



TRANSITION PATHWAYS IN THE CONTEXT OF THE 8TH ENVIRONMENT ACTION PROGRAMME

European commission, DG Environment
October - 2024

RAMBOLL

EUROPEAN COMMISSION

Directorate-General for Environment

Unit ENV/01: Strategy, Digitalization, Better Regulation and Economic Analysis

Contact: Stephen White

E-mail: stephen.white@ec.europa.eu

European Commission
B-1049 Brussels

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Manuscript completed in October 2024

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ISBN 978-92-68-21345-2

Catalogue number KH-01-24-016-EN-N

DOI 10.2779/9848919

Authors:

Thomas Neumann

Karin Attstrom

Christopher Marton

Josep Pinyol Alberich

This report has been prepared by a team from Ramboll in the context of a Service Contract on Support for the Mid-Term Review of the 8th Environment Action Programme for DG Environment.

Cristian Matti from the Joint Research Centre (JRC), Innovation Policy and Economic Impact and European Commission Policy Lab, kindly contributed with his expertise and provided feedback on the draft report.

Executive summary

This paper examines the key aspects of transition pathways to develop a more solid understanding of their definition and main characteristics. Transition pathways represent an approach to envision plausible futures and to understand how change can occur in the direction of these futures. A core underlying aim of the 8th Environment Action Programme (EAP) is to accelerate the green transition “to a climate-neutral, sustainable, non-toxic, resource-efficient, renewable energy-based, resilient and competitive circular economy”. Hence, transition pathways can serve as valuable methods for environmental policy making, as they help pinpoint how to induce the needed systemic changes to build this future. By providing strategic knowledge on transition pathways, this report aims to strengthen the EAP and improve efforts to explore change processes and how to build a desired future in relation to its objectives (and, eventually, its 2050 vision).

Transition pathways are instruments to collectively reflect on plausible desirable futures and the pathways to enable systemic change in the direction of these futures. Transition pathways support such transitions by inviting stakeholders to envision how change can be induced and how this can unfold through co-creation processes. They can be thought of as one specific change trajectory or as an exploration of multiple possible directions. In principle, the core of these pathways consists of deliberative exercises with stakeholders to create strategic knowledge to foster systemic change. In practice, although these foresight exercises are replicated across many sectors and geographical contexts, in many cases they are limited to contemplating technological options without integrating broader elements of existing social and economic systems in their visions of the future.

Transition pathways ideally involve three steps. Firstly, the deliberation of possible scenarios for possible futures. This step allows the different stakeholders to co-create, envision and discuss possible futures. Secondly, the co-creation of pathways involves the creation of multiple narratives to discuss the process of change that could lead to each of the possible visions of the future created in the previous step. Finally, transition pathways can identify the strategic areas of intervention to foster change in the direction of the desired futures. However, in practice transition pathways can assume widely divergent forms and place different emphasis on the different elements. For instance, several documents that reflect cases of transition pathways

include elements such as milestones, timelines and performance indicators, making them effectively hybrid documents between transition pathways and roadmaps.

The quality of transition pathways is generally ensured through stakeholder involvement, with an iterative process to promote adoption, enhance knowledge creation and learning, and incorporate social fairness during the design of the transition. The inclusion of stakeholders in co-creating transition pathways ensures the plurality of the deliberation exercises and that these pathways include a variety of perspectives and information.

This paper also explores the use of transition pathways as strategies to guide the transition towards a sustainable economy. Several transition pathways coincide by focusing on the achievement of net-zero emissions or the SDGs, and in setting their vision to 2050. Such divergences among transition pathways are, for instance, the explicit inclusion or exclusion of social justice, or the scope of change, which can include broad societal issues or be narrowed down to only technological change.

The final section of this paper provides suggestions for sectors that could be identified as a priority for transitioning by analysing their impact on water and marine resources, pollution, the impact on ecosystems, and climate change mitigation. The results indicate that the agricultural sector has a significant impact, together with industry and product manufacturing as well as the transport and energy sectors, which also stand out in terms of their environmental and climate impact.

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1. Introduction

The European Union (EU) economy requires rapid and systemic changes to progress towards the 8th Environment Action Programme (EAP) goals of ensuring the well-being of all Europeans while respecting planetary limits. Transitions and transformations are currently driving the sustainability science and policy agenda, and the concept of ‘transition pathways’ has emerged as a means for collaboratively guiding and realising change. The increased attention to managing transitions within the EU can be exemplified by recent European Commission (EC) initiatives, including the Transition pathways for European industrial ecosystems¹, the Circular Cities and Regions Initiative² and the EU Missions initiative³. These initiatives indicate a growing commitment within the EC to adopt innovative practices that align with the new demands of sustainability transitions. However, a better understanding of transition pathways, their strengths and limitations, as well as their practical application is needed to improve the approach of developing and designing such pathways, and ultimately promoting more robust transition efforts.

To this end, this report provides an overview of the current status of the field of transition pathways. The report structure is presented in Figure 1.

1 European Commission (n.d.). Transition pathways for European industrial ecosystems. Available at: https://single-market-economy.ec.europa.eu/industry/transition-pathways_en

2 European Commission (n.d.). Circular Cities and Regions Initiative. Available at: <https://circular-cities-and-regions.ec.europa.eu/>

3 European Commission (n.d.). EU Missions in Horizon Europe. Available at: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe_en

Figure 1 Overview of report structure

Section 1: Introduction	/
Section 2: Transition pathways in research	Based on review of research papers on transition pathways
Section 3: Mapping of transition pathways	Based on analysis of cases that drafted transition pathways
Section 4: Discussion	Comparing insights from theory (section 2) and cases of transition pathways in policy contexts (section 3)
Section 5: Economic sectors with highest environmental impact	Indications on potential economic sectors that could be covered by transition pathways

Section 2 of the report first discusses the understanding of what transition pathways should be, what they should aim to achieve, and how they should be designed, based on existing research on transition pathways.

Next, section 3 analyses existing transition pathway papers published by EU institutions, Member States and regions, international organisations, and other relevant stakeholders such as industry associations, adding a total of 40 reports on transitions. The analysis was conducted by mapping the identified transition pathways in a matrix to compare the main characteristics, aims, and their objectives within the identified documents. On the basis of the mapping, the study provides insights into how current transition pathways are approached and designed in practice, as well as an overview of sectors for which transition pathways already exist.

Section 4 compares the findings of section 2 and section 3 and reflects on the overlaps and differences between how transition pathways are discussed in theory and in practice. The methodological choice to separate the analysis of the academic sources and the cases that define such pathways in a policy context, as done in sections 2 and 3, allows us to observe specific differences and establish comparisons between these two spheres.

Finally, section 5 presents a high-level overview of economic sectors in the EU with the greatest environmental and climate impact and provides a short analysis of the extent to which transition pathways already exist for those sectors.

2. Transition pathways in research

At a time characterised by rapid technological progress, shifts in global priorities, and emerging environmental crises, the concepts of transitions and transition pathways have gained significant attention in research.

The conversation on transition pathways is multifaceted, but general features can be found in the literature. The academic literature on transition pathways involves various ways of thinking and methods of study, and stems from different disciplinary perspectives. Nevertheless, several shared features can be found, which can help create a general framework of what transition pathways (should) entail. By reviewing and synthesising recent literature on transition pathways, this section aims to contribute to a better understanding of the concept and facilitate the development of such pathways to successfully navigate and guide transitions.

The academic literature on transition pathways stresses the role of transition pathways as instruments to reflect on plausible futures and systemic change. Transition pathways turn the element of sustainability transitions (systemic change) into a discussion about change, which has been part of policy-making practise for many decades.

The exploratory notion differentiates transition pathways from roadmaps or other planning tools. While roadmaps are more specific and outline actions to reach a defined future (which involves clear milestones), transition pathways seek to identify alternative futures and the type of change that needs to happen to realise these futures. Hence, transition pathways offer a better potential for shared reflection on alternative futures and systemic change. However, these two instruments are not mutually exclusive, as in practice many documents labelled as transition pathways can include roadmaps. The two elements can also serve as parts of the same process, i.e., the learnings from a transition pathways exercise can be used to develop one or several roadmaps.

This section is structured as follows. After a brief section on the literature review approach (2.1), different definitions of transition pathways are discussed (2.2), followed by key features of transition pathways found in the literature outlined and described (2.3).

2.1. Review approach

A literature review was performed to identify and describe key features of transition pathways. The review followed a two-step process:

1. Identifying recent literature on research of relevance to the study, and

2. Mapping key features of transition pathways presented in the literature.

Three main channels were used for literature identification. First, the sources mentioned in the Terms of References (TOR)⁴ were screened based on whether they discuss methodological aspects of transition pathways. Second, an open-ended online search was performed using Google Scholar. The applied search terms included 'transition pathways', 'pathways', 'sustainability', 'low-carbon', 'green', and 'just', and were used in various combinations to find relevant literature. Recent and comprehensive sources were preferred to allow for an efficient review process. Third, three academic experts and one policy expert were interviewed and invited to share sources on the topic.

In a second step, an Excel matrix was developed to map methodological considerations of transition pathways mentioned in the literature. This was an inductive process, meaning that features were added to the matrix as they appeared in the literature rather than being part of a predetermined framework. Once the literature had been mapped, categories were summarised based on the sources that covered each specific feature.

2.2. Understanding of transition pathways in research

Transition pathways are instruments for facilitating systemic change by helping stakeholders to envision how change can be induced. The central point is that they relate to the nature and extent of change processes that are necessary to address a specific challenge or that are justified by a particular context. For example, a public institution may feel encouraged to draft transition pathways to explore how to change their fossil fuel dependency and build a fossil-free future. Hence, transition pathways are defined by the main vision, challenge, scenario or overall change that helps to explore plausible futures and create strategic knowledge about systemic change. Also, pathways should always be combined with other tools or methods to be able to go beyond their function of exploring futures or creating knowledge and to implement this created knowledge.

Transition pathways can be thought of as one specific change trajectory, but more commonly they are seen as an exploration of multiple possible directions and alternative ways of achieving a transition.^{5,6} The use of multiple pathways contributes to enriching the understanding of change through a range of different

⁴ 'Service contract on support for the Mid-Term review of the 8th Environment Action Programme' (ref. Ares(2023)4477144), under Framework contract ENV.F.1/FRA/2019/0001.

⁵ European Commission. Joint Research Centre. (2023). Towards a fair and sustainable Europe 2050 :social and economic choices in sustainability transitions. Publications Office. <https://data.europa.eu/doi/10.2760/561899>

⁶ Geels, F., Turnheim, B., Asquith, M., Kern, F., & Kivimaa, P. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

possible futures. This can be used both for framing a discussion (each pathway focuses on a particular type of driver or vision based on elements such as technological, environmental, or societal changes) and for a multi-actor co-creation exercise where analysing across multiple pathways enables the identification of cross-cutting or strategic areas for intervention, and enables actors to visualise their contribution to build such futures.⁷ More specifically, exploratory exercises to delineate multiple alternative ways to realise a transition can serve as a starting point for stakeholders to understand the different possibilities for change and the different plausible outcomes.

While the overarching ideas describing transition pathways are similar, it is important to note that there is no single term that is used unanimously across the research literature. Besides 'transition pathways', other terms used by the reviewed sources to discuss such pathways include 'socio-technical pathway'⁸, 'sustainability transition pathway'⁹, 'transformative industrial development pathways'¹⁰, 'transformation pathways'^{11,12}, 'low-carbon transition development pathway'¹³, 'innovation-led Green Transition pathways'¹⁴, and 'transformative pathways to sustainability'¹⁵.

Another instrument that is commonly used to guide systemic change and that may be confused with a transition pathway is roadmaps. Whereas a transition pathway can encompass multiple narratives and change processes, a roadmap is a more precise collection of interconnected changes and steps. Therefore, transition pathways are more appropriate when applied in a scenario of uncertainty where consensus should also be established between multiple

7 Nilsson, A. E., Bay-Larsen, I., Carlsen, H., Van Oort, B., Bjørkan, M., Jylhä, K., Klyuchnikova, E., Masloboev, V., & Van Der Watt, L.-M. (2017). Towards extended shared socioeconomic pathways: A combined participatory bottom-up and top-down methodology with results from the Barents region. *Global Environmental Change*, 45, 124–132. <https://doi.org/10.1016/j.gloenvcha.2017.06.001>

8 Rosenbloom, D. (2017). Pathways: An emerging concept for the theory and governance of low-carbon transitions. *Global Environmental Change*, 43, 37–50. <https://doi.org/10.1016/j.gloenvcha.2016.12.011>

9 Turnheim, B., & Nykvist, B. (2019). Opening up the feasibility of sustainability transitions pathways (STPs): Representations, potentials, and conditions. *Research Policy*, 48(3), 775–788. <https://doi.org/10.1016/j.respol.2018.12.002>

10 European Commission. Joint Research Centre. (2020). Projecting Opportunities for Industrial Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition. Publications Office. <https://data.europa.eu/doi/10.2760/590389>

11 Erdos, K. et al. (2023). The square: Putting place-based innovation policy for sustainability at the centre of policymaking. Publications Office of the European Union.

