

Towards Transformative EU Climate Policy

Ten Recommendations from
the 4i-TRACTION Project

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1. Background

The EU has set itself the goal to become the first climate-neutral continent. The European Green Deal, the European Climate Law and the Fit-for-55 package are core steps to strengthen EU climate policy, and to deliver on the EU's ambition to transform towards climate neutrality. But despite these efforts, the EU is not on track to climate neutrality by 2050 (e.g., ESABCC, 2024).

Based on extensive analysis of the EU's climate policy instruments and governance, the 4i-TRACTION project finds that substantial transformation gaps remain across innovation, investment, infrastructure, and integration. With a new Commission taking office and European Parliament coming in, the EU has the chance to close these gaps and more closely align the Green Deal with the goal of climate neutrality. **In this report, we develop ten recommendations for EU climate policy going forward.**

Before outlining the 4i-TRACTION project's recommendations for EU policy, the next section briefly summarizes the transformation gaps that remain on the path to climate neutrality.

2. The Transformation Challenge towards Climate Neutrality

Several transformation gaps remain in the fields of integration of policies, rolling out the infrastructure for a climate-neutral economy, mobilising the necessary public and private investments and deploying climate-friendly innovations at scale (Görlach et al., 2024). The following section summarises these four "transformation gaps".

2.1 Integration

Climate policy integration is still uneven across sectors and limited, for example, in agriculture and transport. Moreover, the coordination of innovation, investment, and infrastructure is deficient. To reach climate neutrality, the EU needs a whole-of-government approach that ensures all its policies are aligned with climate neutrality across all sectors, institutions, laws and policies.

This all-of-government approach should achieve both substantive integration (what is being done to achieve climate neutrality) and procedural integration (how climate policy is being made, including participation / deliberative decision making and enabling conditions).

On the substantive side, governance arrangements must facilitate and cope with increasing sector coupling: since electrification is a core part of the solution for many energy end-uses (in particular transport, buildings and industrial heat), successful emission reductions in these sectors increasingly depend on progress achieved in the energy sector (electricity generation, but also infrastructure and market design).

Procedural integration needs to secure democratic ownership of the climate transition in Europe across all levels of government, allowing citizens to have a stake and a voice in its implementation

as a shared achievement, and prevent it from being perceived as a top-down technocratic project and (foremost) a burden for households.

Some elements of the transition will require integrated planning – working back from the desired end state and across sectoral boundaries, and ensuring that innovation, infrastructure and investment are aligned with each other, and with the current knowledge about pathways to climate neutrality. Such planning is especially important for the coordinated phase-out of fossil-based technologies, assets and value chains, to reduce the risks of disruptions and associated hardships. Integrated planning also serves to strengthen a pan-European view, in particular for energy and transport infrastructure.

2.2 Infrastructure

The roll-out of infrastructure for a climate-neutral economy is currently too slow, especially for energy and transport infrastructure, in part due to a lacking comprehensive strategy for transnational infrastructure. The EU therefore needs to strengthen its policy efforts to deliver an EU-wide infrastructure fit for climate neutrality.

Transforming the EU's infrastructure to match the needs of a climate-neutral energy and transport system is crucial to meet future climate goals: without the right infrastructure in place, overall cost will increase, security of supply may deteriorate and industry, transport and the built environment will not be able to decarbonise in time. However, this transformation requires very significant efforts and investments.

Gaps are particularly pertinent in energy and transport infrastructure, inter alia in transmission grids for electricity, hydrogen pipelines, district heating, and the transformation of existing pipelines. The infrastructure gap can be broken down into different issues (Görlach et al., 2024):

- **Insufficient funding:** infrastructure development requires very large upfront investments. Given these large sunk costs and unclear revenue prospects, infrastructure tends to face a funding constraint.
- **Complex coordination:** the “chicken-and-egg” problem of infrastructure development means that large investments in infrastructure require guaranteed supply and demand, while both producers and end users delay transitioning to renewables without assured infrastructure.
- **Long lead times:** Infrastructure projects often have long lead times of 5-10 years from inception to actual realisation.
- **Insufficient transnational planning:** EU energy infrastructure planning is still largely fragmented and Member State driven. As the energy system becomes more integrated and based on renewables, the value of transnational interconnection rises, necessitating better transnational planning.

Increased EU policy efforts are therefore needed to speed up and better manage the transition towards an EU infrastructure fit for a climate-neutral economy, as we recommend below.

2.3 Investment

The climate investment gap is in the order of €406 billion annually and the existing framework is insufficient to mobilise it. Moreover, the EU faces a two-fold challenge regarding investment: not only to scale up climate-friendly investments, but also end investments that perpetuate the fossil-based economy. The EU needs to increase the quantity of public funding and coordinated policies in order to ensure sufficient and predictable funding in the future.

Climate-friendly investments (renewables, energy efficiency, infrastructure, etc.) typically require high upfront capital expenditure. This makes them more sensitive to higher interest rates – but also opens intervention options, by supporting the initial investment costs of the projects (through subsidies, equity or investment tax credits), by funding the necessary infrastructure, or by lowering the cost of capital through public guarantees and access to preferential loans. Pricing emissions does not make clean technologies cheaper in absolute terms – but it makes them more favourable in comparison to (fossil) alternatives. Finally, the creation of new markets, through for instance the creation of new standards can on top of or as alternative to carbon pricing create an incentive into climate friendly investments.

Most climate-friendly investments, and the business models built on them, remain more risky than incumbent technologies and assets. Part of the risk stems from uncertainty because climate-friendly technologies often require enabling conditions to be fulfilled, such as physical infrastructure, sufficient demand, and a supportive regulatory framework. These uncertainties affect the economic viability of the investments, and the potential for new business models to emerge. There are different ways to de-risk climate-friendly investments – a clear, firm and credible commitment to put the necessary infrastructure in place, or by assuring demand for clean products through public procurement and emerging lead markets, or via carbon contracts for difference.

While the climate investment gap is still very large, there is uncertainty about future EU funding for climate neutrality. Among other things, there is no follow-up programme to NextGenEU, carbon pricing revenues will slowly be offset by a declining tax base and lower energy tax revenue, and a prioritisation of defence and competitiveness means climate investments compete with other public investments. Furthermore, the EU fiscal and budgetary framework gives Member States little margin to increase their public climate investment if they do not find additional resources elsewhere. Finally, the EU monetary and regulatory framework may present additional barriers to investment as high interest rates (driven by ECB's interest rates) may stifle climate friendly investment and as the prudential regulation, especially for banks, still not enable a fully stable investment environment for all economic actors. There is therefore a need of coordinated policies in order to ensure predictable and sufficient climate funding in the future.

2.4 Innovation

Progress is lacking across the innovation chain, including limited and incoherent funding and lack of directionality. But the main bottleneck is demonstration and

deployment of innovations. With only two and a half decades left to get to net zero emissions, the focus must be on deploying near- or market-ready technologies at scale. Policy support, in the form of regulations, funding, and strategic direction, is crucial for this.

Policy support for innovation is needed across the innovation cycle. Carbon pricing indirectly supports innovation but is not sufficient in and of itself. Innovations face the “valley of death”, the gap between successful proof of concept of a technology and its demonstration and deployment. Here, the capital intensity and high risks deter many investors, which requires dedicated policy support and incentives. Likewise, there is a large deployment gap, as innovations face many challenges even when they reach maturity. Carbon pricing helps making them relatively cost-competitive, but other non-price barriers remain that inhibit large-scale deployment. Infrastructure, the availability of key inputs, regulatory barriers, or market design issues can slow down or inhibit the roll-out of otherwise competitive technologies and business models. This calls for a more systematic assessment of existing barriers to the uptake of new technologies, and efforts to remove or overcome them.

All these issues pose distinct challenges to EU innovation policy. Because technologies need to be supported over a long process, the programmes that do so must be effectively coordinated both horizontally (at the same level of governance throughout the innovation lifecycle) and vertically (between levels of governance, especially EU/national coordination).

An additional and underexplored aspect of innovation policy is the linkage to phaseout policies: the scale-up of new solutions must proceed in synch with the phase-out of fossil-based technologies, not least since the dominance of fossil incumbents and their asset base often represent a main obstacle to the uptake of low-carbon alternatives. This involves a reconfiguration of current, fossil-based value chains, and may also entail the repurposing of infrastructure.

With the Green Deal and the EU’s innovation support, the EU has much to build on. However, in light of international competition and given the large deployment gap and need to make clean solutions competitive, the EU must step up its efforts on innovation and resolve these barriers across the innovation chain.

3. Towards a Transformative EU Climate Policy

The challenge of transforming the EU economy to climate neutrality cannot be delivered with “policy as usual”. Resolving the transformation challenges outlined above requires a transformative climate policy that meets several needs: (i) it must ensure an integrated and participatory governance, (ii) it needs to provide directionality and certainty, (iii) it should encourage regional differentiation and experimentation, (iv) it must ensure sufficient and predictable funding, and (v) use market dynamics by aligning existing markets or creating new ones. This section presents these five needs, followed by 10 recommendations on how to address the transformation gaps and respond to the governance needs.

