its position as a global leader in climate diplomacy (Oberthür and Dupont, 2021). In an increasingly volatile geopolitical context, fostering stable partnerships to cooperate on climate and sustainability issues based on shared values may also generate important co-benefits in terms of geopolitical stability and security (see e.g. Uilenreef, 2024). The EU could build on the existing cooperation frameworks. For example, environmental sustainability and climate change mitigation is one of the priority areas of the EU's partnership with the Organisation of African, Caribbean and Pacific States (EU and Organisation of African, Caribbean and Pacific States, 2023).

Trade policy represents an additional avenue through which the EU can incentivise climate action beyond its borders. By conditioning access to its internal market, the largest trading bloc globally, on adherence to climate-related standards and commitments, the EU can exert regulatory influence to promote greener production practices abroad while safeguarding its own economic competitiveness (see e.g. Jakob et al., 2022; Lashkaripour and Lugovskyy, 2023). The Carbon Border Adjustment Mechanism (CBAM) exemplifies this approach (EU, 2023a), as it encourages producers in non-EU countries to decarbonise their value chains and incentivises the adoption of carbon pricing instruments internationally by motivating the creation of climate coalitions (Beaufils et al., 2024). Similarly, the Deforestation Regulation of the EU seeks to discourage the unsustainable use and destruction of tropical rainforests and to promote the protection and sustainable use of forests (EU, 2023b). Furthermore,

climate and environmental clauses are increasingly being incorporated into EU trade agreements, as illustrated by the EU–Mercosur agreement (EU, 2019). While there is some evidence suggesting that such provisions could steer partner countries, such as Brazil, towards more sustainable development trajectories (Arima et al., 2021), concerns remain about the potential for this agreement to increase EU imports of greenhouse gas-intensive livestock products (Joint Research Centre, 2024b).

The integrity of collaborative mitigation outcomes cannot be taken for granted.

The environmental integrity, transparency and robustness of the outcomes generated under Article 6 of the Paris Agreement cannot be taken for granted (see Box 2). Ensuring high-quality mitigation outcomes should therefore be a central concern for the EU when participating in such arrangements.

Box 2: Rationale, challenges and risks of international credits

What is the underlying rationale for purchasing international carbon credits?

Mitigation costs and capabilities vary globally due to geographic, climatic and economic factors. International carbon credits (i.e. representing certified emission reductions or removals), enable buyers to access lower-cost abatement opportunities abroad, offering cost-effective ways to achieve their own climate goals. In principle, if these credits deliver comparable abatement outcomes that also go beyond host countries' original commitments, this can result in a net gain in global mitigation. Beyond cost savings, carbon credit trading can also mobilise finance, support technology transfer and build capacity in other countries, for example, to establish governance structures and infrastructure for carbon market development (Gillenwater and Seres, 2011; Schneider and La Hoz Theuer, 2019).

However, the effectiveness of credits depends on the extent to which emission reduction or removal claims have materialised, and whether they have accounted for environmental and social externalities. If the appearance of cost-effective abatement opportunities stem from inadequate additionality or weaker regulations and standards, this may mask negative impacts and shift burdens elsewhere. In general, direct mitigation delivers more certain and transparent mitigation outcomes, and any use of international carbon credits is therefore contingent on similar assurances and procedural transparency.

What are the challenges and risks associated with international credits?

Past experiences with international credit trading under the EU ETS, the Clean Development Mechanism and voluntary carbon markets have highlighted numerous challenges in establishing environmental integrity and risks of substituting direct domestic mitigation with international credits. These include the following.