12 European Environment Agency. (2018). Perspectives on transitions to sustainability. Publications Office. <https://data.europa.eu/doi/10.2800/332443>

13 Garvey, A., et al. (2022). A “spatially just” transition? A critical review of regional equity in decarbonisation pathways. *Energy Research & Social Science*, 88, 102630. <https://doi.org/10.1016/j.erss.2022.102630>

14 Nauwelaers, C., et al. (2022). Towards Green Transition in EU regions: Smart specialisation for transformative innovation. Publications Office of the European Union.

15 Pathways Network. (2021). Transformative Pathways to Sustainability: Learning Across Disciplines, Cultures and Contexts (A. Ely, Ed.; 1st ed.). Routledge. <https://doi.org/10.4324/9780429331930>

stakeholders. The advantage is that transition pathways do not act as a policy or planning tool. They enable deliberations with stakeholders and explorations of how futures can look.

Transition pathways also differ from scenario modelling exercises, which rely on the use of indicators to help to provide quantitative forecasts of future trends. While such efforts can provide valuable data to help uncover expected future outcomes, they are ultimately limited to projecting existing trends into the future. Other instruments such as impact assessments for future policies can integrate more elements to understand future expectations. The Impact Assessment on a 2040 Climate Target¹⁶, for example, is an instrument that combines stakeholder consultations with quantitative analysis of indicators to explore the impact of future environmental policies in the EU economy. However, this report provides a vision limited to the future in 2040, as it is framed as an exercise to explore the impact of certain policies. In comparison, the EU Transition Pathways¹⁷ adopts a broader vision of the future by centrally focusing on stakeholder co-authorship within relatively open-ended discussions to explore how the future of different EU economic sectors could look like, enabling the consideration of broader elements such as the impact of the geopolitical context, behavioural and technological changes, and the preferences to build a more just transition.

Finally, in regard to the term ‘pathways’, it is used in a broader sense than merely for denoting transition pathways. As an example, the box below summarises different ‘low-carbon pathways’ and shows that transition pathways are just one of three different applications for pathways.

Box 1 Different kinds of (low-carbon) pathways and the link to transition pathways

As highlighted in this report, the concept pathways can be understood and approached in multiple different ways. However, the interpretation and framing are rarely explicit when developing different pathways. In an attempt to clarify such differences, Rosenbloom surveys the literature on low-carbon pathways and identifies three avenues; (1) biophysical, (2) techno-economic, and (3) socio-technical.¹⁸ Transition pathways are inspired by reviewing the challenges to the system and the need to change it. Also, differences between the three are outlined in the figure and further described below. When the three are compared, it becomes clear that what is described as socio-technical pathways (3) are most closely associated with the understanding of transition pathways presented in the research literature. As we will see in section 3, the reviewed transition pathway documents fall within the techno-economic and socio-technical understanding of pathways.

16 European Commission. (2024). Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 by building a sustainable, just and prosperous society (SWD/2024/63 final). Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52024SC0063>

17 European Commission (n.d.). Transition pathways for European industrial ecosystems. Available at: https://single-market-economy.ec.europa.eu/industry/transition-pathways_en

18 Rosenbloom, D. (2017). Pathways: An emerging concept for the theory and governance of low-carbon transitions. *Global Environmental Change*, 43, 37–50. <https://doi.org/10.1016/j.gloenvcha.2016.12.011>



19 IEA. (2023). Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach.

<https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach>

20 Mission Possible Partnerships. Sector Transition Strategies. <https://www.missionpossiblepartnership.org/sector-transition-strategies/>

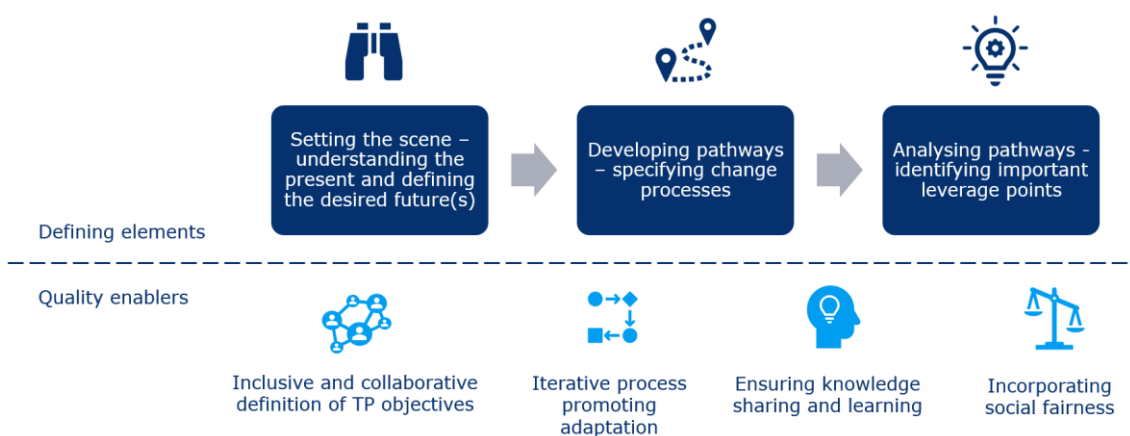
section 3 the transition pathways published by DG GROW appear to capture the main elements of this pathway category.

2.3. Key features of transition pathways

This section presents and summarises a set of features considered important in the development of transition pathways, split into defining elements and quality enablers (see Figure 2). These features have been compiled based on seminal publications on the topic of transition and transition pathways, including both scientific sources and grey literature from leading international organisations.

Since transitions are highly context dependent, the features listed here do not necessarily represent a standardised approach to transition pathways. Rather, they mainly represent ideas generated within primarily European governance structures – democratic settings with certain levels of policy and institutional capacity and R&D investments – as a vantage point. As seen for a couple of the features presented below, there are differences in research about how to understand and best include these features in the transition pathway process.

Figure 2 Key features of transition pathways



Source: Ramboll.

2.3.1. Defining elements

Transition pathways is an instrumental approach to formulating different narratives for system transformation. Consequently, its functions are (1) to explore alternative future scenarios and the type of change that needs to happen to realise these futures. Also, (2) transition pathways can help to break down the steps so real systemic change is guided by building on a shared understanding of how the existing system can transition towards a desired future. In summary, transition pathways help stakeholders explore different possibilities for systemic change and the actions needed to build these changes. But in practice transition

pathways can take various forms and place different emphasis on the different elements.

2.3.1.1. Setting the scene – understanding the present and defining the desired future(s)

Moving away from a particular system, trend or set of practices to another, more sustainable state – i.e., transitioning – is conditional on first understanding the current situation. The business-as-usual direction of the system needs to be analysed, and conditions that might impact change (inertia in existing systems, innovation agents), as well as the consequences of change need to be identified. This kind of analysis should be the starting point of any transition pathways creation.^{21,22}

As for the end point, scenarios outlining the desired future(s) need to be developed.²³ The scenarios should be formulated collaboratively, or broadly validated across stakeholders to ensure relevance. Focusing discussions on visions of the future helps to improve directionality in the transition process and to direct the discussions on possible transitions.²⁴ In contrast, “a transition without a direction invites frustration and fans resistance, if not despair.”²⁵

Importantly, defining a shared vision of the future does not necessarily mean developing one specific scenario; rather it should encompass a broad representation of credible alternatives to the existing system.^{26,27,28,29}

21 European Commission. Joint Research Centre. (2023). Towards a fair and sustainable Europe 2050: social and economic choices in sustainability transitions. Publications Office. <https://data.europa.eu/doi/10.2760/56189>

22 Wigboldus, S. A., van Eldik, Z. C. S., & Vernooij, D. M. (2021). Transition pathways and transitions to sustainability: A critical exploration of perspectives, typologies and agendas. Wageningen Plant Research. <https://doi.org/10.18174/559148>

23 European Commission. Joint Research Centre. (2023). Towards a fair and sustainable Europe 2050: social and economic choices in sustainability transitions. Publications Office. <https://data.europa.eu/doi/10.2760/56189>

24 Geels, F., et al. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

25 European Commission. Joint Research Centre. (2020). Projecting Opportunities for INdustrial Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition. Page 33. Publications Office. <https://data.europa.eu/doi/10.2760/590389>

26 European Commission. Joint Research Centre. (2023). Towards a fair and sustainable Europe 2050: social and economic choices in sustainability transitions. Publications Office. <https://data.europa.eu/doi/10.2760/56189>

27 Geels, F., et al. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

28 Rosenbloom, D. (2017). Pathways: An emerging concept for the theory and governance of low-carbon transitions. *Global Environmental Change*, 43, 37–50. <https://doi.org/10.1016/j.gloenvcha.2016.12.011>

29 Turnheim, B., et al. (2015). Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change*, 35, 239–253. <https://doi.org/10.1016/j.gloenvcha.2015.08.010>

2.3.1.2. Developing pathways – specifying change processes

Next, the processes that need to take place to achieve the envisioned future(s) are determined, i.e., identifying steps to change from today's state(s) to the future one(s). When the transition process is deconstructed into smaller manageable steps, which in themselves are all considered 'doable' and supported by the actors who will implement them, the transition becomes feasible.³⁰³¹ In practice, one way of visualising these processes is through the X-curve tool,³² which helps depict the simultaneous decline of an old system and the emergence of a new one, highlighting critical points of transformation.

Three aspects should be considered when developing the pathways and exploring areas where decisions need to be taken. First, what already works well in the current system should be recognised and preserved. While the overarching concept of transition pathways aims to understand and conceptualise systemic change, it is important to acknowledge that certain practices may already be well-suited for their intended purpose.³³ When the focus is exclusively on what needs to change, there is a risk of overlooking the value of maintaining stability and continuity.

The second aspect concerns phasing out existing (unsustainable) practices and structures. The rationale is that transition pathways cannot focus only on introducing new practices, but also need to consider the phase out and replacement of those that prevent the transition. This is the intentional decline of technologies and practices that are deemed to have unwanted outcomes.³⁴ The dynamics of phasing out preexisting practices are challenging and require careful deliberation, as there is a tendency to see transitions as the introduction of new elements rather than the removal of old ones.³⁵ This is discussed further in section 2.3.2.4 on social fairness of transitions.

The third aspect relates to the consideration of the timing of change processes, introducing new practices or phasing out existing ones at a time when the system

30 Elzen, B., et al. (2020). Transition pathways—Contours of an analytical framework. Stichting Wageningen Research, Wageningen Plant Research, Business Unit Field Crops. <https://doi.org/10.18174/525092>

31 Geels, F., et al. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

32 DRIFT for Transition & EIT Climate-KIC. (2022). X-CURVE booklet. A sensemaking tool to foster collective narratives on systemic change. Available at: <https://transitionshub.climate-kic.org/publications/x-curve-a-sensmaking-tool-to-foster-collective-narratives-on-system-change/>

33 Wigboldus, S. A., van Eldik, Z. C. S., & Vernooij, D. M. (2021). Transition pathways and transitions to sustainability: A critical exploration of perspectives, typologies and agendas. Wageningen Plant Research. <https://doi.org/10.18174/559148>

34 European Commission. Joint Research Centre. (2020). Projecting Opportunities for INDUSTRIAL Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition. Page 33. Publications Office. <https://data.europa.eu/doi/10.2760/590389>

35 Hebinck, A., et al. (2022). An actionable understanding of societal transitions: The X-curve framework. Sustainability Science, 17(3), 1009–1021. <https://doi.org/10.1007/s11625-021-01084-w>

is 'ready'.³⁶ If the transport sector is taken as an example, transition pathways can help illustrate what future transport systems may look like, and for each of these different alternatives, at what points in time different interventions should be implemented. In a future scenario where mobility is shaped by the use of electric vehicles, measures to promote electric vehicle uptake should not be introduced without ensuring that clean electricity and a robust charging infrastructure are in place.

2.3.1.3. Analysing pathways to identify important leverage points

Finally, the developed pathways can be analysed and compared to identify strategic areas of intervention, which are defined as key leverage points deemed significant for achieving any of the alternative futures, i.e., transitioning to sustainability. By pinpointing these areas, policymakers and stakeholders can focus on impactful changes needed to address complex systemic challenges. Moreover, understanding the interconnections between different areas ensures that interventions are holistic and account for the broader implications across multiple sectors and pathways.³⁷ This analysis, which only applies to processes where more than one pathway has been developed, helps to determine the most critical interventions and can facilitate the coordination of efforts.

Reflecting on the capacity and resources of participating actors is vital for understanding how they can effectively shape enabling conditions and processes for sustainability transitions. When the role of key stakeholders in navigating the uncertainty and complexity of the policy landscape is considered, strategies can be developed to improve their ability to manage transformative change.

36 de Haas, W., & Dijkshoorn-Dekker, M. (2021). Tools for transition. Wageningen University & Research, Communication Services. <https://doi.org/10.18174/554460>

37 European Commission. Joint Research Centre. (2020). Projecting Opportunities for INdustrial Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition. Page 33. Publications Office. <https://data.europa.eu/doi/10.2760/590389>

2.3.2. Quality enablers

2.3.2.1. Inclusive and collaborative approach

Strong participation from all relevant stakeholders in a co-creation process is a core feature of transition pathways.^{e.g.,38,39,40,41} Different stakeholders will have diverging goals and perspectives, specific to the context and their interests. This must be addressed transparently and in a way that prevents stakeholder engagement procedures from becoming a mechanism to legitimise certain action based on a subset of (powerful) actor perspectives. Therefore, the emphasis lies on ensuring the quality of the stakeholder involvement (rather than quantity), focusing on the capacity to facilitate robust and inclusive participation. Important questions to consider are: Who decides which stakeholders participate? Are the processes organised in a way that allows for meaningful participation for all stakeholders? Which concerns/perspectives/conclusions are pursued to inform decision making.⁴² Stakeholder mapping exercises and efforts to tailor stakeholder activities to specific contexts can be useful tools to ensure representative and meaningful participation.⁴³ Successfully balancing the diversity of actors' interests and perceptions will also help create necessary societal buy-in and long-term public support for the transition.^{44,45} However, a survey of literature on energy transitions suggests that the inclusivity and diversity of stakeholders is often overlooked.⁴⁶

38 Erdos, K., et al. (2023). The square: Putting place-based innovation policy for sustainability at the centre of policymaking. Publications Office of the European Union.