3.1 Needs for Transformative Governance

I. Integrated and Participatory Governance

Transformation requires ambitious action across all sectors – amid uncertainty, as targets and measures are reviewed in the light of shifting political priorities or techno-economic developments. With the EU Green Deal, the Climate Law and the Fit-for-55 package, the EU has taken steps towards transformative climate governance, but the policies fall short of delivering on the targets set. To coordinate parallel and interdependent developments in different policy areas, and at the same time address the cross-cutting challenges of innovation, infrastructure and investment, a new governance approach is needed. This starts with assessing the gaps, keeps track of progress achieved, monitors target achievement on a regular basis and adjusts policies in a timely and targeted fashion if necessary. It also includes mechanisms to ensure policies learn from mistakes and correct them, so that overall governance becomes more resilient. It also involves a long-term vision of the future that is concrete where it can be, and open where it needs to be.

Turning this vision into reality requires societal support, buy-in and ownership from stakeholders. Europeans are generally supportive of ambitious climate policy – but every concrete step is likely to encounter resistance. Resistance may grow as the next stages of decarbonization will touch upon the daily life of citizens, requiring behaviour changes, private investments or even personal sacrifices, but also changes to jobs, careers and livelihoods. To remain acceptable, climate policy must provide assistance where needed – but refrain from presenting the transformation as a burden brought upon Europe’s citizens. Rather, participatory governance needs to invite the active participation, engagement, commitment and creativity of all Europeans, and thus create ownership. Moreover, clear communication about the choices being made and their implications will allow regions and individuals to provide input and feel involved but also anticipate the consequences and consider means to adapt.

II. Provide directionality and certainty

A transformation of the scale required necessarily involves considerable uncertainty (technical, economic and socio-political), and not all solutions are and can be known. But some elements of the transformation are increasingly clear: the central role for renewable energies, electrification of many end-uses, the need to reduce energy and resources more efficiently, and the need to phase out fossil fuels and associated value chains. In many ways, the road ahead is therefore increasingly clear. Yet travelling this road requires that different elements align – infrastructure, investment, regulatory frameworks, public support etc. Many of these elements are long-lived, with sunk costs and path dependencies. Systemic change from the status quo thus inevitably requires some degree of planning (e.g. in the case of infrastructure). It also means there are limits to how open-ended processes can be: while competition between different solutions may be desirable in many instances, it is unrealistic (and inefficient) to roll out duplicate infrastructures at scale. In such cases, decisions must be taken and clearly communicated about what actions, policies, investments will happen and are needed. This also provides predictability and certainty to implementing stakeholders, be they businesses or individuals, as investors or as consumers.

III. Encourage regional differentiation and experimentation

Addressing the multiple challenges of transformation to climate neutrality requires room for experimentation and learning from mistakes. The diversity of Europe's regions, their different economic and cultural starting points and endowment with resources, skills and infrastructure offers an opportunity for such experimentation. Regional diversification allows regions to capitalize on their strengths, particularly in the areas of innovation. It allows tapping into existing knowledge bases and innovation ecosystems and can be used to reflect local political preferences – or aversions towards particular solutions. But regional diversification also comes into the process of how to fund and coordinate infrastructure roll-out, providing room for experimentation. Finally, the managed phase-out of fossil technologies and value chains will also have a strong regional dimension, which needs to be matched with the search for regional approaches to climate neutrality. Fossil value chains are often regionally clustered – in mining regions or for traditional industries such as car manufacturing or petrochemical industries. Regionally differentiated approaches are therefore also needed for strategies to move beyond fossil fuels.

IV. Ensure sufficient and certain funding

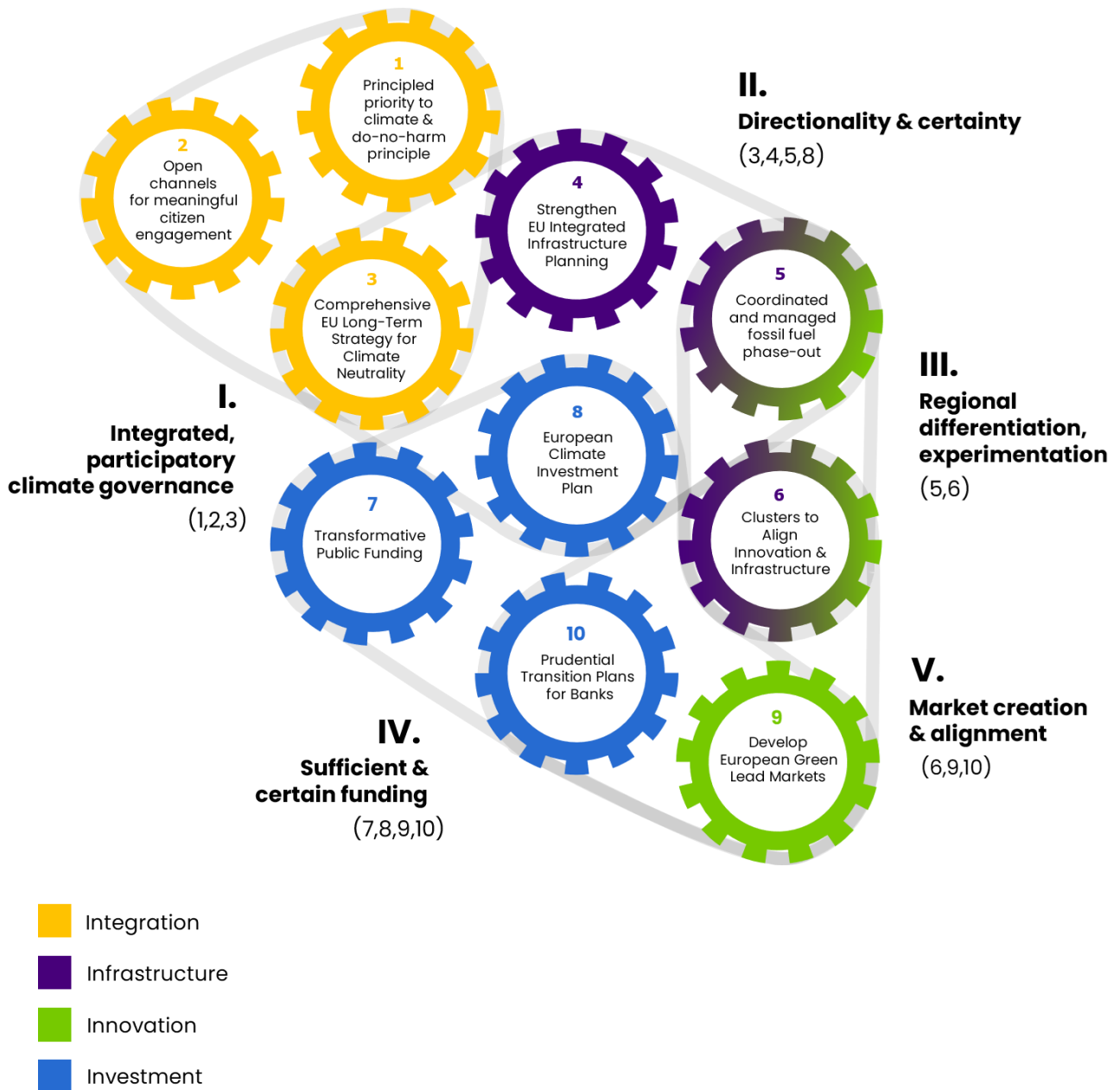
The transition to a climate-neutral economy will require substantial investments. An emission intensive capital stock must be replaced with climate-friendly assets. This will most likely require a net increase in investments and result in an overall rise in the investment-to-GDP ratio, i.e., a shift from consumption to investment. Failure to invest would risk the Green Deal not delivering on its objectives. Furthermore, climate investments, both public and private, also present co-benefits for the modernization of infrastructure, buildings and the EU economy. To ensure the availability of sufficient and predictable funding, a coordinated approach is needed, combining different policy instruments. Public institutions, both at EU-level and Member States level, can invest themselves through public procurement or investment in public companies and publicly owned or operated infrastructure. In addition, public investment crowd-in private finance, by incentivising specific private sector spending choices. Fiscal policy and financial regulation can also play an indirect role in redirecting financial flows through taxation, carbon pricing or prudential regulation for banks. These must be aligned with climate neutrality to correct market prices and provide a stable investment framework for all economic actors.