- **Additionality and over-crediting.** Many credits have been awarded for actions whose outcomes would have happened anyway or failed to deliver genuine mitigation benefits, reflecting a range of common project-level issues in quantification, inadequate or optimistic baselines, and reversal risks (Carton et al., 2021; Erickson et al., 2014; Oeko Institute, 2016; Probst et al., 2024). A systematic review by Probst et al. (2024) has estimated that just 16 % of credits issued under various carbon crediting programmes to date have delivered genuine emission reductions.
- **Carbon leakage.** Credits for individual projects often overlook leakage and rebound effects, which lead to higher emissions in other parts of the economy. For example, an afforestation project may displace food production or land taking to another location, while energy projects may affect fossil fuel consumption elsewhere through market dynamics (Erickson et al., 2014; Filewod and McCarney, 2023; Rosendahl and Strand, 2011).
- **Perverse incentives.** Carbon credit revenues may create perverse incentives for sellers to maintain or increase emissions, expecting credit sales from subsequent emission reductions (Probst et al., 2024). Some authors have also highlighted this risk in relation to government incentives to adopt less ambitious NDCs and climate policies, which could further weaken the additionality of credited actions (Schneider and La Hoz Theuer, 2019).

- **Market effects.** The EU's and others' experiences highlight the potential that international carbon credits can hinder the functioning of domestic carbon markets (Verde and Borghesi, 2022; Leining et al., 2020). While the availability or possibility of using international credits may help mitigate potential price volatility under a tight cap, it can also weaken or lead to more uncertainty in carbon prices, harm incentives to invest in EU mitigation efforts (Schneider and La Hoz Theuer, 2019).
- **Forgone domestic investments.** The cost of high-quality carbon credits that deliver sustainable and long-term mitigation outcomes can be very high (Edenhofer et al., 2024; Advisory Board, 2025). Purchasing such credits from abroad could therefore come at the expense of domestic investment opportunities.
- **Environmental and social impacts.** Any use of international credits effectively outsources any environmental or social impacts to other countries, with both positive and negative impacts documented across different projects and locations (Carton et al., 2021; Rogelj et al., 2021).
- **Governance**. With any international credits, the EU lacks the same ability to directly monitor and control quality, governance, and environmental and social safeguards as it does with emission reduction and removal activities that occur in its own jurisdiction, which can exacerbate many of these challenges listed above.

The quality of international credits therefore depends on the extent to which they are able to address the concerns highlighted above.

Do emission reductions and removals face different challenges and risks when used as international credits?

While both reduction and removal credits face similar challenges and risks, which can vary by project, removal credits have several distinct characteristics that need to be considered. For example, removals also minimise certain carbon leakage and perverse incentive effects, as they do not directly impact international fossil fuel prices; although methods in the land sector can still have significant spillover effects through land and biomass use (Franks et al., 2023; Advisory Board, 2025).

Additionality is often more straightforward to demonstrate, especially for permanent removal methods where there is no plausible counterfactual scenario or where there are more favourable MRV characteristics (Advisory Board, 2025; Smith et al., 2024; Sultani et al., 2024). However, temporary removals can still face greater challenges in this regard, particularly in distinguishing between 'passive' (i.e. natural CO_2 uptake that would have occurred without human intervention) and 'active' or 'anthropogenic' effects that can be attributed to an activity (Nolan et al., 2024). For temporary removal methods, particularly those in the land sector, a lower typical storage duration and a higher risk of reversal means that carbon captured and stored will generally return to the atmosphere in a shorter timeframe (e.g., within decades to centuries) compared to permanent removal methods. These challenges mean that temporary removals and permanent removals are not fully equivalent, and that the temporary removal of 1 tCO_2 will – over the long term – generally have a lower climate mitigation impact compared to a permanent removal. However, this does not preclude potentially higher environmental and social benefits from some temporary removal methods, if all co-benefits are accounted for (Advisory Board, 2025).

A 90–95 % target is feasible and also fair if supplemented by measures including cooperation and partnerships outside the EU.

This chapter underscores that an EU target by 2040 of 90–95 % and based on a fully domestic scope is within reach. However, as none of the assessed feasible pathways towards climate neutrality fully align with estimates of the EU's fair share of the global carbon budget, complementary measures need to be pursued to account for this shortfall, including achieving net-negative emissions beyond 2050 and supporting cooperation and partnerships outside the EU. Such support may be facilitated by international carbon credits provided their high quality is ensured through robust governance.