39 European Commission. Joint Research Centre. (2020). Projecting Opportunities for INdustrial Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition. Page 33. Publications Office. <https://data.europa.eu/doi/10.2760/590389>

40 Frantzeskaki, N., et al. (2019). Transition pathways to sustainability in greater than 2 °C climate futures of Europe. *Regional Environmental Change*, 19(3), 777–789. <https://doi.org/10.1007/s10113-019-01475-x>

41 Wigboldus, S. A., van Eldik, Z. C. S., & Vernooij, D. M. (2021). Transition pathways and transitions to sustainability: A critical exploration of perspectives, typologies and agendas. Wageningen Plant Research. <https://doi.org/10.18174/559148>

42 Ibid.

43 Frantzeskaki, N., et al. (2019). Transition pathways to sustainability in greater than 2 °C climate futures of Europe. *Regional Environmental Change*, 19(3), 777–789. <https://doi.org/10.1007/s10113-019-01475-x>

44 Wigboldus, S. A., van Eldik, Z. C. S., & Vernooij, D. M. (2021). Transition pathways and transitions to sustainability: A critical exploration of perspectives, typologies and agendas. Wageningen Plant Research. <https://doi.org/10.18174/559148>

45 Erdos, K., et al. (2023). The square: Putting place-based innovation policy for sustainability at the centre of policymaking. Publications Office of the European Union.

46 Berka, A., et al. (2022). Just Transitions in Context: A Universal Framework for Comparing Transition Pathways and Policy Mixes in Terms of Inclusivity. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4071205>

2.3.2.2. Iterative processes that promote adoption

Exploring new practices and solutions is a central element of transition literature. Experimentation entails the trial-and-error process of testing promising innovations in small, real-world settings (e.g., a specific urban area, one industrial plant, one organisation).^{47,48} Experiments can for example take the form of community pilot programs, industry demonstration projects or targeted policy instruments. The reviewed literature stresses that experimentation should cover not only technological innovation but also address organisational, social/behavioural and business model innovation.⁴⁹

Developing transition pathways also requires staying cautious about the so-called solutions focus, where specific solutions are emphasised and given a prominent role without proper consideration of potential drawbacks or future concerns. Consequently, experimentation with multiple alternatives is compromised. When various approaches and solutions are accommodated, the risk of new "lock-ins" — where specific solutions become deeply entrenched, creating new (unsustainable) path dependencies — is mitigated because the iterative process allows for the accumulation of expertise and strategic knowledge and improves decision-making.^{50,51,52} Transition pathways should include mechanisms to encourage and support a multiplicity of experimentation. Successful experiments can then be upscaled/mainstreamed horizontally and/or vertically, while unsuccessful experiments are either dropped or adapted as part of an ongoing learning process. This bottom-up logic to innovation highlights the emphasis on exploring multiple opportunities and potential pathways for achieving the transition.⁵³

Navigating through transitions can be challenging due to their inherent complexity. Transitions are often characterised by uncertainty and ambiguity, making it essential to factor in evolving circumstances and emerging realities.⁵⁴

47 Erdos, K., et al. (2023). The square: Putting place-based innovation policy for sustainability at the centre of policymaking. Publications Office of the European Union.

48 Geels, F., et al. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

49 Ibid

50 Geels, F., et al. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

51 Turnheim, B., et al. (2015). Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change*, 35, 239–253.
<https://doi.org/10.1016/j.gloenvcha.2015.08.010>

52 Wigboldus, S. A., van Eldik, Z. C. S., & Vernooij, D. M. (2021). Transition pathways and transitions to sustainability: A critical exploration of perspectives, typologies and agendas. Wageningen Plant Research.
<https://doi.org/10.18174/559148>

53 Turnheim, B., et al. (2015). Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change*, 35, 239–253.
<https://doi.org/10.1016/j.gloenvcha.2015.08.010>

54 Wigboldus, S. A., van Eldik, Z. C. S., & Vernooij, D. M. (2021). Transition pathways and transitions to sustainability: A critical exploration of perspectives, typologies and agendas. Wageningen Plant Research.
<https://doi.org/10.18174/559148>

This act of developing and/or altering mechanisms and interventions in response to new information, is sometimes referred to as reflexivity or reflexive governance^{55,56}, and should be taken into consideration in transition pathways. Doing so means using pathways as a tool to manage uncertainty. In this sense, transition pathways can help navigate through the uncertainty and complexity by (1) forming a strategy for the complex and changing realities of geopolitics and multilateralism while maintaining cooperation and fundamental values such as democracy in a decolonised context, (2) capacity building to act through collective consensus and partnerships to manage uncertainties, and (3) steering change towards strategic, long-term objectives, such as increasing geopolitical resilience by gradually reducing dependencies through international partnerships and sustainable economic activities.⁵⁷

2.3.2.3. Knowledge sharing and learning

Ensuring continuous learning is critical to adapt and improve transition efforts as time passes and change occurs.⁵⁸ The knowledge generated from monitoring and assessing experiments should guide future actions, e.g., scaling of successful innovations and practices, readjustment or phase out of unsuccessful ones, or development of new policy instruments.⁵⁹ Defining processes for stakeholders to engage in collective learning and pathway adjustments is an instrumental part of developing transition pathways. This inclusion of stakeholders across territories, sectors and levels can also support the identification of desired outcomes as well as key knowledge to help with such transitions.⁶⁰ In practice, this can mean including mandatory revisions at specific intervals or planning for knowledge-sharing opportunities.

Further, developing transition pathways and overseeing sustainability transitions requires a diverse array of skills, methodologies, processes, and organisational perspectives. This calls on public authorities to adopt and embrace novel approaches in policymaking, integrating foresight exercises, which involve anticipating future trends and challenges to enable proactive decision-making,

55 Erdos, K., et al. (2023). The square: Putting place-based innovation policy for sustainability at the centre of policymaking. Publications Office of the European Union.

56 Geels, F., et al. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

57 European Commission. Joint Research Centre. (2020). Projecting Opportunities for INdustrial Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition. Page 33. Publications Office. <https://data.europa.eu/doi/10.2760/590389>

58 Geels, F., et al. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

59 European Commission. Joint Research Centre. (2020). Projecting Opportunities for INdustrial Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition. Publications Office. <https://data.europa.eu/doi/10.2760/590389>

60 European Commission. Joint Research Centre. & European Institute of Innovation and Technology Climate KIC. (2022). Co-creation for policy :participatory methodologies to structure multi stakeholder policymaking processes. Publications Office. <https://data.europa.eu/doi/10.2760/495731>

experimentation (i.e., the testing of innovative ideas and solutions in real-world contexts), and evaluation mechanisms for assessing outcomes and informing adjustments. Further, successful transition governance depends on effective stakeholder management, ensuring that diverse voices and perspectives are considered, and creating a sense of ownership among stakeholders. Finally, establishing innovative organisational structures that are responsive to evolving sustainability challenges and opportunities also requires transdisciplinary skills.⁶¹

2.3.2.4. Incorporating social fairness considerations

When introducing changes aimed at driving a transition, it is key to identify potential adverse effects on specific stakeholders or social groups. For instance, changes may result in concentrated noise, air or light pollution in local areas, and may disproportionately impact marginalised communities. Additionally, there is the potential for rebound effects, where unintended consequences arise as a result of the transition.⁶²

Means to support or compensate those people and groups that are negatively affected is imperative to ensure the transition is fair and just.⁶² This is particularly the case for phase-out policies, for which it is crucial to take into account social impacts and consider how actors such as local businesses and workers can reorient from an economic decline in existing industries. For example, the Just Transition and Climate Pathways Study for South Africa (on decarbonising the South African Mining Sector, number 18 in Appendix 1) highlighted the challenge of future job losses in mining, and how to compensate such losses by initiatives such as early retirement and reskilling programmes, and the need to rethink the education system to adapt to the new skills in a way that is fair for the South-African workforce.

Adequate consideration of social fairness not only contributes to a more equitable outcome but also enhances the overall social acceptability of transition measures. This is highlighted by Garvey et al. (2022) who argue that acceptability in low-carbon transitions depends on aspects of perceived fairness and justice.⁶³ This means that taking proactive measures to address the concerns of affected parties not only aligns with the principles of justice but also fosters a positive perception of the transition within the broader community. Also, these considerations of social fairness are highly context-dependent and need to be adapted to the social reality of each case.⁶⁴

61 Geels, F., et al. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.

62 Ibid.

63 Garvey, A., et al. (2022). A “spatially just” transition? A critical review of regional equity in decarbonisation pathways. *Energy Research & Social Science*, 88, 102630. <https://doi.org/10.1016/j.erss.2022.102630>

64 For instance, the Just Transition Strategy of Spain (document 40 in Appendix 1) raises issues such as employment, upskilling and training workers in key affected sectors, and compensating inequality and consumers. These issues are translated into practice by proposing a strategy for energy poverty to alleviate or support those citizens.

3. Mapping of transition pathways

3.1. Identification and mapping of transition pathways

There is a growing body of literature and initiatives dedicated to analysing transition pathways or similar exercises that aim to guide the transition towards sustainable development. For example, the COMMITTED project⁶⁵ aims to improve the scientific understanding of the different approaches to mitigate climate change and the socioeconomic implications. This improved understanding aims to support policymakers by creating a more robust understanding of the different possibilities and their implications. Other initiatives such as the Transition Pathway Initiative Centre (TPI)⁶⁶ support the transition towards climate neutrality within public markets, corporate debt markets and sovereign debt markets by conducting independent analysis and by informing investor decision-making. As a result of these independent studies, the TPI Centre provides transparency and accountability for corporate commitments to net zero. Finally, other cases, such as the EU Transition Pathways⁶⁷, represent an attempt to build long-term policy strategies for different economic sectors of the EU to transition towards a sustainable economy. These examples illustrate the multitude of approaches to the use of transition pathways and the diversity of methods and outcomes under this term.

This report explores the use of transition pathways as strategies to guide the transition towards a sustainable economy. Hence, this section explores documents that meet the following criteria: (1) use the word ‘transition pathway’ and (2) present a plan or proposal to shape future outcomes. Additionally, we integrated examples of such transition documents in other languages to provide a diversified vision of how such transitions are envisioned in different contexts. The identification of transition pathways was conducted by scanning documents that contained the key word ‘transition’ and ‘pathways’ using Google. As a result, this report identifies a set of documents that use transition pathways as an approach to achieving or promoting systemic change towards a sustainable economy. In total, this report identifies 40 documents that represent cases of transition pathways (see Appendix 1: Reports containing examples of transition pathways) as a representative selection to better understand how transition pathway approaches are being applied in practical terms. To ensure this representativity, these 40 documents were strategically selected with the aim to

65 IIASA. 2024. Climate policy assessment and Mitigation Modeling to Integrate national and global TransiTiOn pathways for Environmental-friendly Development (COMMITTED). <https://iiasa.ac.at/projects/committed?page=0>

66 London School of Economics. 2024. The LSE Transition Pathway Initiative Centre. <https://transitionpathwayinitiative.org/>

67 European Commission. 2024. Transition pathways for European industrial ecosystems. https://single-market-economy.ec.europa.eu/industry/transition-pathways_en.

ensure diversity (including different countries, languages and types of authoring institutions). Finally, the documents were systematically analysed to identify the differences and similarities between them.

The documents were compared by inductively identifying a set of common characteristics to compare the different identified reports. These common characteristics included the authorship, the type of author (such as private initiatives, intergovernmental organisations, or consultancies), the time horizon and the scope. These characteristics were combined with the analysis of the presence of the key goals derived from the 8th Environment Action Programme (EAP), including (1) climate neutrality, (2) climate adaptation, (3) circular economy, (4) zero pollution, (5) biodiversity, and (6) just transition. These criteria were scanned from all the identified documents and mapped in an Excel table to allow their comparison and to draft the results of this report.

Box 2. Summary – the transition pathways of DG GROW

The update of the EU Industrial Strategy

(2021)³⁵⁰ demanded the enactment of transition pathways for heavy industry sectors. This strategy was originally set to help the industry to meet the EU's environmental goals, and it was updated to address the need for EU industry to recover after the external shocks of the COVID-19 pandemic and the Russian invasion of Ukraine.

The method and scope for the development of these transition pathways was specified in a document called 'Blueprint for the development of transition pathways or industrial ecosystems'. This blueprint was the basis for the publication of five transition pathways published between 2022 and 2023 (when this report was drafted).

