IIGCC

Principles for developing sector decarbonisation roadmaps - the investor perspective for policymakers

Contents

Executive summary

In the recent paper *Making Nationally Determined Contributions (NDCs) investable — the investor perspective,* IIGCC set out recommendations for how policymakers can better underpin economy-wide decarbonisation targets and help inform private investment decisions in the context of ambitious climate goals. A key recommendation was the development of sectoral pathways and supporting policy frameworks.

This paper builds on that recommendation and suggests that the development of sector decarbonisation roadmaps by policymakers could be an effective way to achieve this. IIGCC defines sector decarbonisation roadmaps as long-term strategic plans to support the decarbonisation of material sectors in a jurisdiction's economy.

Policymakers in several jurisdictions have developed sector decarbonisation roadmaps in recent years, albeit often with different names and large variation in the level of detail. These provide a significant amount of useful content but can also contain multiple key information gaps from the investor perspective.

This paper sets out IIGCC's key principles for the design of these roadmaps, for the consideration of policymakers. This is so the roadmaps can be more effectively used by investors to inform decision-making and investment processes while fulfilling their fiduciary duty to manage risk and return and protect the long-term value of their assets. If done well, the roadmaps can also better allow policymakers to attract the long-term investment required to implement ambitious climate goals.

IIGCC has worked with investor members of its sector decarbonisation roadmaps thematic working group to identify key investor use cases for roadmaps, and principles to help guide policymakers in developing them.

Policymakers should develop sector decarbonisation roadmaps that:	
1	Are **credible and decision-useful for investors** by being action-orientated and directly supporting economy-wide decarbonisation targets.
2	Provide clarity on how **current and anticipated government policies** will interact to support sectoral decarbonisation.
3	Are accompanied by **financing mechanisms** that articulate total investment needs alongside measures to de-risk and crowd-in private capital.

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Introduction

What are sector decarbonisation roadmaps?

Currently, there is no standardised or commonly agreed definition for sector decarbonisation roadmaps.[1] The terms roadmaps, pathways, and sector transition plans are often used interchangeably, but usually encompass long-term emissions reductions pathways or strategies, and accompanying measures designed to achieve sector-level decarbonisation targets.

Ultimately, it is the content and characteristics of these documents that matter, rather than what they are called. For consistency, throughout this paper they shall be referred to as 'sector decarbonisation roadmaps' or simply 'roadmaps'.

IIGCC defines sector decarbonisation roadmaps as long-term strategic plans developed by policymakers to support the decarbonisation of material sectors in a jurisdiction's economy. They should be underpinned by evidence-based emissions reduction pathways as well as the associated policy and financial levers to support the sector's transition.

This paper sets out IIGCC's key principles for how to design these roadmaps so they can be used by investors to inform their decision-making.

How they relate to economy-wide decarbonisation goals

Headline emissions reduction targets, generally included in Nationally Determined Contributions (NDCs) under the Paris Agreement, set out a useful but broad picture of a country's climate and development trajectory.

Through IIGCC's recent paper Making NDCs investable — the investor perspective, investors have suggested several elements policymakers can provide to underpin NDCs, help inform private investment decisions, and better allow countries to attract the long-term investment required to implement ambitious climate goals. They include:

1. Provide more granular detail on the sectoral pathways and overarching macroeconomic context in a country.
2. Quantify investment needs and prepare financing strategies alongside NDCs, to help investors identify long term investment opportunities.
3. Set out supporting policy and regulatory frameworks to achieve NDC targets, to help give investors confidence that a decarbonisation plan is credible.

Policymakers developing robust sector decarbonisation roadmaps can help achieve all three in the context of their country's sectoral, developmental and geographic nuances.

1 A project standard (prEN 18074: Industrial decarbonization — Requirements and guidelines for sectoral transition plans) is under development by CEN/CENELEC Technical Committee (TC) 467 – Climate Change. CEN/CENELEC are officially recognised European voluntary standards organisations.

The benefits for investors and policymakers

By setting out criteria and actions around which investors, policymakers and wider industry stakeholders can coalesce, sector decarbonisation roadmaps can help to build a 'common language' for understanding barriers to, and opportunities for, decarbonisation. When accompanied by clear policy signals and tailored financing mechanisms, they can create the incentives and certainty needed to accelerate transition efforts and align capital expenditure with emissions reduction targets.