4. Strengthening the EU's framework on adaptation and resilience

Adaptation in the EU is not keeping pace with intensifying climate impacts. Adaptation in the EU is fragmented, incremental and insufficient to build system-wide resilience. This risks adaptation efforts being ineffective and even maladaptive. At the same time, climate hazards are increasing in frequency and magnitude. As this continues, we will approach the limits of what we can adapt to and see rising human and economic impacts that threaten the security, competitiveness and long-term prosperity of the EU. Urgent and coordinated adaptation efforts are needed to ensure the EU's long-term resilience.

Gaps in the EU adaptation governance hamper progress. The requirements enshrined in the European Climate Law are insufficient relative to the increasing adaptation gap. While the EU strategy on adaptation to climate change sets out a long-term vision, this is too vague and weak to function as an operational goal. The vision lacks clear objectives connected to measurable indicators and timeframes, making the monitoring of progress and the effectiveness of policy challenging. While the ownership of climate risks is complex, the ambiguity of the EU's role and responsibilities in relation to these risks weakens the governance of adaptation policy. These gaps undermine effective and coherent EU action on adaptation and the responsiveness of adaptation policy.

The EU has an opportunity to enhance its policy framework. The convergence of the European climate adaptation plan, revision of the Governance Regulation and agreement on how to operationalise the global goal on adaptation, which the EU will need to align to, provides a window of opportunity to address gaps in its policy framework. To do so, the EU needs a legally anchored enabling framework to raise ambition on climate adaptation through a clear operational vision, EU-level targets, robust monitoring, evaluation and learning, and to clarify roles and responsibilities with regard to climate risks. The EU should seize this window of opportunity to enhance its policy framework and safeguard the future prosperity of the EU and its citizens.

4.1. Adaptation in the EU is not keeping pace with escalating climate risks

4.1.1. Fragmented and insufficient adaptation across the EU

Adaptation efforts in the EU remain fragmented and insufficient to match escalating climate risks.

The EU and its Member States have made strides in understanding climate risks and started mapping out their ownership, with national climate risk assessments increasingly informing adaptation planning and responses (EEA, 2024). Despite this growing awareness and policy development, climate adaptation ([7]) in the EU remains limited, uneven and too slow to keep pace with accelerating climate risks, posing a serious threat to the bloc's security, resilience, competitiveness and long-term sustainability (EC, 2024g; EEA, 2024). Efforts are also largely incremental, localised and often disconnected from broader system-level resilience (Berrang-Ford et al., 2021). This risks leading to adaptation efforts that are ineffective (Biesbroek and Delaney, 2020; Olazabal and Ruiz De Gopegui, 2021; Reckien et al., 2023) and even maladaptive (Bertana et al., 2022; Psistaki et al., 2024). The EU is therefore not on track to meet its 2050 vision of becoming a climate-resilient society fully adapted to the unavoidable impacts of climate change (EEA, 2024b; , 2024e, 2024d; ECNO, 2024). This puts the EU's

([7]) Climate adaptation is understood as the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities (IPCC, 2022a).

emission reduction and climate neutrality goals at risk. These goals depend on climate adaptation to maintain greenhouse gas emission reduction efforts, for instance as climate impacts (e.g. wildfires) contribute to declining soil and biomass carbon stocks (Advisory Board, 2025).

4.1.2. Urgent coordinated EU-wide adaptation action is needed

Urgent and coordinated adaptation efforts are needed at all levels of governance in the EU to match the pace and scale of escalating climate risks and ensure the EU's long-term resilience.

As climate impacts intensify, we will approach the limits of what we can adapt to (IPCC, 2022d). Failure to match rising risks with adequate and, where needed, transformational ([8]) action will therefore result in mounting human and economic losses, a shrinking solution space and worsening socioeconomic conditions. The threats and impacts of climate change are not restricted to national or regional borders; if a country or region does not take appropriate action, climate impacts may cascade to neighbouring areas (EC, 2024e). Relying on voluntary national measures risks leading to a patchwork approach to risk reduction that could undermine the collective resilience of the EU. Given this characteristic, urgent and coordinated adaptation efforts are needed at all levels of governance to safeguard the EU's long-term resilience.

As part of its adaptation efforts, the EU will need to align national policies with the global goal on adaptation.