The transition pathways of DG GROW and their blueprint were a product of co-authorship, as they were developed after a strong stakeholder involvement process. This deliberation exercise took place within an industrial forum – a stakeholder group specifically created to be an open mechanism for co-designing solutions with stakeholders. The industrial forum is composed of 27 member state authorities, 26 organisations (including 2 NGOs, 19 trade and business associations, one organisation representing business clusters, one professional organisation, one trade union, one research organisation, and one organisation or EU regions), and four representatives of EU institutions (the Committee of the Regions, the European Economic and Social Committee, the European Investment Bank, and the European Bank for Reconstruction and Development (EBRD))⁶⁸

The stakeholder involvement process through the industrial forum enabled not only the co-creation of transition pathways, but also the creation of mutual commitments to take action towards enacting these pathways. Although the transition pathways are

⁶⁸ The full list of the Commission expert group "Industrial Forum" (E03743) is available here:

<https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&groupID=3743>

not a legally binding document, they collect the pledges of different stakeholders that are published and monitored by stakeholder groups.

3.2. Findings

This report provides the main insights on how the transition pathways reports are organised by identifying the structural characteristics in them. These structural characteristics were identified by systematically comparing and inductively analysing the identified documents (see Appendix 1: Reports containing examples of transition pathways). Overall, the transition pathways can differ in terms of these characteristics due to their publication features and the structural elements that they aim to change. The publication features include the authorship or the timing, and help us better understand how these documents are created. The structural elements include the scope and objectives, the involvement of key stakeholders in decision-making, and the final horizons limiting how transitions are envisioned. Such differences illustrate the extent to which transition pathways can change and what their goals are. These structural characteristics are different from the key features of transition pathways (Figure 2) because they do not act as enablers or good practices to build stronger transition pathways; instead, structural characteristics constitute existing transition pathways and define their goals and structure (as detailed in Table 1).

Table 1 Summary of the main structural characteristics of transition pathways

	Structural characteristics	Characteristics
Publication features	Timing	All publications are recent (starting in 2016 and predominating in 2023).
	Authorship and stakeholder involvement	Predominance of collective organisations (business associations and intergovernmental organisations). However, governmental institutions also play a notable role.
Structural elements	Stakeholder participation	Mostly inexplicit, although some documents acknowledge stakeholder involvement to a certain extent.
	Objectives	Predominance of climate neutrality goals, some other socio-environmental and economic objectives present as well.
	Scope	Framing mostly focused on economic sectors, with an emphasis on heavy industry, and mostly within a geographical frame defined either by the national institution or the entity that leads the elaboration.
	Prescriptiveness	Predominance of technocentric visions.
	Timelines	All transition pathways propose time horizons of decades, ranging from 2030 to 2070, with a majority of visions aiming for 2050.

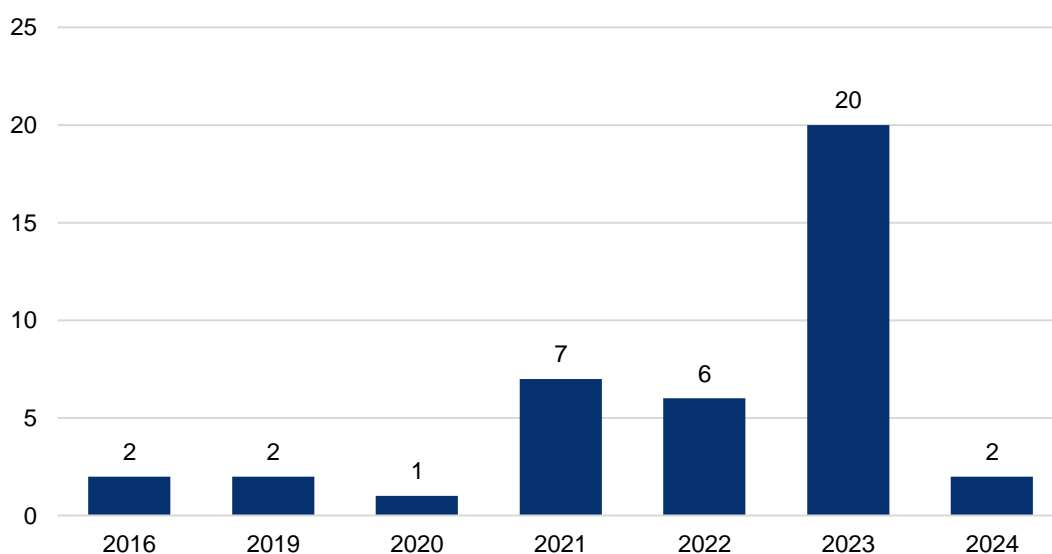
	Structural characteristics	Characteristics
	Implementation	Most transition pathways are limited to acting as voluntary reference points, with the exception of DG GROW, which publishes joint commitments with stakeholders.
	Geopolitical aspects	Most transition pathways include some reflections on the geopolitical aspects of future transitions, including how to address dependencies, improving trade imbalances, or how to contribute to global governance objectives such as the Paris agreements or the Sustainable Development Goals (SDGs).
	Societal aspects	Most of transition pathways are not explicit in this respect. In total, 23 of the identified transition pathways explicitly reflect on the need to create a just transition. This societal dimension is defined differently in each document, depending on the sectoral issue, the timeline, and overall context.

Source: Ramboll.

3.2.1. Timing

Transition pathways appear to be a recent and growing concept applied in different contexts. All identified transition pathways are recent, with the two earliest transition pathways reviewed from 2016 and the most recent in 2024. Hence, the idea of drafting transition pathways is relatively new and the available research and academic papers discussing the concept of transition pathways is still evolving as discussed earlier.

Figure 3 Year of publication of reviewed transition pathways



Source: Ramboll.

3.2.2. Authorship

The existing transition pathways are published mostly by either private initiatives or intergovernmental organisations, although they may be the result of wider discussions that involve more actors. The organisation that has published the most transition pathways reports is the National Business Initiative of South Africa, which is a business association that published 8 different transition pathways reports in 2023. DG GROW (European Commission) has published 6 different transition pathways reports which are co-authored with the participation of a wide variety of stakeholders relevant to each of the industrial ecosystems. Similarly, JPI Urban Europe is an organisation that is co-financed by the European Commission through the Joint Programming Initiatives and it engages 20 countries out of which 14 are members. These examples illustrate how transition pathways are an instrument used preferably by collective authors (i.e., organisations or associations). Finally, national and regional transition strategies are published by agencies or ministries of the respective governments.

3.2.3. Stakeholder participation

The reviewed transition pathways are not always explicit about the methodology applied or the stakeholders involved. The methodology is important to guarantee the quality and inclusivity in the drafting of the report (as mentioned in section 2.3.2 on quality enablers). This is because transition pathways are essentially tools to deliberate and to reflect on transition and systemic change; hence, they require a methodology that enables an inclusive and collaborative approach.

Some transition pathways provide insights on issues or goals that have been discussed, such as the climate neutrality commitments discussed in the Paris agreements, or the Sustainable Development Goals (SDGs). However, these documents do not include an explicit participation or stakeholder involvement process that defines the content of the transition pathway. The transition pathways of DG GROW are a notable exception, as they do include an explicit participation process, are defined as an exercise of co-authorship, create shared discussions, and define shared responsibilities in the design, implementation and monitoring of the transition pathways. Another example is the report from Catalonia called National Agreement for the Energy Transition of Catalonia (Pacte Nacional per a la transició energètica de Catalunya in Catalan), which is based on an agreement between parties within the context of Catalonia and established a follow-up system beyond the regional government to allow for its revision.⁶⁹

⁶⁹ https://icaen.gencat.cat/ca/plans_programes/transicio_energetica/lideratge-del-pacte/

3.2.4. Objectives

Most transition pathways are associated with the achievement of net-zero or the SDGs. From the 40 identified transition pathways, 39 of them explicitly include the goal of climate neutrality (the only transition pathway that does not explicitly talk about climate neutrality, transition pathway number 12, still discusses issues such as urban sustainability, implicitly including climate neutrality). Additionally, the two transition pathways issued by UN agencies (numbers 9 and 10) essentially discuss the achievement of some of the SDGs,⁷⁰ and 23 transition pathways talk about the achievement of a just transition.

This report also reviewed how the analysed transition pathways address the EAP objectives. Those are namely (1) climate neutrality, (2) climate adaptation, (3) a circular economy, (4) zero pollution, (5) biodiversity, and (6) a just transition. The only transition pathway report that explicitly addresses all these elements is the Transition Pathway for Tourism published by DG GROW. The transition pathways of DG GROW are the group of transition pathways that tend to explicitly address more of these objectives, such as the circular economy transition, climate neutrality, or a just transition, which are mentioned in all the DG GROW pathways. Some other objectives can be implicitly covered under other broader key concepts such as sustainability or clean production.

In broad terms, transition pathways are mostly an instrument to identify and open up potential systemic changes towards sustainability. The selection of goals by the transition pathways shows how these instruments are associated with the future achievement of an objective or a specific set of objectives. Also, those objectives seem to be closely related to the enactment of sustainability goals. However, these goals are often complemented by other objectives, such as the creation of jobs, economic growth or competitiveness.

3.2.5. Scope

All the reviewed transition pathways (see Appendix 1) have a defined sectoral and geographical scope that limits their application to a transition, which is often defined either by the institution or the entity that leads the draft. The analysis of this report was based on publications mainly focussed on Europe, as 8 documents define their scope at the EU level, 3 in Europe (including both EU and non-EU countries), and 14 at the level of different Member States (including at regional levels). International examples include 8 transition pathways from South-Africa, while 4 pathways have a global scope.

Table 2 Geographical scope of the analysed transition pathways reports.

⁷⁰ However, the contribution to the SDG is mentioned in a total of 22 reports.

Geographical scope	
EU	8
Europe	3
South-Africa	8
France	6
Global	4
Italy	2
Andorra	1
Asia and Pacific	1
India	1
Spain	1
Asturias (Spain)	1
Catalonia (Spain)	1
The Netherlands	1
Utrecht (the Netherlands)	1
Flanders (Belgium)	1

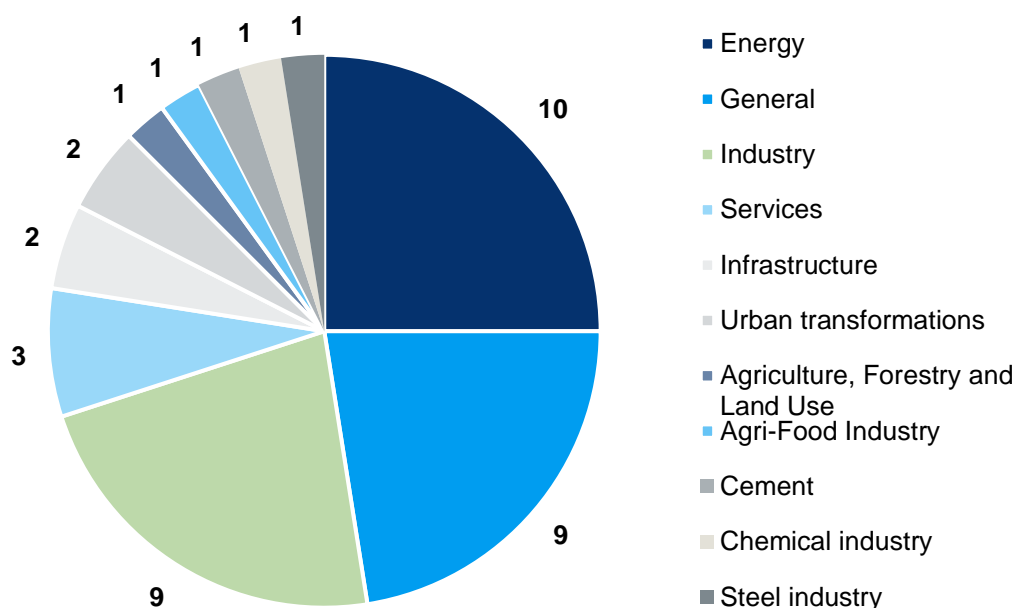
Source: Ramboll.

The reviewed transition documents also have a defined sectoral scope. Up to 12 of the transition pathways have a focus on different industrial sectors (such as heavy industry, steel production, cement, chemicals or textiles), and 10 transition pathways focus on energy-related activities (such as electricity, natural gas or oil). This can be motivated due to the strategic role of these sectors and their environmental impact. Other transition pathways focus on other sectors, such as services (including the financial sector or tourism), agriculture, or urban transitions. Only one of the transition pathways (number 23⁷¹)⁷² presents an unspecified approach covering diverse economic sectors within one country.

⁷¹ This refers to India's energy transition pathways. A net-zero perspective.

⁷² The assessed transition pathways are numbered in Appendix 1.

Figure 4 Scope of transition pathways



Source: Ramboll.

3.2.6. Prescriptiveness

The scope of transition pathways varies significantly depending on how they explore change. Most of the transition pathways are limited to studying technological change. This limitation may be seen as a technocentric vision of sustainability that dismisses critical societal, political and economic changes that can be made in the direction of sustainability. Some transition pathways provide more extensive advice on change, discussing elements such as the enactment of public policy, infrastructure alternatives or funding and investment. In this case, the transition pathways of DG GROW show a more holistic approach, as they include advice on policies, stakeholder collaborations, the development of new skills, research, investment in funding. This is more in line with the vision of transition pathways within the academic literature.

