CEPS

GREEN AND ENVIABLE

How to deliver net zero and a more competitive EU

Irina Kustova, Vasileios Rizos, Edoardo Righetti,
Milan Elkerbout and Christian Egenhofer

CEPS IN-DEPTH ANALYSIS

May, 2024 - 10

SUMMARY

As the EU prepares for the next political cycle, policymakers are poised to continue their efforts to deliver on the objectives of the European Green Deal and the Fit for 55 package, to achieve climate neutrality by 2050.

Reflecting on the policy experiences of the 2019–2024 political cycle, the implementation of the European Green Deal will not be an easy task. Recent geopolitical tensions and economic shifts, compounded by the 2021–2022 energy crisis and Russia's invasion of Ukraine, have highlighted vulnerabilities in the green transition. The 2024–2029 cycle will need to strike the right balance between decarbonisation, international competitiveness and economic security.

To chart the right course ahead, this report holds that it is vital to make a robust and compelling business case for the European Green Deal. It calls for honest discussions about the economic and societal impacts of the transition as well as the benefits. Success hinges on the formulation of predictable and coherent policies, conducive framework conditions and a functioning, integrated single market.

The report presents 30 policy recommendations across seven thematic chapters, addressing various aspects of the European Green Deal. These provide a comprehensive roadmap for policymakers, offering insights and guidance for the 2024–2029 legislative cycle.

Irina Kustova is a Research Fellow in the CEPS Energy, Resources and Climate Change (ERCC) unit. Vasileios Rizos is a Senior Research Fellow, heading the ERCC unit, and Head of Sustainable Resources and Circular Economy at CEPS. Edoardo Righetti is a Researcher in the CEPS ERCC unit. Milan Elkerbout is a Non-Resident Associate Fellow at CEPS and a Fellow at Resources for the Future in Washington, D.C. Christian Egenhofer is an Associate Senior Research Fellow in the CEPS ERCC unit and Senior Research Associate at the Florence School of Transnational Governance, European University Institute, Florence. The authors thank Luca Nipius and Nwamaka Ikenze, Research Assistants in the CEPS ERCC unit, for providing support with data collection.

This report has received funding by the Europe Unlocked coalition.

CEPS ▪ Place du Congrès 1 ▪ B-1000 Brussels ▪ Tel: (32.2) 229.39.11

Policy recommendations for the 2024–2029 political cycle

Ensuring predictability, quality and coherence in the 'implementation cycle'

- Legislators should prioritise the coherent implementation of the Fit for 55 package. New legislative proposals should focus primarily on the issues crucial to advancing the net-zero agenda that must be addressed before 2030.
- Legislators should strive to ensure that better regulation principles are prudently observed and enforced throughout all stages of law-making.
- The European Commission should further enhance the vertical and horizontal coherence of provisions in critical areas for advancing the green transition. Permitting is one of these areas requiring further attention in the 2024–2029 political cycle.
- With climate neutrality established as a legally binding target, the main objective is to translate the multitude of sectoral- and technology-specific targets, including those set in the 2019–2024 legislative cycle, into actionable policies. This also calls for a comprehensive review of existing targets to ensure coherence and to avoid overlap and policy redundancy.
- The 2040 target should provide much needed clarity and predictability, which is required for investment decisions beyond 2030. The European Commission should discuss the technological and regulatory options that will be available to address residual emissions and manage the transition to net zero beyond 2030.

Decarbonising while staying competitive and economically secure

- In reconciling the EU's competitiveness with the firm goals to reach net zero, priority should be given to market-driven innovation and technology adoption. Picking technology winners should be avoided. Public interventions should instead concentrate on 'building the guardrails', thus creating the conditions to endorse the most cost- (and carbon-) efficient options in a competitive environment, rather than 'building railroads' by prescribing specific technological solutions.
- A comprehensive approach to the EU's competitiveness is needed. It should extend beyond industry to encompass the entire business landscape.
- A delicate balance needs to be struck by reducing external strategic dependencies while maintaining a commitment to open and competitive markets.
- The EU has the capacity to develop low-carbon standards and rules in multilateral and plurilateral settings, driving the green transition beyond its borders. However, this ability hinges on sustaining technological frontiers and maintaining a strong presence in green markets along with a robust single market, attractive to external partners.

Financing the green transition

- While targeted green public spending will still be required to reach net zero, the majority of the overall investment will have to come from the private sector. A prerequisite for such investment is a framework that ensures it is profitable and supported by a solid business case. The framework conditions for private investment in the green transition should be improved, including by strengthening the single market (its functioning and the integration of capital and energy markets) and reducing the regulatory burden.
- Public support at the EU level should be strategically targeted at where it can leverage positive cross-border and/or cross-sectoral effects, correct market failures or where there is no real alternative to public investment, such as (cross-border) energy infrastructure and green innovation.

Pricing carbon beyond 2030

- Carbon pricing, accompanied by carbon leakage protection and compensation for lower income households, should remain a precondition that provides a long-term price signal for reinforcing the low-carbon investment case.
- Legislators should evaluate the pros and cons of various sources of EU Emissions Trading System (ETS) supply and liquidity. Each potential source – whether it involves sectoral expansion, merging or linking the EU ETS and ETS2, carbon removal credits or Article 6 Paris Agreement credits – offers its own benefits, particularly if introduced in limited quantities.
- The EU must emphatically avoid introducing additional supply or liquidity that undermines the EU's climate targets.
- The European Commission should give an indication, as soon as possible, of how long carbon removals will still be accepted and which ones.
- Legislators will need to discuss the future setup of ETS2 after 2030, in terms of the coherence of targets and objectives in the EU's climate policy mix. Consideration is also needed of its potential interrelation with the EU ETS, specifically the merging of these systems and any further adjustments to the ETS2 price cap.

Decarbonising the energy system

- Decarbonising the energy system requires reducing investment uncertainty to unlock private investment in low-carbon generation and identifying solutions for flexibility. At the same time, a thorough discussion is needed to avoid undue fiscal burdens on states through subsidies or price stabilisation mechanisms. It is equally important to ensure there are mechanisms to shield consumers from price spikes, and to have a thorough discussion on the distributional impacts of transitioning to a decarbonised energy system. Meanwhile, a sufficient supply of input goods, skills and services must be ensured for managing this decarbonisation.

- The growing need for resource flexibility calls for an assessment of future requirements for energy system flexibility in and across Member States. Policymakers must engage in open discussions regarding all viable low-carbon solutions, including dispatchable options. EU-wide solutions should be found in cases if and where market failures occur, particularly with regard to seasonal storage.
- The European Commission should take a more rigorous and thorough approach to integrating an assessment of total system costs into future legislative and non-legislative initiatives.
- The EU and Member States must ensure the rapid construction of both transmission and distribution grids. The EU must increase its funds to cover the cross-border externalities of interconnectors, while keeping in mind that each Member State has a responsibility for the resilience and reliability of its respective power systems.
- The forthcoming electricity market reform must maintain an integrated EU-wide electricity market, not least to ensure liquidity, enable business, industry and suppliers to hedge and ensure a level playing field for business and industry.

Taking the next step to boost the circular economy

- As the EU policy mix for the circular economy expands, it is important to improve the alignment of its instruments and objectives. It is becoming evident that the objectives of different legislative processes are not always in sync, which can result in conflicting messages for EU businesses and additional administrative burdens. As part of efforts to successfully implement the new legislative portfolio for the circular economy, it will be important to carefully assess existing inconsistencies and provide a coherent set of rules for EU businesses.
- The recent surge in regulatory activity has led to the development of an ambitious but also complex policy mix that will test the capacities of EU businesses and especially SMEs. It is essential to intensify efforts to support SMEs in the green and circular transition. There needs to be continuous support for businesses in the form of capacity-building and knowledge-sharing platforms. When preparing secondary legislation, priority should be given to avoiding duplicate requirements and reducing administrative burdens. The launch of a dedicated strategy giving high priority to SMEs – similar to the 2014 Green Action Plan for SMEs – could support and help streamline these efforts.
- Strengthen the EU framework for monitoring the circular economy. With several data gaps, the present monitoring approach only captures parts of the transition

and cannot yet provide a full picture of how the EU and its businesses perform on circularity. There is need to reinforce efforts to fill existing gaps and also complement the framework with additional indicators covering the adoption of innovations beyond the areas of waste management and recycling.

BEYOND CARBON: REINFORCING BIODIVERSITY PROTECTION

- The 2024-2029 political cycle should allocate greater attention to exploring options for enhancing biodiversity. An integrated approach is needed to effectively balance the accelerated green transition with ecosystem preservation.
- Advancing the bioeconomy is crucial for bridging the gap between strengthening biodiversity and mitigating climate change. Supporting technological development in the bioeconomy sector through research and innovation is essential. A robust bioeconomy will facilitate the increased adoption of bio-based products, replacing those derived from fossil fuels. This development should be complemented by the promotion of circular economy practices.
- By strategically aligning efforts in carbon removal with practices aimed at preserving biodiversity, policymakers could maximise the positive impact on both climate change mitigation and ecosystem health. Promoting innovative approaches, particularly in conjunction with nature-based solutions and carbon farming, could unlock the full potential of these synergies.
- Legislators may find it useful to more thoroughly investigate the creation of incentives for specific restoration activities and their potential in strategies for climate change mitigation. This approach could better link the EU's climate agenda with biodiversity goals. Furthermore, such incentives could better align the interests of land managers, including farmers and foresters, with climate and nature restoration activities.
- Meeting the growing demand for sustainable biomass, whether for bioenergy or as an input for bio-based products, requires careful consideration of the types and sources of feedstocks, taking into account local conditions and impacts on biodiversity.
- Accelerating renewable installation should be accompanied by robust and thorough land-use planning. It is also essential to further explore technological innovations to minimise potential disruptions to land and marine ecosystems.

CONTENTS

Introduction

With 26 years left to achieve climate neutrality, the EU's forthcoming political cycle faces a dual challenge: to deliver on the recently agreed 2030 climate objectives while laying the foundations for the post-2030 framework for the last mile towards net zero by 2050. This decarbonisation path must be laid out in a way that ensures the EU's economic security and maintains its international competitiveness.

This challenge is not entirely new. For the last few decades, structural economic and political transformations have continued to put pressure on the EU's economy globally, especially when compared with fast-growing emerging economies. These longstanding issues have been further exacerbated by recent black swan events, such as the Covid-19 pandemic and the Russian invasion of Ukraine in 2022. Additionally, the energy transition has introduced a range of new risks and dependencies, including the need to secure access to the (critical) raw materials that are indispensable for many low-carbon solutions. The EU also faces increasing global competition in the production of clean technologies[1], often accompanied by greater state involvement and trade-distortive practices.

These systemic shifts and geopolitical tensions have amplified uncertainties surrounding the EU's decarbonisation, even if the adage 'never waste a good crisis' has proven its worth in recent years. They have dispelled the rosy expectations of 2019, a year in which the outgoing European Commission first announced its ambition to become the world's first climate-neutral continent by 2050. The concern now is that the green agenda may receive less attention in the 2024-2029 political cycle.

Although future electoral outcomes across the EU Member States and the recently held EU elections might reshuffle the green agenda to a certain extent, the legal commitment to climate neutrality is a cornerstone of the EU's (not solely climate) agenda. Progress towards net zero is not expected to be straightforward; most likely, a 'pull and push' dynamic – as famously framed by Christiana Figueres, former Executive Secretary of the UNFCCC[2] – will prevail. The Fit for 55 legislation has provided a regulatory framework for Member States to follow by 2030.

What is more important – once the electoral dust settles – is to engage in a frank discussion about the economic and societal impacts of the transition[3] and about how the effective implementation of the European Green Deal can finally lead to a prosperous green transition.

Still, there are many hurdles ahead. Extensive inflows of investment will be needed for decarbonisation. But the gradual phase-out of fossil fuel infrastructure and the accelerated obsolescence of existing capital stock risk reducing the overall economic gains from green investment in the shorter term. Carbon costs may increase inflationary pressures, posing shorter-term difficulties for the economy. However, as Isabel Schnabel, an ECB board member, argues[4], green investment is still the preferred scenario compared with the case where political pushbacks against decarbonisation prevail. The latter scenario, which would delay growth gains while likely experiencing the inflationary impact of the green transition, would most likely lead to stagflation and should be avoided.

Opportunities to leapfrog these potential negative economic impacts of the green transition in the short term include innovation. Although surrounded by persisting uncertainties, technological breakthroughs may have significant potential to increase productivity, reduce costs, accelerate emission reductions and reconcile ecosystem preservation with economic activity. They may also give rise to improvements in circularity, which can stimulate more efficient use of resources, including reducing dependency on imports of (critical) raw materials. These positive implications become an argument for green growth in the political debate.

In the 2024–2029 political cycle, a comprehensive and honest debate needs to take place about the costs and benefits of the European Green Deal. This debate will be essential to secure societal support, build consensus on the goals of the green transition and acknowledge the distributional fallout[5]. Various EU funds introduced in the 2019–2024 cycle (i.e. Just Transition Fund and Social Climate Fund) have attempted to alleviate the distributional effects of the green transition. Even so, more comprehensive measures are needed to mitigate the wider social impacts of EU climate policy.

Policymakers will have to double down on these issues, particularly amid the rising cost of living and growing narrative gap around the objectives of the European Green Deal. It will be essential to minimise the costs of decarbonisation, particularly in the short run, by prioritising cost-effective policy options. So will be preventing policy reversals in response to economic concerns and public discontent[6], in order to capitalise on the broad support for the green transition among the EU population[7].

The overall success of the green transition largely depends on the composition and implementation of climate policies and their related instruments. What primarily matters here is predictability and policy coherence, along with conducive framework conditions and a functioning, integrated single market. All of this is needed to create the conditions for business to maximise its contribution to the green transition and to make cost-effective choices towards sustainable solutions.

To some extent, this business case for decarbonisation has been missing in many ways, and needs to be brought to the fore. In the complex transformation triggered by the green transition, the entire business sector will play a key role in attracting private capital and in spearheading decarbonisation efforts and technological advances across sectors.

This report takes stock of 5 years of policy and legislative activity under the European Green Deal. It presents a perspective on the business case for a path towards net zero. The discussion covers the key prerequisites and enablers needed to achieve this ambitious goal, and potential issues requiring attention in the upcoming political cycle.

Section 1 of the report begins with what is widely referred to as the regulatory 'implementation cycle'. It highlights the need to streamline regulation, to improve coherence across legislative files and targets, and to ensure effective measures to attain the objectives set. Section 2 looks at the potential for balancing competitiveness, decarbonisation and economic security. There, the report calls for a strategic reassessment of the available instruments and for the EU to leverage its inherent strengths and move beyond the crises-driven political approach.

In Section 3, the focus shifts to financing the green transition, emphasising the efficient use of public funds and ways to mobilise private investment. Section 4 explores the potential of the reformed carbon pricing framework to bolster low-carbon solutions. It considers the post-2030 framework for emissions trading and ongoing discussions on liquidity and supply. Section 5 then examines the central role of the energy system in achieving a decarbonised economy, highlighting the need to increase electrification rates, find flexibility solutions, expand and modernise the grid and ensure well-functioning markets.

Section 6 investigates strategies for enhancing circular economy practices and takes stock of the recently reshuffled circular economy portfolio. Lastly, Section 7 evaluates approaches to strengthen the protection of biodiversity in the 2024–2029 political cycle. It urges exploration of the bioeconomy and new technologies for economic progress while safeguarding ecosystems.

1. TAKING STOCK AND LOOKING AHEAD AT THE IMPLEMENTATION CYCLE

The 2024–2029 political cycle will need to capitalise on the impressive legislative achievements of the Fit for 55 package. *First*, this requires improving the quality and coherence of law-making, enhancing the horizontal and vertical alignment of provisions crucial for the green transition, and engaging in comprehensive dialogue with stakeholders. *Second*, with numerous targets already in place, there is a need to ensure their consistency and effective implementation. This requires policy instruments that match targets with actionable measures. *Third*, adoption of the 2040 target will require further clarity on the enabling conditions for the post-2030 track towards net zero, particularly on the management of residual emissions.

1.1 ENHANCING COHERENCE IN IMPLEMENTATION AND REGULATORY QUALITY

The Fit for 55 package has brought about extensive legislative changes, signalling a comprehensive overhaul of EU policy towards the 2030 objectives. Moving forward, effective implementation and regulatory refinement will be crucial, not least to support EU competitiveness. There has been growing concern about regulatory fatigue[8], along with the need for closer observance of the Better Regulation principles[9].

Recommendation 1.1: Legislators should prioritise the coherent implementation of the Fit for 55 package. New legislative proposals should focus primarily on the issues crucial to advancing the net-zero agenda that must be addressed before 2030.

Ensuring consistency across legislative files has proven challenging, allegedly stemming from inconsistent preparatory work and lack of sufficient stakeholder engagement[10]. This inconsistency may also stem from coordination deficiencies among Directorates-General of the European Commission and with Member State initiatives, as well as in consultations with third parties, including businesses from affected non-EU countries.

The recent increase in regulatory activity, sometimes lacking proper adherence to Better Regulation procedures, underscores **the need to enhance regulatory quality**[11]. **Priority should be given to improvements across all stages of law-making.** Properly conducted public consultations are vital not only for securing stakeholder buy-in but also for the quality of law-making[12]. Renewed engagement in sector-specific dialogues[13] is a positive approach that should be sustained. This will complement the focus on the 'Green' aspect of the European Green Deal in the outgoing political cycle by addressing sectoral policies and better engaging stakeholders to effectively deliver on the 'Deal'.

Recommendation 1.2: Legislators should strive to ensure that better regulation principles are prudently observed and enforced throughout all stages of law-making.

In the 2024–2029 political cycle, the European Commission and Member States will initially have to focus on implementing the Fit for 55 legislation. **Enhancing coherence both vertically (between the EU and Member States) and horizontally (across EU legislative files) will be crucial.** It is particularly important in permitting processes, which have proven to be key bottlenecks for green transition projects. While the Commission has taken steps to streamline permitting processes for renewable energy projects under REPowerEU and the revised Renewable Energy Directive, as well as for cleantech manufacturing under the Net-Zero Industry Act (NZIA), their success hinges on proper implementation by Member States.