V. Align markets and create new ones

If they are guided by the right incentives, markets can be very powerful for scaling up solutions, turning them into business models and mobilising private funding. To stimulate market dynamics and ensure they are aligned with transformation needs, the EU should further strengthen the market-based elements in its policy portfolio. Carbon pricing through the EU Emissions Trading System has a key role to play in this respect but is not sufficient in and of itself. In addition, other policies are needed to a) make sure other key markets (electricity market, financial markets) are compatible with the incentives originating from the ETS and other climate policy instruments, b) ensure there is sufficient demand for climate-neutral solutions and a business case for investing in them, including by fostering the emergence of lead markets, and c) overcome bottlenecks and barriers on the supply side, e.g. by de-risking and facilitating access to capital. This may also involve the creation of new markets, e.g. to reward flexibility in electricity use, for carbon dioxide removals, or as green lead markets for products produced in a climate-friendly way.

3.2 Ten Recommendations to Make EU Climate Policy Fit for Transformative Change

The following section presents 10 recommendations on how the EU should address the transformation gaps in the field of integration, infrastructure, investment and innovation. These recommendations are clustered around the governance needs identified above.



1. Give climate principled priority and avoid policies that significantly harm climate objectives

In brief:

Climate policy integration (CPI) is crucial to prevent climate change from being treated as an isolated issue, but instead to consider it in and coordinate it across all sectors and policy areas. To ensure a whole-of-government approach towards the climate-neutrality transition we recommend to:

- ➔ Include new provision in European Climate Law to prioritize CPI for EU policymaking and implementation. Strengthen institutional coordination and ensure climate policy expertise in all relevant bodies and processes. Make CPI a requirement in regulatory fitness-checks.
- ➔ Further develop the principles of Do No Significant Harm and synergy so as to extend their application beyond funding and investment instruments minimising inconsistency and maximising coherence between climate and other policy objectives.
- ➔ Amend Governance Regulation to include CPI, DNSH, and synergy principles in EU and Member-State-level long term strategies and related planning and monitoring processes.

Climate policy integration (CPI) refers to the systematic incorporation of climate change considerations and objectives into non-climate policy areas. Ensuring CPI is a key for advancing the climate transition given its cross-sectoral and whole-of-society character. Effective CPI requires that other policies that significantly undermine climate policy objectives are prohibited (Do No Significant Harm principle), and that other policies should support climate policy as much as possible (synergy principle). Neither principle should lead to negative effects on other environmental issues. CPI also requires collaboration and coordination between different government departments, agencies, and stakeholders to address climate change challenges comprehensively both during policymaking and policy implementation. CPI also necessitates strong public support for the climate transition and giving principled priority for climate policy. Principled priority implies that deviations are possible but require strong, overriding reasons.

In 2021, for the first time, the European Climate Law introduced a legal requirement for CPI across all EU policymaking. It obliges the European Commission to review the compatibility of its legislative and budgetary proposals with the objectives of the European Climate Law. While this was an important first step, the implementation of the related provision in the European Climate Law needs to be strengthened. To this effect, a new provision should be included in the European Climate Law defining CPI as an overarching priority for EU policymaking and implementation. In addition to screening new policy and budget proposals from the perspective of CPI, we also recommend screening existing EU policies for their compatibility with the climate-neutrality objective and ensuring that CPI is included in institutional arrangements.

Closely related are also the 'green oath' of do no harm in the European Green Deal and the do no significant harm (DNSH) principle. The DNSH principle is detailed in the EU Taxonomy Regulation as a criterion for defining sustainable finance. It has subsequently been introduced as a condition for EU funding, for example, from the Resilience and Recovery Facility, Just Transition Fund and

Social Climate Fund, as well as the Modernisation and Innovation Funds linked to the EU Emissions Trading Scheme. To advance CPI, we propose advancing the DNSH and synergy principles, including by broadening their application beyond funding and investment instruments. As both principles are closely linked to Article 11 of the Treaty of the Functioning of the European Union (TFEU), their further development can be considered an operationalisation of existing principles of EU law.

The potential of EU climate governance mechanisms should be harnessed to support CPI. For example, our recommendations concerning a regularly prepared and updated EU Long-term Strategy can also serve to advance CPI. We recommend amending the Governance Regulation to include the consideration of CPI and the DNSH and synergy principles as elements of both, the EU-level and Member-State-level long-term strategies and related planning and monitoring processes. Strong monitoring will need to ensure accountability for giving principled priority to CPI.

Advancing CPI is not possible without strong public support for climate policy. To ensure the necessary support for stronger CPI, we also recommend further developing EU procedural climate governance and opening channels for meaningful citizen engagement.

2: Open channels for meaningful citizen engagement

In brief:

Broad societal ownership and support are crucial for enabling the climate transition across the EU (and beyond). The upcoming review and revision of the EU's Governance Regulation (and European Climate Law) provide a unique opportunity for a quantum leap towards firmly anchoring such ownership and support and bringing related EU policy in line with the Aarhus Convention. The EU should fully exploit this opportunity by:

- Establishing high standards and a comprehensive approach to public participation in EU climate governance in a dedicated section on public participation in the Governance Regulation; and
- Enhancing accountability to citizens by ensuring general and consistent access to justice in climate-related matters across the EU, anchored in the Governance Regulation.

The climate transformation requires broad societal ownership and support. Entailing far-reaching change of key societal systems such as housing and mobility, the production and consumption of energy, and industrial production, the climate transition will increasingly be felt in the daily lives of citizens, at times involving additional costs or requiring profound behavioural adaptations and changes to long-engrained ways of life. As such, its diverse components have a considerable potential for political and societal contentiousness and discord. As the transition progresses, the potential for discord becomes increasingly visible and has already contributed to some "climate backlash".

The need for societal anchoring of the climate transition calls for effective **procedural climate governance**. While substantive climate policies directly address GHG emissions, procedural

climate governance refers to the instruments, institutions and processes for making and implementing substantive EU climate policies. It includes aspects such as planning, target-setting, scientific and other inputs into policymaking, reporting and review, and arrangements for effectuating implementation. Two aspects possess particular importance for the climate transition's anchoring in European societies: (1) public participation and (2) access to justice in climate matters (Moore et al., 2023; Oberthür et al., 2023).

EU climate governance has addressed these aspects to some extent. The EU's Governance Regulation (Regulation 2018/1999) has required Member States to (a) conduct public consultations on their National Energy and Climate Plans (NECPs) and Long-Term Strategies (LTSs) and (b) to establish national Multilevel Climate and Energy Dialogues. Furthermore, the EU's "Aarhus Regulation" allows eligible NGOs and individuals to challenge climate-related decisions by EU institutions, with a right of appeal to the EU courts.

These mechanisms have remained wanting in several respects. The Governance Regulation has only addressed public participation to a very limited extent, falling considerably short of the international standards of the 1998 Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters. Research by 4i-TRACTION has furthermore revealed substantial shortcomings in arrangements for public participation on NECPs and LTSs as well as Multilevel Climate and Energy Dialogues (von Homeyer et al., forthcoming; Faber et al., 2024). Also, access to justice in climate matters remains deficient and continues to fail the mark of the Aarhus Convention in many EU Member States (Mähönen, forthcoming). **Improved legal provisions could help significantly to enhance both public participation and access to justice.**

Therefore, we suggest that the EU should double down on advancing public participation and ensuring access to justice in climate matters. Upgrading these two core aspects of procedural climate governance will not only help anchor the climate transition in European societies but may also contribute to reinvigorating European democracies. Specifically, we propose (see also Oberthür et al., 2024):

1. To **establish an ambitious and more encompassing approach to public participation** in a dedicated section of the Governance Regulation, including the following key elements:
 - Acknowledge **Aarhus Convention standards** on public participation and the need for democratic anchoring of climate transition,
 - Anchor **national participation frameworks in EU Member States**, including an upgrade of Multilevel Climate and Energy Dialogues and public participation for developing and implementing NECPs and LTSs; facilitation of a wide range of participatory and deliberative mechanisms; and commitment to considering participatory inputs in political decision-making.
 - **Dedicated support for effective participation**, including best-practice guidance by the Commission; integration of related capacity-building support into relevant EU funding arrangements; and establishment of an EU-level consultative forum to foster learning and the sharing of best practice.
 - Development of **participatory mechanisms at the EU level**, including as key elements: (a) enhanced/focused use of (innovative) public participation mechanisms

to inform policymaking; and (b) establishment of a permanent structure for consultation with societal stakeholders on EU climate policy.

2. To pursue a **more general and consistent access to justice in climate-related matters in the EU in line with the Aarhus Convention** through the following key actions to be implemented through the upcoming revision of the Governance Regulation:
 - A commitment by the Commission and the other EU institutions to the **systematic introduction of appropriate access to justice provisions** in all climate-related EU legislation.
 - **Confirmation of the applicability of the Aarhus Convention's provisions on access to justice to all climate-related EU legislation** and commitment of Member States to taking implementing action accordingly.
 - Clarification that recommendations by the European Commission to Member States under the Governance Regulation and the European Climate Law are **judiciable under the EU's Aarhus Regulation** (which should also support effective implementation of public participation requirements addressed above).