3.2.7. Timelines

The timelines of the designed transitions within the analysed transition pathways are surprisingly similar. 32 of the transition pathways set the horizon of their transition in 2050, 4 of the transition pathways set their horizon in 2030 (numbers 11, 30, 36, and 37), one in 2035 (number 24), one in 2070 (number 23), and one does not specify a time horizon (number 14). This illustrates how transition pathways are unanimously drawing up plans for a foreseeable medium-term horizon of decades. The dominance of timeframes that project a time horizon of

decades suggests that transition pathways are useful tools for practitioners to enact an extended vision in policy planning and to avoid short-term decisions to address broader challenges. The predominance of the 2050 time horizon is probably associated with the aims to meet the Paris Agreements, as many countries in Europe have adopted the target to become climate neutral by 2050.

Table 3 Time horizon of transition pathways

Time horizon	Number of transition pathways
2030	4
2035	1
2040	1
2050	32
2070	1
Unspecified	1
Total	40

Source: Ramboll.

3.2.8. Implementation

Most of the transition pathways (30 out of 40) are limited to describing what the possible options are for building different future outcomes. In other words, these transition pathways only provide general advice on technological options without influencing actions or defining commitments to implement the future transition that they advise. In other words, these transition pathways provide reflections from scenario analysis and modelling to provide a performance progression, but they don't force any particular technology explicitly and act simply as a reference point for actors to use in determining the ambition and commitments of their company-level transition plans.

In this sense, the transition pathways published by DG GROW and those from the national and regional institutions are a notable exception. Due to the stakeholder involvement within these documents, DG GROW is able to publish transition pathways where concrete actions are defined, responsibilities are explicitly shared, mechanisms for monitoring their implementation are laid out, and commitments by stakeholders are ensured. This provides a very clear guide on how their goals will be implemented and an expectation that these actions can be implemented. The national and regional reports also combine the exercise of visualising different future outcomes with the creation of political commitments or the definition of policies to enact the future visions created. However, the public participation of the national or regional transition reports varies from case to case. For instance, the French Conseil National de l'Industrie does not include an explicit stakeholder involvement process, but it defines actions to be developed by the state and by the different economic sectors to build these transitions.

3.2.9. Geopolitical aspects

The transition pathways are framed within a context of evolving international relations and geopolitics. In this sense, transition pathways act as a discursive exercise to frame this understanding of the international context, and how this framing feeds into the strategic need for a transition to overcome strategic challenges derived from such a context.

There are two aspects that emerge as relevant to the geopolitical aspects in transition pathways. These are (1) the future contribution of transitions to global governance agreements, such as the Paris agreements or the SDGs, and (2) the role of transitions to address specific challenges within the geopolitical context.

The contribution to global governance is the most common aspect present in transition pathways. Approximately, slightly more than half of the transition pathways (26 out of 40) included some references to the Paris Agreement of 2015, and 14 transition pathways included the attainment of the SDGs. In contrast, the aspects regarding specific challenges within the geopolitical context generally received less attention for the analysed transition pathways. For instance, only 4 transition pathways report the issue of possible material or resource scarcity. The most mentioned issue regarding geopolitical aspects is the concern for the critical raw materials supply (also named critical minerals), as this is seen as a key enabler for the green transition, and the dangers of disruptions in their supply (11 documents reference it). Finally, other aspects mentioned are the political implications of international dependencies on third countries due to the supply of resources and the trade balance. For instance, the Transition Pathway for the Agri-Food Industrial Ecosystem⁷³ of DG GROW mentions the dependencies on food imports of the EU (such as oilseeds meals for livestock feed). Just as many of the transition pathways published by DG GROW also mention the issue of energy due to the recent Russian invasion of Ukraine.

3.2.10. Societal aspects

The publication of transition pathways and the exercise to imagine a desired future and the pathway towards it has strong societal implications, including issues such as well-being or fairness. In total, 23 of the identified transition pathways explicitly reflect on the need to create a just transition. This transition is defined differently in each document. For instance, some documents reflect on

⁷³ European Commission. (2024). Agri-food transition pathway. Available at: https://single-market-economy.ec.europa.eu/sectors/agri-food-industrial-ecosystem/transition-pathway-agri-food-industrial-ecosystem_en

the need to create jobs,⁷⁴ or the fair⁷⁵ distribution of costs of the transition,⁷⁶ and some transition documents include societal well-being more centrally.⁷⁷ In summary, the societal dimension in transition pathways is defined differently in each document, depending on the sectoral issue addressed, the timeline and overall context.

74 Such as the Plan sidérurgie: vers une sidérurgie française compétitive, innovante, décarbonnée et attractive from the French National Industry Council.

75 These new costs that disproportionately affect low-income groups could be for instance the electrification of domestic heating installations or the installation of air conditioning as a necessary measure to adapt to the effects of climate change.

76 Such as the Prospective Transitions 2050 report from the French Agency of the Ecological Transition.

77 Such as the Transition Pathway for Proximity and Social Economy from DG GROW.

4. Discussion

4.1. Considerations on transition pathways in research and practice

The following considerations and insights are laid out on the basis of a comparison between the findings in section 2 and 3. The first insight derived from this report is the novelty of transition pathways. The debate on the definition and suitability of transition pathways emerged within the academic sphere, especially within the innovation⁷⁸ and regional development fields⁷⁹, and the body of literature has expanded rapidly in recent years. As argued by Wigboldus et al., sustainability transitions and transition pathways have, to a large extent, even replaced the perspective of sustainable development and related development pathways.⁸⁰ The definition of such desired futures is itself a process where a set of stakeholders are enabled to discuss and envision possible pathways towards systemic change. As a result, transition pathways may produce a narrative or set of narratives about how existing social and technological systems can transition towards a desired future.

Transition pathways in practice have emerged recently as a new instrument for collective organisations, and they are used to define medium-term ambitions, always in connection with environmental goals and often in relation to a specific sector of the economy. These commonalities indicate that practitioners share a set of common notions about how transition pathways should be. Those notions are related to grand topics, such as the economy, driving desired change, and certain environmental goals, especially climate neutrality. The ambitious timeline, mostly aiming at 2050, but consisting of decades, also appears to be a commonality, as practitioners use transition pathways to plan decisions with a medium-term scope of decades. Despite these commonalities, transition pathways can differ in terms of advice, authorship, level of ambitions, or the defining of responsibilities in terms of implementation. Such decisions are critical, as they influence how ambitious transition pathways can be.

The use of transition pathways as an instrument for practitioners to plan medium-term changes is even newer, as the oldest example of a transition pathway report is from 2019. But the growing number of publications in recent years shows that

78 Warnke, P., Weber, M., & Leitner, K.-H. (2008). TRANSITION PATHWAYS TOWARDS USER-CENTRIC INNOVATION. *International Journal of Innovation Management*, 12(03), 489–510.
<https://doi.org/10.1142/S136391960800200X>

79 Gereffi, G., & Fonda, S. (1992). Regional Paths of Development. *Annual Review of Sociology*, 18(1), 419–448.
<https://doi.org/10.1146/annurev.so.18.080192.002223>

80 Wigboldus, S. A., et al. (2021). Transition pathways and transitions to sustainability: A critical exploration of perspectives, typologies and agendas. *Wageningen Plant Research*. <https://doi.org/10.18174/559148>

the concept is gaining attention as a way to explore and advance change toward sustainability. Transition pathways emerge mostly around climate policy issues, which leads to a shared evolution of the climate policy governance in the direction of more comprehensive medium-term and long-term planning. The development of transition pathways has led to (i) modelling on different scenarios/pathways and their socio-economic implications (ii) the active selection of the most effective pathway, and (iii) the creation of a governance framework to ensure implementation.

There are different approaches to building transition pathways. As the academic literature emphasises, there are no defined standards on what transition pathways entail and how they are organised, although the general vision is that transition pathways are intended as instruments to identify transformative knowledge, to enable the visualisation of desirable futures and the deliberation among stakeholders on how to enable pathways towards these futures.⁸¹ This lack of definition leads to a range of approaches on how policy actors or other relevant stakeholders develop transition pathways in practice. Despite the absence of standards or guidelines, this report identifies two prominent approaches to enacting transition pathways: a (1) techno-economic approach, more limited to the prescription of technological options and a focus on observing tendencies in the market. This techno-economic approach can include scenario analysis and modelling that point to a performance progression route acting as a simple reference point for actors to use in determining the goals and commitments of their transition plans without forcing any particular technology explicitly. We also identify a (2) socio-technical approach, with a broader vision on social and policy issues. This socio-technical approach can also provide specific technological and behavioural transition routes and include commitments and targets for key actors. This categorisation coincides with the previous research from Rosenbloom,⁸² that identifies three separate kinds of transition pathways (as explained in Box 1).

The practical findings of this report (see section 3) illustrate how the majority of the identified transition pathways adopt a techno-economic approach, as they are restricted to mapping technological advances from a market-based perspective. These pathways are authored by diverse stakeholders, such as business organisations, consultancies, or agencies from the UN. In some cases, such transition pathways go beyond being a participation process or a narrative of desired visions of the future and also become policy instruments. This is essentially the case in the GD GROW transition pathways, as they encompass shared analysis and visions for the future with a set of shared aims and goals, and shared commitments, in a way that it does not represent just a policy but a broader societal commitment that includes private stakeholders along with public

81 Hebinck, A., et al. (2022). An actionable understanding of societal transitions: The X-curve framework. *Sustainability Science*, 17(3), 1009–1021. <https://doi.org/10.1007/s11625-021-01084-w>

82 Rosenbloom, D. (2017). Pathways: An emerging concept for the theory and governance of low-carbon transitions. *Global Environmental Change*, 43, 37–50. <https://doi.org/10.1016/j.gloenvcha.2016.12.011>

institutions. The socio-technical approach to transition pathways is illustrated by the transition pathways published by DG GROW. This group of transition pathways include a broader scope that includes political, institutional and social factors in the design of a transition (as discussed in section 2).

The analysis of existing transition pathways illustrates the differences between two approaches to drafting transition pathways. This division in approaches (socio-technical vs techno-economic) further correlates with the level of stakeholder involvement, both regarding the development and the foreseen implementation of transition pathways. The DG GROW transition pathways are the result of a broad deliberation process including a wide and representative number of stakeholders, and they include a set of commitments shared by the participating stakeholders and the European Commission. This broader participation process and stakeholder commitments to ensure the effort sharing align with the socio-technical perspective on transitions. Instead, the other pathways, characterised by a techno-economic approach, do not include explicit processes of stakeholder involvement or any explicit commitment to their implementation.

The academic literature provides a set of key features for developing transition pathways (explained in section 2.3). These features may serve as a guide/good practice for stronger and more purposeful transition pathways and can provide valuable grounds to assess their soundness. Comparing the practical transition pathways published by practitioners with academic thinking on how to build transition pathways illustrates significant gaps but suggests that DG GROW pathways are more aligned with features prescribed by the research literature. This comparison further indicates that transition pathways published by other organisations don't reflect the same level of complexity of transitions and regularly do not cover dimensions other than technological change. However, it is important to note that this lack of complexity may also reflect critical contextual elements, such as the type of organisation that elaborates and publishes the transition pathway, or the role that the involved organisations play in advancing a sustainability transition. In this sense, it is important not to look at different transition pathways in isolation, but to understand that these documents play a role within a broader political context. As one of the interviewees phrased it, different transition pathways can be seen as small pieces of a bigger puzzle that is the transition towards a sustainable or climate neutral economy.

The key features of transition pathways (see section 2.3) stress the need for robust and diverse stakeholder participation to develop transitions pathways and ensure their implementation. However, research also indicates that the inclusivity and diversity of stakeholders is an element often overlooked within transition pathways.⁸³ In the case of the transition pathways from DG GROW, the

83 Berka, A., Hoicka, C., Sperling, K., Turner, J., MacArthur, J., & Hytten, K. (2022). Just Transitions in Context: A Universal Framework for Comparing Transition Pathways and Policy Mixes in Terms of Inclusivity. SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.4071205>

stakeholders involved in their deliberations were mostly trade and business organisations (19 in total), whereas the presence of NGOs and worker unions was limited, and only one academic research organisation participated (Box 2). These differences in power relations within stakeholder groups can strongly influence what issues are debated and how the ability to draw agreements is biased towards certain stakeholder groups, while other voices that can ask for more transformative changes are either absent from the debate or sidelined. This raises questions about the ability of these transition pathways to define more holistic and broader reforms, changes to social configurations and, overall, more goals.

4.2. Implications for policy-makers

This report illustrates how transition pathways are an instrument for the exploration and construction of visions of the future through narratives, the identification of transformative knowledge and for identifying tools and governance mechanisms to enact a desirable future.⁸⁴ Transition pathways can also support the creation of roadmaps for policy-makers to plan medium-term changes, such as the sectoral transition towards a sustainable economy, the achievement of the SDGs, or the urban transformations to build a climate neutral and more sustainable society. Although transition pathways are mostly used as a reference to envision future trends on issues such as climate mitigation (techno-economic approaches), transition pathways have the potential to be used as a tool for policy planning and for creating shared societal commitments towards a sustainability transition (socio-technical approaches). Transition pathways can also help guide public policy by incorporating elements such as deadlines, indicators, and the definition of milestones and goals for medium- and long-term planning. In this sense, the transition pathways published by DG GROW can be a useful example of good practices to inspire the creation of new transition pathways to guide policy-making in the medium and long term.