Meanwhile, permitting legislation in Member States still applies in many respects to these projects as well, including environmental impact assessments and zoning plans. Some of these procedures still need streamlining and improvements at both the national and local levels. Technical capacity building will be important to support better permitting processes, especially at the local level.

Recommendation 1.3: The European Commission should further enhance the vertical and horizontal coherence of provisions in critical areas for advancing the green transition. Permitting is one of these areas requiring further attention in the 2024–2029 political cycle.

Moreover, facilitating permitting processes will also involve enhancing the horizontal consistency of EU-level legislation. Despite significant efforts to establish straightforward one-stop-shop rules for permitting in the NZIA and for renewables in the revised Renewable Energy Directive, other EU legislation, such as the Water Framework Directive and the Industrial Emissions Directive, contain important aspects from a permitting perspective. The 2024–2029 political cycle will need to improve consistency across these files.

Monitoring the implementation of the European Green Deal will also be a significant task for the Commission. Shortcomings in the EU climate governance framework have been highlighted by the European Scientific Advisory Board on Climate Change[14]. An assessment of National Energy and Climate Plans (NECPs) has revealed discrepancies, with efforts falling short of the 2030 goals and a lack of alignment in the climate targets of Member States, compounded by delays in NECP submissions. Enforcement procedures for non-compliance currently rely on the Commission's recommendations to Member

States, with infringement procedures as a last resort. Yet, these procedures are often lengthy, hindering timely remedies for climate-related non-compliance. Addressing these disparities will be an important task for the Commission, particularly following the anticipated review of the Governance Regulation[15].

1.2 Ensuring target consistency and policy implementation

The European Climate Law established the climate neutrality target for 2050. Achieving net zero by 2050 involves a combination of mechanisms, including legally binding targets allocated to Member States under the Effort Sharing Regulation, which covers sectors not included in the EU Emissions Trading System (ETS). It also involves the newly introduced land-based carbon removal target for 2030, translated into national binding targets, under the revised Land Use, Land-Use Change and Forestry (LULUCF) Regulation. For sectors within the emissions trading systems, the expectation is that pricing externalities will incentivise economic operators to cut the costs they incur for allowances by implementing measures aimed at reducing their emissions. Some sectors currently falling under the Effort Sharing Regulation will also be subject to emissions trading under a new ETS2 (Section 4).

In addition, for some time, the EU has used complementary sectoral and sub-sectoral targets to attain specific policy objectives[16]. Among others, updated targets for renewable energy and for energy efficiency, along with sectoral targets across transport, industry and buildings, heating and cooling, aim to accelerate the transition towards sustainable fuels and low-carbon energy, ultimately leading to overall emission reductions. Recently, new technology-specific targets within cleantech manufacturing and additional targets for hydrogen production and imports and biomethane production under REPowerEU have been motivated by concerns about post-2022 energy security and tightened global competition in cleantech.

The proliferation of various targets has escalated in recent years, adding further layers of complexity. While a single climate-neutrality target offers flexibility for Member States and businesses to devise tailored strategies, sectoral and technology-specific targets can provide crucial direction, particularly for nascent industries and technologies. However, these targets can also lead to suboptimal outcomes if not carefully crafted or implemented, as discussed in Section 2.1. Enforcement also remains a challenge, even for legally-binding targets, as

> Recommendation 1.4: With climate neutrality established as a legally binding target, the main objective is to translate the multitude of sectoral- and technology-specific targets, including those set in the 2019-2024 legislative cycle, into actionable policies. This also calls for a comprehensive review of existing targets to ensure coherence and to avoid overlap and policy redundancy.

evidenced by compliance issues in Member States in meeting the targets established by the Renewable Energy Directive and the Effort Sharing Regulation.

Ultimately, the effectiveness of these varied targets relies on the presence of robust policy frameworks and instruments that facilitate the adoption of green technologies and projects. In the 2024–2029 political cycle, priority should be given to the careful selection and implementation of policy and regulatory instruments for effectively achieving the existing targets. **This also necessitates ensuring predictability and coherence across all current targets.** For example, conducting a comprehensive assessment of the interrelationship of these targets could offer valuable insights into future policy priorities, prompting reflections on the need for greater clarity in approach.

1.3 THE 2040 TARGET

Discussions on the 2040 target are to take centre stage in political deliberations in the 2024–2029 legislative cycle. While the incoming Commission will not be bound by it, the impact assessment[17] published by the outgoing Commission likely aimed to catalyse and shape the debate, serving as a reference point for deliberations in the European Parliament and informing 2024 electoral debates.

Recommendation 1.5: The 2040 target should provide much needed clarity and predictability, which is required for investment decisions beyond 2030. The European Commission should discuss the technological and regulatory options that will be available to address residual emissions and manage the transition to net zero beyond 2030.

With the commitment to climate neutrality firmly established for 2050, the focus of discussions on the 2040 target is likely to be more on the 'how' rather than the 'if'. Still, **the discussion on 'how' is important to provide regulatory clarity.** This will lay the groundwork for decarbonisation efforts by business and provide predictability for the substantial investment needed for low-carbon solutions in industrial processes and transport.

Central to this clarity will be the role designated for various types of carbon removals[18]. This will involve discussion of their limitations and opportunities, especially as a bridging mechanism between EU climate and industrial policies (Section 4) and as potential business incentives for decarbonising the agricultural sector (Section 7).

These discussions on the 2040 target will inform the EU's new Nationally Determined Contribution (NDC) for 2035, scheduled for submission to COP30 in 2025. But given the constrained timeframe for post-election deliberations, the likelihood of the EU's NDC being communicated by the end of 2024 is slim, leaving its fate intertwined with the political dynamics shaping the Council in the 2024–2029 cycle[19].

2.The EU's competitiveness and economic security on the path towards net zero

The expectations at the inception of the European Green Deal in late 2019 that Europe's transition away from fossil fuels would be relatively straightforward were swiftly proved optimistic at best[20]. A series of crises transformed the 2019–2024 political cycle into a testing time, prompting further concerns about new and old dependencies, risks and threats. In the 2024–2029 cycle, the EU will need to square the circle of advancing decarbonisation while remaining competitive and maintaining economic security.

A response requires careful exploration, with no immediate or easy answers. What is crucial, however, is a measured approach that leverages the EU's inherent strengths rather than discards them in response to crises. This entails a careful reassessment of the instruments that have been used to address these challenges so far and a pragmatic understanding of the risk premiums necessary in a new geopolitical landscape – all while upholding principles of market openness in both letter and spirit.

2.1 Decarbonising while maintaining competitiveness

Geopolitical upheavals and economic disruptions resulting from the Covid-19 pandemic and the Russian invasion of Ukraine compelled the EU and Member States to pivot towards ad hoc crisis-management strategies[21]. This included emergency measures and legislation across the gas and electricity sectors and public intervention to safeguard affected businesses and households[22], supported by generous national fiscal measures and relaxed EU state aid provisions[23].

Although the EU managed to weather the energy crisis and price shocks of 2022[24], its economy has emerged in distress. The fragmentation of the single market has become increasingly visible and concerning, necessitating urgent action, as highlighted in a recent analysis by CEPS and the report by former Italian Prime Minister Enrico Letta in April 2024[25]. Occasional decline of investment attractiveness, even sluggish investment flows and the failure to secure financing in green sectors are important concerns, even though some improvement has recently been observed.

Energy costs soared throughout the 2021–2022 crisis, particularly affecting energy-intensive industries[26]. While the energy crisis may have eased, the EU's dependence on global energy (oil, coal and natural gas) and commodity prices leaves it vulnerable to externally induced shocks. Energy costs will continue to play a major role in EU competitiveness, necessitating a cost-efficient energy system as discussed in Section 5.

The 2019–2024 political cycle has also witnessed growing anxiety about competition for cleantech supremacy. While a faster rollout of cleantech equipment is beneficial for mitigating global climate change, the competitive advantages of national industries are highly sensitive. The uncharted waters of state subsidies in an era of increasing problems with the WTO regime[27] have led to the swift expansion of heavily subsidised cleantech production, particularly in China, with which EU firms often find it difficult to compete. Meanwhile, the introduction of subsidies under the US Inflation Reduction Act has posed the threat of cleantech relocating to the US and intensified anxiety regarding cleantech competition from the EU's closest ally[28].

Recommendation 2.1: In reconciling the EU's competitiveness with the firm goals to reach net zero, priority should be given to market-driven innovation and technology adoption. Picking technology winners should be avoided. Public interventions should instead concentrate on 'building the guardrails', thus creating the conditions to endorse the most cost- (and carbon-) efficient options in a competitive environment, rather than 'building railroads' by prescribing specific technological solutions.

Safeguarding the competitiveness of the EU industry has been a focal point, with attention drawn to energy-intensive sectors affected by energy prices and to cleantech, influenced by global subsidy races. This has resulted in arguably a U-turn in traditional EU industrial policy, expanding beyond the conventional realms of EU competition policy and closely monitored state aid. Legislative action under the Green Deal Industrial Plan has included measures targeting net-zero technologies and critical raw materials[29], and relaxed state aid has offered greater flexibility for subsidy allocation. Balancing competitiveness-friendly policies with a robust single market is in principle feasible, but ongoing discussions have predominantly revolved around fiscal measures thus far.

There has also been a tendency to support certain technologies, given the pressure from cleantech incentives introduced by the US Inflation Reduction Act. This selection of strategic technologies and materials for support has proven highly susceptible to political frictions and controversies, emerging as a major point of contention during interinstitutional negotiations of the NZIA. If vertical and/or uncoordinated green industrial policies turn out to be costly and inefficient, an EU industrial strategy aimed at crowding in private financing – including for the green transition – should be as horizontal and coordinated as possible.

In that regard, **public interventions should seek (and, to the extent feasible, be limited) to create the conditions for market forces to promote and reward the most cost- (and carbon-) efficient options in a competitive environment (i.e. 'building the guardrails), rather than prescribe specific technological solutions (i.e. 'building railroads').** Ultimately, given the limited ability to predict the future, picking technology winners carries risks. Indeed, the limited foresight of governments to determine the most efficient solution in the long run and to pick winners has traditionally been one of the strongest arguments against vertical industrial policies.

Recommendation 2.2: A comprehensive approach to EU competitiveness is needed. It should extend beyond industry to encompass the entire business landscape.

Moreover, **a comprehensive debate about the EU's competitiveness in the 2024–2029 political cycle should not be restricted to industry and has to encompass the entire business landscape**. Policymakers need to facilitate a conducive environment for the green transition for SMEs, services, green startups and technology companies alike.

Finally, policymakers will be tasked with refining precise and consistent definitions of 'competitive sustainability' and 'sustainable competitiveness', terminologies that have been employed inconsistently and often interchangeably across EU documents[30]. Their objective will be to articulate clear outcomes achievable through the realisation of these concepts.

2.2 OPEN MARKETS AND ECONOMIC SECURITY

A shift towards low-carbon energy sources has brought forth a multitude of new dilemmas and dependencies. For the EU, the need for acceleration was reinforced by the turbulence sparked by the Russian invasion of Ukraine in 2022. The intensifying global tensions have also highlighted Europe's vulnerability along supply chains. In a fossil-based economy, the EU's inherent weaknesses due to resource scarcity made it a major energy importer subject to supply disruptions. Shifting to a low-carbon economy offers the EU opportunities in terms of domestically sourced energy and more efficiency through electrification (Section 5). However, new import dependencies, not least for critical mineral resources, are creating new strategic vulnerabilities and supply risks[31].

The challenge of balancing economic security with the principles of open and competitive markets is growing, and it is clear that new realities are emerging that necessitate a reconciliation of the EU's traditional open market approach. The concept of Open Strategic Autonomy, an expansion of the EU's strategic autonomy in defence, reflects this challenge. Open Strategic Autonomy implies that prioritising purely economic considerations in investment, outsourcing or trade decisions could expose the EU to manipulation by unreliable partners seeking to achieve, inter alia, political goals at the EU's expense[32]. The signal has already been noticed through growing trade distortions in the low-carbon technology sector, including solar PVs, EVs and electrolysers, among others.

Yet, the devil, as always, is in the details. Economic efficiency may decline with excessive and unbalanced public intervention. Government interventions in certain strategic sectors may prove necessary at times, albeit always contingent upon a clear definition of what qualifies as 'strategic'. Nevertheless, they need to be carefully balanced with the realities of the global economy and ensure cost-competitiveness in the long run.

The focus on vertical, supply-side interventions motivated by the need to secure the EU's strategic autonomy in specific sectors has led to the rise of interventionist provisions, such as the establishment of self-sufficiency targets for specific clean technologies (by NZIA) or critical raw materials (by the Critical Raw Materials Act, CRMA). The emphasis on reshoring (energy-intensive) cleantech manufacturing or the production of critical raw materials and refining capacity in the EU risks supporting uncompetitive, subsidies-dependent industries, particularly in oversupplied markets, such as solar PVs[33].

Recommendation 2.3: A delicate balance needs to be struck by reducing external strategic dependencies while maintaining a commitment to open and competitive markets.

This brings into question the equilibrium between the objectives of the single market and strategic autonomy. To address this, **a delicate balance of the available instruments is needed to reduce external strategic dependencies, which would inevitably also imply a certain risk premium, while maintaining a commitment to openness and competitive markets.** Given that the EU comprises trading nations where trade serves, among other things, as a tool for global influence, any reduction in openness – whether due to external factors or policy choices – will impact the EU's economic model and global standing.

2.3 LEADING BY EXAMPLE IN EMERGING LOW-CARBON MARKETS

The EU has long positioned itself as a frontrunner in climate action, showcasing its achievements in decoupling emissions from GDP to make a strong case for decarbonisation alongside economic development. Often described as a 'market power', 'regulatory power' or having the 'Brussels Effect'[34], the EU has an ability to shape norms by establishing standards through its regulatory frameworks offering access to its single market. Some examples of this influence are apparent in the realm of the low-carbon transition. Recent initiatives include the integration of carbon considerations within existing product standards in the EU's sustainable product policy, the digital battery passport and demand-side measures for deforestation-free products. Even the much-debated Carbon Border Adjustment Mechanism (CBAM) aims to incentivise other countries to adopt carbon pricing mechanisms. This inclination towards setting new benchmarks remains a cornerstone of the EU's strategy to maintain its leadership status, as long as access to its single market remains attractive.

Recommendation 2.4: The EU has the capacity to develop low-carbon standards and rules in multilateral and plurilateral settings, driving the green transition beyond its borders. However, this ability hinges on sustaining technological frontiers and maintaining a strong presence in green markets along with a robust single market, attractive to external partners.

As the world shifts towards a low-carbon future, early leadership in cleantech manufacturing among others can translate into significant economic advantages, including capturing a larger market share and gaining the economic benefits associated with leadership in setting global or regional standards. The development of standards in emerging low-carbon markets is of paramount importance as they align practices across industries, enabling cross-border cooperation and expediting clean technology markets.

The challenge here is ensuring the comparability and traceability of product characteristics, and measuring and verifying the carbon content of industrial goods, e.g. shaping the definitions and benchmarks for technologies like low-carbon and renewable hydrogen or low-carbon products such as green steel. Still, **this strong regulatory/market power that the EU may exert in future beyond its borders may only be possible as long as trade with the EU and access to its internal market and technology remain attractive.**

3. Financing the green transition

A profound structural transformation of the EU's economy as part of the green transition requires an unprecedented scale of investment. Overall, the investment needed to achieve net zero by 2050 has been estimated at EUR 40 trillion, equalling approximately EUR 1.5 trillion annually[35]. This will translate into a significant increase of current green (or climate) investment, especially in the short to medium term. Depending on the estimate, an additional EUR 350-400 billion on top of current green investment will need to be mobilised every year throughout the current decade to meet the EU 2030 decarbonisation objectives[36].

Public spending will inevitably need to cover a portion of this additional investment. Ultimately, the actual degree of public investment will markedly differ across economic activities and technologies as well as Member States[37]. For certain sectors, for instance housing and infrastructure, the public share of overall investment is likely to be relatively high. Investment in innovative, high-risk technologies could warrant sizeable public involvement as well. Nonetheless, it is clear that the vast majority of this additional green investment will have to be sourced from the private sector.

3.1 Green public funding: Setting the right priorities amid constraints

In the EU, public spending has long been instrumental in supporting green investment, at both the EU level through the EU budget and the Member State level. Despite being dispersed across a wide range of funding instruments, the amount of EU green spending has climbed substantially. With roughly 30 % of the 2021–2027 Multiannual Financial Framework and 37 % of the Recovery and Resilience Plans dedicated to climate action, it is estimated that almost EUR 700 billion has been allocated to support the EU's energy transition over the 2021–2027 period[38]. Member States have also largely supported renewable energy generation and deployment, and the recent relaxation of the State Aid Guidelines under the new Temporary Crisis and Transition Framework (TCTF) has given them even greater flexibility to do so.

Yet given macroeconomic, fiscal, legal and political constraints, the availability of **public funding may shrink in coming years, at both the EU and Member State levels**. The gradual phase-out of NextGenerationEU, along with new policy priorities (like increased defence funding) and concerns over the distributional impacts of green policies could sharply curtail the availability of EU funding for green purposes[39]. The absence of fresh money allocated to legislative initiatives in the Green Deal Industrial Plan as well as a somewhat under-budgeted Strategic Technologies for Europe Platform[40] might be early signs of this trend. The phase-out of the TCTF in 2025 and potential reductions in fiscal capacity due to the EU's revised public spending rules[41] and greater fiscal discipline could constrain the ability of Member States to subsidise the decarbonisation of their economies[42].

Recommendation 3.1. Public support at the EU level should be strategically targeted at where it can leverage positive cross-border and/or cross-sectoral effects, correct market failures or where there is no real alternative to public investment, such as (cross-border) energy infrastructure and green innovation.