Global progress on climate adaptation also remains slow, fragmented and far from sufficient to meet the scale of the challenge (UNEP et al., 2024). The global goal on adaptation, established under Article 7.1 of the Paris Agreement, seeks to address this gap by enhancing adaptive capacity, strengthening resilience, promoting locally led adaptation and reducing vulnerability worldwide (UNFCCC, 2015). While progress has been slow, an overarching framework setting out key areas of action for global adaptation was agreed at COP28 in 2023 (UNFCCC, 2023). At the upcoming COP30, the concrete means of verifying progress towards the goal, through measurable targets and indicators to track adaptation progress, are expected to be agreed. As part of the EU's adaptation efforts, the EU will need to translate these international commitments once agreed into actionable national policies. This offers a window of opportunity to strengthen adaptation efforts in the EU, which is urgently needed to minimise the cost of climate impacts and safeguard the EU's security and prosperity.

4.2. Key policy gaps hamper further progress on adaptation

4.2.1. Current adaptation governance is nationally led and increasingly mainstreamed

Adaptation in the EU remains nationally driven, guided by EU law and global commitments.

So far, climate adaptation is primarily driven by national policies, deemed adequate at the EU level insofar as they ensure the continuous progress required under the European Climate Law (EU, 2021). The progress is guided by the EU strategy on adaptation to climate change (EC, 2021b) and the national commitments under the Paris Agreement. Member States are required to report on their respective adaptation policy measures and progress through the national energy and climate plans under the Governance Regulation (EU, 2018). This regulation supports the development of national adaptation plans aligned with UNFCCC obligations, helping to operationalise the EU's global climate commitments.

([8]) The IPCC defines transformational adaptation as 'adaptation that changes the fundamental attributes of a social-ecological system in anticipation of climate change and its impacts' (IPCC, 2023).

The EU has increasingly mainstreamed adaptation across EU legislation and sought to drive adaptation efforts through various policy initiatives.

Adaptation is also becoming increasingly embedded in EU legislation, such as the Nature Restoration Law (EU, 2024a), the Water Framework Directive (EU, 2000), the Floods Directive (EU, 2007), the Critical Entities Resilience Directive (EU, 2022b), the revised Energy Performance of Buildings Directive (EU, 2024b) and the Trans-European Networks for Energy Regulation. Climate adaptation has been advanced through the Recovery and Resilience Facility (EC, 2024h) and EU funding programmes, supported by the 'do no significant harm' principle and guidance. Resilience is also a component of the EU's new economic governance framework (EC, 2024i) and the EU taxonomy for sustainable activities (EC, 2025j). The EU seeks to directly enable adaptation through the EU Mission on Adaptation to Climate Change, which supports multi-level governance in building resilience to climate impacts, and foster action through policy initiatives such as the urban agenda for the EU and the 2030 territorial agenda. The EU has put in place several tools supporting adaptation across the governance levels, including Climate-ADAPT, a knowledge sharing tool to support climate adaptation; the Copernicus Climate Change Service, providing free satellite and other measurement data to better understand the planet and changing climate; and the EU Covenant of Mayors for Climate and Energy, a voluntary initiative bringing together local governments to commit and work towards ambitious climate action.

Climate resilience has also featured prominently in recent Commission communications, notably the European Preparedness Union Strategy, as presented in Section 2.3.4, which aims to enhance the EU's ability to anticipate, prevent and respond to both climatic and non-climatic risks. The strategy underscores the importance of systemic resilience across sectors and governance levels. It calls for a number of initiatives that would support climate adaptation, including embedding the principle of 'preparedness by design' into EU policymaking.

EU policymaking is required to align with the European Climate Law through consistency checks but the effectiveness for climate adaptation is likely limited by the law's vague adaptation goal.

The European Commission is required to check the consistency of any EU draft measure or policy with the objectives of the European Climate Law, specifically the EU climate goals for 2030, 2050 and soon 2040 as well as the objective of continuous progress on adaptation. Accordingly, the lawmaking guidance has been updated to ensure EU policies are consistent with these objectives (Advisory Board, 2024) from the outset. To what extent these consistency checks have helped and will help to ensure that climate adaptation is effectively embedded in EU policies is still unclear however, particularly given the European Climate Law's rather vague climate adaptation objective. It is therefore welcome that the European Commission has committed to embed climate risk (EC, 2024f) and, more recently, 'preparedness by design' considerations (EC and HR/VP, 2025) in its lawmaking guidance, which could strengthen consistency checks for climate adaptation.