4i-TRACTION research suggests that in particular realising high standards of public participation requires their proper embedding in varying socio-cultural and legal-political contexts in EU Member States. This should be taken into account in the design of the related rules. Harnessing the unique opportunity of the upcoming revision of the Governance Regulation in this way could mean a quantum leap for anchoring the climate transition in European societies.

3: A Comprehensive EU Long-Term Strategy for Climate Neutrality

In brief:

Planning plays a key role in the transition towards climate neutrality. Through planning, policymakers are able to identify and evaluate policy options and their impacts, and solicit independent scientific advice and public input. There is currently no requirement to update the EU Long-term Climate Strategy, or to prepare a new strategy.

- ➔ An EU-level long-term strategy for climate neutrality (LTS) should be prepared at 10-year intervals and updated at least every five years. The requirement should be included in the Governance Regulation.
- ➔ The preparation of the EU-level LTS should be informed by the latest science, including advice by the European Scientific Advisory Board on Climate Change (ESABCC). The preparatory process of the EU-level LTS should be transparent and inclusive.
- ➔ The EU LTS should assess mitigation options for all sectors and seek to ensure climate policy integration. It should assess innovation, investment and infrastructure needs, and integrate social aspects of a just transition and the objective of 'leaving no one behind.'

- Include a provision in the European Climate Law/Governance Regulation mandating key economic sectors to create net-zero transition roadmaps and require the Commission to provide guidance and supervision.

Planning helps to ensure the achievement of climate targets and allows policymakers to compare scenarios on how greenhouse gas emissions and their removals could develop. Furthermore, the planning process includes the development of different policy scenarios and their costs and benefits, and based on this, the identification and evaluation of different policy options and their combinations.

The transformation to climate neutrality necessarily involves a great deal of uncertainty, be it techno-economic, political or social. The function of the LTS is to reduce the overall uncertainty by providing guidance and specifying a way forward where possible, and otherwise by identifying knowledge gaps and charting possible alternatives. Part of this function is that the LTS should inform the needs for innovation and investment in clean-technologies, and the roll-out of climate-neutral infrastructure.

In its current form, the Governance Regulation requires the Member States to prepare:

- Long-term Climate Strategies (with a 30-year perspective) every ten years and update them every five years if necessary;
- National Energy and Climate Plans (NECPs) with a ten-year perspective every ten years and update them every five years. These plans currently focus on identifying how the Member States will achieve their 2030 climate and energy targets.

The Governance Regulation also includes a requirement for the Commission to prepare an EU-level LTS by April 2019, which the Commission did in 2018. However, the Governance Regulation does not regulate in detail the contents or the preparatory process of the EU-level LTS. Importantly, there is currently no requirement for the Commission to update the EU LTS or to prepare a new one. This constitutes a clear gap in EU procedural climate governance. We suggest closing the current governance gaps by **reforming the Governance Regulation** as follows:

- Introducing a **new obligation for the Commission to regularly prepare an EU-level LTS** every ten years and update it regularly, at least at five-year intervals. The LTS should have a perspective of at least 30 years and provide an overall vision on ways for the EU to reach climate neutrality and negative emissions thereafter.
- The preparation of the **EU-level LTS should be informed by the latest science**, including advice by the ESABCC. Its preparatory process should be transparent and inclusive, with the relevant information to be made available to the public early and in an easily accessible format to facilitate broad input, including by underrepresented groups and stakeholders beyond the EU.
- The **EU LTS should consider mitigation options, as well as related innovation, investment and infrastructure needs**. It should also consider climate policy integration and identify policies that could significantly harm or unlock the climate transition. It should integrate social aspects of a just transition and the objective of 'leaving no one behind.'
- The **timing** of the EU LTS should be such as to inform and **support the preparation and updating of the Member States' LTSs**, which is an existing requirement under the

Governance Regulation, as well as being informed by relevant international assessments such as the quintennial Global Stocktake under the Paris Agreement.

- A next EU-level LTS could be elaborated **prior to the codification of a related requirement** in the Governance Regulation.

The EU-level LTS should be complemented by **net-zero transition roadmaps** for all economic sectors. In its current form, the European Climate Law requires the Commission to engage with sectors that choose to prepare 'indicative voluntary roadmaps' towards achieving climate neutrality. The Commission's role is to monitor the development of such roadmaps, as well as to facilitate a dialogue at Union level, and the sharing of best practice among relevant stakeholders.

To complement the EU-level LTS, we recommend **strengthening provisions concerning sectoral roadmaps in the European Climate Law/Governance Regulation** so as to:

- Translate the current non-binding provision into a binding requirement for key economic sectors to prepare transition roadmaps; and
- Request the Commission to provide guidance and supervise the process.

4: Strengthen EU Integrated Infrastructure Planning

In brief:

Transforming the EU's infrastructure to match the needs of a climate-neutral energy and transport system requires very significant efforts and investments. Achieving these changes in time is crucial to meet future climate goals, since lack of infrastructure may cause delays in the decarbonisation of industry, transport and the built environment, increase energy costs and endanger security of supply. We therefore recommend the following:

- ➔ Building on existing EU-coordination programmes and institutions, the EU should take a stronger role in ensuring the necessary transnational infrastructure is planned and implemented.
- ➔ Develop an EU Integrated Infrastructure Plan that aligns with the EU's climate goals and long-term strategy.
- ➔ Strengthen EU governance by designating infrastructure as one of the key dimensions of the EU climate and energy Governance Regulation. Strengthen and expand infrastructure-related planning requirements in NECPs and LTSs.
- ➔ Initially, EU infrastructure policy should focus on expanding electricity infrastructure. Interoperability should support the electrification of end uses and their expansion.

A climate-neutral energy system requires a very different infrastructure than we have today. Indeed, some of the changes that are needed are drastic and include local power grid reinforcements to accommodate charging of electric vehicles, heat pumps and local renewable energy production, developing district heating networks, expanding the EU-wide interconnection

of the power grid the creation of a hydrogen grid that extends to different regions and end users.¹ Achieving these changes in time is crucial to meet future climate goals (see, for example, 4i-TRACTION Deliverables D1.5 and D1.6). Without the right infrastructure in place, the energy system will not be able to accommodate the continued growth of renewable energy production, increasing overall cost and endangering security of supply (see D4.2, Zachmann et al., 2024). Lack of energy infrastructure will also be a barrier for the decarbonisation of industry, transport and the built environment, since emitters in these sectors will not be able to replace fossil fuel use by renewable energy – be it through direct electrification, or indirectly by using green hydrogen and hydrogen-based synthetic fuels. Similar arguments can be made for the transport infrastructure: climate-neutral mobility is different from current mobility, and requires, for example, more bicycle lanes and rail capacities than we have now.

On this route towards a climate-neutral energy and transport infrastructure, a number of challenges need to be overcome. Most notably, these are (as elaborated on in 4i-TRACTION deliverables D4.3, D4.4, D2.6 and D3.5):

- **Funding:** very significant investments are required to extend the existing networks. To illustrate this: The RePowerEU Plan estimates investment needs for key hydrogen infrastructure to range from € 28-38 bn for EU-internal pipelines and from € 6-11 bn for storage (European Commission, 2022a).
- **Coordination:** infrastructure projects face a "chicken-and-egg" dilemma. Large investments in infrastructure require guaranteed supply and demand, while end users delay transitioning to renewables without assured infrastructure. In addition, the future energy system has a strong need **for** cross-border infrastructure, including more interconnection capacity for electricity and an intra-EU backbone for hydrogen. Finally, infrastructure projects may have significant societal impacts, regarding spatial planning, energy cost and security of supply, etc. Coordination of these projects necessitates decisive infrastructural choices, despite uncertainties about cost-effectiveness and future needs.
- **Long lead times:** Infrastructure projects easily take 5-10 years from inception to actual realisation. As infrastructure often is a **condition** for further decarbonisation, it is key that these lead times are kept as short as possible in the coming years and decades. This includes planning, permitting and spatial planning, but should not come at the expense of participation and public support.

Several EU-institutions and programmes are already meant to coordinate EU-wide infrastructure planning and projects, such as ENTSO-E/G, Projects of Common Interest (PCIs), TEN-E and TEN-T, and funding programmes such as the CEF. Attention for this topic has been limited in the past (see 4i-TRACTION deliverables D2.1, D2.2, D2.7, D4.2), but is growing in recent years as the critical role of energy infrastructure in meeting the climate goals and maintaining energy affordability and security of supply has become clearer to both stakeholders and governments. To this end, we have identified several areas where EU policy needs to be strengthened.