The possibly diminishing availability of public financing for the green transition – at both the EU and national levels – calls for **more efficient, targeted and coordinated (green) public investment. In this light, EU public investment should be strategically aimed at areas that are inherently trans-European, where they can bring positive externalities via cross-sectoral or cross-border benefits or where there is simply no real alternative to public funding**.

One such example is **energy infrastructure, particularly cross-border** (Section 5). In the EU's action plan for grids, for instance, the European Commission estimated that approximately EUR 580 billion will be required for the expansion of electricity grids over this decade alone[43]. Although of a lower magnitude, investment in CO_2 infrastructure[44] as well as in that for EV charging and hydrogen refuelling[45] infrastructure for road transport will also need to significantly scale up in the near future. As a large share of this will need to be anticipatory investment, meaning high risks of initial unprofitability[46], direct public funding or other support mechanisms for de-risking private investment will likely be necessary in this domain. In a similar fashion, public investment in other (cross-border) transport and digital infrastructure (e.g. railways and or fibre networks) would also bring major benefits.

Beyond infrastructure, **a second priority area for EU green spending is innovation**. Despite remaining one of the world's most active regions in green innovation, the EU has gradually fallen behind the US and China on R&D spending[47] and has long been outperformed by the US on several innovation performance indicators[48]. Innovative EU companies face a big funding gap compared with their US peers[49].

Sustained support for innovation would be beneficial in the cleantech space to stay ahead in the technological frontier and increase EU competitiveness in this fast-growing and highly dynamic sector. The vast majority of public R&D spending in the EU is currently undertaken by Member States[50]. But **more support from the EU budget is desirable** to better exploit competitive regional advantages, to avoid inefficient and unviable national projects and to prevent distortions of competition due to differing fiscal capacities among Member States[51]. Further, while existing EU funding mechanisms for green innovation focus mainly on 'mid-technology' R&D (Horizon Europe) and demonstration projects (the

EU Innovation Fund), a **stronger emphasis on high-risk, breakthrough innovation projects** could increase the effectiveness of EU innovation spending[52].

Prioritising green public spending on key strategic, no-regret areas such as energy infrastructure and green innovation could help the EU and Member States cope with emerging budget constraints, especially in the short to medium term. In the longer term, however, the EU's green investment should be framed as part of a more comprehensive EU strategy[53] designed to clearly set forward-looking green investment priorities and possibly be supported by additional, dedicated EU resources. The strategy should capitalise on the crucial role of public funding in providing strategic direction and ultimately stimulate private investment in the transition.

3.2 Encouraging private investment for the green transition

The need to rapidly scale up green investment amid the public funding constraints outlined above requires creating the conditions to crowd in private capital in the green transition. With carbon pricing being a cornerstone of its climate policy, the EU has long relied on a technology-neutral price signal to reduce the green premium of (and create a business case around) low-carbon options, hence driving private investment.

To some extent, the emergence of technology-specific targets or support schemes might have somewhat affected this trend over the last political cycle. However, a solid carbon pricing mechanism (complemented by measures for carbon leakage protection and support for low-income households) should remain the key technology-neutral policy option to spur private investment in the transition. Whether the price signal in the reformed EU ETS and a new ETS2 will be enough is a question policymakers will need to address (again) in the 2024–2029 political cycle (Section 4).

On top of the need for a solid carbon price signal to drive investment in low-carbon innovation, in the recent past, several obstacles have slowed the rate of private investment, including in low-carbon solutions. High energy costs, a lack of skilled labour, tightening financial conditions and long-term uncertainty were identified as the main obstacles to private investment in 2023[54]. Regulatory complexity and over-reporting have also emerged as major hurdles for the private sector[55].

The recent wave of industrial policy initiatives in the EU has partially responded to these challenges, especially within the domains of cleantech and critical raw materials. The EU's Green Deal Industrial Plan and its associated legislative initiatives – the NZIA and the CRMA – have set the direction towards simplifying the regulatory framework, streamlining permit-granting processes, coordinating access to existing financing tools and enhancing skills development.

Yet further, non-sector-specific actions will be required to enhance EU competitiveness and attract private capital for the transition. The focus should be on improving the broader horizontal framework conditions driving or affecting investment decisions in the EU, including in low-carbon solutions.

This objective should primarily be pursued by strengthening and deepening the EU single market in its various facets, especially the EU capital and energy markets. Private investment in the EU is currently hindered by the lack of a single market for capital. Deepening the capital markets union would enable the EU to achieve a larger and more competitive capital market, thereby improving firms' access to capital (notably SMEs and startups)[56], including those investing in low carbon. Similarly, promoting the integration of energy markets (as discussed in Section 5) would lead to a more resilient energy system, reduce overall system costs and ultimately lower energy prices, thereby enhancing the competitiveness of EU business[57].

Recommendation 3.2. While targeted green public spending will still be required to reach net zero, the majority of the overall investment will have to come from the private sector. A prerequisite for such investment is a framework that ensures it is profitable and supported by a solid business case. The framework conditions for private investment in the green transition should be improved, including by strengthening the single market (its functioning and the integration of capital and energy markets) and reducing the regulatory burden.

More could also be done to maximise the impact of limited public resources as a catalyst for private investment. For example, the EU could make more effective use of public sector guarantee mechanisms by improving the functioning and reducing the leverage of the InvestEU programme[58]. Or, as recommended in Enrico Letta's report, the EU could create a dedicated European green guarantee, supporting financial institutions lending to green projects[59]. Building on the success of EU industrial alliances, the EU could further promote the use of public-private partnerships, including by involving institutional investors like insurance companies and pension funds to further reduce green investment risks and crowd in corporate finance.

There is also a need to streamline and reduce the cumulative burden of regulation to ease overall administrative requirements for the private sector[60]. Red tape, a longstanding issue, has been exacerbated by recent mandates on disclosure and reporting. Businesses have raised concerns about regulatory inconsistencies, conflicting objectives and unnecessary complexity. Among others, this was highlighted in the Antwerp Declaration for a European Industrial Deal, launched in February 2024 and endorsed by major industries. This feedback, widely acknowledged in expert and policy circles, resonates not only with large industries but also with SMEs, which are pivotal in many sectors. For SMEs, complex reporting requirements and access to funds have become increasingly difficult due to tighter economic constraints and greater regulatory demands.

4. Carbon markets in post-2030 EU climate policy

Pricing emissions has been, and will remain, at the heart of EU climate policy. Since its inception in 2005, the EU ETS, a cap-and-trade system presently covering approximately 40 % of the EU's total GHG emissions, has undergone substantial reforms, particularly between 2012 and 2017. These reforms, including the introduction of the Market Stability Reserve and revamped free allocation rules, have heightened certainty within the system and stabilised the carbon price level[61].

Under the Fit for 55 package, the EU ETS has been further reformed, introducing key changes in Phase IV of the EU ETS (2021–2030). This revision realigned the cap with the new emission reduction targets for 2030, integrated maritime transport into the scheme starting in 2026 and introduced a gradual phasing-out of free allocations to industry by the end of 2033. Concurrently, the CBAM was introduced to address carbon leakage and ensure a level playing field for certain European industries vis-à-vis their non-EU counterparts. Additionally, the reform established a separate ETS for buildings, road transport emissions and non-ETS industry (referred to as 'ETS2'), which will start in 2027.

In the 2024–2029 political cycle, legislators are expected to continue refinements to ensure carbon pricing fulfils its key role in the EU's ever-expanding climate policy mix. Discussions will need to concentrate on the critical aspects of the post-2030 architecture of carbon markets to ensure their efficient functioning.

First, with the EU ETS reform sealed during the 2019–2024 political cycle, renewed debate should further address the ability of the EU carbon price to provide a long-term price signal for low-carbon investment across the EU economy. Another layer to this discussion should concern the competitiveness of carbon- and energy-intensive industries during their decarbonisation, particularly in the context of phasing out free allocations.

Second, as the cap on emissions is projected to approach zero by 2039 if the recently agreed trajectory is sustained beyond 2030, providing a sufficient supply of EU allowances (EUAs) to address remaining and permanent residual emissions and to maintain liquidity within the EU ETS calls for solutions that legislators will need to find.

Third, with the establishment of a separate ETS2, discussion will be needed on its future interrelation with the EU ETS and consistency with the targets under the Efforts Sharing Regulation, also in the context of overall coherence of the EU's climate policy mix.

4.1 CARBON PRICE AS A LONG-TERM INVESTMENT SIGNAL FOR THE LOW-CARBON TRANSITION

By pricing carbon in line with the polluter-pays principle, the cost of GHG emissions is internalised, giving economic operators incentives to reduce their carbon intensity and invest in cleaner technologies.

Ensuring that an emissions trading system sets such a long-term price signal, as a prerequisite for attracting private capital (as discussed in Section 3), has been central to policy debate. The role of carbon pricing in the EU is expected to transcend its traditional disciplinary and backstop functions[62], contributing to the widespread deployment of low-carbon solutions across various sectors and providing a compelling business case for these solutions. EU ETS-covered emissions have shown a decrease in the EU, with significant progress recently observed in the power sector[63]. While it is hard to attribute the precise share of this emissions decrease to emissions trading, the EU ETS has been widely acknowledged as one of the key drivers in decarbonising the power sector.

> Recommendation 4.1. Carbon pricing, accompanied by carbon leakage protection and compensation for lower income households, should remain a precondition that provides a long-term price signal for reinforcing the low-carbon investment case.

The stability of a certain ETS price level is one of the factors facilitating investment decisions, as for many transformative low-carbon technologies, abatement costs currently exceed EUR 100/tonne. After nearly a decade of low levels, and following a series of reforms[64], EU ETS prices have shown a gradual and consistent upward trend[65]. However, **price fluctuations are inherently part of the EU ETS. They reflect the normal functioning of the carbon market, driven by various combinations of factors affecting the demand for EUAs unless price floors and ceilings are introduced – measures that have been rejected so far by legislators for the EU ETS.** While there were brief sharp dips during the early phase of the Covid-19 pandemic and spikes during the energy crisis in 2022[66], these fluctuations should not be viewed as a cause for concern.

Various projections converge on estimations of the EU ETS price level reaching EUR 130-160/tonne by 2030[67]. **In the shorter term, amid the absence of a higher EU ETS price and given the price fluctuations, instruments such as carbon contracts for difference might be more important to trigger investment in industrial decarbonisation. That said, they may come at a higher cost.**

At the same time, rising carbon costs following the EU ETS reform in 2023 will further exert pressure on energy- (and carbon-) intensive industries to accelerate decarbonisation of industrial processes. Technological solutions across industrial processes vary widely in terms of readiness, deployment and commercialisation, many of which depend on access to affordable low-carbon (dispatchable) electricity. In some cases, such as cement, some residual emissions are unavoidable.

The forthcoming CBAM, which is yet to be fully operationalised, aims to protect certain sectors – currently, cement, iron and steel, aluminium, fertilisers, electricity and hydrogen – against carbon-intensive imports. All the same, it does not address how to shield these sectors from imports of low-carbon goods during their decarbonisation. The vulnerabilities of export-oriented sectors have also been left unaddressed. With increasing ETS costs and resulting production costs, export-oriented industries are struggling to remain competitive with their more carbon-intensive competitors, which incur lower or no carbon costs, and in the absence of standards embedding the carbon content globally or regionally[68].

Unless these industries find cost-efficient decarbonisation options, they may consider closing their most carbon-intensive operations or relocating production outside Europe. **An open dialogue is needed on the economic and social repercussions of industrial decarbonisation in Europe and shifting patterns of production by energy-intensive industries across Europe**.

Carbon pricing in the EU ETS has been widely used to finance Member State budgets and the EU Modernisation and Innovation Funds. In that regard, high ETS prices for a certain period will be beneficial for reinvesting in low-carbon solutions. Still, here too the details matter. A careful discussion on the purpose and design of the ETS may be necessary, especially as the EU ETS has been subject to interventions aimed at using it as a tool for direct revenue generation. The recent reallocation (frontloading) of additional EUAs to be auctioned between 2023 and 2026 was largely motivated by the need to raise EUR 8 billion for the REPowerEU chapters of the Recovery and Resilience Facility plans of EU Member States. These had been designed to expedite the transition from Russian fossil fuel imports following the Russian invasion of Ukraine in February 2022.

This decision has several repercussions. The frontloading may result in lower volumes of EUAs available for auctions between 2026 and 2030, reinforced by a constrained trajectory of the emissions cap. Quantifying the financial objectives of the REPowerEU plan in monetary terms rather than in terms of EUAs also increases the amount of EUAs that need to be frontloaded in the context of the lower ETS price, which fell after its peaks in 2022. That could further suppress current ETS prices, thus distorting price signals, reinforcing a vicious cycle of price suppression and further tightening the supply of EUAs in the second half of the 2020s[69]. It cannot be ruled out that similar ad hoc interventions in the future could likewise be justified by 'critical situations'[70] – underscoring the need for transparency and ex-ante provisions regarding such measures to maintain market stability and ensure the credibility of the EU ETS.

4.2 POST-2030 CARBON MARKET ARCHITECTURE

In line with the trajectory set by the revised ETS Directive, the cap on emissions will reach zero by 2039[71]. This means that no new allowances will be made available through auctions, but any allowances issued and 'banked'[72] before then may still be traded and used for compliance. Emissions from intra-EU aviation will remain subject to separate allocation rules. Irrespective of EU ETS supply, ETS-covered operators[73] will remain obliged to surrender allowances for their emissions. This raises issues about market functioning, as supply and liquidity in the EU's carbon market will be much scarcer, potentially as soon as the early 2030s.

It is highly improbable that all emissions within EU ETS sectors will have been eliminated by 2039. The transition away from process emissions in industry may require more time; the maritime sector will likely also continue emitting. Overall, potentially slower emission reductions beyond the power sector can be expected. With industry emissions increasingly constituting a larger proportion of EU ETS emissions, there will be also shifts in carbon market dynamics. Unlike the power sector, trading dynamics within industrial sectors are not as thoroughly understood yet[74].

As a result, ETS prices are expected to experience a swift upward trajectory and greater volatility due to a diminishing number of EUAs alongside a persisting need to surrender allowances. This scenario, often referred to as an 'ETS endgame'[75], poses significant difficulties for policymakers. **The forthcoming Commission will need to carefully consider the source of supply and liquidity within the EU ETS while ensuring the EU's climate objectives remain steadfast.**

> Recommendation 4.2: The EU must emphatically avoid introducing additional supply or liquidity that undermines the EU's climate targets.

Importantly, **discontinuing the EU ETS once the cap is depleted would be ill-advised**, despite the potential regulatory appeal. Halting EUA trading could drive up costs given the heterogeneity of abatement costs, thereby diminishing the cost-effectiveness of abatement efforts. Equally, **options undermining the EU's climate targets should not be considered, including the possibility of reintroducing the pot of 'invalidated' allowances**. The removal of the historical oversupply was perhaps the critical factor in restoring the functionality and credibility of the EU ETS as a powerful EU climate policy tool. While 'invalidation' is legally different from 'cancellation', such a step would be lethal for the credibility of the EU ETS.

In theory, establishing a single ETS and cap for the entire EU economy is conceivable. Extending carbon pricing to waste incineration and agriculture – alongside the new ETS2 – could create a level playing field for economic operators across the EU and enhance the cost-efficiency of emission reductions. Yet, implementing a single carbon price across all sectors in practice will have to overcome significant political and institutional obstacles.

Apart from this, there are several complementary options to explore to sustain EU ETS supply/liquidity[76]:

- permitting carbon removals for compliance under the EU ETS;
- linking or merging the EU ETS and ETS2;
- accepting Article 6 Paris Agreement credits;
- creating a separate ETS for agriculture.

Recommendation 4.3: Legislators should evaluate the pros and cons of various sources of EU ETS supply and liquidity. Each potential source – whether it involves sectoral expansion, merging or linking the EU ETS and ETS2, carbon removal credits or Article 6 Paris Agreement credits – offers its own benefits, particularly if introduced in limited quantities.

When considering any options, however, it remains crucial to bear in mind that the EUA supply stems from fundamental political decisions. Any future approach to carbon pricing would invariably include (i) ensuring sustained reductions in emissions rather than merely purchasing credits; (ii) maintaining emission levels within technological and economic feasibility at any given time; and (iii) assessing the political acceptability of ETS price impacts on various stakeholders, including end consumers and households.

Carbon removals

Carbon dioxide removal, or the extraction of CO_2 from the atmosphere through human-based activities, encompasses a spectrum of methods[77]. They may be necessary to offset residual emissions and further achieve net-negative emissions beyond 2050. The untapped potential of carbon removals across sectoral strategies has been steadily recognised in the 2019–2024 political cycle.

The EU has initiated its certification process for carbon removal activities through the Carbon Removal Certification Framework (CRCF), published in early 2024[78]. This new mechanism will establish quality criteria and set out monitoring and reporting processes to encourage investment in carbon removals. It will helpfully distinguish between different categories of carbon-removal activities, notably whether they are land-based or involve permanent technological removals (or even removals at all, because the CRCF also – unhelpfully – credits certain projects for agricultural emissions avoidance, which are different altogether from carbon removals).

The combination of emission reductions and carbon removals may entail trade-offs in resource deployment, especially when lower-cost options for emission reductions are still available. If there are clear market signals for both emission reductions and negative emissions, and competitive technologies are available for each, these trade-offs will naturally resolve themselves. But until this point is reached, policymakers may need to make explicit decisions regarding the extent of financial and regulatory support for different options[79].

Recommendation 4.4: The European Commission should give an indication, as soon as possible, of how long carbon removals will still be accepted and which ones.

Valid concerns persist regarding the perception that purchasing carbon removals is a lower cost alternative to emission reduction efforts; until emission reductions reach their limits, any level of residual emissions continues to counterbalance the GHG emissions that persist. This once again underscores the importance of prioritising emission reduction measures before resorting to removals. That way, in instances where residual emissions are genuinely unavoidable and entail prohibitively high abatement costs, the attractiveness of carbon removal credits would increase only if the already high costs associated with permanent credits are lower than the costs of abating residual ETS emissions.