The existence of relatively shared timeframes (predominantly with a view towards 2050) and shared goals in a majority of documents (climate neutrality) hints at how transition pathways tend to have a shared inspiration, either rooted in shared agreements (such as the Paris Agreement of 2015) or in coordinated policies (such as the policy goals of the EU for climate neutrality by 2050). This raises the question of who should be responsible for developing transition pathways and at what level. In this sense, central governments seem to have the potential to coordinate or provide guidelines for such transitions with holistic and more ambitious approaches to transition pathways, enable socio-technical approaches and include policy commitments to strengthen such transitions.

84 Hebinck, A., et al. (2022). An actionable understanding of societal transitions: The X-curve framework. *Sustainability Science*, 17(3), 1009–1021. <https://doi.org/10.1007/s11625-021-01084-w>

4.3. Advice on building future transition pathways

Based on the review of the multiple approaches to building transition pathways in the literature, this report proposes a set of guidelines and elements to ensure good practices when drafting new transition pathways. Firstly, transition pathways are defined as an instrument to enable the collective definition of desired futures and to create the critical knowledge that enables transformation towards these futures. To achieve that aim, transition pathways need to be created as a methodology that enables deliberation and includes a broad set of relevant stakeholders, taking into consideration the context in which these pathways are developed.

Secondly, transition pathways discuss the contextual elements and ambitions to change reality and enable desired future outcomes. Such contextual elements and ambitions may be the environmental objectives, including issues such as climate change, resource depletion or pollution. Additionally, social objectives and geopolitical elements are integrated by giving consideration to a fair transition or the need to overcome strategic dependencies on third countries or to contribute to global commitments such as the Paris agreements. These contextual elements can be considered both in analysing the present situation and identifying potential unsustainable situations, necessary transformations, and defining desirable outcomes regarding these three issues. Although the three fields that compose the environmental, social and geopolitical aspects are listed separately, it is important to note that these three elements are interconnected and dependent on each other, as, for instance, the implementation of renewable sources of energy can reduce energy dependencies on third countries and reduce prices, improving access across society. Also, the promotion of circular economy measures reduces the dependence on strategic minerals and other materials that are imported from third countries, alleviating geopolitical dependencies.

Thirdly, transition pathways may include actions for change. These actions include knowledge creation, public policy and actions regarding the social context. The reflection of the role of these elements is central to defining the pathways to build desired future outcomes. Transition pathways can identify the state of the art, and how to guide the development of knowledge and innovation in the direction of enabling the desired future outcomes previously discussed. Finally, several transition pathways also consider the role of societal aspects in enabling such transitions and how such roles can be tapped through initiatives such as reskilling the workforce or educating citizens to incentivise new behaviours.

Finally, some transition pathways explore the role of responsibilities in promoting such transitions, along with the mobilisation of public policies and public and private investments to enable such transitions. The division of responsibilities includes the definition of specific tasks, the definition of timelines, responsible

stakeholders, and even a monitoring framework to ensure the compliance of this transition. The definition of responsibilities may be useful to help visualise the role of different stakeholders in building such a transition, and can play a role in going beyond the initial aim of the transition pathway to explore how desirable futures can look and create knowledge for system transformation.

Table 4 Guidelines for best practices to build transition pathways

Structural elements	Field	Good practices	Definition
Methodological issues	Stakeholder participation	Open to stakeholder input	Transition pathways should be a collective exercise.
	Aim	Explore plausible futures	Transition pathways should primarily aim to explore what desirable futures can look like, and generate knowledge for system transformation.
	Timelines	Medium-term and long-term vision	Transition pathways are intended to guide changes from medium- and long-term perspectives.
Contextual elements and ambitions	Objectives (environmental)	Comprehensive vision of environmental impacts	Avoid the carbon tunnel vision and review the environmental impacts broadly.
	Objectives (social)	Consider how to build a just transition	Revision of the impact of the transition across all societal groups.
	Geopolitical aspects	Include international context	Revision of existing geopolitical vulnerabilities and contribution to international commitments.
Actions towards change	Knowledge creation	Develop R&I towards transformative change	Recognise directions for research and innovation to generate new knowledge for systemic change.
	Social aspects	Build new social behaviours and skills to build change	Define societal changes needed to enable the transition.
Responsibilities	Implementation	Public policy directed towards change	Define policies and investments needed for enabling the transition, including the uptake of new practices and the phase down of old practices.
		Definition of responsibilities, timelines and actions	Transition pathways should avoid replicating roadmaps, since their focus is to explore desired futures and the pathways towards them. However, their insights can be combined with the future definition of roadmaps or policy strategies.

4.4. Limitations

Transition pathways still constitute a novel conception, lacking universally accepted definitions and frameworks, and constantly evolving as different types of organisations use them in different ways. This poses challenges in terms of scope and understanding of the concept, which may affect the comparability and consistency of the analysis. To mitigate this risk, a narrow selection approach was adopted when identifying published transition pathways for inclusion in the study.

The identified transition pathways currently available provide strategies for possible future interventions, making it inherently challenging to analyse the appropriateness of such plans. The lack of empirical evidence on the actual outcomes could limit the study's ability to draw concrete conclusions about the effectiveness or viability of the transition pathways.

Transition pathways are intended as a tool to enable reflection on how to explore desirable futures and to build transformative knowledge. The inherent limitations of transition pathways are therefore mitigated by combining their use with other instruments (instead of being used as a stand-alone approach) that may vary according to the policy and social context or the creator of them.

The study's scope might be restricted by a limited set of search terms used to identify relevant literature and the published transition pathways. This could potentially cause valuable sources of information to be overlooked, reducing the comprehensiveness of the literature review and the insights gained from the selected publications.

The reviewed documents are predominantly in English (27 out of 40 reports), which could introduce bias and restrict the generalisability of the study's findings. This approach may exclude insights that are present in research and practical transition pathways conducted in other languages, and possibly overlook important perspectives and experiences that could contribute to a more comprehensive understanding of the subject matter. To compensate for the predominance of English documents and obtain a broader vision of how transitions to the future are addressed, we introduced an additional 13 documents in French, Dutch, Spanish, Catalan and Italian. Also, we introduced reports that referred to different geographical scopes, as well as different administrative levels (such as regional, national, intranational and international).

5. Economic sectors with highest environmental impact

5.1. Identification of sectors with high environmental and climate impact

In line with the TOR for this task, this section provides suggestions for sectors that could be identified as a priority for transitioning due to their environmental and/or climate impacts.

The suggestions are based on a 2020 study implemented by Ramboll for DG ENV called “Sustainable finance taxonomy: Data collection and environmental objectives”,⁸⁵ which supported the Platform on Sustainable Finance by providing data on the environmental impact of economic activities and the potential for reducing this impact, in relation to the taxonomy’s environmental objectives 3 to 6, i.e.:

- Sustainable use and protection of water and marine resources;
- Transition to circular economy, waste prevention and recycling;
- Pollution prevention and control;
- Protection of healthy ecosystems.

While having served a different original purpose, the outputs of the DG ENV study provide important insights regarding the prioritisation of sectors with the highest environmental impact. The results of the data collection and analysis of limits for a sequencing of sectors, i.e., identifying a priority list of economic activities with the highest negative environmental impact (and the highest potential for reducing them). A short summary of the approach followed in that study is presented in Appendix 2: Overview of approach in study “Sustainable Finance Taxonomy: Data Collection and Environmental Objectives”. For reusing the results of that study, it is beneficial that the structure of the sustainable finance taxonomy (i.e., the environmental objectives) to some extent align with the six thematic priority objectives of the 8th Environmental Action Programme (EAP). However, as mentioned above, the study for DG ENV did not include the two climate objectives in its scope, i.e., climate neutrality, and adaptation and resilience to climate change. For climate neutrality, EEA data on the highest emitting sectors in the EU can be used to inform prioritisation.⁸⁶ For adaptation and resilience to climate change, no relevant metrics were identified, and no list was developed.

85 SPECIFIC CONTRACT No 070203/2020/826904/SFRA/ENV.F.1 Implementing framework contract No ENV.F.1/FRA/2019/0001

86 EEA. (2023, April 18). EEA greenhouse gases—Data viewer. <https://www.eea.europa.eu/data-and-maps/data-data-viewers/greenhouse-gases-viewer>

For the purpose of identifying relevant sectors, the lists of economic activities developed in the DG ENV study (see Appendix 3: Lists of economic activities with high environmental impact) were condensed to the top five sectors according to the taxonomy's environmental objectives. In practice, this was done by bundling the listed economic activities into sector categories.

5.2. Sector prioritisation

This section outlines the top five sectors per category covered in the studies described above, i.e., the sustainable finance taxonomy's environmental objectives 3 to 6⁸⁷ and the EEA results on the highest emitting sectors in the EU. Reflections on the results and key considerations for prioritising sectors in the transition focus.

Priority sectors per category are listed in Table 5. Due to the nature of this exercise, in which previous findings on impactful economic activities are grouped into overarching sectors, the outcome should be seen as a general indication of the most relevant sectors rather than a definitive list. Along these lines, the order of sectors listed under each area is indicative. The impact of sectors also depends on contextual factors, including differences in local vulnerabilities of nature and societies across the EU. Such considerations have not been taken into account.

Table 5 Mapping of high impact sectors per environmental and climate category

Sustainable use and protection of water and marine resources	Transition to a circular economy	Pollution prevention and control	Protection of healthy ecosystems	Mitigating climate change (reducing GHG emissions)
Agriculture	Industry/product manufacturing	Agriculture	Agriculture	Energy
Industry/product manufacturing	Construction	Industry/product manufacturing	Mining	Transport
Transport	Energy	Transport	Forestry	Industry/product manufacturing
Mining	Transport	Energy	Tourism, sports, and leisure	Buildings ⁸⁸
Aquaculture	Agriculture	Waste treatment	Energy	Agriculture

Source: Ramboll, based on findings from Ramboll study for DG ENV called "Sustainable Finance Taxonomy: Data collection and environmental objectives" (2020) and data from the EEA (2023).
Note: The sectors for all categories except 'mitigating climate change' have been derived from longer

⁸⁷ Sustainable use and protection of water and marine resources (3); Transition to circular economy, waste prevention and recycling (4); Pollution prevention and control (5); Protection of healthy ecosystems (6).

⁸⁸ Emissions from direct use of fossil fuel in residential and commercial buildings.

sequences of economic activities, developed in the study “Sustainable Finance Taxonomy: Data collection and environmental objectives” (2020).

Note: For ‘adaptation and resilience to climate change’ no suitable metrics were identified. No list was developed for this category.

Reflections on the possibility of accelerating transitions in high impact sectors

The table above shows that the agricultural sector has a significant impact on several of the categories, and that it is on the list of most impactful sectors for all of them. Agriculture strongly influences water resources through diking and irrigation activities, and contributes to soil degradation, chemical pollution and biodiversity loss by using large amounts of fertiliser and pesticides. Moreover, emissions from the agricultural sector have been more or less stable since 2005 and are projected to decrease by a mere 1.5% between 2020-2040⁸⁹, a period for which major reductions are needed to achieve EU emissions targets.

Together, this calls for ambitious environmental and climate action within the **agricultural sector**. Various opportunities exist for reducing the negative impact of agriculture without jeopardising production volumes, including the use of low carbon fuels and electric machinery, applying crop-rotation and cover cropping techniques. Demand side efforts like shifting to plant-based diets and reducing food waste can also help reduce the sectors impact. Despite the availability of solutions, the prospects of rapid transformation in the agricultural sector are impaired by stakeholder opposition and climate and environmental policy inertia. For example, emissions from agriculture are not covered by the EU Emissions Trading Scheme (EU ETS),⁹⁰ and the Common Agricultural Policy has not effectively incentivised climate change mitigation activities.⁹¹ Recent farmer protests in several EU countries, which led to the European Commission allowing a one-year derogation from new rules to keep 4% of farmland fallow,⁹² further highlight the sensitivity of agri-related policy. Against this backdrop, there appears to be limited room for pushing transitions within the agricultural sector at the moment.

Besides agriculture, the **industry and product manufacturing, transport and energy sectors** also stand out in terms of their environmental and climate impact. These three sectors are highly impactful, especially in their contribution to climate

89 EEA. (2023, April 26). Progress and prospects for decarbonisation in the agriculture sector and beyond.

<https://www.eea.europa.eu/publications/Progress-and-prospects-for-decarbonisation/progress-and-prospects-for-decarbonisation>

90 European Commission. (n.d.). Scope of the EU Emissions Trading System. Retrieved February 2, 2024, from

https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/scope-eu-emissions-trading-system_en

91 European Scientific Advisory Board on Climate Change. (2024). Towards EU climate neutrality: Progress, policy gaps and opportunities. Publications Office of the European Union. [https://climate-advisory-](https://climate-advisory-board.europa.eu/news/eu-climate-advisory-board-focus-on-immediate-implementation-and-continued-action-to-achieve-eu-climate-goals)

[board.europa.eu/news/eu-climate-advisory-board-focus-on-immediate-implementation-and-continued-action-to-achieve-eu-climate-goals](https://climate-advisory-board.europa.eu/news/eu-climate-advisory-board-focus-on-immediate-implementation-and-continued-action-to-achieve-eu-climate-goals)

92 European Commission. (2024, January 31). Commission proposes to allow EU farmers to derogate for one year from certain agricultural rules. https://ec.europa.eu/commission/presscorner/detail/en/IP_24_582

change and in the generation of polluting particles. They also present notable opportunities to build the transition to a circular economy and reduce the material footprint of the EU. In this sense, the report brings attention to the potential environmental benefits if the European Commission designs ambitious policies targeting these sectors.