More specifically, sector decarbonisation roadmaps can provide:

- Improved **understanding of the trajectory and pace of emissions reductions** envisaged for economic sectors material to a country's decarbonisation, and associated policy and technological levers to support the transition.
- Clarity on the **sequencing considerations, interdependencies and trade-offs** that will need to be navigated as part of this transition, including technological and policy-related milestones.
- A **bridge between economy-wide emissions reduction targets and the growing number of entity-level transition plans** being developed by corporates and financial institutions.

This increased clarity will be conducive to long-term investment decision making. Much of the supporting materials for the development of these roadmaps are likely to exist already. But investors have emphasised the benefits of collating these materials in a way that 'joins the dots' between sectoral decarbonisation targets, emissions reductions trajectories, and the various levers to accelerate progress.

State of play: sector decarbonisation roadmaps today

Policymakers in several jurisdictions have undertaken work to develop sector decarbonisation roadmaps in recent years. While a wide range of approaches are being adopted, some common elements include:

- A focus on the most energy-intensive or hard-to-abate sectors.
- Links to wider national or regional emissions reduction targets, and the sector's contribution towards these.
- Attempts to provide transparency over the associated policy and technological levers to accelerate decarbonisation.

Current roadmaps provide much useful information and represent important contributions to debates about how economies and sectors will decarbonise. Annex 1 contains overviews of existing roadmaps from the EU, Japan, Australia and France. It should also be noted that in their updated NDCs published during COP29, both Brazil and the United Arab Emirates include details on the role of sectoral pathways in supporting their national climate commitments, pointing to potential further more detailed work in this area.

The challenges

However, current roadmaps often contain multiple **key information gaps from the investor perspective.** This limits the extent to which investors can use them to inform decision-making. Issues can include:

- **No common understanding** of the key features and components that should be included in sector decarbonisation roadmaps.
- Significant **variations in ownership of roadmaps** (e.g. government, industry, civil society) and level of stakeholder input into their development.
- **Disconnected from wider national decarbonisation action plans** and initiatives (e.g. NDCs).
- Global sectoral decarbonisation pathways often referenced, but often **lack references to more specific national or sectoral pathways** that would enhance relevance and credibility.
- Significant variations in **quality and level of detail**.
- Lack of focus on **financial levers** to crowd-in finance towards a sector's decarbonisation.
- Lack of detail on **actionable measures** intended to support sectoral decarbonisation.

To make roadmaps more decision-useful for investors, the most immediate priority for policymakers should be to build consensus on the core components they need to include. While a balance will always need to be struck, emphasis should be on providing relevant information in as concise and easily digestible a format as possible. The high-level principles set out in this paper provide investor-led insights into what these core components should be.

In addition, detailed analysis of a specific roadmap through a case study on the EU's transition pathway for the chemical industry can be found in Annex 2. This includes an overview of information gaps from the investor perspective as compared to the key design principles set out in this paper.

Investor uses for sector decarbonisation roadmaps

Investors could use roadmaps developed by policymakers in four main ways. These align with key elements of IIGCC's Net Zero Investment Framework (NZIF), the most widely used guide by investors to set their own targets and produce related net zero strategies and transition plans.

1. **Inform asset allocation decisions** by supporting assessments of:

- Transition-related risks and opportunities across their portfolios.
- The investment potential in sectors that are material to a given jurisdiction's decarbonisation.
- The deployment trajectories of climate solutions, alongside overall financing needs and gaps.
- Assets and technologies that present a potential stranding risk, making it easier to identify, manage and, as necessary, phase them out.
- Entity-level corporate transition plans, particularly where these are dependent on external factors that vary according to local context such as policy environments, new infrastructure or other geographical dependencies.[2]

2. **Support stewardship activities** by informing engagement with companies on their transition plans, including on:

- How corporate transition plans compare to the decarbonisation trajectory for the relevant sector in a jurisdiction and the reasons for any divergence.
- How and why these comparisons differ between peers in a sector.
- Corporate responses to sector-level assessments and benchmarking, including targeted engagement with laggards.
- How the different levers for a company's decarbonisation interact, where key external dependencies lie, and the steps companies can take to address these.
- Whether any potential lack of progress is attributable to an inadequate company transition plan or the need for more supportive policy and financing mechanisms.