Offsetting residual emissions with carbon removal credits would allow the EU ETS to operate without an additional allocation of EUAs, while providing a more limited and measured source of supply/liquidity. **A certain volume of permanent carbon removal credits, certified by the CRCF and determined at the political level (such as by the European Council) could be permitted for compliance under the EU ETS, covering a tonne of emissions.** If policymakers intend to integrate carbon removals into the EU ETS, they must weigh various factors, including approaches for how to manage the overall EU ETS supply:

- **Maintain the overall EU ETS supply while allowing removal credits on top of the regular EUA supply.** Since the credits would be utilised for EU ETS compliance (i.e. fungible with regular EUAs), the share of EU ETS emissions would increase while still being in line with the EU's climate-neutrality goals, as each removal credit would represent a tonne of carbon removed from the atmosphere.
- **Cancel an EUA for every removal credit allowed into the EU ETS.** This approach would compel ETS operators to contribute to net-negative emissions, but its effectiveness hinges on the availability of EUAs in the market. In the longer term, if the EU were to adopt a net-negative emissions target, a different ratio of surrendered credits to cover a tonne of emissions might be applied. For instance,

as a purely hypothetical illustration, two credits could be required to cover one tonne of emissions.

Merging the EU ETS and the ETS2

Merging the EU ETS with the ETS2 to expand the size of the EUA market would require minimal legislative changes compared with other alternatives, and in that regard could be viewed as the most straightforward and easiest option to source additional supply. All the same, **the prospect of merging the two systems is likely to provoke political controversy in the future.** The demand for EUAs by multinational steel and chemical companies would then influence the carbon costs for household heating, and conversely, the rate of electrification of heating and road transport would also affect the demand for EUAs, the EU ETS price and subsequently the competitiveness of energy-intensive industries.

Extending emissions trading to encompass the buildings and road transport sectors has long been a controversial choice due to the potential impacts of a carbon price on households. By doing so, legislators opted for securing a certain price level (EUR 45/tonne adjusted for inflation), exceeding which the price adjustment mechanism will be activated. This price adjustment mechanism will function until the end of 2029[80], but a new legislative initiative can be tabled by the Commission to amend, extend or adjust it.

Initial estimates suggest that once this price adjustment mechanism is removed, the ETS2 could see prices surge to EUR 200/tonne[81]. Furthermore, the implementation and operationalisation of ETS2 remain to be seen. **The introduction of ETS2 raises questions about coherence with other targets and the broader climate policy mix.** Specifically, a discussion is needed about how the new ETS2 will coexist with the obligations under the Effort Sharing Regulation.

Recommendation 4.5: Legislators will need to discuss the future setup of ETS2 after 2030, in terms of the coherence of targets and objectives in the EU's climate policy mix. Consideration is also needed of its potential interrelation with the EU ETS, specifically the merging of these systems and any further adjustments to the ETS2 price cap.

Nonetheless, **there are compelling arguments in favour of further exploring options for merging the two systems.** *First,* broad sectoral coverage offers economic efficiency benefits by enabling emission reductions to occur at the lowest possible cost. Presently, significant sectoral disparities exist within the EU ETS, spanning from utilities operating numerous large power plants to small-scale tile factories or breweries. *Second,* the sectors covered by ETS2 represent a substantial portion of total EU GHG emissions[82]. With the anticipated rise in electrified road transport, a growing share of transport emissions will indirectly shift to the power sector. This trend may add to rationales for a gradual merging of the two emissions trading systems.

There may be concerns that merging the two systems could lead to ETS operators from the EU ETS simply purchasing allowances from ETS2, or vice versa, instead of actively reducing emissions. Yet, theoretically, any underperformance in emissions abatement within one sector should prompt accelerated abatement efforts in another sector[83]. Ultimately, achieving climate neutrality by 2050 necessitates the decarbonisation of all sectors to the extent that only unavoidable residual emissions persist. This implies a convergence in the pace of decarbonisation across sectors.

International credits

If admitted, international credits from Article 6 of the Paris Agreement could potentially inject liquidity into the EU ETS. During Phases II and III (2008–2012/2013–2020) of the EU ETS, international credits from Kyoto mechanisms like the Clean Development Mechanism were permitted for compliance within the EU ETS, up to a specified limit. However, these international credits garnered a negative perception, as their significant volume was seen to contribute to oversupply within the EU ETS between 2008 and 2015, suppressing ETS prices during that period. Concerns over the quality of Clean Development Mechanism credits, often sold at prices as low as EUR 1/tonne, also emerged as a key issue.

Currently, **the complexities of reaching a full Article 6 rulebook at the COPs indicate that the EU has yet to reconsider its position on the use of international credits within its domestic carbon market.** But if Article 6 were to deliver credits of credible quality in the future, the discussion surrounding their incorporation into the EU ETS might swiftly change. This prospect becomes even more plausible if the domestic carbon price significantly exceeds that of potential good quality Article 6 credits (although this remains a big 'if' for the time being), as it would bolster arguments of increased cost-effectiveness and competitiveness.

Carbon pricing in agriculture

The debate about expanding carbon pricing to agriculture, the only major sector not covered by emissions trading today but perhaps the most challenging sector for climate policy (or for any policy – given the context of recent farmers' protests all over Europe), will inevitably inform the 2024–2029 policy cycle.

In 2021, the European Court of Auditors advised that the Commission should 'assess the potential to apply the polluter-pays principle to emissions from agricultural activities, and reward farmers for long-term carbon removals'[84]. Later, the EU Climate Advisory Board recommended the introduction of some form of emissions pricing in the agricultural and land-use sectors by 2031 at the latest[85]. For this to occur, **the Commission would need to evaluate whether an additional policy measure is necessary to address agricultural GHG**

emissions and removals, and if so, whether such a measure should adhere to the polluter-pays principle[86]. One of the potential options under consideration is creating a separate ETS (i.e. an ETS3) for agriculture as well, which could be augmented by certain types of carbon removal, to incentivise the practice of carbon farming.

4.3 Post-2030 governance: A need for a supervisory institution?

A dialogue on the governance framework for emissions management beyond 2030 can be enriched with a careful exploration of options for a supervisory institution. The idea of a 'carbon central bank' has been circulating within expert circles as a potential governance adjustment for the current carbon-pricing framework beyond 2030[87]. This concept offers **an alternative to addressing issues related to EU ETS supply and liquidity compared with automated rules like the Market Stability Reserve.** Proponents argue that the transition from the current governance based on volumetric regulation to net-zero management would necessitate novel approaches, inter alia, in order to ensure a price signal for negative emissions[88].

The scope and mandate of such an institution are subjects of extensive discussion, requiring careful consideration of whether this administrative body would be empowered to make (legally-binding) decisions or perhaps serve solely in an advisory capacity regarding ETS supply and liquidity management, particularly during anticipated liquidity crunches. While the idea of a carbon central bank and other forms of delegation may hold promise, they will not alter the underlying reality that ETS supply primarily results from fundamental political choices that are (and should be) made in legislation. Finally, whether a new institution is perceived as an additional political intervention in market dynamics or as a valuable tool to manage carbon markets in the future, its establishment will need to comply with the EU Treaties.

5. Decarbonising the energy system

Decarbonisation of the energy sector – a cornerstone of the green transition – will need to tackle significant challenges in the 2024–2029 cycle. Already ambitious in its goals, its decarbonisation path includes expanding electrification across sectors, decarbonising hard-to-abate industries and other sectors such as transport and buildings. This must all occur in the very different post-2022 realities alongside an expedited phase-out of energy imports from Russia.

First, efforts to increase electrification rates will need to double down. Transitioning to a decarbonised energy system will require prudent discussion on how to ensure the reliability, cost-efficiency, flexibility and resilience of the energy system. All options for flexibility solutions merit careful consideration. Additionally, discussion will be beneficial on total system costs and the options to reduce them in a cost-efficient manner.

Second, the expansion, modernisation, and decarbonisation of grids at both transmission and distribution levels will become urgent priorities, necessitating solutions for their financing, and the construction of cross-border interconnectors wherever needed. *Finally*, the 2024–2029 political cycle will need to assess the results of the electricity market design reform and intensify efforts to deepen market integration while ensuring the effective functioning of both short-term and forward markets.

5.1 Post-2022 consensus and new challenges in decarbonising the energy system

In transitioning towards a low-carbon energy system, electricity is positioned to become the main energy source. The principle of energy efficiency and electrification first prioritises electrification as the most effective means of decarbonisation, particularly in end-use sectors such as industry, buildings and transportation, where feasible. Projections from various sources indicate significant surges in electricity demand by 2030 and by 2050. Meeting the targeted electrification rate, expected to surpass 60 % by 2050 in the EU's final energy demand, may nonetheless be difficult. Despite continual efforts, the rate of electricity penetration in final energy demand has only moderately increased in 30 years, reaching up to a quarter by 2023[89].

Recommendation 5.1. Decarbonising the energy system requires reducing investment uncertainty to unlock private investment in low-carbon generation and identifying solutions for the flexible use of resources. At the same time, a thorough discussion is needed to avoid undue fiscal burdens on states through subsidies or price stablisation mechanisms. It is equally important to ensure there are mechanisms to shield consumers from price spikes, and to have a thorough discussion on the distributional impacts of transitioning to a decarbonised energy system. Meanwhile, a sufficient supply of input goods, skills and services must be ensured for managing this decarbonisation.

Achieving far higher electrification rates requires not only replacing fossil fuel-based electricity generation with low-carbon alternatives, but also extensively deploying new, additional, low-carbon generation capacity. This entails substantially scaling up the deployment of wind and solar energy, as outlined in the higher targets for the renewable energy share in the revised Renewable Energy Directive and capacity installations for wind and solar by 2030 and 2050 in relevant EU strategies. However, relying solely on domestic renewable energy sources may be insufficient[90]. A new decarbonised system will also need 'molecules', including renewable hydrogen, which again will need more renewable electricity[91].

The 2024–2029 political cycle will also need an open dialogue on the potential externalities of all low-carbon solutions, including their carbon and environmental footprints. While reducing the carbon footprint is crucial for decarbonising systems, discussions about the environmental impacts of new technologies should not be overlooked (Section 7).

Moreover, **the transition towards a low-carbon energy system in the EU is unfolding against a backdrop of new challenges in a volatile global context.** Since 2022, the decarbonisation of the energy system has faced systemic hurdles amid shifting and shattering macroeconomic conditions. The energy crisis of 2022 prompted the EU to urgently search for alternatives to Russian fossil fuel imports, often sourced from spot markets, thereby leading to increased energy costs. The post-2022 consensus, as outlined in the REPowerEU Plan, aims to eliminate dependency on Russian imports by 2027, necessitating even more ambitious renewable energy deployment, faster electrification, and new – also green – molecules. Yet, while the immediate crisis of soaring energy prices has subsided, at least for now, lingering inflation and rising capital costs have adversely affected the economics of renewable projects; meanwhile, the business case for hydrogen is still in its infancy.

While the traditional trilemma of security, competitiveness and environmental concerns continues to shape the EU's energy policy, the transition to a low-carbon energy system, particularly in the post-2022 context, has introduced specific issues. Policymakers are tasked with squaring this circle by:

- incentivising significant private investment by reducing investment uncertainty while avoiding excessive fiscal burdens on states through various price stabilisation mechanisms;
- protecting consumers against elevated price spikes and similar crisis situations while tackling the distributional implications of the high costs of transition; and
- ensuring a sufficient supply of manufacturing equipment, skills and services for deploying low-carbon energy, flexibility solutions for the energy system and expansion of the grid.

First, **substantial investment is needed across the energy system**, spanning renewables, flexibility solutions, grid expansion and modernisation, alongside the decarbonisation of grid equipment. In practical terms, although factors beyond financial considerations, such as permits, environmental impact assessments or grid connections, can severely impede project advancement, the *ultimo ratio* for inflows of private investment is the profitability and bankability of projects – a conundrum faced by many low-carbon and renewable projects. Furthermore, addressing the need to encourage anticipatory investment in regulated businesses like networks is another significant aspect that will inevitably require attention (as discussed in Sections 3.1 and 5.3).

Second, in the wake of the energy crisis, it became clear that in many cases **neither consumers nor suppliers were sufficiently hedged against price spikes**. While certain steps have been taken through reform of the electricity market design to better shield final consumers from future price spikes, broader consideration is needed to assess the socioeconomic impacts of the increasing decarbonisation of energy systems.

Third, **ensuring sufficient manufacturing capacity is crucial for the rapid deployment of renewables and grid expansion**. Sourcing the necessary equipment is indispensable for scaling up the decarbonised energy system. Energy costs may be more sensitive for energy-intensive industries; problems related to accessing critical raw materials, their availability and volatile prices pose significant obstacles to procurement[92]. For example, the wind turbine market is overstretched and cannot meet the demand for wind equipment. Similarly, shortages of grid components like transformers can affect grid expansion efforts[93]. On top of that, an important discussion is needed on the requisite **skills for the green transition**, and in particular delivering decarbonisation of the energy system[94].

5.2 Cost-efficient decarbonisation of the electricity system

In transitioning to low-carbon solutions, ensuring the reliability, cost-efficiency, flexibility and resilience of the energy system is critical. With the EU's electricity system set to be dominated by renewables, **flexibility solutions on both the demand and supply sides – i.e. the ability to adjust consumption or production in response to price signals or to provide services to system operators – will be essential to manage the weather-dependent output of renewables**[95]. A significant adaptation of the current electricity system is necessary, with projections from the European Environmental Agency and ACER suggesting that Europe's electricity system flexibility will need to almost double by 2030[96]. The 2024–2029 political cycle will be instrumental in ensuring that the current regulatory framework can effectively facilitate this system transformation. It will be crucial to assess future flexibility needs and ways to address them across Member States and from a cross-border perspective within the EU's internal energy market.

Traditionally, the flexibility of the electricity system relied on dispatchable generation, such as large hydro, bioenergy, natural gas and coal power plants, along with later-generation nuclear reactors. The transition to a decarbonised electricity system with a high share of variable renewables requires the adoption of various (and new) cost-efficient resources. Among others, these resources, at different stages of development and commercialisation[97], include low-carbon dispatchable energy and energy storage (both short-term options like batteries and long-term or seasonal solutions such as thermal energy storage or hydrogen). Other flexible solutions involve cross-border exchanges, grid enhancements like smart grid technologies and demand-side measures to adjust electricity usage in response to price signals.

> Recommendation 5.2. The growing need for resource flexibility calls for an assessment of future requirements for energy system flexibility in and across Member States. Policymakers must engage in open discussions regarding all viable low-carbon solutions, including dispatchable options. EU-wide solutions should be found in cases if and where market failures occur, particularly with regard to seasonal storage.

They all need to be explored and pursued, considering local availability and conditions. Their suitability for providing flexibility across various timeframes should be assessed, including for daily demand peaks, weekly demand differences and seasonal flexibility, accounting for heating/cooling periods and weather patterns[98]. Different types of variable renewables necessitate different flexibility solutions[99]. Unlocking flexibility potential in electricity markets and networks would depend on well-designed market signals to incentivise the deployment of these solutions.

Seasonal storage

Seasonal storage will be crucial for managing seasonal variability and imbalances in both supply and demand, with cross-border implications for balancing variable renewables generation and supporting long-term planning in renewable energy infrastructure. Seasonal storage has a larger capacity than short-term storage, which is suited to load balancing on a daily or intra-day basis and often deployed on a smaller scale, such as for residential, commercial or utility-scale installations. By comparison, seasonal storage enables the efficient utilisation of surplus renewable energy generated during periods of high production, by storing it for use during periods of low production or high demand. This also enhances grid resilience and reduces the need for backup power sources – essential in geographical areas where no low-carbon backup solution is available. Furthermore, seasonal storage can provide valuable grid services and support system reliability over extended periods.

Low-carbon dispatchable energy

In the 2024–2029 political cycle, greater attention should be directed towards the role of dispatchable low-carbon energy sources[100] and the benefits they offer for a decarbonised energy system. These sources reliably generate electricity on demand, provide a steady supply of energy that can also be stored for later use, and contribute to grid stability, enhancing the overall reliability of the energy system. There has been limited understanding of the benefits of a balanced energy system combining variable renewables with dispatchable renewables, as discussed by the IEA in its recent report[101].

The importance of this discussion is ever more pronounced as the resurgence of natural gas power plants to provide dispatchable power is apparent, with Germany's plans to build hydrogen-ready gas-fired power plants[102], and the UK's decision to resume the construction of several natural gas power plants. Some Member States will probably follow suit. In light of the current rather modest developments in hydrogen production, there needs to be an open discussion regarding realistic timelines and availability of supply for transitioning to low-carbon hydrogen in power generation.

The deployment of low-carbon dispatchable energy, such as large hydro, bioenergy or geothermal energy, is often dependent on geographical conditions and the availability of resources. Nuclear energy offers another avenue for ensuring dispatchable low-carbon energy, especially with the development of new reactors designed to respond to varying load factors. Recently, nuclear energy has regained more positive attention in EU-level debate, as it is recognised as one of the solutions to meet increasing demand for low-carbon energy. Notable steps include the creation of the Nuclear Alliance by Member States interested in pursuing nuclear energy, its inclusion in the NZIA and the establishment of the Industrial Alliance on Small Modular Reactors.

This growing attention to nuclear energy aligns with the discussion surrounding the need to strengthen domestic supply chains and uphold the competitiveness of the European nuclear industry. Yet, obstacles loom large in the sector, with projects for EDF's EPR-2 reactors having encountered delays and cost overruns, while reliance on entities like Rosatom for fuel supplies has sparked security concerns. Competition from non-EU manufacturers and technology vendors, particularly those from the US and South Korea, adds to pressure on the EU's nuclear industry, particularly concerning the prospective deployment of new reactors in Member States like Czechia and Poland.