The **industry and product manufacturing sector** has significant importance in several categories, and it is a sector with great potential for improvements in water consumption, the circular economy transition, the contribution to climate change, and pollution reduction. Industrial production processes are highly dependent on water resources, and in Europe industry is the second biggest user of water. Responsible for a hefty 50 per cent of total water consumption,⁹³ European industry uses more water annually than agriculture (30%).⁹⁴ Further, EU industry plays a central role in the transition to a circular economy, as industrial processes shape the design of production, repairability or the ability to use recycled material. Yet this transition shows a low level of adoption, as the circular material use rate in the EU has only increased 1% between 2010 and 2021.⁹⁵

A more ambitious approach to industry and product manufacturing policies could create the opportunity to reduce the carbon and material footprints of the EU while also reducing issues such as pollution and water consumption. The enactment of an ambitious circular economy with a strong position towards sustainability requires considerable changes in consumption models. This means finding ways to reduce the consumption of new products and improve on issues such as repairability, durability of products, promoting second-hand markets and lease-based approaches to consumption. Also, these new consumption patterns can be complemented with new and more efficient production technologies, enabling new production methods with a lower environmental footprint.

Moreover, there is tremendous potential for the **transport sector** to improve its environmental performance and to help with the achievement of the sustainability goals of the EU. The transport sector saw a steady increase in its greenhouse gas emissions from 2013 until the disruption of the Covid-19 pandemic, largely due to growth in passenger transport and inland freight volumes. During the Covid-19 pandemic, GHG emissions associated with transport fell by 13.5%, but

93 As clarified by EEA, 2023. Water use in Europe — Quantity and quality face big challenges — European Environment Agency (europa.eu). <https://www.eea.europa.eu/signals-archived/signals-2018-content-list/articles/water-use-in-europe-2014>

94 Partnerships and cooperation for water. (2023). United Nations Educational, Scientific and Cultural Organization.

95 EEA. (2023). 8th Environment Action Programme: Circular material use rate in Europe.

<https://www.eea.europa.eu/publications/european-union-8th-environment-action-programme/indicators/15-circular-material-use-rate/view>

rebounded in 2021, rising by 8.6%.⁹⁶ These emissions need to decline significantly to meet the Paris agreements on GHG. The same problem is repeated in the control and prevention of pollution (including nitrogen oxides or sulphur dioxide emissions), and to protect water and marine environments (including the generation of underwater noises by maritime transports or the unintended introduction of new non-indigenous species in European waters).⁹⁷

Europe cannot improve its climate and environmental ambitions without a sustainable mobility system based on cleaner and more active transport modes, cleaner fuels and, where possible, reducing the need for mobility. This can be achieved by fostering innovation and adopting technology that enables the use of alternative fuels, batteries and onshore power supply in transport systems. Also, new modes of transport, such as the creation of long-distance cross-border passenger rail services can help to lower the environmental impact of transport.⁹⁸ The EU can further broaden its vision to mitigate the impact on transport by reducing mobility. Enabling online working and reducing consumption (for instance, limiting fast-fashion can reduce the import of low-cost goods) are the most ambitious measures to lower the environmental impact of transport.

The adoption of more ambitious measures in the **energy sector** can help achieve the EU environmental objectives. The most urgent issues related to the energy sector are its associated impact in the form of GHG emissions – although the energy sector plays a role in the circular economy transition –, the release of harmful substances, and the impact on ecosystems.

The consumption of energy in the EU has been decreasing since 2005.⁹⁹ Also, the share of renewables in energy consumption in Europe went from 10% in 2005 to 22.5% in 2022.¹⁰⁰ These trends in the energy sector are highly encouraging, but they still fall short considering the new target of 42.5% for renewable energy by 2030. To meet the EU goals on renewable use, it is necessary to double the rates of renewables deployment in comparison to the deployment rates from the past decade, and it is important to transform the European energy system.

96 EEA. (2023, October 24). Greenhouse gas emissions from transport in Europe.

<https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-from-transport>

97 EEA. (2023, February 9). EU maritime transport: First environmental impact report acknowledges good progress towards sustainability and confirms that more effort is needed to prepare for rising demand.

<https://www.eea.europa.eu/highlights/eu-maritime-transport-first-environmental>

98 Steer & KCW. (2021). Long-distance cross-border passenger rail services: Final report. Publications Office of the European Union.

99 EEA. (2023). 8th Environment Action Programme: Energy consumption: Primary and final energy consumption in Europe. <https://www.eea.europa.eu/publications/european-union-8th-environment-action-programme/indicators/13-energy-consumption-primary-and/view>

100 EEA. (2023). 8th Environment Action Programme: Share of energy consumption from renewable sources in Europe. <https://www.eea.europa.eu/publications/european-union-8th-environment-action-programme/indicators/14-share-of-energy-consumption/view>

The policies to transform the EU energy system can benefit from creating a holistic transformation that establishes changes in connection with other sectors. For instance, energy consumption can significantly decrease by promoting smarter mobility systems, such as improvements in the biking infrastructure within EU cities. These can reduce the demand for non-electrified forms of energy (such as fuel) in transportation, reducing demand for cars and energy demand in manufacturing. Other examples are the transition to an ambitious circular economy, consumption based on repairing and refurbishing, and moving away from waste and extraction, which all involve a significant reduction in energy needs. It is important that the circular economy is based on ideas such as product durability and repairability and reduces its dependence on recycling, as recycling activities can be energy intensive and can unintentionally aggravate the environmental performance of the energy sector in the EU.

In short, the sectors of industry and product manufacturing, transport and energy have the opportunity to reduce the environmental impact of the EU and to significantly contribute to meeting the EU environmental ambitions. These sectors offer the advantage that there are available techniques and means to drive improvements in reducing their environmental impact (two examples are the existence of repairability methods in existing products, and the existence of train infrastructure across the continent for the creation of long-distance routes for cleaner transportation). Further, several measures and goals have already been approved and integrated within the EU policy framework. These include, amongst others, the adoption of the circular economy action plan, and the renewable energy target for 2030. Finally, there is general support at the societal level and among relevant stakeholders in these sectors to promote more transformative policies for sustainability. The existence of agreed policies and targets for the technical means, along with the high environmental impact of these three sectors can be seen as a key opportunity to meet the EU's ambitious environmental goals and to accelerate the transition towards a sustainable Europe.

Other sectors with significant environmental or climate impact that appear in Table 5 are **mining, construction and buildings, waste treatment, and the tourism, sports and leisure sector**. They all appear under one or two categories respectively. Hence, action within these sectors can be explored depending on the categories sector for which the transformation is considered most pressing (mining for the categories of 'Sustainable use of water resources' and 'Protection of healthy ecosystems', construction for 'Transition to a circular economy', waste treatment for 'Pollution prevention and control'). Overall, these sectors are important according to the mapping above, but perhaps not as relevant as some of those previously discussed.

6. Bibliography

- Berka, A., Hoicka, C., Sperling, K., Turner, J., MacArthur, J., & Hytten, K. (2022). Just Transitions in Context: A Universal Framework for Comparing Transition Pathways and Policy Mixes in Terms of Inclusivity. SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.4071205>
- de Haas, W., & Dijkshoorn-Dekker, M. (2021). Tools for transition. Wageningen University & Research, Communication Services. <https://doi.org/10.18174/554460>
- Elzen, B., de Haas, W., Wigboldus, S., Bos, B., & Dijkshoorn-Dekker, M. (2020). Transition pathways—Contours of an analytical framework. Stichting Wageningen Research, Wageningen Plant Research, Business Unit Field Crops. <https://doi.org/10.18174/525092>
- Erdos, K., Foray, D., Georghiou, L., Gołębiowska-Tataj, D., Kivimaa, P., Koundouri, P., McCann, P., Morgan, K., Plataniotis, A., Radošević, S., Renda, A., Rodríguez-Pose, Andrés., & Tripl, M. (with Schwaag Serger, S., Soete, L., & Stierna, J.). (2023). The square: Putting place-based innovation policy for sustainability at the centre of policymaking. Publications Office of the European Union.
- European Commission. Joint Research Centre. (2020). Projecting Opportunities for INdustrial Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition. Publications Office. <https://data.europa.eu/doi/10.2760/590389>
- European Commission. Joint Research Centre. (2023). Towards a fair and sustainable Europe 2050 :social and economic choices in sustainability

transitions. Publications Office.

<https://data.europa.eu/doi/10.2760/561899>

European Commission. Joint Research Centre. & European Institute of Innovation and Technology Climate KIC. (2022). Co-creation for policy: participatory methodologies to structure multi stakeholder policymaking processes. Publications Office.

<https://data.europa.eu/doi/10.2760/495731>

European Environment Agency (EEA). (2018). Perspectives on transitions to sustainability. Publications Office.

<https://data.europa.eu/doi/10.2800/332443>

European Scientific Advisory Board on Climate Change. (2024). Towards EU climate neutrality: Progress, policy gaps and opportunities. Publications Office of the European Union. <https://climate-advisory-board.europa.eu/news/eu-climate-advisory-board-focus-on-immediate-implementation-and-continued-action-to-achieve-eu-climate-goals>

Frantzeskaki, N., Hölscher, K., Holman, I. P., Pedde, S., Jaeger, J., Kok, K., & Harrison, P. A. (2019). Transition pathways to sustainability in greater than 2 °C climate futures of Europe. *Regional Environmental Change*, 19(3), 777–789. <https://doi.org/10.1007/s10113-019-01475-x>

Garvey, A., Norman, J. B., Büchs, M., & Barrett, J. (2022). A “spatially just” transition? A critical review of regional equity in decarbonisation pathways. *Energy Research & Social Science*, 88, 102630. <https://doi.org/10.1016/j.erss.2022.102630>

- Geels, F., Turnheim, B., Asquith, M., Kern, F., & Kivimaa, P. (2019). Sustainability transitions: Policy and practice. Publications Office of the European Union.
- Gereffi, G., & Fonda, S. (1992). Regional Paths of Development. *Annual Review of Sociology*, 18(1), 419–448.
<https://doi.org/10.1146/annurev.so.18.080192.002223>
- Hebinck, A., Diercks, G., Von Wirth, T., Beers, P. J., Barsties, L., Buchel, S., Greer, R., Van Steenberghe, F., & Loorbach, D. (2022). An actionable understanding of societal transitions: The X-curve framework. *Sustainability Science*, 17(3), 1009–1021.
<https://doi.org/10.1007/s11625-021-01084-w>
- Nauwelaers, C., Harding, R., Perianez-Forte, I., Arregui, E., & Haegeman, K. H. (2022). Towards Green Transition in EU regions: Smart specialisation for transformative innovation. Publications Office of the European Union.
- Nilsson, A. E., Bay-Larsen, I., Carlsen, H., Van Oort, B., Bjørkan, M., Jylhä, K., Klyuchnikova, E., Masloboev, V., & Van Der Watt, L.-M. (2017). Towards extended shared socioeconomic pathways: A combined participatory bottom-up and top-down methodology with results from the Barents region. *Global Environmental Change*, 45, 124–132.
<https://doi.org/10.1016/j.gloenvcha.2017.06.001>
- Partnerships and cooperation for water. (2023). United Nations Educational, Scientific and Cultural Organization.

- Pathways Network. (2021). Transformative Pathways to Sustainability: Learning Across Disciplines, Cultures and Contexts (A. Ely, Ed.; 1st ed.). Routledge. <https://doi.org/10.4324/9780429331930>
- Penna, C. C. R., Romero Goyeneche, O. Y., & Matti, C. (2023). Exploring indicators for monitoring sociotechnical system transitions through portfolio networks. *Science and Public Policy*, 50(4), 719–741. <https://doi.org/10.1093/scipol/scad015>
- Rosenbloom, D. (2017). Pathways: An emerging concept for the theory and governance of low-carbon transitions. *Global Environmental Change*, 43, 37–50. <https://doi.org/10.1016/j.gloenvcha.2016.12.011>
- Steer & KCW. (2021). Long-distance cross-border passenger rail services: Final report. Publications Office of the European Union.
- Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B., & van Vuuren, D. (2015). Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change*, 35, 239–253. <https://doi.org/10.1016/j.gloenvcha.2015.08.010>
- Turnheim, B., & Nykvist, B. (2019). Opening up the feasibility of sustainability transitions pathways (STPs): Representations, potentials, and conditions. *Research Policy*, 48(3), 775–788. <https://doi.org/10.1016/j.respol.2018.12.002>
- Warnke, P., Weber, M., & Leitner, K.-H. (2008). TRANSITION PATHWAYS TOWARDS USER-CENTRIC INNOVATION. *International Journal of*

Innovation Management, 12(03), 489–510.