3. **Enable more effective dialogue with policymakers** about the policy landscape and how to drive investment in decarbonisation across the economy and at the sectoral level by:

- Providing a basis for collaboration to identify and address climate-related and economy-wide risks and develop supportive policy measures to facilitate this.
- Helping investors better contribute as stakeholders to policy processes, for example by providing more specific insights on sectoral investment barriers or effective financial instruments.
- Supporting the incorporation of fair share principles into sectoral and national-level target setting.
- Serving as a useful tool to assess a country's decarbonisation efforts and policy environment at the sectoral level and supporting, for example, associated engagement by sovereign bond holders.

4. **Inform their own climate-related disclosures**, both in relation to regulatory reporting requirements and wider disclosures in line with the above.

2 For further work on geographical dependencies and corporate transition plans, see the European Commission Joint Research Centre's Science for Policy Brief on Credible company transition plans for climate change mitigation: a geographical dependency assessment (August 2024).

Principles for effective sector decarbonisation roadmaps

1 Credible and decision-useful

To effectively enable the deployment of private capital in support of decarbonisation, sector decarbonisation roadmaps should directly support economy-wide national decarbonisation targets. They should be evidence-based, economically credible and provide information that is decision-useful for investors.

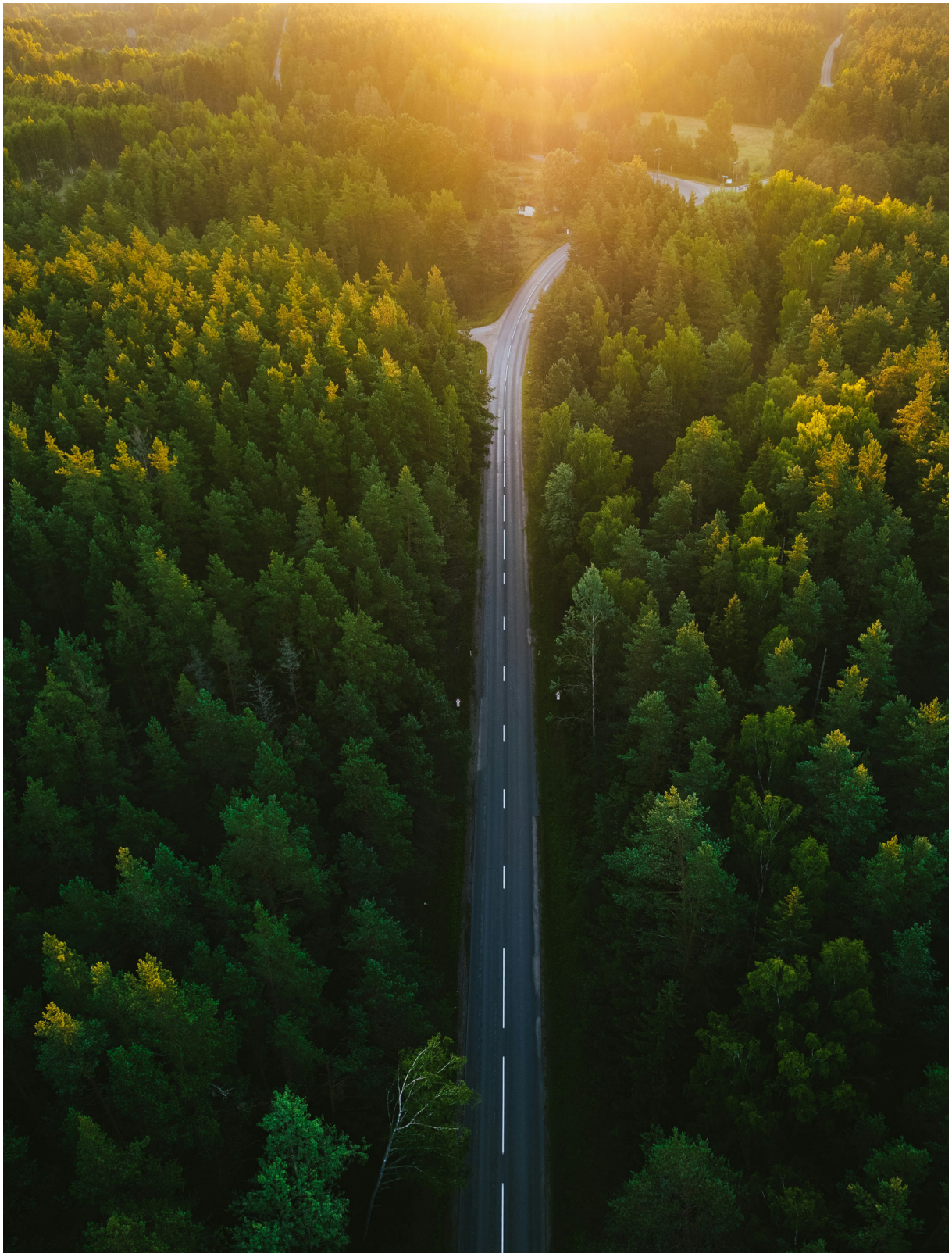
Policymakers should ensure they:

- Have **clear time-bound actions for relevant stakeholders** that can be transparently monitored.
- Clearly **reference and support the economy-wide emissions reduction targets** set out in a country's NDC and/or relevant legislation. These goals themselves should be consistent with the Paris Agreement.
- Are put in place for **the highest impact and most economically significant sectors in a jurisdiction as a priority**.[3] Coverage should then be expanded to provide a complete aggregate picture of how the economy will decarbonise.
- Are based on **emissions reduction trajectories and underlying assumptions consistent with recognised evidence-based pathways** developed by credible organisations. International or regional pathways should be **appropriately adapted to account for a given country's national circumstances**, whilst still reflecting a best effort basis in line with the Paris Agreement.
- Cover **emissions for all material greenhouse gases (GHG)** in a sector's roadmap, using distinct reduction pathways for each material GHG.[4]
- Cover **relevant upstream and downstream emissions**.
- Set a **clear deadline for the sector's decarbonisation**, underpinned by ambitious but achievable **interim targets and milestones**. This will enable the assessment of progress over time. Examples of this include the deadlines set by some countries for the decarbonisation of their power systems.
- Account for the **interactions between sectors**. For instance, in most countries the energy sector's decarbonisation path will have a major impact on all others. Sectoral disparities in availability and quality of data should also be acknowledged.
- Set out **key interdependencies and potential trade-offs**, including with nature and biodiversity, reliance on international value chains, feasible technology deployment rates, policy implementation, skills requirements and a just transition for workers in carbon-intensive industries. They should consider both the economic costs and benefits over time.
- **Account transparently for a sector's 'locked-in' future emissions** based on current and planned assets over their expected operating lifetime.
- Are informed by **forums that allow for meaningful dialogue with stakeholders across a sector's value chain**. These should include investors, businesses, civil society and other relevant groups.

3 For lists of high impact material sectors as a starting point, see IIGCC's Net Zero Investment Framework 2.0 (page 23) and the Science Based Targets initiative's Sector Guidance.

4 For an example of accounting for non-CO_2 gasses, see IIGCC's paper on Addressing methane emissions from fossil fuel operations.

- Are **reviewed on a regular basis and updated as necessary** to reflect progress, challenges and changing circumstances, noting that consistent policy direction is key for investment certainty. If appropriate updates could be linked to the review and setting of new headline emissions reduction targets as per relevant legislation and/or the Paris Agreement's five yearly NDC cycle.
- **Include underpinning data** on emissions pathways, technology deployment, total investment and financing needs, alongside **transparency over assumptions, methodologies and data sources**.



2 Clarity on how policy supports sectoral decarbonisation

Roadmaps should set out the policy initiatives being taken to decarbonise a sector and how these interact with the wider policy environment. They should also explain how these are expected to evolve as the sector transitions, and vice versa.

Policymakers should ensure they include:

- An **overview of the current and expected future policy mix** impacting a sector, including an explanation of **how policies interact** to support the sector's key decarbonisation levers. Where relevant, this should encompass both national and sub-national policy mechanisms and include those owned by different government ministries or departments.
- Details on addressing the **current policy, regulatory and market barriers** to a sector's decarbonisation and how **gaps and inconsistencies** will be tackled.
- Details on the **fiscal and market incentives and policies** that will make decarbonisation cost-competitive and the economic profile of climate solutions and transition-focused investments more compelling. This includes detail on relevant carbon pricing regimes. To be effective, there will generally need to be incentives for **both supply and demand-side measures**.
- Assessments of the **maturity of relevant technologies and their capacity to be scaled**, for example through the use of Technology Readiness Levels (TRLs).
- **Clear phase-out dates for environmentally harmful technologies and incentives**. Once these are set, it is important they remain consistent and backed by clear policies to be credible. Examples include deadlines set by some jurisdictions for new vehicles to have zero tailpipe emissions or the commitments certain countries have made to end fossil fuel subsidies by a given date.
- Consideration of **how the policy mix relates to the wider macroeconomic context**, including relevant international value chains as well as the potential social benefits and costs of the sector's decarbonisation. This should account for the potential benefits of less physical climate risks on the economy and society.
- Transparent explanations of **policy processes**, including how **holistic planning systems with clear governance and oversight** ensure effective implementation as well as reviewing and monitoring progress.
- **Transparency on the data underpinning policy development**, for example assessments on the quantitative costs and benefits of decarbonisation policies, associated financing requirements and the assumed role of marked-led forces. The availability of accurate and accessible data will ensure institutional investors are able to internally assess risk, long-term value creation, and reduce information asymmetry across policy frameworks.

3 Accompanied by financing mechanisms

Sector decarbonisation roadmaps should articulate the total investment needed to decarbonise a given sector and close financing gaps. They should also provide transparency over existing and planned financing mechanisms to de-risk and catalyse private investment flows.

Sector decarbonisation roadmaps should feature:

- Assessments of the **total investment needs** for the decarbonisation of the relevant sector, alongside **current and anticipated levels of public and private financial flows**. These should be placed in the context of the broader financing strategies that support economy-wide decarbonisation targets.
- Granular breakdowns of **financing and investment needs by sub-sector and relevant technologies**, where possible.
- An indication of how interventions to support the financing of projects and activities should be **prioritised based on their potential to accelerate sectoral decarbonisation and address barriers to investment**.
- A mapping of a sector's investment needs to **the most relevant sources of finance** that are expected to be mobilised, both public and private.
- Information about the **public and private financial instruments** that will be deployed to finance a sector's decarbonisation and how these support the delivery of climate targets. These will be **different for each sector** based on associated investment barriers, risk-return profiles, relevant technologies and their stage of maturity, as well as policy and other factors.
- Transparency about the relevant assumptions, methodologies and data sources underpinning these assessments **to enable the effective tracking of public and private financial flows**. Policy and financing mechanisms can then be adjusted where investment flows are insufficient.
- A process for **regular financing dialogues with stakeholders across the economy** to identify barriers to and opportunities for investment, and to help 'crowd in' private finance.

Examples of financing instruments

- **Public funding** can be used to finance or support projects and activities where commercial access to capital is either unavailable or prohibitively expensive. Examples include pull finance mechanisms such as direct grants and subsidies, tax credits, Research and Development (R&D) funding, Feed-in Tariffs (FiTs), Contracts for Difference (CfD), and green public procurement, particularly for sectors or technologies at a nascent stage of development.
- **Blended finance approaches** combine public or concessional funds with private finance to support early-stage solutions and scale-up technologies or activities that need additional de-risking to build market confidence, with the aim of catalysing further private investment. Examples of financial instruments that apply the blended approach include concessional loans, total/partial guarantees, first-loss capital, public-private partnerships, and catalytic funds.
- **Private financing instruments** can be utilised for projects and assets that are commercially viable, and which have already reached scale or full maturity. There is a significant opportunity to leverage financial instruments directly linked to the achievement of climate targets. These include use-of-proceeds bonds, sustainability-linked debt, as well as public and private equity investments in transitioning companies and project finance.

Conclusion

The development of comprehensive sector decarbonisation roadmaps by policymakers would provide investors with an impactful tool to support their decision-making. They would help to enhance awareness of the key policy, technological and financial levers available to accelerate progress. By promoting greater certainty and stability over the trajectory of the policy landscape, they will also provide investors with more confidence to make long-term investments across key sectors of the economy.

The imperative for sector decarbonisation roadmaps continues to grow for other stakeholders too. As an increasing number of financial institutions and corporates implement transition plans, sector decarbonisation roadmaps can underpin them with greater credibility and help them attract financing. And as countries enhance their economy-wide emissions reduction targets and submit updated NDCs, sector decarbonisation roadmaps present an opportunity for policymakers to make these commitments more 'investable' through the development of tailored policies to crowd-in and incentivise private capital. Different groups will use these roadmaps in different ways, and their usefulness and success will depend on dialogue with, and inputs from, a wide range of stakeholders. IIGCC emphasises the need for policymakers to engage early and often with corporates, investors and other stakeholders when designing and implementing sector decarbonisation roadmaps.