Growing reliance on EU-level capacities to support national emergency responses to climate-induced events contrasts with the weaker role of the EU in adapting to intensifying climate hazards.

In parallel to the policies outlined above, EU-level coordination and funding has been triggered increasingly often in recent years, mainly in response to climate-induced disasters, notably under the EU Civil Protection Mechanism and the EU Solidarity Fund (EC, 2024f). EU funding available to respond to

natural hazards ([9]) has increased significantly in recent years, with funding allocated under the Solidarity and Emergency Aid Reserve growing by 46 %, in real terms, since 2014. While significant, this arguably lags behind the economic losses from the increasing frequency and severity of natural disasters, which on average more than doubled between 2021 and 2023 compared with 2014–2020 (Bruegel, 2025). As climate hazards increase in frequency and magnitude, EU funds are expected to be increasingly solicited and risk being insufficient or fiscally unsustainable (Hochrainer-Stigler et al., 2023). The growing need for a strong EU collective response to climate-induced disasters stands in contrast with the insufficient pace of adaptation and of the rather lose nature of EU policy instruments to prevent or attenuate them in the first place. More needs to be done to proactively prepare for increasing climate hazards to cost-effectively reduce the negative socioeconomic impacts.

4.2.2. Gaps in the legal foundations and governance framework

The long-term vision for climate resilience by 2050 is vague and lacks a legal framework to drive adaptation efforts commensurate with the intensifying climate impacts and risks.

The EU strategy on adaptation to climate change outlines a long-term vision for 2050 in which the EU becomes a climate-resilient society, fully adapted to the unavoidable impacts of climate change. To support this vision, the strategy sets out action points for the European Commission and the EU. Yet, the vision remains too vague and weak to function as a meaningful operational goal and relies on Member States' voluntary commitments. To be operational, the EU vision needs to set out what becoming a fully climate resilient society means, how this will be achieved with measurable goals to monitor progress and adjust as needed. While the long-term vision provides a general direction of travel, as a communication, it is limited in its ability to drive the necessary adaptation efforts through concrete and binding targets (EEA, 2024). While the European Climate Law enshrines a requirement to demonstrate continued progress in adapting to climate change, this sets a low ambition for climate adaptation that does not reflect the evidence that adaptation efforts are not keeping pace with intensifying climate impacts and escalating risks, as presented in Section 4.1.

Scattered adaptation efforts lack adequate progress indicators for monitoring, evaluation and learning.

The long-term vision lacks clear objectives connected to measurable indicators and timeframes, making the monitoring of progress problematic (Buser, 2022). The Governance Regulation is the main instrument to track progress towards the goal of continuous adaptation (EU, 2018). However, in a recent assessment, the European Commission concluded that its contribution to climate adaptation policy has been limited, with the scope and quality of information reported by Member States impeding domestic adaptation planning (EU, 2018, pp. 22 and 26). An assessment by the European Court of Auditors similarly concluded that Member States' reporting on climate adaptation was insufficient, lacking common indicators and adding little value in terms of tracking progress and supporting future policy decisions (European Court of Auditors, 2024, pp. 5 and 25). Monitoring and evaluation are necessary for evidence-based policy adjustments (EC, 2023, 2021c). Addressing this gap is critical to ensure that adaptation policies drive progress and remain responsive.

Mainstreaming has been a key tool to support climate adaptation at the EU level (Candel et al., 2023) and features prominently in the European Preparedness Union Strategy, which underscores the importance of embedding the principle of 'preparedness by design' across EU policies (see Section 4.2.1).

([9]) For example, the EU Solidarity Fund provides financing for restoring to working order infrastructure for energy, water, transport, telecommunications, health and education infrastructure; provide temporary accommodation; fund rescue services to help the affected population; and secure preventive infrastructure and clean-up operations (EC, 2025k)

However, in the absence of an overarching commitment at the EU level, the mainstreaming of adaptation across EU legislation has made it difficult to monitor, evaluate and learn about climate adaptation outcomes resulting from the various policies.