<https://doi.org/10.1142/S136391960800200X>

Wigboldus, S. A., van Eldik, Z. C. S., & Vernooij, D. M. (2021). Transition pathways and transitions to sustainability: A critical exploration of perspectives, typologies and agendas. Wageningen Plant Research.
<https://doi.org/10.18174/559148>

7. Appendix 1: Reports containing examples of transition pathways

#	Title	Year of publication	Lead author	Language
1	Zero-Emission Vessels: Transition Pathways.	2019	Lloyd's Register (LR) and University Maritime Advisory Services (UMAS)	English
2	Industrial Transformation 2050 Pathways to Net-Zero Emissions from EU Heavy Industry	2019	Material Economics	English
3	Net Zero by 2050. A Roadmap for the Global Energy Sector.	2021	IEA – International Energy Agency	English
4	BioLPG: A Renewable Pathway Towards 2050	2021	Liquid Gas Europe	English
5	Transition Pathways for Canada's Oil and Gas Sector. How the sector can decarbonise operations and develop new net zero products.	2022	Canadian Climate Institute	English
6	Transition Pathway for Tourism	2022	European Commission DG Internal Market, Industry, Entrepreneurship and SMEs ¹⁰¹	English
7	Transition Pathway for Chemicals	2023	European Commission DG Internal Market, Industry, Entrepreneurship and SMEs	English
8	Transition Pathway for Construction	2023	European Commission DG Internal Market, Industry, Entrepreneurship and SMEs	English
9	Transition Pathway for Proximity and Social Economy	2023	European Commission DG Internal Market, Industry, Entrepreneurship and SMEs	English
10	Transition Pathway for Textiles	2023	European Commission DG Internal Market, Industry, Entrepreneurship and SMEs	English

101 The number of available transition pathways may change as new documents are published by DG GROW. See here for further information on transition pathways published by DG GROW: https://single-market-economy.ec.europa.eu/industry/transition-pathways_en

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#	Title	Year of publication	Lead author	Language
11	Driving Urban Transitions to a Sustainable Future (DUT)	2023	JPI Urban Europe	English
12	Urban Transition Pathways for the 2030 Agenda for Sustainable Development: Developing a National Roadmap for Sustainable Development Goal 11	2023	UN Economic and Social Commission for Asia and the Pacific	English
13	Pathways to Sustainable Energy	2023	United Nations Economic Commission for Europe	English
14	Sustainable infrastructure for the climate transition	2023	Global Infrastructure Hub (GI Hub).	English
15	Just Transition and Climate Pathways Study for South Africa. Chapter 1: Decarbonising South Africa's Power System	2023	National Business Initiative	English
16	Just Transition and Climate Pathways Study for South Africa. Chapter 2: Decarbonising South Africa's Petrochemicals and chemicals sector	2023	National Business Initiative	English
17	Just Transition and Climate Pathways Study for South Africa. Chapter 3: The role of gas in South Africa's path to net zero	2023	National Business Initiative	English
18	Just Transition and Climate Pathways Study for South Africa. Chapter 4: Decarbonising South African Mining Sector	2023	National Business Initiative	English
19	Just Transition and Climate Pathways Study for South Africa. Chapter 5: Decarbonising the Agriculture, Forestry and Land Use Sector In South Africa	2023	National Business Initiative	English

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#	Title	Year of publication	Lead author	Language
20	Just Transition and Climate Pathways Study for South Africa. Chapter 6: Decarbonising the South African Transport Sector	2023	National Business Initiative	English
21	Just Transition and Climate Pathways Study for South Africa. Chapter 7: Decarbonising South Africa's Heavy Manufacturing Sector	2023	National Business Initiative	English
22	Just Transition and Climate Pathways Study for South Africa. Chapter 8: Decarbonising South Africa's Building and Construction Sector	2023	National Business Initiative	English
23	India's energy-transition pathways. A net-zero perspective	2023	Deloitte	English
24	Development of a transition pathway towards a close to net-zero electricity sector in Italy by 2035. A state-of-the-art model-based optimisation approach	2023	ECCO the Italian Climate Change Think Tank	English
25	Sectoral Pathways for Financial Institutions	Unspecified (2022 or after)	Glasgow Financial Alliance for Net Zero (GFANZ)	English
26	Energy Pathways to 2050	2021	RTE France	English
27	Prospective Transitions 2050 - Rapport	2021	ADEME - Agence de la transition écologique	French
28	Transition Pathway for the Agri-Food Industrial Ecosystem	2024	European Commission	English
29	Plan sidérurgie : vers une sidérurgie française compétitive, innovante, décarbonnée et attractive	2022	Conseil National de l'Industrie	French
30	Feuille de route de décarbonation de la filière Chimie.	2021	Conseil National de l'Industrie	French

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#	Title	Year of publication	Lead author	Language
31	Feuille de route de décarbonation de la filière Ciment	2021	Conseil National de l'Industrie	French
32	Planification écologique : un plan d'action pour accélérer la transition écologique	2023	Ministère de la Transition écologique et de la Cohésion des territoires	French
33	Piano per la Transizione Ecologica	2022	Ministero dell'Ambiente e della Sicurezza Energetica	Italian
34	Pacte Nacional per a la transició energètica de Catalunya	2016	Generalitat de Catalunya	Catalan
35	Trajecten naar een klimaatneutrale samenleving voor Nederland in 2050	2024	PBL Planbureau voor de Leefomgeving	Dutch
36	Estrategia Asturiana de Acción por el Clima	2023	Consejería de Administración Autonómica, Medio Ambiente y Cambio Climático. Gobierno del Principado de Asturias	Spanish
37	Samen op koers naar duurzame infra in 2030	2022	Provincie Utrecht	Dutch
38	Visie 2050. Een langetermijnstrategie voor Vlaanderen	2016	Vlaamse Regering	Dutch
39	Estratègia energètica nacional i de lluita contra el canvi climàtic	2021	Oficina de l'Energia i del Canvi Climàtic d'Andorra	Catalan
40	Estrategia de Transición Justa	2020	Ministerio para la Transición Ecológica y el Reto Demográfico	Spanish

8. Appendix 2: Overview of approach in study “Sustainable Finance Taxonomy: Data Collection and Environmental Objectives”

The following steps were undertaken for each of the taxonomy’s environmental objectives 3 to 6:

First, a conceptual framework (‘assessment logic’) was developed to define the goal and scope of the objective and major drivers to such a goal based on the Taxonomy Regulation and other EU political frameworks or pieces of legislation relevant for the respective objective.

Then, a definition of what impact and potential improvements refer to and how they are assessed was developed for each of the objectives.

Subsequently, indicators and data needs were developed for conducting the assessment of the impact and potential improvements in each objective.

Guided by the assessment logic, the data collection and analysis of impact and potential improvements were carried out for each environmental objective and summarised in a comprehensive table

Results were used to assess the magnitude of impact & potential improvements per economic activity.

On the basis of the final assessments, sequences of economic activities are derived for each environmental objective

Based on that approach, the following types of sectors were identified:

Sectors with a high negative impact (i.e., footprint) on the environment

Sectors with activities that positively affect the objective

Economic activities that enable potential improvements in other sectors or activities with a high negative impact. An example of such an ‘enabling’ activity is ‘the manufacture of pollution control equipment’.

The lists of sectors through a multi-criteria-analysis (MCA). In this MCA, numerical weights were introduced to reflect the relative importance of each indicator, and the weighting was based on considerations that have emerged from literature research. However, different ranking options were still prepared, based on different scenarios for numerical weighting. In the next sections, not all the different scenarios are presented, but rather, per section, the one mentioned to be the “most likely” in the 2020 study; or, where this was not defined, the first one to be presented in the final report.

9. Appendix 3: Lists of economic activities with high environmental impact

Final results of MCA (incl. 'impact' + 'improvement potential' scores)		
Ranking	Name of sector / activity	Score
1	Growing of non-perennial crops	655
2	Growing of perennial crops	624
3	Manufacture of basic metals	485
4	Manufacture of rubber and plastic products	456
5	Inland passenger water transport	441
6	Inland freight water transport	441
7	Manufacture of chemicals and chemical products	426
8	Sea and coastal passenger water transport	421
9	Sea and coastal freight water transport	421
10	Manufacture of fabricated metal products + machinery and (electrical) equipment	391
11	Manufacture of basic pharmaceutical products and pharmaceutical preparations	386
12	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	381
13	Mining of metal ores ; Other mining and quarrying; Mining support service activities	349
14	Manufacture of leather and leather related products	341
15	Manufacture of ceramic products	340
16	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary	340
17	Freshwater aquaculture	311
18	Manufacture of paper and paper products	311
19	Construction	304
20	Marine Fishing	290
21	Manufacture of textiles	270
22	Other passenger land transport + Freight transport by road	254
23	Manufacture of cement, lime and plaster	240
24	Manufacture of glass and glass products	240
25	Raising of dairy cattle	204

Figure 5: Sequence of sectors for objective “Sustainable use and protection of water and marine resources”. Source: Study “Sustainable Finance Taxonomy: Data collection and environmental objectives”.

Note: Highest score means highest environmental impact, while at the same time also having a high potential for reducing the impact

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Final results of MCA (incl. 'impact' + 'reduction potential' scores)		
Ranking	Name of sector / activity	Score
1	27 Manufacture of electrical equipment	620
2	26 Manufacture of computer, electronic and optical products	620
3	13 Manufacture of textiles	615
4	14 Manufacture of wearing apparel	595
5	41 Construction of buildings	585
6	23 Manufacture of other non-metallic mineral products	505
7	15 Manufacture of leather and related products	505
8	10 Manufacture of food products	475
9	28 Manufacture of machinery and equipment n.e.c.	445
10	35 Electricity, gas, steam and air conditioning supply	445
11	16 Manufacture of wood and of products of wood and cork, except	415
12	20 Manufacture of chemicals and chemical products	410
13	42 Civil engineering	405
14	24 Manufacture of basic metals	375
15	25 Manufacture of fabricated metal products, except machinery	355
16	11 Manufacture of beverages	335
17	30 Manufacture of other transport equipment	310
18	17 Manufacture of paper and paper products	310
19	49 Land transport and transport via pipelines	310
20	43 Specialised construction activities	290
21	50 Water transport	280
22	29 Manufacture of motor vehicles, trailers and semi-trailers	280
23	21 Manufacture of basic pharmaceutical products and pharmace	245
24	51 Air transport	235
25	01 Crop and animal production, hunting and related service activit	195

Figure 6: Sequence of sectors for objective “Transition to a circular economy”. Source: Study “Sustainable Finance Taxonomy: Data collection and environmental objectives”.

Note: Highest score means highest environmental impact, while at the same time also having a high potential for reducing the impact

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Final results of MCA (incl. 'impact' + 'reduction potential' scores)		
Ranking	Name of sector / activity	Score
1	Crop production, including support activities	562
2	Manufacture of chemicals and chemical products	561
3	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	480
4	Other passenger land transport; freight transport by road and removal services; individual traffic	478
5	Manufacture of textiles + Manufacture of wearing apparel	439
6	Manufacture of basic pharmaceutical products and pharmaceutical preparations	427
7	Electric power generation, transmission and distribution	426
8	Manufacture of fabricated metal products + electrical and electronic equipment + motor vehicles and transport equipment	420
9	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	408
10	Manufacture of pesticides and other agrochemical products	396
11	Manufacture of rubber and plastic products	376
12	Water transport	366
13	Manufacture of cement, lime and plaster	363
14	Manufacture of glass and glass products	363
15	Manufacture of basic iron and steel and of ferro-alloys	361
16	Manufacture of ceramic products	357
17	Manufacture of leather and leather related products	349
18	Manufacture of other chemical products (explosives, glues, essential oils,)	331
19	Animal production	318
20	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	303
21	Treatment and disposal of hazardous waste	290
22	Specialised construction activities	267
23	Manufacture of other non-metallic mineral products	256
24	Construction of buildings	255
25	Manufacture of food products	253

Figure 7: Sequence of sectors for objective “Pollution prevention and control”. Source: Study “Sustainable Finance Taxonomy: Data collection and environmental objectives”.

Note: Highest score means highest environmental impact, while at the same time also having a high potential for reducing the impact

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Final results of MCA		
Ranking	Name of sector / activity	Score
1	Agriculture animal production	560,00
2	Agriculture crop production	560,00
3	Mining and quarrying	441,00
4	Forestry and logging	422,60
5	Tourism, sports and leisure activities	415,70
6	Marine fishing	328,80
7	Hydropower (dams, weirs, run-off-the-river)	324,00
8	Construction including conversion from other land uses	314,80
9	Passenger or freight land transport	276,00
10	Wind, wave and tidal power	270,10
11	Water transport	225,10
12	Marine aquaculture	212,00
13	Research and experimental development on natural sciences and engineering	210,40
14	Manufacture of food and beverage products	200,00
15	Waste collection, treatment and disposal activities; materials recovery	194,10
16	Real estate activities (including use of real estates)	181,60
17	Defence activities	143,80
18	Freshwater fishing	135,20
19	Freshwater aquaculture	135,00
20	Production of electricity	126,60
21	Manufacture of textiles	126,40
22	Manufacturing (impact due to use of buildings)	109,60
23	Transmission of electricity	101,60
24	Transport via pipeline	85,10
25	Solar power	78,60

Figure 8: Sequencing of sectors for “Biodiversity and ecosystems”. Source: Study “Sustainable Finance Taxonomy: Data collection and environmental objectives”.

Note: Highest score means highest environmental impact, while at the same time also having a high potential for reducing the impact

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