We consider integrated infrastructure planning as a key tool to overcome the coordination challenge, and in its wake, the challenges of funding and lead times. An integrated assessment of the infrastructure needed in the future can be key to ensure cost-effectiveness of the future

¹ The 4i-TRACTION project applies a narrow definition of infrastructure, understood as a grid connecting (usually many) locations, allowing something to be transported from A to B. Related assets such as power plants and electrolyzers are not included in our definition.

energy system, as well as security of supply throughout the EU (Vendrik et al., 2023). It can provide more certainty to market actors and governments and thus speed up decision making and investment in infrastructure expansion. The objective of these integrated infrastructure plans would be to ensure a transition of energy and transport infrastructure that supports mitigation throughout the EU and continues to meet market demands during the transition to climate-neutrality.

To this end, we suggest **strengthening the EU's role in planning, coordination and alignment at EU level**. An EU Integrated Infrastructure Plan should be developed that aligns with the climate goals and the EU's long-term strategy (see recommendation 3 above). The EU focus can then be on ensuring **transnational infrastructure** is planned from a systemic perspective, taking into account EU-wide benefits of improved interconnectedness. The Plan can take a desired end state of a climate-neutral European energy and transport system as starting point, deciding on shorter term actions through back-casting. Since infrastructure is of so much importance to the decarbonisation efforts of other sectors and to future energy cost, these actions should rather aim for 'too much' than 'too little'.

Furthermore, the regional approach to infrastructure planning and development that has evolved in recent years (e.g. for North Sea grids) can be strengthened further, to benefit from national and regional opportunities and characteristics (see Recommendation 6 below). We also recommend making Integrated Infrastructure Planning mandatory for Member States. Since infrastructure projects can affect local and regional communities, their planning should also include process transparency and local consultations, to improve the quality of the plans and to ensure the public support needed for their roll-out.

We further recommend **strengthening the Governance Regulation by elevating infrastructure as one of the key dimensions** of EU climate and energy governance. Infrastructure is currently recognised as one of the relevant aspects under some of the other pillars, notably energy efficiency and internal energy market, and Member States are required to report on various infrastructure aspects in the NECPs. This includes their implementation of the current electricity interconnectivity target, the main infrastructure projects and any long-term targets for carbon transport, use and storage infrastructure (Art. 23 and 25 of the Governance Regulation). Yet so far, reporting on infrastructure progress has been limited and inconsistent between Member States, and focused on security of supply rather than the transformation toward a climate-neutral energy system. Furthermore, the current Regulation gives only limited means to the EU to assess whether actual implementation is sufficient (the electricity interconnection target being the only exception). Including concrete obligations on planning, monitoring and reporting can enable the EU to assess progress against a well-founded integrated infrastructure plan and improve the effectiveness and transparency of infrastructure governance.

Increasing the priority of infrastructure in EU governance can support the EU's ability to manage the transition better, monitor the speed of the developments and intervene if progress is too slow. An obligation for Member States to develop an Integrated Infrastructure Plan can then be included in the Regulation, requiring alignment with the EU long-term strategy and the EU Integrated Infrastructure Plan. Planning and monitoring can be included in the NECP process. EU governance can also ensure that the Plans are evaluated and updated regularly, to take into account new insights on the future need for transnational infrastructure and the results of the monitoring and evaluation of actual progress. These actions can all serve to give greater certainty to end users and other stakeholders, including industry and local and regional governments.

Initially, EU infrastructure policy should **focus on electricity infrastructure** – transmission and distribution, and further interconnection of European grids. Interoperability should support the electrification of end uses and their expansion (EV charging, rail, demand-side flexibility / PtX). Heat grids are also important, but best addressed at the local/regional level; hydrogen and synfuel at the level of regional clusters. Aligning transport infrastructure policies with the future needs for climate-neutral transport can also benefit from the recommendations provided above and can be implemented in parallel. However, since decarbonisation of transport is less dependent on transport infrastructure developments than on energy infrastructure (including for EV charging), starting with a strong focus on electricity grids seems justified for that sector as well.

These developments can all **build on existing institutions and regulations**. Apart from the suggested modifications to the Governance Regulations, increased coordination and planning may be achieved through strengthening the role of existing institutions such as ENTSO-E/G, the Projects of Common Interest, TEN-E and TEN-T and funding programmes such as CEF-Energy and CEF-Transport. The Integrated Infrastructure Plans can build on the existing Ten-Year Network Development Plans (ENTSO-E), by further aligning these with the long-term strategy towards a climate neutral Europe (see recommendation 3).

5: Coordinated and managed fossil fuel phase-out

In brief:

The EU economy and its infrastructure has developed around fossil-based value chains. An uncoordinated demise of these as they are rendered obsolete by the rising carbon price, stricter regulations, changing consumer tastes or superior climate-neutral alternatives could have disruptive effects leading to social hardship, public resistance and welfare losses through stranded assets. We recommend establishing the managed phase-out of fossil technologies and value chains as a distinct element of climate policy, including through the following:

- ➔ Anchor timelines and end dates for fossil-based technologies in relevant EU legislation, for example the Ecodesign Directive, the Directive on the Energy Performance of Buildings (e.g. for gas boilers in buildings) and the (Industrial Emissions Directive (industrial heat, blast furnace steelmaking).
- ➔ Plan the decommissioning or repurposing of the infrastructure that supports fossil-based technologies, such as gas grids, also considering social aspects.
- ➔ Agree to end all public funding for fossil assets and infrastructure and revise EU Taxonomy Regulation to ensure private investments in fossil-based value chains are not labelled as Paris-aligned and are identified as incompatible with climate goals.

The EU economy and its infrastructure has developed around fossil-based value chains – from the energy sector to mobility to large parts of industry. Reconfiguring these value chains requires not only policies that drive the emergence of new, fossil-free technologies and value chains – but also policies that manage the phase-out of the incumbent, fossil-based technologies and value chains.

The alternative to a managed phase-out of fossil value chains would be an uncoordinated, disruptive demise of fossil technologies as they are rendered obsolete by the rising carbon price, stricter regulations, changing consumer tastes or superior climate-neutral alternatives. A managed phase-out is preferable for several reasons: First, it stimulates innovation. Second, it helps to overcome the economic and political path-dependencies that would otherwise create a prolonged bias towards the status quo, favouring incumbents. Fossil assets are cheap to operate as their capital cost has usually been recovered, and they benefit from tailored physical and regulatory infrastructure, as well as political representation. All of these create an advantage that new technologies need to overcome. Third, a managed phase-out means intervention opportunities to reduce friction, provide affected groups with alternatives and to avoid social hardship while increasing acceptance. This benefits the affected stakeholders, in particular workers in fossil industries, but also (would-be) investors. But above all, a managed phase-out is needed to create predictability for the affected stakeholders, be they consumers of fossil fuels (as homeowners or car drivers), or employees or investors in fossil-based industries. The alternative – disruptive change – would create social hardships and welfare losses in the form of stranded assets and could therefore reinforce existing opposition to climate policy.

To prevent this, active and forward-looking management of fossil phase-out should be established as a distinct element of European climate policy, complementing existing instruments such as the EU ETS. For selected technologies, EU climate policy already contains phase-out dates, either implicit or explicit. The phase-out date for the internal combustion engine in new cars and light-duty vehicles is fairly explicit; the goal to phase out coal in power generation is only formalised in some Member States – at EU level, it is implied and necessitated by the shrinking EU ETS cap.

We suggest that the following elements be adopted to support the phase-out process:

- **Anchor phase-out timelines in relevant pieces of EU legislation:** This includes identification of clear end-dates for the sale / installation of fossil-based technologies, to provide clarity to consumers and investors. Relevant pieces of EU legislation are the Ecodesign Directive and the Directive on the Energy Performance of Buildings for fossil heating systems; and the Industrial Emissions Directive e.g. for industrial heat generation.
- **Phase out fossil infrastructure:** just as the construction of infrastructure creates a chicken-and-egg problem for climate-neutral solutions, so does the phase-out of fossil technologies and supporting value chains. As consumers shift to non-fossil alternatives, such as electric mobility or heat pumps, the existing fossil fuel infrastructure will be used less intensively and by fewer consumers. The operation cost is therefore more concentrated, driving up costs for the remaining users. Ultimately, the bulk of the cost will accrue to the “last user on the line” who is unable or unwilling to move away from fossil fuels. To avoid social hardship, for gas grids, Member States should oblige distribution system operators to plan the deconstruction or repurposing of gas grids as part of the integrated infrastructure planning, and to announce with sufficient lead time (e.g. ten years) which regions will be taken off the grid at which point in time. For transport fuels, planning is needed for the reduction and eventual decommissioning of refinery infrastructure, including transboundary coordination where refineries serve markets in different countries. This can also extend to a dedicated fund to support the decommissioning and accelerated write-off for stranded assets, or their (temporary) transfer into public ownership.
- **End public investment into fossil technologies:** A political commitment among EU Member States to abstain from any public investment into fossil-based value chains and

infrastructure: The EU and Member States should commit to stop all public investments into assets that are not aligned with climate neutrality. In particular, this applies to investments that involve the expansion of fossil infrastructure, e.g. LNG terminals. Modernisation of existing fossil infrastructure only remains possible within narrow parameters, e.g. to make infrastructure ready for repurposing, or to reduce leakage from gas grids. The political commitment should be substantiated by an update of the EU Environmental Impact Assessment Directive, as well as sectoral regulations such as the Industrial Emissions Directive, to ensure that no (re-)investments can be permitted that involve an addition, extension or prolongation of fossil-based assets. To discourage any further private investments into fossil-based value chains, the Commission should revise the EU Taxonomy Regulation to ensure such private investment cannot be labelled as Paris-aligned and is identified as incompatible with sustainability goals.