In addition, mainstreaming does not necessarily lead to strong adaptation outcomes (Bertana et al., 2022; Biesbroek, 2021; Biesbroek and Candel, 2020). Mainstreaming relies, among other things, on effective monitoring and evaluation being successful. For example, in 2025, the Advisory Board recommended that the EU integrate land-related policies into a coherent framework requiring sectoral measures to enhance land sinks and support climate adaptation. It emphasised that improved monitoring is a prerequisite for the effectiveness of this approach and called for the adoption of the Forest Monitoring Law and the Soil Monitoring Law (Advisory Board, 2025). Robust monitoring and evaluation also enable learning feedback loops allowing for meaningful course corrections.

Uncertainty around the roles and responsibilities of EU institutions further hampers climate adaptation efforts across the governance levels.

The complex and at times ambiguous ownership of climate risks[10] also creates uncertainty in climate adaptation governance, including on the exact roles and responsibilities of EU institutions (EEA, 2024). This ambiguity and vagueness contributes to the inadequate EU adaptation efforts so far, with the adaptation governance largely relying on voluntary and non-harmonised approaches. A disconnect between the governance levels addressing climate adaptation was highlighted recently by the European Court of Auditors, which surveyed 400 municipalities and found that local authorities 'were largely unaware of climate adaptation strategies and plans and were not using the EU adaptation tools (Climate-ADAPT, the Copernicus Climate Change Service and the EU Covenant of Mayors)' (European Court of Auditors, 2024, p. 5).

As introduced in Section 4.1, despite some progress, adaptation efforts are not keeping pace with escalating climate risks. Importantly, as climate impacts in Europe increase in both magnitude and frequency, transboundary and systemic threats are also intensifying – making the EU particularly well placed to implement adaptation measures (EEA, 2024). This calls for a revision of the current EU governance approach (see Figure 10) to ensure adequate coordination and implementation of climate adaptation at the EU level.

Figure 10 High-level gaps in the adaptation governance need to be addressed

1. Vague common vision with no legislative anchor	2. Insufficient monitoring, reporting and learning at the EU level	3. Unclear roles and responsibilities of the EU
The EU's long-term vision on adaptation is vague and lacks a legal framework, underpinned by meaningful operational goals, to drive adequate adaptation efforts.	Climate risk considerations are included across EU policies, but the monitoring framework and measurement of the effectiveness of adaptation outcomes remain inadequate.	EU-level coordination and policy action remain insufficient relative to the growing magnitude and frequency of climate hazards affecting the EU.

Source: Advisory Board.

[10] Risk ownership can be defined as identifying "a person or an entity with the accountability and authority to manage risk" (ISO, 2021, p. 20). In the EUCRA report, risk ownership 'describes where the lead responsibility to manage a major climate risk lies between the European level and Member State level'. Risks that are co-owned are defined as those where 'policy areas fall under shared and special competencies, where the EU could implement policies, but also circumstances where actions in more than one policy area are needed and where the level of risk ownership differs' (EEA, 2024, p. 393)

4.3. Enhancing the EU policy framework to enable a resilient and well-prepared EU by 2050

4.3.1. Coherent adaptation policy framework

To address the climate adaptation policy gaps, the EU should enhance its policy framework.

The upcoming European climate adaptation plan and the revision of the Governance Regulation offer an opportunity to address the policy and governance gaps identified in Section 4.2 (see also Figure 10). A coherent adaptation policy framework rooted in the following three pillars can advance the EU on the path towards climate resilience by 2050.

- Common vision and EU targets.
- Robust monitoring, reporting and learning at the EU level.
- Clear roles and responsibilities.

The Advisory Board will put forward further advice relevant to climate adaptation in its upcoming publications.

4.3.2. Common vision and EU targets

A clear vision embedded in binding legislation, underpinned by collective adaptation targets at the EU-level can drive the necessary acceleration in adaptation efforts.