The economics of nuclear power also present challenges in an electricity market dominated by renewables. One major concern is the load factor. While flexibility is typically no longer a technical problem for new generation reactors, frequent ramping up and switching off can reduce the load factor. In a system primarily driven by renewables, price volatility is anticipated as well, including periods of negative prices. While price volatility may pose a risk for the economics of nuclear energy, it is also worth of considering the price cannibalisation effect when it comes to the continued buildout of renewables. In terms of costs, governments may need to offer guarantees to cover price risks through contracts for difference, as well as construction costs and potential overruns via the Regulated Asset Base model. However, this places additional financial liabilities on Member States opting to pursue new nuclear energy, as seen in examples like the UK and France, where cost overruns have burdened governments. Other options also need to be discussed to address the issue of price stabilisation. Arguably, the economics of nuclear power may improve if it is viewed as a long-term solution with high upfront costs but the potential to provide a stable and cost-competitive baseload power supply, as well as to contribute wider electricity system benefits by helping to integrate an increasing share of renewables into the energy mix.

Total system costs in a low-carbon system

While the levelized cost of electricity (LCOE) of renewables has been steadily falling, making them competitive with fossil fuel generation, cost-efficient decarbonisation of the energy system also depends on the overall costs of a decarbonised system. System costs entail considering not just generation costs but other factors like grid infrastructure, storage solutions and other flexibility measures. **The overall system costs have the potential to emerge as a pain point for the competitiveness of the EU economy, extending beyond energy-intensive industries to cover manufacturing, transportation, services and other sectors.** With the increasing electrification of these sectors and the increasing demand for electricity in cleantech manufacturing and digital solutions, the significance of energy costs is ever more apparent for the EU's competitiveness.

Recommendation 5.3: The European Commission should take a more rigorous and thorough approach to integrating an assessment of total system costs into future legislative and non-legislative initiatives.

To some extent, a system reliant solely on renewables can be more expensive than a more diverse one that incorporates various combinations of renewables and low-carbon, dispatchable sources[103]. At the EU level, it will be important to integrate an assessment of total system costs into future legislative and non-legislative initiatives for decarbonisation. The energy mix is within the competence of EU Member States, yet it depends on geographical conditions and the availability of low-carbon energy resources and flexibility solutions. In that regard, a more holistic approach can help to create a more cost-efficient, low-carbon energy system with pan-EU solutions.

5.3 GRID EXPANSION, MODERNISATION AND DECARBONISATION

Expanding grids is essential to accommodate the growing share of renewables in the system, at both the transmission and distribution levels, especially with increasing decentralisation of energy production alongside increasing renewables penetration. Cross-border interconnectors will also play a crucial role in ensuring cost-efficient flexibility and reliability of the EU power system. While regulatory frameworks for grid and cross-border planning have been established over the past decade, the focus now lies on their effective implementation. Three main issues are worth consideration in the 2024–2029 political cycle.

First, the need for **more cross-border interconnectors** requires improvements in certain cross-border areas, including the construction of new interconnectors and the synchronisation of grids[104], as well as the construction of meshed offshore grids[105]. In enhancing cross-border transmission capacity, it is useful to adopt a holistic approach by considering generation capacities, including self-sufficiency rates and optimal bidding zones to avoid imbalances in cross-border flows across the EU. Ensuring that the transmission capacity is made available for cross-zonal electricity trading is expected to enable the optimisation of trading capacities and market integration.

Yet, to ensure system security and efficiency it is essential to address the future needs of various types of generation capacity, including low-carbon dispatchable sources, across Member States. With heightened interdependency among Member States, questions arise regarding sufficiency and imbalances in generation that can result in or be affected by potential imbalances in imports.

Recommendation 5.4. The EU and Member States must ensure the rapid construction of both transmission and distribution grids. The EU must increase its funds to cover the cross-border externalities of interconnectors, while keeping in mind that each Member State has a responsibility for the resilience and reliability of its respective power systems.

Second, **the expansion and modernisation of grids** is crucial, and the grid action plan outlines actions to accelerate this[106]. However, the big question about anticipatory investment remains. A radical rethinking of how to finance new lines and interconnectors is necessary, as the Regulated Asset Base model may not be suitable for such a massive undertaking. Public support will be inevitable and welcome, requiring major investment in public infrastructure, as discussed in Section 3.1. For cross-border infrastructure, increasing EU funding under the Connecting Europe Facility is essential.

Third, while discussions have largely focused on decarbonising generation capacities, there needs to be closer examination of **decarbonising grid equipment and components**. Sulphur hexafluoride (SF6), commonly used in high-voltage circuit breakers and switchgear, and less commonly in transformers, to ensure safe and reliable operation of high-voltage grids, is a potent greenhouse gas with a high global warming potential. In the EU, with a significant push to phase out SF6 by 2031 under the F-Gases Regulation, technological options and their commercialisation need to be explored and advanced[107].

5.4 Deepening market integration, forward markets and investment in generation

The 2019–2024 political cycle was largely dominated by discussion of reform to the electricity market design, which was agreed in late 2023. In the immediate aftermath of escalated gas prices during the summer of 2022, the debate expanded to question the merit order system and marginal pricing, calling for the decoupling of electricity prices from gas. Then, as electricity prices stabilised and gas prices fell during the rest of 2022, discussions on market design calmed down to more pragmatic debates. By early 2023, when the Commission's proposal was presented, the reform, which had initially been expected to become a significant overhaul of the market design, had been reduced to focused improvements of certain instruments[108]. Among others, it focused on stimulating investor certainty in renewable generation and strengthening consumer protection.

As a top priority, this reform has been ignited by the price spikes resulting from the energy crisis of 2021–2022, along with the political urge to shield consumers from price variability. Much focus was placed on **price risk management**, with the aim of mitigating the risk of supplier failure and bolstering social provisions. During the 2021–2022 crisis, many suppliers were inadequately hedged, which exacerbated the problem. Effective supply hedging strategies, such as power purchase agreements (PPAs) and forward contracts, were viewed as crucial to addressing these challenges.

The extensive debate surrounding **revenue caps on inframarginal generation** (which is in most cases renewables and nuclear) in price-led emergencies highlighted the core issue of how long and to what extent Member States can derogate from the internal energy market, even under crisis-induced circumstances. Introduced in 2022 as an emergency measure, the inframarginal cap has faced increasing critique as an interventionist measure undermining regulatory stability, and has also been applied heterogeneously across Member States. Although ultimately excluded from the final version of the crisis mechanism under Article 66(a) added to Directive (EU) 2019/944, the debate on the inframarginal cap has significantly undermined regulatory certainty. Reinstating regulatory stability will be of paramount importance[109].

Allowing public interventions in price formation when a **regional or EU-wide electricity price crisis** is declared has become another contentious issue. The criteria for activating this mechanism, outlined in the much-debated Article 66(a), were finally reshuffled during interinstitutional negotiations to minimise any negative fragmentation of the internal energy market. However, when calculating average prices over the last 5 years, Article 66(a) excludes any periods when such crises have been declared, which may be seen as cherry-picking and as avoiding a reflection of true scarcity. During 2022, although energy prices were elevated, they provided the market signal expected during scarcity. The problem was not the price signal itself, but rather that it was politically troubling and deemed unacceptable.

The market reform was also driven by the chronic issue of stimulating **long-term investment in renewable generation**, which both influenced and was impacted by the functioning of the electricity market[110]. Investment in renewables, which are capital-intensive, requires ensuring that revenue streams from electricity sales cover debt payments and current costs. Revenue uncertainty can lead to higher risk premiums, making projects less attractive to investors. Therefore, price stabilisation is a crucial aspect of investment decisions in renewable generation. While it has been assumed that decreasing the levelized cost of electricity (LCOE) would make renewables competitive and drive their uptake, the bankability of renewables requires careful consideration of revenue mechanisms, which were uncertain under the market design and pricing mechanisms.

For the reform of 2022–2023, legislators have primarily addressed this problem through two mechanisms, i.e. two-way contracts for difference (CfDs)[111] and PPAs[112], with long-term contracts serving as price stabilisation mechanisms to provide investment certainty. The uptake of these long-term contracts is not expected to materialise as a new market but rather as a basket of tools and legislative provisions aimed at accelerating the growth of electricity exchanged long term above overall consumption.

Recommendation 5.5. The forthcoming electricity market reform must maintain an integrated EU-wide electricity market, not least to ensure liquidity, enable business, industry and suppliers to hedge and ensure a level playing field for business and industry.

The focus in the 2024–2029 cycle is expected to shift to implementation and deepening market integration across the EU. This includes strengthening forward markets, ensuring market liquidity and facilitating price discovery[113]. While CfDs and PPAs are effective tools for decoupling from short-term price volatility and providing investor certainty, effective delivery on CfDs and PPAs remains to be seen in practice. If their volume grows, it could impact overall market dynamics by removing volumes from the market to over-the-counter and should be carefully balanced with forward markets.

In forward markets, increasing the level of hedged electricity in the total traded electricity is crucial, with a careful balance with shorter-term price signals. Enhancing liquidity in less liquid markets and improving price discovery mechanisms are also essential steps for fostering a more integrated and efficient market. The European Commission is expected to submit a report by the end of 2025 to review the implementation of these provisions and potentially introduce a legislative proposal if needed. Clearly, the discussion is far from over.

6. Circular economy

Emerging from academic discourse, the concept of the circular economy reached the policy mainstream over a decade ago. The concept is based on the idea that organisational and technological innovations, combined with non-linear thinking about the use of products and resources throughout their lifecycle, can reduce overconsumption of natural resources while providing new business opportunities[114]. Moving towards a circular economic model can also make an important contribution to tackling other major sustainability challenges, namely biodiversity loss and climate change[115].

At the EU policy level, the circular economy concept offered a fresh and more holistic approach to resource and waste management policies, which went beyond merely dealing with products and their environmental impacts at the end of their lifecycle. This paradigm shift was cemented in two EU circular economy action plans[116] during the two recent political cycles. These plans outlined actions encompassing all stages of a product's lifecycle, with the overarching objective of easing the transition from a linear to a circular economy model.

In response to the heightened geopolitical tensions and concerns regarding raw material supply risks, the circular economy received renewed impetus through the CRMA. It aims to increase the availability of secondary raw materials from domestic resources to support the EU's strategic autonomy objectives[117].

While the EU has taken the lead in strategically embracing the circular economy concept, government-led initiatives are appearing in other regions of the world, reflecting a growing global momentum[118]. Recognising its potential for contributing to the objectives of the Paris Agreement, the concept was also mentioned for the first time in the Global Stocktake document prepared for the UNFCCC COP28 in Dubai.

6.1 An ever-expanding policy mix, bringing forward new opportunities and challenges

With two consecutive circular economy action plans and the completion or near completion of almost 90 legislative and non-legislative files, the EU has set out the most extensive policy mix on circular economy to date. Among the notable legislative actions, which target specific value chains, are revisions to regulations on batteries, packaging and packaging waste. The establishment of a new policy framework for sustainable products, which includes new requirements on ecodesign and information disclosure, represents another significant legislative development. Complementing these regulatory efforts, various non-legislative initiatives have been introduced. These include the formulation of an EU circular economy monitoring framework and the launch of the Global Alliance on Circular Economy and Resource Efficiency.

The expansive bandwidth of horizontal and sector-specific policy instruments introduced over the past decade positions the EU as a global frontrunner, with the most comprehensive and ambitious circular economy policy mix in place. In a period of intense global competition for leadership in green technologies, Europe is using its regulatory clout to set standards in global markets.

Some aspects of this regulatory influence can already be seen. For instance, in the case of the digital product passport (DPP), China is developing its own version of standards[119], echoing what the EU does in this domain. Similarly, there is potential for the EU to have a regulatory impact in areas like carbon footprint requirements and ecodesign criteria. In one such example, the EU has replaced the Ecodesign Directive – which has delivered successful results[120] – with the Ecodesign for Sustainable Products Regulation (ESPR[121]), It aims to introduce horizontal sustainability requirements for a range of different product groups entering the EU single market through secondary legislation. The replacement of previous directives on batteries, packaging and end-of-life vehicles with regulations reflects efforts to minimise divergences in the implementation of rules across Member States and strengthen the EU single market.

Recommendation 6.1: As the EU policy mix for the circular economy expands, it is important to improve the alignment of its instruments and objectives. It is becoming evident that the objectives of different legislative processes are not always in sync, which can result in conflicting messages for EU businesses and additional administrative burdens. As part of efforts to successfully implement the new legislative portfolio for the circular economy, it will be important to carefully assess existing inconsistencies and provide a coherent set of rules for EU businesses.

This revived policy mix resulting from the recent surge in regulatory activity has led to new governance demands for both EU institutions and businesses. At the EU level, there is a significant amount of secondary legislation that will need to be adopted in the 2024–2029 political cycle, given the important milestone EU regulations of the 2019–2024 cycle. This will in turn create administrative pressures but also requests for clarification and interpretation of newly introduced legal requirements. One example is the new EU Batteries Regulation, which introduces new definitions and requirements, prompting businesses to seek further clarifications to ensure compliance[122].

The successful implementation, supervision and enforcement of the new rules will be of vital importance for the smooth functioning of the single market and the development of a level playing field without any instances of free riding. Likewise, carbon footprint requirements pose challenges, as public administrations will need to develop the capacity to verify the credibility of claims made by products entering the EU market. Actions to build capacity will be important in this regard.

The capacities of businesses, and particularly SMEs, will also be tested by the plethora of new rules and reporting requirements they will need to comply with. To support them in this transition, technical assistance will be crucial. Capacity-building workshops, training, guidance and knowledge-sharing platforms have been identified as essential tools to help companies (including SMEs) comply with their future legal obligations and become more resource-efficient[123].

Recommendation 6.2: The recent surge in regulatory activity has led to the development of an ambitious but also complex policy mix that will test the capacities of EU businesses and especially SMEs. It is essential to intensify efforts to support SMEs in the green and circular transition. There needs to be continuous support for businesses in the form of capacity-building and knowledge-sharing platforms. When preparing secondary legislation, priority should be given to avoiding duplicate requirements and reducing administrative burdens. The launch of a dedicated strategy giving high priority to SMEs – similar to the 2014 Green Action Plan for SMEs – could support and help streamline these efforts.

While the replacement of several directives by regulations will contribute to harmonising EU-wide rules, any duplication of requirements should be avoided as much as possible in the secondary legislation (e.g. delegated acts of the ESPR for different product groups). This will help prevent additional administrative burdens. The provision in the Batteries Regulation to introduce interoperability between its DPP and other DPPs through the ESPR delegated acts is a step in the right direction.

The breadth of policies recently adopted also calls for a holistic perspective to examine the overall policy mix and the interactions between its various instruments. Studies have shown that different instruments – often designed in the context of a previous legislative process with different objectives – may not always be aligned to contribute to the realisation of an overarching policy goal[124]. Conflicts between the rules stemming from the EU chemicals legislation and the objectives of maximising the reuse and recycling of products represent one such example[125]. Moving to the next stage of implementation of circular economy policies, it will be important to thoroughly assess existing policy inconsistencies and establish a consistent set of rules that carefully balance different policy goals.

6.2 From high ambitions to a slow start

Despite political will and positive signs on the ground, evidence indicates that the so-called circular economy transition is still in its early stages. According to Eurostat's indicator for circular material use, in 2022, the share of materials in the EU economy originating from recycled sources stood at 11.5 %, with only a minor increase of 0.1 % compared with the previous year[126]. On the positive side, the indicator has seen a rise of 3.3 % during the last 20 years[127]. This figure masks significant variations among Member States, however, which exhibit different performance levels in their circularity rate.

Similar divergences are visible in EU municipal waste statistics, with some Member States on the verge of missing their 2025 recycling targets. Moreover, there are data quality issues, with several Member States not reporting figures on certain streams (e.g. ferrous metals packaging and aluminium packaging)[128]. Assessing EU performance further upstream is difficult since Europe currently lacks appropriate indicators to monitor progress on ecodesign, for example[129].

A blurry picture furthermore emerges with regard to the rate of adoption of circular innovations. Currently, the EU has only one such indicator in its circular economy monitoring framework[130], measuring the number of patents, which only covers the end-of-life stage of products.

Recommendation 6.3: Strengthen the EU framework for monitoring the circular economy. With several data gaps, the present monitoring approach only captures parts of the transition and cannot yet provide a full picture of how the EU and its businesses perform on circularity. There is need to reinforce efforts to fill existing gaps and also complement the framework with additional indicators capturing the adoption of innovations beyond the areas of waste management and recycling.

Some key messages can be drawn from the above. First, the circular economy is coming to the forefront of policy and business agendas as a concept that can help open up new markets, processes, products and ultimately opportunities for EU companies. Despite the several regulatory developments and the widespread acceptance of the concept by companies in the EU[131], the full potential of creating an EU single market where resources are fully utilised to generate new business opportunities has yet to be fully realised.

In addition to stepping up implementation of its waste *acquis*, the EU would need to look into its regulatory portfolio, which extends beyond traditional command-and-control measures. Demand-side tools, particularly green public procurement, have long been discussed as a driver of change and should be leveraged further[132]. Harmonising product and labelling rules for circular and green products that distinguish them from conventional goods would further boost the market[133]. Improving the rules for the intra-

EU cross-border trade of secondary raw materials and reused/refurbished good will also be important. Farther down the road, there may be a need to revisit the EU waste hierarchy and recycling definition as new innovations for materials and processes emerge[134].

A renewed approach to monitoring progress towards circularity would be advantageous. With several pieces of legislation in place and only limited progress revealed by the existing indicators, there is a risk of stakeholder fatigue surrounding the concept. Given its multi-dimensional nature, it is important to define how circularity objectives interact with the overarching goal of achieving net-zero emissions by 2050 and to establish clear milestones to measure progress. Work in this domain should benefit from developments on the standardisation front and specifically from the standards on circularity by ISO[135] and CEN[136].

In addition, it is important to intensify efforts to bridge existing data gaps and identify ways (and indicators) to better show EU business performance on circularity. Despite numerous documented cases of businesses adopting circular economy models, the latest monitoring framework does not capture how EU businesses perform in this domain[137] or how they are responding to the new business environment and markets.

7. Beyond carbon: Balancing biodiversity protection and climate change mitigation

Healthy ecosystems serve as essential carbon sinks and buffers against climate change, yet climate change itself is a leading driver of biodiversity loss, highlighting the interconnectedness of addressing them both. At present, climate change mitigation strategies often involve land-use changes, as well as intense resource extraction and waste generation for green technologies, undermining biodiversity's potential to alleviate and adapt to climate change. But there are opportunities for synergies and a delicate balance between sustaining biodiversity and achieving climate goals. Some of these opportunities lie in innovation and research to enhance sustainable solutions for the bioeconomy and the development of circularity as a cross-cutting synergy.