6: Clusters to Align Innovation and Infrastructure for Climate-Neutrality Solutions

In brief:

Local clusters can spearhead the transformation to climate neutrality: particularly to align innovation support, infrastructure deployment and finance in line with regional transformation strategies, to deploy and scale up new climate solutions and the supporting business and innovation ecosystems. This includes the following elements:

- ➔ Use local clusters specifically to test and facilitate the co-evolution of technology development and the reconfiguration of value chains with the deployment of supporting infrastructure, an enabling regulatory framework, and new business models.
- ➔ Include a clustering element in EU Missions calls, allowing regional clusters to apply for EU level funding that supports their regional transformation.
- ➔ Monitor the dynamics of different clusters to facilitate learning from successes and failures, avoid both over-emphasis of particular technologies but also neglect of other options, and to ensure cluster dynamics are aligned with the EU long-term strategy.
- ➔ Develop a governance structure to oversee the emergence of different clusters – while cluster definition is primarily a bottom-up process, this can be complemented with oversight elements to ensure coordination with infrastructure policies and EU funding instruments.

European regions differ in their industrial structure and endowment with skills and knowledge, their geography, natural resources and physical infrastructure, their technological preferences, but also their capacities to adapt to changing circumstances. In addition, due to agglomeration effects, many industries have regional value chains and/or are concentrated in particular locations. As a result, the transformation to climate neutrality affects different regions in different ways. Regional diversification of transformation strategies allows to capitalize on these strengths, and to allow for experimentation with different support policies and regulatory environments, such as

regulatory sandboxing. Diversification can also offer a way forward if certain technological trajectories are contested or divisive in particular locations. Finally, locally adapted transformations may also offer a new perspective for regions whose economy was previously shaped by fossil-based value chains.

The development of local clusters for climate neutrality solutions builds on these existing strengths. The development of offshore wind in Belgium (Wyns, 2023), and of EV charging in the Netherlands (Rienks, 2023), offer successful examples of building up innovation ecosystems and using European regions as a space for experimentation, including new modes of collaboration between private investors and public regulators.

In EU policy, regionally diversified approaches are well established as a tool to foster the emergence of regional clusters around particular industrial cores. The Net Zero Industry Act introduced the concept of Net-Zero Acceleration Valleys, leaving it to Member States to identify such regional hotspots for particular net-zero industries. Regional approaches are arguably most advanced for hydrogen, with initiatives such as the hydrogen backbone and hydrogen valleys fostering the emergence of clusters where supply and demand for hydrogen are combined with innovation ecosystems.

- **Clusters for climate neutrality solutions** should be used as pioneers to develop and test new approaches, and in particular to build up experiences for aligning innovation support, infrastructure deployment and financing, as well as an enabling regulatory environment. Such clusters should predominantly address solutions and technologies produced at industrial scale, such as renewable energies, electrolysers, large-scale heat pumps and other industrial heat solutions, storage (battery, chemical or thermal), climate-neutral basic materials, circular and bioeconomy solutions, including biobased or hydrogen-based feedstocks, CCUS and carbon dioxide removal, serial renovation, etc.. Drawing on experiences with EU structural and cohesion policy and existing tools to foster innovation clusters, EU policies and funding tools (such as the innovation fund, just transition fund, EIB lending) should support the emergence of clusters for climate neutrality solutions in those EU regions that have an existing technological and research knowledge base for the value chains in question, as well as the necessary physical, economic and regulatory infrastructure. This may include regions whose economy is currently shaped by fossil-based value chains. Elements of public (EU) policy to support the emergence of clusters include temporary regulatory exemptions (sandboxing) to enable the scaling of technologies and associated business models; forging partnerships between municipal / regional governments, businesses, R&D institutions and other stakeholders; and targeting innovation funding for these clusters.
- **EU Missions funding:** an example of targeted innovation funding is to provide for co-funding from the EU Missions programme for local clusters that have developed a transformation strategy. Establishing a new mission for net-zero industry clusters by 2040 would combine the need for regions to develop a regional transformation strategy with the potential for EU (and Member State) funding to implement the strategy. As funding is allocated in a competitive process, it allows for competition between different European regions for the best solutions.
- **Monitoring and oversight of the regional dynamics:** While each cluster would formulate its vision and strategy in a bottom-up way, there is also a need for coordination and alignment across clusters (or at the level of meta-clusters, such as the Antwerp-

Rotterdam-Rhein/Ruhr area). This is particularly pertinent where neighbouring clusters rely on shared infrastructure or are connected through integrated value chains, or where regional (meta-)clusters extend across national borders. Coordination may also be warranted to avoid excessive emphasis on certain technological pathways while other options remain underdeveloped. To avoid this, ongoing monitoring of the cluster dynamics is needed, to support the alignment of funding tools and (energy) infrastructure with the emerging clusters, to enable knowledge-sharing among them, but also to respond to imbalances. To this end, governance under the Net Zero Industry Act should be strengthened and mandated to provide such coordination: for instance, the European Commission (DG GROW) should appoint officials as contact points for NZI clusters, who assist the clusters in the implementation of missions and coordination of multi-level policies.

- Aligned with the innovation clusters, the **roll-out of climate-neutral infrastructure** is prioritised for these (meta-)clusters to serve as real-life laboratories for aligned development of infrastructure, innovation and investment. Following the example of the North Sea Grids and Hydrogen Backbone Initiatives, similar mechanisms are established for other European regions. Some elements of infrastructure roll-out must be coordinated (and accelerated) across broader European regions or even EU-wide – in particular interconnection and transmission of electricity. Other elements of the new infrastructure for a climate-neutral economy are more likely to be deployed (initially) as island grids in those regions where there is strong demand (green H₂ and/or climate-neutral gases, CCUS infrastructure). To coordinate infrastructure deployment, the decision-making for the ‘Important Projects of Common European Interest’ already provides a (basic) structure for regional coordination, which should be strengthened. Specific cross-boundary net-zero infrastructure plans need to be developed well before 2030, with the goal to complete the infrastructure by 2035 (or 2040 at the latest). Finally, while some parts of infrastructure require transboundary coordination and alignment, others leave more room for diverging approaches, different priorities and experimentation (such as local public transport, infrastructure for active mobility - but also the roll-out of EV charging infrastructure as long as interoperability is ensured). In these cases, efforts are needed to improve the sharing of experiences and best practices.

7: Transformative public funding

In brief:

The EU already has an extensive and complex funding landscape at its disposal to provide public funding for the transition. To ensure that a shortage of public funding does not obstruct the transition and a robust European Long-Term Climate Investment Plan (see recommendation 8) can be drawn up, the EU should:

- **Increase the quantity of public funding.** Higher interest rates, changing political priorities, and the phase-out of Next Generation EU threaten to reduce public funding for the transition. However, our research suggests that more, rather than less public funding is needed, especially in a period in which the transition could face pushback by actors that feel that they carry a disproportional share of the burden. To avoid thinking in terms of

net contributors and net beneficiaries these funds would ideally be generated by the EU's own resources, e.g., EU ETS auction revenues.

→ **Improve the distribution between centralised EU-level and decentralised funding.** Member states should consider whether EU-level systems could deploy funds more effectively for aims relating to issues that transcend national borders, e.g., Horizon Europe. Meanwhile, building on the example of the EU Hydrogen Bank, the EU should also make it easier for member states to do this.

Public funding plays a key role in the transition. It is essential to finance transition activities related to publicly owned assets, e.g., making public buildings energy efficient, or for genuine public tasks, such as basic research. For activities that are also of interest to private sector actors, public funding can crowd-in private funding, by de-risking investment opportunities and turning insufficiently profitable projects into profitable ones. It can also increase the investment capacity of private actors, especially those with limited access to finance.