To ensure a legislative anchor, the EU's 2050 vision for adaptation should be made more concrete and embedded in binding legislation. This process should aim at aligning with the global goal on adaptation in an ambitious manner and make the vision:

- **critical**, by acknowledging the evolving incremental and transformational solution space for adaptation and addressing how to manage residual risks and losses beyond adaptation limits; and
- **operational**, underpinned by a set of explicit targets and causal pathways that connect interventions to long-term goals.

To support adaptation initiatives and the monitoring of progress, the Advisory Board recommends that a post-2030 policy framework include clear collective adaptation targets at the EU level. These targets should guide national efforts while reflecting the EU's differentiated risk exposure (EEA, 2024) and adaptive capacities (Oberthür and Dupont, 2021). The EU should also be ambitious when aligning with the global goal on adaptation by setting high standards (e.g. for risk assessments, planning quality or indicator thresholds) and encouraging the delivery of targets on an ambitious timescale. Given the long lead time to agree on the new targets and reflect them in the relevant policies, the Advisory Board recommends the EU act now to avoid locking in low ambition until well beyond 2030.

4.3.3. Robust monitoring, reporting and learning at the EU Level

Indicators should be set to help operationalise the EU vision on adaptation and ensure the effectiveness and progress of adaptation can be meaningfully assessed.

Work is ongoing as part of the UAE–Belém work programme for the global goal on adaptation to produce a set of indicators (see, for example, the illustrative list of indicators proposed by the UN Foundation (2023)). However, there is no consensus in the scientific literature on a single best approach to measuring adaptation. Output, process and outcome indicators all have strengths and limitations (Leiter et al., 2019), with a mixed-methods approach, combining qualitative and quantitative process and outcome indicators, helping to balance these trade-offs (Craft and Fisher, 2018; Klostermann et al., 2018).

Translating the global goal on adaptation targets into the EU context offers an opportunity to develop needed indicators that can be tailored to reflect the EU's priorities while remaining consistent with international commitments. To make the long-term vision operational, the Advisory Board recommends that these indicators should be linked to clear EU targets. Given the complexity of monitoring progress towards becoming a fully climate resilient society, these should also be grounded in a theory of change – an explanation of how actions taken by a group of stakeholders are expected to deliver a desired change or goal – ensuring they are not only measurable but also meaningful in assessing adaptation effectiveness and progress.

This should be supported by periodic EU-wide risk assessments (e.g. the *European Climate Risk Assessment*) to inform both national and EU-level planning, which would support decision-makers in their planning effort. As there are a lot of unknown and uncertain aspects related to adaptation, these efforts should be complemented by timely evaluations of EU and national adaptation policies and assessments of the effectiveness of adaptation measures, to ensure learning and that policies respond as needed (Bertana et al., 2022; Biesbroek and Candel, 2020).

4.3.4. Clear roles and responsibilities

Clarifying the EU's roles and responsibilities can improve climate adaptation governance and enable the EU to drive adaptation efforts where best placed to do so.

To boost climate adaptation governance and ensure better compliance with EU legislation requiring the consideration of climate risks (EC, 2024f), the EU should clarify its own roles and responsibilities to ensure effective coordination and enable the necessary acceleration of adaptation efforts (EEA, 2024; Kivimaa et al., 2025; Runhaar et al., 2018; Townend et al., 2023). In light of the findings of the recent *European Climate Risk Assessment* (EEA, 2024), the Advisory Board recommends that the EU clarifies the climate adaptation governance structure and continues to mainstream efforts across policy domains and levels of government. For example, adapting to transboundary risks (e.g. those affecting forest, marine, coastal and mountain areas) is an area where the EU is well positioned to lead, given the cross-border nature of these risks and the need for international coordination (EEA, 2024). Clarifying the EU's roles and responsibilities is a first step towards allocating resources, building capacity and ensuring that adaption is meaningfully embedded across policies and an effective 'whole-of-government' approach is taken to adapt to transboundary risks (Townend et al., 2023).