7.1 Biodiversity protection in the 2024–2029 political cycle

The importance of protecting natural areas and biodiversity has long been acknowledged in the EU, as evidenced by cornerstone legislation such as the Birds and Habitats Directives. These directives laid the groundwork for the establishment of Natura 2000, a pan-European network of protected areas. The Water Framework Directive has been instrumental in safeguarding aquatic ecosystems. In line with its commitments to the Convention on Biological Diversity, in May 2011 the EU adopted the Biodiversity Strategy to 2020, delineating six main targets aimed at halting the loss of biodiversity and mitigating ecosystem degradation. The importance of biodiversity preservation was further reflected in the EU's strategic long-term vision, 'A Clean Planet for All' in 2018.

The European Green Deal has recognised the critical relationship between climate change and unsustainable resource use, along with the detrimental impacts on land, water and soil quality, all contributing to the alarming loss of biodiversity. Building upon the Biodiversity Strategy to 2020, the European Commission reinforced its commitment in 2020 by adopting the Biodiversity Strategy for 2030, aiming for heightened levels of protection for both land and sea and restoration of degraded systems. Throughout the 2019–2024 political cycle, the Commission introduced a spectrum of legislative proposals in the areas of nature restoration, land use, agriculture, sustainable chemicals and pesticide use, soil health, fisheries, food systems and forests – albeit with varying degrees of success.

> Recommendation 7.1: The 2024–2029 political cycle should allocate greater attention to exploring options for enhancing biodiversity. An integrated approach is needed to effectively balance the accelerated green transition with ecosystem preservation.

Although biodiversity-related legislative and policy initiatives have recently made considerable strides, there remains **a notable gap between acknowledging the issue and formulating tangible actionable strategies to tackle it**. While the European Green Deal has predominantly focused on laying out a comprehensive framework for climate action to fulfil the 2050 net-zero pledge, the biodiversity agenda seems to have fallen behind in prioritisation and implementation.

The complexities of effectively communicating the value of biodiversity, compounded by the plethora of metrics used to assess it, may also contribute to this discrepancy. Political sensitivities have further complicated this discussion, as evidenced by the arduous co-decision process surrounding the EU's first-ever Nature Restoration Law.

Moving 'beyond carbon', and **integrating multiple sustainability indicators, each carrying equal significance within a comprehensive framework, also presents considerable challenges**. This is exemplified by the monitoring framework of the 8th Environment Programme[138], which aims to provide an overarching assessment of environmental pressures but continues to suffer from data gaps. The 2024–2029 political cycle will serve as a litmus test for whether biodiversity and environmental concerns receive closer attention on the political agenda.

7.2 SUSTAINABLE RESOURCE MANAGEMENT FOR A GREEN TRANSITION

The green transition will increase demand for certain materials and prompt a shift in resource use, thereby adding pressure to the environment, including biodiversity. To effectively manage this, the primary drivers of biodiversity loss should be addressed, such as certain agricultural and forestry practices, marine pollution, and land conversion for urban expansion and (critical) raw material extraction.

The waste and pollution generated at the end of life of green technologies also necessitate circularity solutions. Embracing circularity, which prolongs material lifecycles and minimises waste through better design and resource utilisation, is the primary solution for reducing material demand and the environmental impacts of strategies for climate change mitigation[139]. **Exploring synergies between circular economy practices and biodiversity conservation**, and aligning their practices, are essential steps for halting biodiversity loss.

Recommendation 7.2: Advancing the bioeconomy is crucial for bridging the gap between strengthening biodiversity and mitigating climate change. Supporting technological development within the bioeconomy sector through research and innovation is essential. A robust bioeconomy will facilitate increased adoption of bio-based products, replacing those derived from fossil fuels. This development should be complemented by the promotion of circular economy practices.

Innovative technologies can also smooth the transition to sustainable resource-production practices while minimising the effects on ecosystems. Promising advancements include research into artificial photosynthesis, utilising ocean surfaces to produce photosynthetic products and extract grass proteins or sea surfaces as alternative food production methods. Innovative applications enable the conversion of captured CO_2 into sugars and complex proteins through processes such as microbial fermentation or synthetic biology techniques. Such technologies potentially yield a diverse array of bio-based products, ranging from food ingredients and animal feed to materials like bio-based plastic and biofuels.

7.3 SYNERGIES BETWEEN CARBON REMOVALS AND BIODIVERSITY

Various negative emission technologies and nature-based solutions offer the potential to improve biodiversity, but they come with trade-offs and potential adverse effects on ecosystems[140]. Industrial carbon removal methods like **bioenergy with carbon capture and storage (BECCS)** and **direct air carbon capture and storage** can utilise captured CO_2 as a feedstock, thereby reducing pressure on natural resources and fossil fuel usage.

However, these technologies are energy-intensive and reliant on stable sources of (low-carbon) electricity. As the demand for low-carbon energy rises, their development may be concentrated in regions with abundant or accessible low-carbon energy sources. BECCS, while offering solutions for negative emissions in energy combustion and hard-to-abate sectors, carries potential negative side-effects for biodiversity due to its use of bioenergy. Additionally, concerns arise about the growing demand for biomass feedstock for material use, further complicating the issue (Section 7.3). Although BECCS boasts a lower land footprint compared with afforestation or reforestation, its CO_2 reduction potential is also comparatively lower.

Recommendation 7.3: By strategically aligning efforts in carbon removal with practices aimed at preserving biodiversity, policymakers could maximise the positive impact on both climate change mitigation and ecosystem health. Promoting innovative approaches, particularly in conjunction with nature-based solutions and carbon farming, could unlock the full potential of these synergies.

Enhanced weathering, soil carbon sequestration and biochar have the potential to offer co-benefits such as improved soil nutrients and reduced N_2O emissions. But their implementation may entail extensive land use. Enhanced weathering accelerates the mineral weathering process, leading to the formation of carbonates, or carbon rocks, which can sequester carbon. Yet, this process may also result in water and ground pollution, as well as supply chain risks associated with mining, extraction and the energy-intensive grinding of rocks. Biochar, produced through the pyrolysis of biomass, increases carbon uptake in soils and can improve soil quality. Still, its effectiveness relies on the availability of biomass, which may lead to more demand for biomass resources (Section 7.3).

Afforestation and reforestation can yield positive side-effects for soil quality, boosting carbon sinks and potentially benefiting biodiversity through the restoration of natural ecosystems. There may be negative consequences, however, if these activities lead to the displacement of biodiverse grasslands with forests. Approaches like integrated land-use management systems, such as agro-forestry, which combine trees and shrubs with crops and/or livestock on agricultural land, benefit biodiversity conservation by providing habitat and food sources for plant and animal species[141]. Various techniques, such as novel tree-crop combinations or optimised spatial arrangements, can also provide high-quality nature-based carbon removals through mixed landscapes and reforestation rather than monocultural afforestation[142].

In recent years, the EU has witnessed a concerning decline in its natural carbon sinks[143]. **There has been a notable absence of a compelling business case for nature-based solutions for a long time[144].** However, the revised LULUCF Regulation marks a positive step. Building on its 'no debit rule', the revisions introduce the first-ever dedicated target for land-based net carbon removals of 310 Mt CO_2e for 2030. The CRCF (discussed in Section 4) also incorporates carbon farming. More specifically, it allows for the certification of forest[145] and soil restoration, avoidance of soil emissions, rewetting of peatlands, more efficient use of fertilisers and other innovative farming practices, as types of carbon removals.

> Recommendation 7.4: Legislators may find it useful to more thoroughly investigate the creation of incentives for specific restoration activities and their potential in strategies for climate change mitigation. This approach could better link the EU's climate agenda with biodiversity goals. Furthermore, such incentives could better align the interests of land managers with climate and nature restoration activities.

There is still an opportunity to better combine climate change mitigation with nature restoration by creating incentives through regulatory frameworks and funding mechanisms. Potentially, such measures can also better align the interests of land managers, including farmers and foresters, with the EU's agendas on climate and biodiversity conservation. To some extent, this approach may serve to reduce resistance to nature restoration practices where land use is contested.

7.4 SUSTAINABLE BIOMASS USE BEYOND 2030

Biomass derives from a variety of organic materials, ranging from forestry products to agricultural products – including dedicated energy crops and biodegradable waste residues[146]. Its applications span various sectors, with bioenergy playing a central role and serving as the largest renewable energy source in the EU. Additionally, use of biomass is rising in industry and transport fuels, including in the production of biomethane[147].

A key question arises about how to ensure the sustainable and efficient use of bioenergy in the post-2030 landscape, particularly given forecasts of the buildup of bioenergy demand after 2030. According to the European Commission's impact assessment[148], the overall demand for bioenergy is expected to grow substantially, with estimates indicating a 69 % increase on average by 2050 compared with 2030. This heightened demand stems from bioenergy's increasing use as a low-carbon dispatchable power source, tied to the rising electrification trends discussed in Section 5. Bioenergy is anticipated to play a role in delivering negative emissions through BECCS as well, as explored in Section 4. Moreover, bioenergy is expected to replace fossil fuels in hard-to-abate industries, such as high-temperature industrial processes, and long-distance transport, and in the maritime and aviation sectors. In addition, in agricultural zones, biogas[149] can serve as a dispatchable energy source (discussed in Section 5.2) because it can provide stable electricity and heat supply from combined heat and power plants when variable energies do not operate. As biogas is primarily produced from cattle manure, scaling up biogas will contribute to the sustainability of the agricultural sector by reducing methane emissions from cattle. To accelerate deployment of its purified form, biomethane, the EU will need to improve the single market by facilitating cross-border recognition of guarantees of origin for renewable gases.

Further discussion on biomass availability to meet growing demand beyond 2030, as well as its sourcing options, is warranted. Forestry is projected to remain the chief source of bioenergy supply, with the potential for further sustainable extraction of forest biomass for broader bioeconomy use[150]. The waste sector will also play a role in supplying biomass, prompting the need to evaluate its potential integration into the EU ETS and provide incentives for waste-to-energy initiatives (Section 4). Biogas or biofuels derived from food crops will remain marginal in the EU by 2050. Instead, there is increasing interest in utilising agricultural residues for the production of biogas or solid biomass.

Recommendation 7.5: Meeting the increasing demand for sustainable biomass, whether for bioenergy or as an input for bio-based products, requires careful consideration of the types and sources of feedstocks. It must also take into account the local conditions and impacts on biodiversity.

It will also be essential to acknowledge **the growing importance of biomass in substituting carbon-intensive materials** across diverse sectors, including bioplastics, biofuels, bio-based chemicals and bio-based textiles. This transition towards biomass-derived alternatives is expected to progressively gain traction, possibly generating competition with the rising demand for biomass for bioenergy. Using biomass as a material rather than solely as a fuel not only sustains carbon sequestration but also offers considerable added value as a product.

Land-use dynamics are especially influential in bioenergy production, and biomass sources are not homogeneous. From agricultural and food waste to crops or woody biomass, each type carries unique implications for land use. Intensive biomass harvesting poses the risk of converting diverse and thriving ecosystems into monocultural landscapes. If it displaces or disrupts ecosystems that are highly biodiverse, the proliferation of bioenergy could pose a threat to biodiversity. At the same time, deploying bioenergy on degraded land could yield benefits such as soil restoration and erosion prevention. Ultimately, the overall sustainability impacts of biomass use depend heavily on the types, sources and efficient utilisation of biomass feedstocks, along with the tightened sustainability criteria in the revised Renewable Energy Directive.

7.5 RECONCILING THE ENVIRONMENTAL IMPACTS OF RENEWABLE ENERGY DEPLOYMENT

The acceleration of renewable energy deployment – well justified by the post-2022 energy security urgencies and transformational needs for decarbonising the energy system, as outlined in Section 5 – must be accompanied by a thorough consideration of its environmental ramifications.

Mitigating the externalities linked to resource extraction and end-of-life impacts needs to involve better recycling processes for decommissioned renewable installations. The expansion of renewable energy installations may also contribute to habitat loss and fragmentation, while operational facilities could pose direct threats to animal populations[151]. Instances such as bird collisions with wind turbines or the ramifications for marine biodiversity of seabed drilling are among the examples[152].

Recommendation 7.6: Accelerating renewable installation should be accompanied by robust and thorough land-use planning. It is also essential to further explore technological innovations to minimise potential disruptions to land and marine ecosystems.

Leveraging innovative techniques and digital solutions can play a pivotal role in mitigating these adverse effects. For instance, bird monitoring systems can be used to identify the patterns of migratory birds, so wind turbines can be shut down when birds cross their paths[153]. Offshore wind installations can benefit marine life by providing sanctuaries from boat traffic, fostering fish reproduction[154]. New technologies also offer opportunities to minimise land-use requirements. Approaches like agrivoltaics[155], which involve co-siting agricultural activities and solar energy production, can reduce ecosystem disruption while maximising land utilisation for renewable energy generation.

Scaling up renewable energy infrastructure will undoubtedly require significant land and resource utilisation, potentially posing environmental risks to landscapes. Therefore, it is essential that **the newly introduced provisions to streamline permitting processes and generally lower procedural barriers to renewable energy installations in the revised Renewable Energy Directive are applied in a way to strike a fair balance between environmental protection and accelerated renewables deployment**[156].

On the one hand, the revised Renewable Energy Directive mandates Member States to designate go-to areas for renewables acceleration to expedite renewable energy deployment. Projects in these areas are deemed an overriding public interest, receiving simplified environmental assessments and exemptions from certain impact evaluations. The Directive also exempts projects in renewables acceleration areas from the requirements of Natura 2000 sites under the Habitats Directive for environmental impact assessments and assessments of project implications, both of which are time-consuming and complex but essential to promoting the maintenance of biodiversity.

On the other hand, plans designating these renewables acceleration areas are still subject to ordinary environmental assessments. Acceleration area plans are, among others, required to prioritise artificial surfaces and degraded land and exclude areas of high biodiversity value. Individual projects in these areas are subject to a backstop environmental screening process, to evaluate the projects against certain unforeseen adverse effects. In this regard, it is crucial to **properly execute procedures to map land use, site renewables to achieve a delicate balance between reducing emissions through faster renewables deployment and protecting biodiversity in those areas.**

Conclusion: Beyond trade-offs

This report has presented a comprehensive set of 30 policy recommendations that are critical for attaining the ambitious climate targets set for 2030 and charting a path towards net zero. It underscores the vital importance of coherent coordination among diverse policy objectives – not only in their formulation but also, more crucially, in their effective execution. It is important to move away from perceiving these priorities as irreconcilable trade-offs, a mindset that regrettably gained traction during the recent political cycle. Some of these concerns have remained consistently at the forefront of discussions. Among them are the potential adverse effects of decarbonisation on competitiveness and calls for re-evaluating market openness and economic integration amid the new global realities. There is also the dual challenge of balancing ecosystem preservation and increasingly ambitious efforts to mitigate climate change with sustaining economic progress.

Drawing from the insights provided in the report, the implementation of the European Green Deal should not be confined to simplistic binary choices between ostensibly competing and conflicting priorities. Instead, the 2024–2029 political cycle must embrace a complexity-driven, nuanced approach. It must weigh multiple objectives on a case-by-case basis while upholding the fundamental aims of establishing a single market that 'shall work for the sustainable development of Europe based on balanced economic growth', as enshrined in Article 3(3) of the Treaty on the EU.

Indeed, decarbonisation objectives can be aligned with initiatives aimed at securing and maintaining the EU's international competitiveness, while industrial policies can fortify the readiness of firms for open competition. Concurrently, the large-scale deployment of low-carbon solutions and increasing resource demand for the green transition can be harmonised with the safeguarding of the biosphere. This amalgamation of policy aims is not merely speculative; it is rooted in the recognition that socioeconomic frameworks have historically adapted to various shifts. Despite the undeniable impact of economic activity on natural ecosystems and the resultant societal risks, the adverse effects have gradually diminished with economic and technological progress.

The 2024–2029 political cycle will need to figure out how to manage this process effectively, considering its ramifications for social welfare, potential macroeconomic constraints and other risks that could undermine EU prosperity. Yet, if managed successfully, the 2024–2029 cycle holds the promise of demonstrating that growth, prosperity, clean energy, and environmental protection can indeed coexist harmoniously. By doing so in practice, the EU can genuinely set a precedent and lead by example in global decarbonisation efforts.

NOTES

[1] Clean technologies were defined by the Commission of the European Communities in COM/1979/0144 as a concept covering three distinct but complementary purposes: less pollution, less waste and less demand on natural resources.

[2] The concept of 'pull and push dynamics' in relation to green transition is often attributed to Christiana Figueres, who served as the Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC) from 2010 to 2016. Figueres, C. (2011), Address at the CEO Sustainability Forum of the United Nations Framework Convention on Climate Change, 26 September.

[3] These impacts are, to a large extent, uncertain and subject to various estimations and projections. Nonetheless, there is a consensus that the cost of transition is undeniably lower than the cost of inaction. For more detailed discussion see: Pisan-Ferry, J. (2021), *Climate Policy is Macroeconomic Policy, and the implications will be significant*, PIIE Policy Brief No 20, PIIE, Washington DC, August. International Monetary Fund. Research Dept. (2022). 'Chapter 3 Near-Term Macroeconomic Impact of Decarbonization Policies', in *World Economic Outlook October 2022*, International Monetary Fund, pp 71-95. Claeys, G., Le Mouel, M., Tagliapietra, S., Wolff, G. B., and Zachmann, G. (2024). *The Macroeconomics of Decarbonisation: Implications and Policies*. Cambridge University Press.

[4] Schnabel, I. (2024), 'The last mile of disinflation may be the most difficult one', *Financial Times*,6 February.