The EU already has an extensive and complex landscape of tools to provide public funding. This landscape provides various financing schemes, such as loans, grants, equity, and guarantees. It enables public financing schemes for projects in all phases of technological readiness, ranging from European Research Council starting grants for technologies in the discovery phase up to Invest EU Sustainable Infrastructure for technologies in the deployment stage (Humphreys, 2023; Rienks & Moore, 2023). Adding new funds to this landscape risks cannibalizing current funds and increases the complexity of the landscape, as illustrated by the experiences with the STEP fund. **Rather than adding new funds it appears more promising to improve both the quantity and quality of existing EU funding instruments.**

Regarding the quantity of public funding, our analysis suggests that there is still ample scope to increase public funding for R&D on climate change mitigation (Rienks & Moore, 2023). Funds are also lacking for the renovation of public buildings, the modernization of the power grid, and railway infrastructure (Calipel et al., 2024) (see recommendation 4). Additional funding may also help to decrease resistance against the transition from actors that feel that they carry a disproportional share of its costs. However, despite the need for additional resources, there is a high risk that the available funding will decrease in the coming years due to budgetary pressures, rising interest rates, competing needs for public spending and changing political priorities. For example, in 2024 some funds reserved for climate related R&D was repurposed towards EU defence spending and the phase out of the Next Generation EU programme will also reduce transformation funding. Without a political response, the second half of the 2020s could see a significant decrease in the quantity of EU public funding dedicated to climate action rather than the required increase. To avoid thinking in terms of *net contributors* and *net beneficiaries* these funds would ideally be generated by the EU's own resources, e.g., EU ETS auction revenues. Having a clear EU Long-Term Strategy that clearly outlines the common interests of member states might also help to avoid such thinking. Increased funding would enable closing the € 406 billion annual investment gap and setting up a robust European Long-Term Climate Investment Plan (see recommendation 8).

Besides enlarging transformation funding, current funding can also be used more effectively. For both transboundary challenges and **investment projects that have a strong transboundary component**, such as transboundary energy-related infrastructure, public funding administered

at the EU level can be more effective and efficient than public funding administered at the national level. Arguments for why the EU might be better positioned to allocate and manage public funds than national governments, especially for technologies in an early phase of technological readiness, include: The EU's potential to reduce transaction costs related to cross-border cooperation; reducing the risk of fragmented national approaches; increased potential for competition between firms and investment locations; a reduction of political risk; and the way the EU internalizes cross-border externalities (Rienks & Moore, 2023). For example, large multinational companies can be tempted to shop around between Member States, leading to suboptimal outcomes with subsidy packages reaching up to € 10 billion for a single factory (Bloomberg, 2023). However, although its share has grown, only a small percentage of public R&D funding within the EU is allocated through the EU whereas the lion's share of funding is allocated by member states.

While Member States should investigate whether funds for specific aims can be deployed more effectively by using EU-level systems, the EU on its part can also take steps to make it easier for member states to allocate resources in a coordinated and cooperative way, building on the example of the EU Hydrogen Bank. The 'Auctions-as-a-Service' scheme of the Hydrogen Bank allows member states to fund projects within their territory that were promising according to the bank but weren't awarded funding. Using this innovative scheme Germany allotted € 350 million from its national budget to German hydrogen projects while using the allocation mechanism provided by the Hydrogen Bank (European Commission, 2023). The Important Projects of Common European Interest (IPCEI) are another interesting example. The IPCEI partly remedies the difficulties with EU State Aid rules, which aren't tailored to a transformation of the economy, in a well-coordinated fashion that increases effectiveness.

8: A European Long-Term Climate Investment Plan to Close the Climate Investment Deficit

In brief:

For the EU to reach its climate objectives, significant additional investments are needed. An EU climate investment plan can be a solution to close the climate investment deficit at EU level. This EU climate investment plan should:

- Be aligned with the EU long-term strategy (LTS) (see recommendation 3) and must describe how it intends to finance its investment needs.
- Explain how much EU funding should be mobilized and how. The long-term investment plan will should spell out how the EU intends to finance which parts of the climate investment deficit across different sectors. To this end, EU funds must be mobilised more effectively to close this deficit and, if necessary, their volume must be increased (see recommendation 7).
- Explain how much money is expected to come from public budgets at Member States level or even sub-national level, based on Member States' estimation of their investment needs as laid out in their NECPs' i.

- ➔ Point out options to align subsidies, taxation and fiscal policies with EU climate objectives, in order to provide a clear price signal for private investments.

In line with the EU climate and energy targets, Member States have adopted National and Energy Climate Plans. Delivering on these plans and achieving the objectives requires significant investments, both public and private. Investments made today shape the future: renovating a building reduces energy demand for the next decades, making the economy more resilient to fossil fuel crises. Building a new wind power plant increases the amount of renewable electricity available to decarbonise end uses in industry, transport or buildings.

For the EU, several assessments show a significant investment deficit to reach the climate and energy objectives. The Institute for Climate Economics estimated that reaching EU 2030 targets requires at least 813 billion euro per year between 2024 and 2030 in the energy, transport and buildings sectors (Calipel et al., 2024), which suggests an annual climate investment deficit of 406 billion euro. The European Commission estimates that reaching the EU's 2040 target will require 1.5 trillion euro per year between 2030 and 2040 (European Commission, 2024).

While several instruments and policies exist at EU and national level to finance climate action, the scale of funding is insufficient (see recommendation 7), and there is currently no mechanism in place to coordinate the different elements, including both public and private finance. In order to deliver the European Green Deal, and related national policies, and to close the climate investment deficit, we suggest that the EU develops a climate investment plan with a long-term view. This EU long-term climate investment plan should answer several questions, such as:

- How the plan is aligned with an EU long-term strategy (LTS) (see recommendation 3), what investment needs are implied by the LTS, and how these should be financed. The investment needs of the EU LTS should be assessed annually and at a granular level. The sectoral assessment of the investment needs could also rely on the net-zero transition roadmaps for each economic sector (see recommendation 3).
- How much EU-level funding will be mobilized and how. The long-term investment plan will have to explain how the EU intends to finance which sectors of the climate investment deficit and for how much. EU funds are especially relevant to finance cross-border investment as well as innovation support. To this end, European funds must be mobilised more effectively to close this deficit and, if necessary, increased (see recommendation 7).
- How much money is expected to come from public budget at Member States level and sub-national levels. This decision should be based on granular, national and regional (NUTS2) assessments of national investment needs, estimated for each Member States from their NECPs. This would help EU, national and regional policy makers to share the same diagnosis, and discuss policy options that articulate EU, national and regional policies. For example, on building renovation, many norms and standards are EU-level, financing of renovation tends to be shaped by national policies, while vocational training of workers is shaped by regional policies.
- How to align subsidies, taxation and fiscal policies with EU climate objectives to provide a clear price signal for private investments. By choosing where and how those taxes are levied, public authorities affect the market price paid by businesses and households. The EU long-term climate investment plan should ensure that these different policies are coordinated to ensure sufficient private investment complements public funding.

9: Develop European Green Lead Markets for Climate-Friendly Basic Materials

In brief:

Green lead markets ensure predictable demand for low-emission products and processes, particularly in basic materials such as steel, cement or fertilisers. Green lead markets for such products can reduce uncertainty and incentivise transformative investments into climate-friendly production methods. To foster the emergence of green lead markets, the EU should:

- Develop an EU strategy for creating lead markets for basic materials, streamlining existing processes.
- Work towards common methodologies for calculate the emission intensity of products and associated (dynamic) standards to establish which products qualify as "climate-friendly" or "low-emissions", and can thus be traded on lead markets.
- Revise the public procurement directives to make the environmentally sustainable option the norm, oblige procuring authorities to take environmental criteria into account and mandate the strategic use of public procurement (by Member States as well as Commission Services) to create demand for low-emission basic materials.
- Consider the introduction of (tradable) quotas or standards for end products.

Deep GHG emission cuts in the production of basic materials requires switching to low-emission production processes, such as direct reduction in steelmaking using green hydrogen. This involves a reconfiguration of production methods, and therefore large capital investments. However, even with the EU ETS in the industry sector going to zero by 2040, the business case for these investments is not straightforward. Under existing and projected carbon and input prices, low-emission and circular production will still be more expensive than conventional production in the short- to medium-term. In addition, markets for basic materials are very competitive, and low-emission products do not differ from conventional ones in their product qualities. This lacking cost-competitiveness of low-emission products in combination with large uncertainties about the availability and cost of key inputs, such as green hydrogen, electricity, or infrastructure, makes it unlikely that investments will be forthcoming at the scale and pace needed, absent additional incentives.

Green lead markets can reduce these uncertainties and incentivise investments in low-emission processes. They are markets for low-emission and circular products, where the cost-premium of more sustainable production is factored into the market price of the product. In other words, green lead markets allow to producers to recover (part of) the additional costs from climate-friendly production, and thus represent a stable and secure source of demand for such products. Different instruments can create lead markets:

- **Standards** for the emission-intensity of end products can induce demand for low-emission basic materials.

- **(Tradable) quotas** that prescribe a minimum annual volume of low-emission basic materials to be used by market actors.
- **Public procurement:** by strategically introducing environmental and climate criteria, public procurement can guarantee demand for certain low-emission goods.