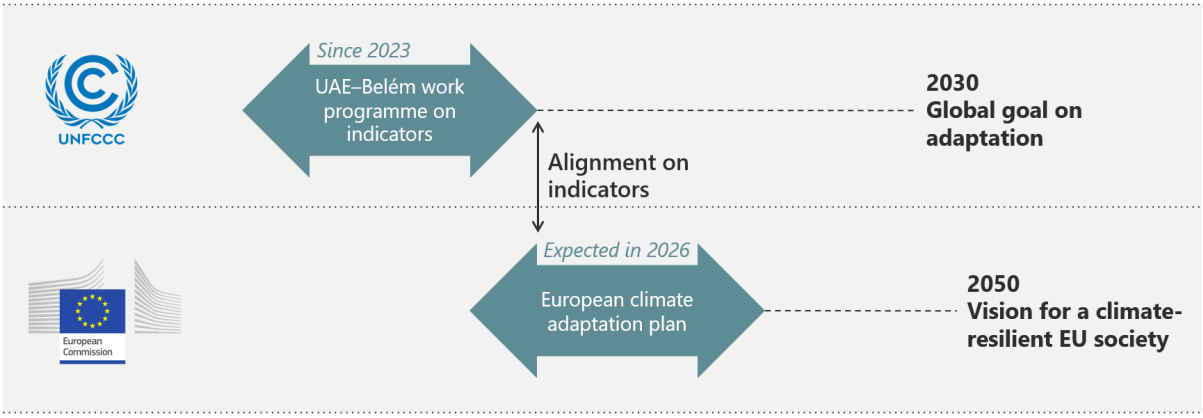
As part of its role, the EU should also take action to ensure a level playing field and support adaptation efforts, by the public and private sector, for instance through harmonised climate reference scenarios, clarity on investment risk and oversight on risk disclosure. On disaster risk management, the EU already plays an important role and demand for collective resources in response to climate hazards has been and will continue to increase (see Section 4.2.1). To manage the increasing economic cost and financial strain, the EU should ensure this is done with long-term adaptation in mind through proactive risk management, stress testing and upgrading of early warning systems for changing extreme events such as those seen recently in Valencia (Martin-Moreno et al., 2025). The EU should also ensure that climate adaptation is meaningfully embedded in EU funding instruments and the next multiannual financial framework. Monitoring progress on these initiatives should be part of the operational long-term vision and robust monitoring framework discussed in Sections 4.3.1 and 4.3.2. It is therefore welcome that, among other relevant initiatives, the European Commission has committed to clarifying the EU climate adaptation governance framework (EC, 2024f) and the European Preparedness Union Strategy has committed to clarifying some of the EU roles related to both climatic and non-climatic risks.

4.3.5. Seizing the EU's opportunity to implement the global goal on adaptation

The Global Goal on Adaptation and upcoming EU initiatives offers a window of opportunity for the EU to accelerate adaptation efforts with concrete and actionable policies.

The concrete means of verification for the global goal on adaptation targets are to be agreed upon at COP30 in Belém, but translating these into actionable national policies will involve a series of complex and time-consuming processes. These processes include defining measurable indicators, aligning them with EU priorities, integrating them into national budgets and planning frameworks, and deploying tailored adaptation initiatives across multiple governance levels. Despite this complexity, the convergence in timing between upcoming EU adaptation legislation, such as the EU climate adaptation plan, and the ongoing international process to operationalise the global goal on adaptation means the EU has a strategic opportunity to accelerate adaptation efforts and raise its level of ambition to better manage escalating climate risks (see Figure 11). This would provide a legal anchor to reinforce political action on climate change adaptation and contribute to the EU's overall preparedness against climatic and non-climatic threats.

Figure 11 Window of opportunity with the upcoming alignment of international and EU adaptation targets and monitoring



Source: Advisory Board.

The EU should strengthen its climate adaptation framework and accelerate adaptation efforts to prepare for intensifying climate impacts and safeguard the EU and its citizens' prosperity.

This chapter underscores the need for urgent adaptation action to ensure the EU is resilient to escalating climate hazards, the impacts of which are already being felt. While there are gaps in the current EU adaptation governance framework that hamper adaptation efforts, there is a window of opportunity the EU can seize to accelerate adaptation efforts and ensure these are commensurate with the pace of escalating climate risks. To this end, the EU should strengthen its climate adaptation framework by clarifying its vision for climate resilience and preparedness, supporting it with effective governance and a solid legal foundation.

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