[5] See our initial reflections on this in: Elkerbout, M. and Egenhofer, C. (2021*)*, Fit for 55 – is the European Green Deal really leaving no-one behind?, *CEPS,* Brussels*,* 12 July. For a further discussion: Fuest, C., Marcu, A., Mehling, M. (2024), *Climate Policy Priorities for the Next European Commission*, EconPol Policy Report No 48, CESifo Gmbh, Munich, March.

[6] This is evident in actions such as the retraction of certain provisions in the pesticide reduction plan following farmers' protests in early 2024, as well as policies concerning gas boilers and the ban of internal combustion engine cars in Germany.

[7] European Commission (2023), *Special Eurobarometer 538 Climate Change*, Eurobarometer 2954/ SP538, Brussels, June.

[8] Apart from President Macron's call for 'a regulatory pause', which has been extensively discussed (see Nguyen, P.-V. (2024) 'EU Green Deal: towards a "European regulatory pause"?', *Jacques Delors Institute*, 9 January) and criticised (see Leguet, B. (2023) 'A "regulatory pause" on environmental legislation: Emmanuel Macron's "faux pas"', *Institute for Climate Economics*, 8 June.), the prevailing sentiment is to take stock of the currently agreed legislative files before moving forward.

For example, see Defard, C. (2023), *Energy Union 2.0. to deliver the European Green Deal*, Jacques Delors Institute, Paris, 10 November; and Bonfani, M., Christopoulou, I., and Engstrom, M. (2023), *European Green Deal until 2024: which vision and priorities?*, Think2030 Session Brief, Brussels, 20 April.

[9] Meyers, Z. (2024), *Better regulation in Europe: An action plan for the next Commission*, CER Policy Brief, CER, March.

[10] For example, see Eyl-Mazzega, M. and Gherasim, D. (2024), *How Can the Green Deal Adapt to a Brutal World?*, *Ifri Studies*, Ifri, Paris, January.

[11] Meyers, Z. (2024), Note 9.

[12] Thompson, L. A. (2023), "The EU consultation process and citizen participation", The Parliament Magazine, 5 September.

[13] European Commission (2024), *The clean transition dialogues – stocktaking / A strong European industry for a sustainable Europe*, Communication, COM (2024) 163 final, Brussels, 10 April.

[14] ESABCC (European Scientific Advisory Board on Climate Change) (2024), *Towards EU climate neutrality : Progress, policy gaps and opportunities*, Publications Office of the European Union, Luxemburg, 18 January.

[15] European Commission (2023), *Energy Union and Climate action: Review report on the Governance Regulation*, Brussels, 6 July.

[16] Egenhofer, C. (2007), *Looking for the cure-all? Targets and the EU's New Energy Strategy*, CEPS Policy Brief No 118, CEPS, Brussels, January.

[17] European Commission (2024), *Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society*, Impact Assessment Report, SWD/2024/63 final, Strasbourg, 6 February.

[18] Interestingly, the Commission's Impact Assessment does not mention international credits.

[19] Schenuit, F. and Geden, O. (2024), *The Next Phase of European Climate Policy: Laying the Groundwork with the 2040 Target*, SWP Comment, SWP, Berlin, 17 April.

[20] The widespread perception was that the European Green Deal would primarily impact external energy partners, and that Europe's fossil fuel supplies would be automatically assured until their phase-out. This has proven to be more complex than anticipated, as highlighted in the work by Thijs Van der Graaf, see Van der Graaf, T. (2023), *Gulliver Unchained? Europe's Changing Relations with Oil and Gas Producers*, Egmont Policy Brief No 324, Egmont Institute, Brussels, December 2023.

[21] See our reflections on this in: Elkerbout, M., Egenhofer, C., Ferrer, J., Cătuţi, M., Kustova, I., and Rizos, V. (2020), *The European Green Deal after Corona: Implications for EU climate policy*, CEPS Policy Insights, CEPS, Brussels, March; and Blockmans, S. (ed) (2022), *A transformational moment? EU's response to Russia's war in Ukraine*, IdeasLab Special Report, CEPS, Brussels.

[22] For post-pandemic recovery, NextGenerationEU, a temporary recovery instrument totalling over EUR 800 billion until 2027, has enabled joint borrowing on capital markets by the European Commission on behalf of the EU. This has facilitated a coordinated response to pandemic-induced economic challenges. European Commission (2022), *EU budget policy brief – The EU as an issuer – The NextGenerationEU transformation*, Publications Office of the European Union, Luxemburg, 3 July.

[23] Sgaravatti, G., Tagliapieta, S., Trasi, C., and Zachmann, G. (2021), *National policies to shield consumers from rising energy prices*, Bruegel Datasets, Bruegel, Brussels, 4 November.

[24] Approximately EUR 600 billion has been spent since 2022 on urgently purchasing alternatives. This amount is about three times more than the usual fossil-fuel import bill in the last decade.

[25] Pelkmans, J.(2024), *Empowering the single market: A 10-point plan to revive and deepen it*, CEPS In-depth Analysis, CEPS, Brussels, 3 January. Letta, E. (2024), *Much more than a market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*, Publications Office of the European Union, Luxemburg, April.

[26] European Commission, Smith, M., Jagtenberg, H., Lam, L. et al., (2024), *Study on energy prices and costs – Evaluating impacts on households and industry – 2023 edition*, Publications Office of the European Union, Luxembourg, 13 March.

[27] Schaus, M. (2022), *Reviving the WTO and rules-based trading: The EU's role*, CEPS Policy Insights No 1, CEPS, Brussels, 24 January.

[28] See varying opinions on the implications of the US Inflation Reduction Act for European cleantech: Kleimann, D., Poitiers, N., Sapir, A., Tagliapietra, S., Véron, N. , Veugelers, R.and Zettelmeyer, J. (2023), *How Europe should answer the US Inflation Reduction Act*, Bruegel Policy Contribution No 4, Bruegel, Brussels, February; and Gros, D., Mengel, P., and Presidente, G. (n.d.), *The EU and The US Inflation Reduction Act. No rose without thorns,* IEP@BU Working Paper Series, IEP@BU.

Our take on this in: Elkerbout, M., Righetti, E., and Egenhofer, C. (2023), *Different Roads, Aligned Goals. How and why the Inflation Reduction Act and EU green industrial policies differ in supporting cleantech deployment*, CEPS Explainer No 16, CEPS, Brussels, 5 December.

[29] See the discussion in CEPS Report: Elkerbout, M., Righetti, E., Egenhofer, C. (2023). Note 29.

[30] Renda, A. (2024), *What 'North Star' for future EU industrial policy?*, CEPS In-Depth Analysis, CEPS, April.

[31] Righetti, E. and Rizos, V. (2024), *Reducing supply risks for critical raw materials. Evidence and policy options*, CEPS In-Depth Analysis, CEPS, January.

[32] A detailed discussion is provided in Alcidi, C., Kiss-Gálfalvi, T., Postica, D., Vasileios, R., Shamsfakhr, F. (2023), *What ways and means for a real strategic autonomy of the EU in the economic field?*, CEPS, Brussels, 10 November. Also see CEPS/CDP Policy Workshop 'From economic integration to geopolitical vulnerability? The search for EU strategic autonomy', 27 June 2023.

[33] McWilliams, B., Tagliapietra, S. and Trasi, C. (2024), *Smarter European Union industrial policy for solar panels*, Bruegel Policy Brief No 2, Bruegel, Brussels, 8 February.

[34] As defined by Bradford, A. (2019), *The Brussels Effect: How the European Union Rules the World*, Oxford University Press, New York.

[35] Institut Rousseau (2024), *Road to Net Zero: Bridging the green investment gap*, Institut Rousseau, Paris, January.

[36] Pisani-Ferry, J., Tagliapietra, S., and Zachmann, G. (2023), *A new governance framework to safeguard the European Green Deal*, Bruegel Policy Brief No 18, Bruegel, Brussels, 6 September.; Calipel, C., Bizien, A., and Pellerin-Carlin, T. (2024), *European Climate Investment Deficit report: An investment pathway for Europe's future*, I4CE, Paris, February; Institut Rousseau (2024), *Road to Net Zero: Bridging the green investment gap*, Institut Rousseau, Paris, January.

[37] According to the EIB, the share of public sources would need to cover up to 60 % of overall additional investments in Central and Eastern Europe, versus the 37 % in Western and Northern Europe. European Investment Bank (2021), Investment *Report 2020/2021 – Building a smart and green Europe in the COVID-19 era*, European Investment Bank, EIB.

[38] European Commission (2023), *Investment needs assessment and funding availabilities to strengthen EU's Net-Zero technology manufacturing capacity*, Staff Working Document, SWD(2023) 68 final, Brussels, 23 March.

[39] EEA (European Environment Agency) (2023), *Investments in the sustainability transition: leveraging green industrial policy against emerging constraints*, EEA Briefing No. 20, EEA, 7 November.; EIB (European Investment Bank) (2023), *Investment Report 2022/2023: Resilience and Renewal in Europe*, EIB, Publications Office of the European Union, Luxembourg, 28 February.

[40] This Platform is a scale-back version of the previously proposed Sovereignty Fund, which was intended to support green technologies.

[41] The Council and the European Parliament (2024), *Review of the Economic Governance Framework*.

[42] EEA (European Environment Agency) (2023), *Investments in the sustainability transition: leveraging green industrial policy against emerging constraints*, EEA Briefing No. 20, EEA, 7 November.

[43] European Commission (2023), *Commission sets out actions to accelerate the roll-out of electricity grids*, *Press Release,* 28 November 2023.

[44] Tumara, D., Uihlein, A. and Hidalgo Gonzalez, I., *Shaping the future CO2 transport network for Europe*, JRC, Publications Office of the European Union, Luxembourg, 2024

[45] In the case of hydrogen refuelling infrastructure, see Righetti E. and Egenhofer C. (2022), *Exploring cost-effective support mechanisms for hydrogen mobility infrastructure*, CEPS In-Depth Analysis No 6, CEPS, Brussels, 15 December.

[46] The term 'anticipatory investment' has been explicitly used in the power grid context and refers to investment that 'proactively addresses expected developments, looking beyond immediate needs of generation or demand, assuming with sufficient level of certainty that new generation and demand will materialise, notwithstanding potential low utilisation in the short term'. Eurelectric (2024), *How can DSOs rise to the investments challenge? Implementing Anticipatory Investments for an efficient distribution grid*, Eurelectric position paper, Eurelectric, Brussels, March.

[47] Eurostat (2024), 'R&D Expenditure', Eurostat Statistics Explained, 18 March.

[48] European Commission, Directorate-General for Research and Innovation, Hollanders, H. (2023), *European Innovation Scoreboard 2023*, Publications Office of the European Union, Luxembourg.

[49] European Investment Bank and European Patent Office (2024), *Financing and commercialisation of cleantech innovation*, EPO, 25 April.

[50] European Commission, Directorate-General for Research and Innovation, Hollanders, H. (2023), *European Innovation Scoreboard 2023*, Publications Office of the European Union, Luxembourg.

[51] Pinkus, D., Pisani-Ferry, J., Tagliapietra, S., Veugelers, R., Zachmann, G., and Zettelmeyer, J. (2024), *Coordination for EU Competitiveness*, Economic Governance and EMU Scrutiny Unit European Parliament, Brussels, February.

[52] Fuest, C., Gros, D., Mengel, P-L., Presidente, G., and Tirole, J. (2024), *EU Innovation Policy - How to Escape the Middle Technology Trap*, econpol@cesifo, IEP@BU, Toulouse School of Economics.

[53] Calipel, C., Bizien, A., and Pellerin-Carlin, T. (2024), *European Climate Investment Deficit report : An investment pathway for Europe's future*, I4CE, Paris, February.

[54] EIB (European Investment Bank) (2023), *Investment Report 2022/2023: Resilience and Renewal in Europe*, EIB, Publications Office of the European Union, Luxembourg, 28 February.

[55] The Antwerp Declaration for a European Industrial Deal, 20 February 2024.

[56] Pelkmans, J. (2024), *Empowering the single market: A 10-point plan to revive and deepen it*, CEPS In-depth Analysis, CEPS, Brussels, 3 January. Letta, E. (2024), *Much more than a market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*, Publications Office of the European Union, Luxemburg, April.

[57] Zachmann, G., Batlle, C., Beaude, F., Maurer, C., Morawiecka, M., and Roques, F. (2024), *Unity in power, power in unity: why the EU needs more integrated electricity markets*, Policy Brief NO 3, Bruegel, Brussels, 14 February.

[58] Findesein, F. and Mack, S. (2023), *Do more with more: How the EU can improve funding for the European Green Deal*, Hertie School Policy Brief, Hertie School GmbH, Berlin, 25 May.

[59] Letta, E. (2024), *Much more than a market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*, Publications Office of the European Union, Luxemburg, April.

[60] Pelkmans, J. (2024), Note 56.

[61] For more details, see Elkerbout, M. (2017), *A strong revision of the EU ETS, but the future may bring impetus for further reform*, CEPS Commentaries, CEPS, Brussels, 14 November.

[62] Edenhofer, O., Kosch, M., Pahle, M., and Zachmann, G.(2021), *A whole-economy carbon price for Europe and how to get there*, Bruegel Policy Contribution No 6, Bruegel, March.

[63] From 1 099 to 657 MtCO_2 during 2000-2023, Data are from Ember Climate (database), London.

[64] The introduction of the Market Stability Reserve and its revision in 2017, along with the adoption of the legally binding EU climate neutrality target in 2021.

[65] Data from Carbon Price Tracker (database), Ember Climate.

[66] In 2022, the ETS price experienced a temporary spike, surpassing EUR 100/tonne, but throughout 2023 and 2024 it decreased from its peak, returning to levels seen prior to the crisis. It is currently fluctuating at around EUR 55-60/tonne as of April 2024. Identifying the precise drivers behind these ETS price fluctuations is challenging, as multiple factors are at play. The interplay of high energy prices and economic slowdown may have contributed to the decline in industrial output, particularly in sectors like ammonia production, where elevated gas prices rendered operations economically unviable. Additionally, reduced economic activity coupled with milder weather conditions during the winter of 2023-2024 likely led to decreased coal consumption and a greater share of renewable energy sources in power generation, thereby decreasing the demand for EUAs. If industrial output remains suppressed, it will likely weaken demand for EUAs, potentially lowering ETS prices. However, predicting the exact trajectory of ETS prices in response to industrial demand fluctuations is inherently complex and subject to various factors and uncertainties. Given that the ETS cap is declining rapidly, this would indicate that the market is not very forward-looking. Some purely administrative reasons might also factor into trading behaviour: the compliance deadline in 2024 was

shifted to September for the first time, thereby also shifting the date when operators need to surrender their allowances for compliance, which may affect purchase timings.

[67] Pahle, M., Sitarz, J., Osorio, S., and Görlach, B. (2022), *The EU-ETS price through 2030 and beyond: A closer look at drivers, models and assumptions*, Kopernikus-Projekt Ariadne Potsdam-Institut für Klimafolgen-forschung, Potsdam, 30 November.

[68] Sgaravatti, G., Tagliapietra, S., Zachmann, G. (2023), *Adjusting to the energy shock: the right policies for European industry*, Bruegel Policy Brief No 11, Bruegel, Brussels, 17 May.

[69] Marcu, A., Maratou, A., Lopez, J.F. (2024), *EU carbon price: regulatory intervention, economic cycle, market fundamentals*, ERCST, April.

[70] Ibid.

[71] Accordingly, the ETS cap is being reduced by almost 100 million tonnes annually along the stronger Linear Reduction Factor increased from 2.2 % to 4.3 % in 2024 and 4.4 % from 2028.

[72] Banked EUAs are the EUAs that have been allocated to ETS-covered operators, but not yet used for compliance purposes.

[73] Power, industry, aviation and maritime transport. From 2024, Member States measure, verify and report emissions from municipal waste incinerators. By January 2026, the Commission will submit a report assessing the possibility of incorporating these facilities into the EU ETS starting in 2028, with a provision for potential opt-outs until 2030. However, waste incineration contributes only a small percentage to the total GHG emissions of the EU and, if included, will not substantially affect EUA supply.

[74] In contrast to the straightforward switching prices observed in the power sector, demand by the industrial sector is primarily influenced by the marginal abatement cost of its installations and processes. Investments in industrial sectors are characterised by their irregularity, specificity to particular installations and reliance on a diverse array of industrial processes and products. Moreover, these investments often involve technologies that have not yet achieved widespread adoption or are still in early phases of commercial deployment. See the discussion in: Pahle, M., Sitarz, J., Osorio, S., Görlach, B. (2022), Note 67.

[75] Pahle, M., Quemin, S., Osorio, S., Gunther, C., Pietzcker, R. (2024), 'The Emerging Endgame: The EU ETS on the Road Towards Climate Neutrality', *SSRN*, 5 January. Zetterberg, L., Elkerbout, M., (2023), *EU Emissions Trading System – Implications of the 2023 reform and prospects for the 2030'ies*, Mistra Carbon Exit, IVL Swedish Environmental Research Institute, Stockholm, 20 September.

[76] Zetterberg, L., Elkerbout, M., (2023), Note 75.

[77] Nature-based carbon removals work through the protection, sustainable management and restoration of ecosystems and natural features as natural carbon sinks. Technological CO_2 removals involve technologies designed to capture and store CO_2, often using mechanical or chemical means, such as direct air capture with carbon storage, bioenergy with carbon capture and storage, and enhanced weathering. Technologies and nature-based solutions vary in terms of costs, technological advancement and land use, with most negative emissions technologies at earlier stages of development.

For a detailed discussion on the definition and scope of negative emissions see: Elkerbout, M., Bryhn, J., (2021), *Setting the context for an EU policy framework for negative emissions*, CEPS Policy Insight No 12, CEPS, Brussels, 16 September.

[78] European Parliament and Council (2022), *Establishing a Union certification framework for permanent carbon removals, carbon farming and carbon storage in products*, Proposal for a Regulation, 2022/0394 (COD).

[79] For more details, see: Elkerbout, M., Bryhn, J. (2021), Note 77.

[80] The regulated entity will be fuel provider; the cap will be reduced at 5.1 % annually.