A necessary pre-condition for the development of lead markets and the above instruments is that there is **transparent, verifiable information** about the emission intensity of the products in question (through product declarations or labels), as well as **clear and consistent definitions** for “climate-neutral”, “circular”, or “low-emission” products.

The EU has taken first steps to create lead markets through legislative changes in key Fit for 55 files, including the Construction Products Regulation, the Batteries Regulation, or the Net-Zero Industry Act. However, the concrete implementation is left to the upcoming legislative cycle, with most details still to be defined in implementing and delegated acts.

An EU strategy for green lead markets, especially for low-emission basic materials, is needed to create demand and thereby complement the EU’s ambitious climate policies on the supply. Recently some EU member states have launched their own initiatives for creating lead markets. Germany, for example, has published its green lead market strategy, including proposals for definitions for low-emission basic materials. While such national initiatives are welcome, they do create a risk of fragmentation, where an EU wide approach to lead markets would be more efficient and compatible with the single market.

To this end, the EU Commission should:

1. **Develop an EU strategy for creating lead markets** for basic materials, streamlining existing processes.
2. **Work towards common methodologies** for calculate the emission intensity of products and **associated (dynamic) standards** to establish which products qualify as “climate-friendly” or “low-emissions” and can thus be traded on lead markets.
3. Oblige procuring authorities to take environmental criteria into account and **mandate the strategic use of public procurement** (by Member States as well as Commission Services) to create demand for low-emission basic materials.
4. **Consider the introduction of (tradable) quotas** or standards for end products.

Strategic use of public procurement to create green lead markets

Public procurement in the EU accounts for 14% of EU GDP. Public bodies are moreover major buyers of emission-intensive products, in particular steel and concrete. According to 4i-TRACTION estimates, approximately 11% of the EU’s GHG emissions result from public purchasing decisions (Mähönen et al., 2023).

Most public procurement contracts across the EU are awarded based on price alone (European Commission, 2022b). This is a failed opportunity to use public procurement strategically to create (guaranteed) demand for input materials produced with climate-friendly production methods.

We suggest that the **EU should make more strategic use of its purchasing power**, align purchasing decisions with climate targets, and thereby foster the emergence of green lead markets. This would be enabled by recent revisions of the Construction Products Regulation and

the Ecodesign for Sustainable Products Regulation, which empowers the Commission to adopt delegated acts specifying minimum environmental public procurement criteria.

We refer to the strategic use of public procurement to create demand for selected low-emission goods and services as “Public Procurement for Climate Neutrality” (Mähönen et al., 2023). To harness this strategic potential and create lead markets, three areas of actions must be addressed: (1) revise the public procurement directives to make the environmentally sustainable option the norm; (2) introduce rules in sectoral legislation to create demand for key low-emission products; and (3) put the enabling conditions in place.

To facilitate a wider uptake of environmental and climate considerations in public procurement, the EU Public Procurement Directives should be revised in the following aspects:

- Introduce a general obligation for procuring authorities to take environmental considerations into account, at least in those areas with high environmental impacts;
- Restrict the price-only assessment to pre-defined conditions, and
- Introduce an indicative adoption target and an obligation to draft national Green Public Procurement Action Plans, including reporting on Public Procurement for Climate Neutrality.

In addition to these general changes and to use public procurement more strategically, **mandatory rules should be established in sectoral legislation** in areas which hold the most strategic potential to create demand and lead markets for low-emission products. These criteria can take the form of technical specifications, award criteria, or contract performance clauses.

The revision of the Construction Products Regulation and the Ecodesign Regulation enables such a strategic use. To make it work, the Commission must adopt delegated and implementing acts, specifying the minimum mandatory environmental criteria for public tenders. The Commission should be ambitious in setting these criteria with a phase-in strategy to create lead markets.

To harness the full potential of public procurement for climate neutrality and circularity, the EU should also ensure that the enabling conditions are in place. At EU level, these include **better and clearer guidance on the implementation of environmental criteria** to procuring authorities, **improved monitoring** and data on the environmental footprint of public procurement, as well as the establishment of a **common methodology** for calculating the environmental footprint of products and projects by the Commission. At Member State level, the capacity of procuring authorities must be improved through appropriate skilling and staffing of procuring authorities.

10: Prudential Transition Plans for Banks

In brief:

There is as substantial gap between current lending and investment practices by banks and the EU's ambitious climate goals. The European Banking Authority (EBA) should introduce clear guidelines for EU banks to set up prudential transition plans in order to align to align their investment and lending practices with the EU's climate goals.

- These guidelines should require banks to develop detailed, actionable strategies for decarbonization, setting scientifically credible targets for 2050 and intermediate milestones, tailored by sector.
- The plans should be verified by banking supervisors and their implementation monitored. If implementation proved to be deficient, banking supervisors should prescribe corrective action e.g. through requesting an evolution in the governance and the risk management, prescribing trainings or setting concentration limits that prevent excessive investment in any single sector.

There is as substantial gap between current lending and investment practices by banks – with perpetuated investments in high-carbon activities – and the EU’s ambitious climate targets. This misalignment poses significant risks not only for the transition to climate neutrality but also to financial stability, as assets tied to fossil fuels may depreciate rapidly due to policy shifts and technological advancements. Several recent studies have shown that existing voluntary climate commitments by banks – oftentimes in the framework of collective commitments – such as those made under the Net Zero Banking Alliance, lack ambition and are often not upheld, failing to produce the necessary changes in the real economy.

In a recent review of the Capital Requirements Directive, a key piece of EU banking legislation, a significant addition was the inclusion of “transition plans” which are now part of the prudential regulations that govern banks’ operations. Prudential regulations are the rules that banks must follow to ensure they are operating safely, particularly concerning their financial stability.

These transition plans are strategies that banks will need to create, showing how they intend to align their business operations with the EU’s climate goals. The guidelines for these transition plans will be set by the European Banking Authority (EBA), ensuring that banks have a clear framework to follow. Firstly, we suggest making requirements for bank transition plans consistent with the European directives on Corporate Sustainability Reporting (CSRD) which contain mandates for transition plans for more than 50,000 companies.

Secondly, we suggest that the EBA guidelines include a comprehensive definition of transition plans aiming at mobilising banks towards climate neutrality by 2050. Transition plans would set out each bank’s decarbonisation strategy by 2050, indicating their intermediate targets, by that date, by sector. In the plan, it would have to be indicated which procedures will be put in place internally to achieve the targets, ensuring that the commitments cover all the activities of the institutions concerned, on and off-balance sheet.

Transition plans, verified by the banking supervisors should:

- Establish a strategic vision and greater sectoral coverage;
- Ensure the scientific credibility of targets;
- Enable consistency with European policy objectives.

Prudential transition plans can have key impact in various sectors.

- For instance, for the **fossil fuel sector**, prudential transition plans should accelerate their gradual and orderly exit from the economy. Transition plans would strengthen and give

credibility to commitments in the fossil fuel sector, including clarifying the carve-out policy for new projects.

- For the **energy renovation of buildings**, the central issue is the choice of indicators, because an artificial greening of portfolios must not lead to the exclusion of low-income households from credit. These households are the main ones concerned by the renovation objectives. It is therefore important to ensure that the objectives of transition plans are relevant, with targets for the volume of loans or renovations granted, rather than targets for emissions reductions.
- For the **automotive sector**, banks are key players as they finance both manufacturers and buyers, as well as other businesses across the automotive value chain (auto parts manufacturers, garages, car dealers, etc.). Banks must continue to support the transition of the automotive sector in their commitments set out in the transition plans, not only by proposing offers adapted to the purchase of electric vehicles but also by extending their strategy to all the production chains and professions in this sector.

Banking supervisors would then verify the actual implementation of the transition plan and take corrective action if it proved to be deficient. To do so, they have many tools in their belts: For example, they may request banks to enhance their governance and risk management, to ensure that climate goals are taken into account at every level of decisions. Supervisors may also request general training for executives, board members, risk committee members and managers to increase staff awareness and capability in managing climate risks. They may also set concentration limits to prevent investments in highly exposed sectors, such as fossil fuels. Remuneration schemes may also be adjusted to link bank managers' bonuses to their success in achieving sustainability targets. Finally, supervisors may impose additional capital requirements for banks to buffer against potential losses from high-carbon investments deemed risky in a transitioning economy.

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About the project

4i-TRACTION – innovation, investment, infrastructure and sector integration:
TRAnsformative policies for a ClimaTe-neutral European UnION

To achieve climate neutrality by 2050, EU policy will have to be reoriented – from incremental towards structural change. As expressed in the European Green Deal, the challenge is to initiate the necessary transformation to climate neutrality in the coming years, while enhancing competitiveness, productivity, employment.

To mobilise the creative, financial and political resources, the EU also needs a governance framework that facilitates cross-sectoral policy integration and that allows citizens, public and private stakeholders to participate in the process and to own the results. The 4i-TRACTION project analyses how this can be done.

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