[81] Nesselhauf, L. and Müller, S. (2023), *Der CO2-Preis für Gebäude und Verkehr: Ein Konzept für den Übergang vom nationalen zum EU-Emissionshandel*, Agora Energiewende and Agora Verkehrswende, 19 October.

[82] In 2022, buildings and transport collectively accounted for approximately 1.3 billion tonnes, and even by 2030, they are projected to remain around the billion-tonne mark. EEA (European Environmental Agency) (2023), *Trends and Projections in Europe 2023*, EEA Report, Publications Office of the European Union, Luxembourg, July.

[83]Zetterberg, L. and Elkerbout, M., (2023), Note 75.

[84] ECA (European Court of Auditors) (2021), *Common Agricultural Policy and climate: Half of EU climate spending but farm emissions are not decreasing*, ECA Special Report, Publications Office of the European union, Luxembourg.

[85]ESABCC (European Scientific Advisory Board on Climate Change) (2024), *Towards EU climate neutrality: progress, policy gaps and opportunities*, ESABCC Assessment Report, Publications Office of the European Union, Luxembourg, 18 January.

[86] European Commission (2023), *Pricing agricultural emissions and rewarding climate action in the agri-food value chain*, Publications Office of the European Union, Luxembourg, November.

[87] Edenhofer, O., Franks, M., Kalkuhl, M., and Runge-Metzger, A. (2023), *On the Governance of Carbon Dioxide Removal – A Public Economics Perspective*, CESifo working paper No 10370, CESifo, Munich, 2023. Marcu, A., López Hernández J.F., and Romeo G. (2023), *EU ETS Post-2030 : a European Central Carbon Bank to manage the EU ETS?*, ERCST, September.

[88] E.g. ensuring carbon price stability or integration of carbon removals or international credits into the EU ETS. See the discussion in Marcu, A., López Hernández J.F., and Romeo G. (2023), Note 87.

[89] Eurelectric (2024), 'EU Electrification rates are not on track for 2050: time for an Electrification Action plan', 5 April.

[90] Belmans, R., Dos Reis, P., Vingerhoets, P., (2021), *Electrification and sustainable fuels: Competing for wind and sun*, EUI Working Paper, EUI, San Domenico di Fiesole (FI), May.

[91] Ibid.

[92] Vasileios, R., Righetti, E. (2024), *Reducing supply risks for critical raw materials*, CEPS In-depth Analysis No 1, CEPS, Brussels, 18 January.

[93] Kurmayer, N. (2024), 'Europe's looming power grid roadblock: Transformers', *Euractiv,* 7 May.

[94] Urban, P., Rizos, V., Ounnas, A., Kassab, A. and Kalantaryan, H. (2023), *Jobs for the green transition*, CEPS In-depth Analysis, September.

[95] Nouicer, A. (2022), Distributed resources and flexibility, Florence School of Regulation, February.

[96] EEA/ACER (European Environment Agency/ Agency for the Cooperation of Energy Regulators) (2023), *Flexibility solutions to support a decarbonised and secure EU electricity system*, EEA/ACER Report, Publications Office of the European Union, Luxembourg.

[97] For a detailed overview of wide range of flexibility resources, see Energy Community (2022), 'Energy Community power system can support at least 30 GW of renewables without additional investments into flexibility', 13 July.

[98] Ylä-Mononen, L. and Zinglersen, C., (2023) *Tackling the power system flexibility challenge - rapid growth in renewables calls for greater cooperation*, Presentation at the European Parliament's joint ITRE-ENVI session Brussels, 28 November.

[99] For example, solar generation demands significant daily flexibility, while wind energy requires weekly adjustments. Moreover, the electrification of heating through heat pumps introduces a need for more seasonal flexibility. Ylä-Mononen, L., and Zinglersen, C., (2023) *Tackling the power system flexibility challenge- rapid growth in renewables calls for greater cooperation*, Presentation at the European Parliament's joint ITRE-ENVI session Brussels, 28 November

[100] Reservoir-based hydropower, nuclear, geothermal, ocean, biomass, and concentrated solar power installations.

[101] IEA (International Energy Agency) (2022), *Renewables 2022 Analysis and forecast to 2027*, IEA, Paris, December.

[102] Gavin, G. (2024), 'After scrapping nuclear reactors, Germany to spend billions on new gas power plants', *Politico,* 5 February. Rowlatt, J. (2024), 'New gas power plants needed to bolster energy supply, PM says', *BBC News,* 12 March.

[103] It is worth noting that various studies have different estimations regarding the system costs of a future decarbonised electricity system. See among others: RTE (2021), Energy pathways to 2050. Key results, October; Swedish Enterprise, Future electricity supply in Sweden. Long-term scenario analysis; Heymann, E. (2023), Costs of electricity generation: System costs matter, Germany Monitor, Deutsche Bank, March; Ueckerdt, F., Hirth, L., Luderer, G. and Edenhofer, O. (2013), 'System LCOE: What are the costs of variable renewables?', Energy, Vol.63; Deason, W. (2018), 'Comparison of 100% renewable energy system scenarios with a focus on flexibility and cost', *Renewable and Sustainable Energy Reviews*, Vol 82, part 3.

[104] More specifically, connecting the Baltic states to continental Europe via the Harmony Link or continental Greece with Cyprus. See European Commission (2023), 'Commission, Baltic States and Poland commit to accelerate Baltic Grid synchronization with Continental Europe', *European Commission,* 19 December.

[105] These grids will connect clusters of offshore wind farms in the northern regions of Europe with cables linked to the shore, enabling the routing of power to several national grids. See Wind Europe (2023), 'Meshed grids the next frontier in leveraging the potential of offshore wind', *Wind Europe*, 25 April.

[106] More details in: European Commission (2023), Commission sets out actions to accelerate the roll out of electricity grids, November.

[107] Many companies are currently working on SF6-free alternatives. See some examples: Siemens Energy, Hitachi Energy, GE Vernova.

[108] Gazzoletti, F., Egenhofer, C. and Righetti, E. (2023), In the time we have left, how can we realistically reform the EU's electricity market? CEPS Explainer, April.

[109] Gazzoletti, F., Righetti, E. and Egenhofer C. (2023), Could the EU electricity market design reform sabotage the very internal energy market it is supposed to uphold? CEPS Explainer, October.

[110] Kustova, I. and Egenhofer, C. (2019), 'The EU electricity sector will need reform, again', *Intereconomics*, Vol 54, No 6.

[111] CfDs guarantee a certain revenue under a specified strike price, shifting the risk from the investor to the government. This arrangement can result in increased financial burdens for the government when it needs to make payments to generators when the market price is below the strike price. Attempts to lower strike prices, such as those in the UK, have led to failed auctions. There is also concern that Member States negotiating CfDs with large producers, often too complex and technical, may face disadvantaged conditions. A voluntary approach to CfDs enables Member States to make decisions tailored to their specific needs, also allowing considerable room for interpretation, with different designs suiting various projects and market situations. Still, the need for a European framework for CfDs in certain forms and scope could become a topic of discussion in the 2024– 2029 political cycle.

[112] Commercial PPAs have also been considered incentives for long-term investor certainty for renewable energy generation, allowing generators to enter into agreements with consumers, often large customers. But experience with recently negotiated PPAs has shown that the prices negotiated with large companies are often too low – and probably, too forward-pressured, by locking generators into long-term contracts of 10-20 years. Despite efforts to streamline negotiations and make PPAs more accessible to smaller players, the PPA landscape in the EU remains heterogeneous. Contract structures, pricing mechanisms and risk allocations vary across countries, influenced by market maturity, policy support and investor preferences. The lack of standardisation in PPAs complicates matching supply and demand.

Additionally, large consumers, including industry and data centres, often secure low-carbon electricity at better conditions through PPAs, usually in areas with abundant renewable resources. This may raise concerns about the long-term availability of affordable energy for other consumers if saturation, also in these areas, makes finding new suppliers challenging. Facilitating cross-border PPAs also raises questions about allocating cross-zonal capacity for such extended timeframes. Clean 24/7 PPAs offer an option to decarbonise the grid, but issues like timing requirements (hourly, monthly, annually) and tracking and verification processes need to be addressed, with digital tools becoming crucial.

[113] ACER (2023), ACER policy paper on the further development of the electricity forward market, Agency for the Cooperation of Energy Regulators, February. ACER (2023), Progress of EU electricity wholesale market integration, 2023 Market Monitoring Report, Agency for the Cooperation of Energy Regulators, November.

[114] Rizos, V., Tuokko, K. and Behrens, A. (2017), *The Circular Economy: A review of definitions, processes and impacts*, CEPS Research Report No. 2017/08, CEPS, Brussels, April; Lieder, M. and Rashid, A. (2016), 'Towards circular economy implementation: a comprehensive review in context of manufacturing industry', *Journal of Cleaner Production*, Vol. 115, pp. 36-51.

[115] Recent modelling work by Forslund et al. (2022) has concluded that a move towards circular models in the food and agriculture, buildings, textiles and forest sectors can shift long-lasting biodiversity loss trends. See Forslund, T., Gorst, A., Briggs, C., Azevedo, D., Smale, R. (2022), *Tackling root causes. Halting biodiversity loss through the circular economy,* Sitra Studies, Sitra, Helsinki, May.

[116] European Commission (2015), *Closing the loop – An EU action plan for the circular economy*, COM (2015) 614 final, Brussels; European Commission (2020), *A new circular economy action plan: For a cleaner and more competitive Europe*, COM (2020) 98 final, Brussels.

[117] European Commission (2023), *A secure and sustainable supply of critical raw materials in support of the twin transition,* Communication, COM (2023) 165 final, Brussels, 16 March.

[118] For an overview, see: Weick, M., Ray, N., (2022), Regulatory landscape of the circular economy, EY, 16 December.

[119] China Industrial Association of Power Sources (2024), 'Successful Launch of the "Battery Passport Guide" Group Standard Seminar', CIAPS, 26 January.

[120] Egenhofer, C., Drabik, E., Alessi, M. and Rizos, V. (2018), *Stakeholders views on the Ecodesign Directive: An assessment of the successes and shortcomings*, CEPS Research Report No. 02, CEPS, Brussels, March.

[121] European Parliament and the Council (2022), *Establishing a framework for setting ecodesign requirements for sustainable products and repealing Directive 2009/125/EC,* Proposal for a Regulation, 2022/0095 (COD).

[122] The analysis of the pilot cases of implementing the digital battery passport across the EU has shown that businesses would favour more certainty about which economic operator is responsible for meeting the obligations of the regulation at all stages of the batteries' lifecycle (also during reuse or repurposing). See: Rizos. V. and Urban, P. (2024), *Implementing the EU digital battery passport: Opportunities and challenges for battery circularity*, CEPS In-Depth Analysis, CEPS, Brussels, March.

[123] Rizos, V., Behrens, A., van der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., Flamos, A., Rinaldi, R., Papadelis, S., Hirschnitz-Garbers, M., and Topi, C. (2016), 'Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SMEs): Barriers and Enablers', *Sustainability,* Vol. 8, No. 11.

[124] Lieu, J., N.A. Spyridaki, R. Alvarez-Tinoco, W. van der Gaast, A. Tuerk and O. van Vliet (2018), 'Evaluating Consistency in Environmental Policy Mixes through Policy, Stakeholder, and Contextual Interactions', *Sustainability*, Vol. 10, 1896; Meissner, D. and Kergroach, S. (2021), 'Innovation Policy Mix: Mapping and Measurement', *The Journal of Technology Transfer*, Vo. 46, pp. 197-222.

[125] Rizos, V. and Bryhn, J. (2022), 'Implementation of circular economy approaches in the electrical and electronic equipment (EEE) sector: Barriers, enablers and policy insights', *Journal of Cleaner Production*, Vol. 338; Van Barneveld, J., van der Veen, G., Enenkel, K., Mooren, C., Talman-Gross, L., Eckartz, K., Ostertaget, K. et al. (2016), *Regulatory barriers for the Circular Economy – Lessons from ten case studies*, Technopolis Group, Fraunhofer ISI, thinkstep, Wuppertal Institute, Amsterdam, June.

[126] Eurostat (2023), 'In 2022, the EU's recycling rate for packaging waste reached 64 %, with 57.7 million tonnes coming from recycled waste materials', Eurostat News, 14 November.

[127] Eurostat (2023), 'Circular economy- material flows', Eurostat Statistics Explained, 14 November.

[128] European Environment Agency (EEA) (2023), *Many EU Member States not on track to meet recycling targets for municipal waste and packaging waste*, Briefing, June.

[129] European Court of Auditors (2023), *Circular economy - Slow transition by member states despite EU action*, Publications Office of the European Union, Luxemburg, 3 July.

[130] Eurostat. (n.d.). Monitoring framework for the circular economy.

[131] Rizos, V., Behrens, A., Drabik, E., Rinaldi, D. and Tuokko, K. (2018), *The Role of Business in the Circular Economy*, Report of a CEPS Task Force, CEPS, Brussels, 26 March.

[132] Ibid.

[133] Elkerbout, M. and Rizos, V. (2022), *Industrial transformation in a time of crisis: How to keep our eye on the low-carbon ball*, CEPS Policy Brief No 9, CEPS, Brussels, November.

[134] Rizos, V., Urban, P., E. Righetti and A. Kassab (2023), *Chemical recycling of plastics: Technologies, trends and policy implications*, CEPS In-Depth Analysis No 11, CEPS, Brussels, 30 June.

[135] ISO (International Organisation for Standardisation), Catalogue of standards by ISO/TC 323 – Circular Economy.

[136] CEN (European Committee for Standardisation), Catalogue of standards by CEN/TC 473 – Circular Economy.

[137] Currently, the framework includes only one indicator on innovation: 'Patents related to waste management and recycling'.

[138] European Commission (2022), *On the monitoring framework for the 8th Environment Action Programme: Measuring progress towards the attainment of the Programme's 2030 and 2050 priority objectives*, Communication, COM(2022) 357 final, Brussels, 26 July.

[139] *ETC/CE* (European Topic Centre on Circular Economy) (*2023*), *Circular Economy and Biodiversity*, Report No7, Eionet Portal, 12 June; Rizos, V. and Righetti, E. (2022), *Low-carbon technologies and Russian imports: How far can recycling reduce the EU's raw material dependency?,* CEPS Policy Insight No 17, CEPS, Brussels, 22 April.

[140] See IPCC (Intergovernmental Panel on Climate Change) (2018) 'Strengthening and Implementing the Global Response', pp 313-444; also the discussion in Elkerbout, M. and Bryhn, J. (2021), Note 77.

[141] Torralba, M., Fagerholm, N., Burgess, P., Moreno, G. and Plieninger, T., (2016), 'Do European agroforestry systems enhance biodiversity and ecosystem services? A meta-analysis', *Agriculture, Ecosystems & Environment*, Vol. 230.

[142] Dooley, K., Harrould-Kolieb, E., and Talberg, A. (2021), 'Carbon-dioxide Removal and Biodiversity: A Threat Identification Framework', *Global Policy*, *12*(S1), pp 34–44.

[143] European Commission (2024), *Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society,* Impact Assessment Report, SWD/2024/63 final, Strasbourg, 6 February.

Winkler, K., Yang, H., Ganzenmüller, R., Fuchs, R., Ceccherini, G., Duveiller, G., Grassi, G., Pongratz, J., Bastos, A., Shvidenko, A., Araza, A., Herold, M., Wigneron, J.-P., and Ciais, P. (2023). 'Changes in land use and management led to a decline in Eastern Europe's terrestrial carbon sink'. *Communications Earth & Environment*, *4*(1), 237.

[144] EIB (European Investment Bank) (2023), Investing in nature-based solutions. State-of-play and way forward for public and private financial measures in Europe, European Investment Bank.

[145] See a detailed discussion in our report: Elkerbout, M., Catuti, M. and Egenhofer, C. (2020), *What role for forest-based industries in a climate-neutral future?,* CEPS Policy Insights, November.

[146] For a detailed overview of biomass, see our report: Catuti, M., Elkerbout, M., Alessi, M., and Egenhofer, C. (2020), *Biomass and climate neutrality*, CEPS Policy Insights, August.

147 European Commission (2023), State of the Energy Union Report 2023 (Pursuant to Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action*)*, Report, COM(2023) 659 final, Brussels, 24 October.

148 Impact assessment report- SWD(2021)621 https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12553-EU-renewable-energy-rules-review_en

149 Guidehouse (2024), Biogases towards 2040 and beyond. A realistic and resilient path towards climate neutrality, April.

150 See publications on forest biomass and bioeconomy by the Joint Research Council.

151 Pörtner, Hans-Otto, Robert J. Scholes, John Agard, Emma Archer, Almut Arneth, Xuemei Bai, David Barnes, et al. (2021) *Scientific Outcome of the IPBES-IPCC Co-sponsored Workshop on Biodiversity and Climate Change'*, Zenodo, 24 June.

152 Bennun, L., van Bochove, J., Ng, C., Fletcher, C., Wilson, D., Phair, N., and Carbone, G. (2021). *Mitigating biodiversity impacts associated with solar and wind energy development. Guidelines for project developers*, IUCN, Gland and Cambridge.

153 For example, see: Salkanovic, E. (2023), 'Protecting avian wildlife for windfarm siting: The Screening Tool Proof of Concept'. *Energy for Sustainable Development,* Vol 74; ArcGIS. Interactions between birds and offshore wind farms; IdentiFlight.

154 For example, see: Wilson, J.C. and Elliot, M. (2009), 'The Habitat-creation potential of offshore wind farms', *Wind Energy*, Vol. 12. Galparsoro, I. Menchaca, I., Garmendia, J.M., Borja, A., Maldonado, A., Iglesias, G. and Bald, J. (2022)., 'Reviewing the ecological impacts of offshore wind farms', *Nature, Ocean Sustainability*, Vol 1.

155 Fraunhofer ISE (2022), Agrivoltaics: Opportunities for agriculture and the energy transition, A guideline for Germany, Fraunhofer Institute for Solar Energy Systems, April.

156 For a detailed discussion, see Gallop, P., (2023), *Towards a renewables scale-up that works for nature*, FEPS, FES, IEV, July 2023.

CEPS
PLACE DU CONGRES 1
B-1000 BRUSSELS