As an urgent first step, a more consistent understanding of the core components for inclusion in these roadmaps should be advanced. Roadmaps that build on the key principles outlined in this paper could help to create a 'common language' around which investors, policymakers and wider industry stakeholders can coalesce. In turn, this should enable the alignment of the relevant levers to support decarbonisation with the needs of key sectors and their overall emissions reduction trajectories. While a balance will always need to be struck, policymakers should focus on providing relevant information in as concise and easily digestible a format as possible.

IIGCC will continue to focus on this topic in the context of our wider policy advocacy, including work to engage policymakers to make NDCs more 'investable' in the runup to COP 30 and our dedicated sector-specific work in support of investors. Potential further work could also include more detailed assessments against the principles set out in this paper of specific sector decarbonisation roadmaps across different geographies and sectors.

Annex 1: Examples of existing sector decarbonisation roadmaps

The European Union

The European Commission, in collaboration with national and regional authorities, industry participants and other stakeholders, developed a series of transition pathways as part of the EU's 2020 New Industrial Strategy and its 2021 update. The pathways are intended to serve as actionable plans to enable the twin digital and green transition of key industries in support of a resilient European economy. As such, while decarbonisation is a key objective of the pathways, is it not their sole focus.

The EU has sought to cover 14 industrial ecosystems[5] through 17 transition pathways, one of which is still to be published.[6]

In addition, under the EU Climate Law, the Commission is required to engage with and support voluntary sectoral initiatives to develop roadmaps, facilitating dialogue and the sharing of best practice among relevant stakeholders.

See Annex 2 for a more detailed assessment of IIGCC's principles against a specific EU transition pathway for the chemicals industry.

Japan

In 2021, the Japanese Ministry of Trade, Economy and Industry (METI) developed a series of sector-specific technology roadmaps to support Japan's 2050 net zero commitment. The roadmaps were designed to be used as a reference point for companies seeking to formulate transition strategies and asses the suitability of different technologies when raising transition finance. They are also intended to enhance investor understanding of the decarbonisation trajectories for key sectors and the identification of transition-related investment opportunities.

The roadmaps were initially formulated for seven hard-to-abate and high impact sectors, including power, steel, petroleum and gas, and are aligned with Japan's NDC and wider international Paris-aligned scenarios. They also reference various domestic policies designed to accelerate decarbonisation, including the Green Growth Strategy which sets out how Japan will meet its 2050 net zero target. The roadmaps highlight how the rollout of new, low-carbon technologies in designated sectors support decarbonisation, alongside pathways for the conversion, decommissioning and discontinuation of legacy technologies.

As of March 2023, the technology roadmaps have supported companies operating in the relevant sectors in raising over 1 trillion yen in transition finance. Japan has since launched a new Green Transformation (GX) programme, intended to catalyse over 150 trillion yen of public-private investment over the next ten years, catalysed by an initial 20 trillion in upfront public investment. The programme will be underpinned by sector-specific investment strategies for sixteen target sectors.

5 The industrial ecosystems covered are aerospace and defence; agri-food; construction; cultural and creative industries; digital; electronics; energy intensive industries; renewables; health; automotives; social economy; retail; textiles; tourism.

6 At the time of this paper's publication the transition pathway for 'metals sectors' had not been published.

Australia

In 2024, Australia's Climate Change Authority completed a review of potential technology transition and emission pathways to support Australian's transition to net zero by 2050.[7]

Commissioned by the Australian Parliament, the review considers the decarbonisation pathways for six sectors — agriculture and land; built environment; electricity and energy; industry and waste; transport and resources.

The pathways identify both mature and emerging low-carbon technologies that can accelerate the transition of the targeted sectors. They also identify current policy- and market-related barriers to investment and set out a range of actions to tackle them. This includes policy interventions and market-based and financing mechanisms to address:

- Green premiums for net zero technologies;
- Slow and complicated approval and planning processes;
- Lack of community support for the deployment of renewable infrastructure;
- Supply chain constraints;
- Workforce shortages; and
- Information and data gaps.

France

The French Environment and Energy Management Agency (ADEME) has developed sectoral transition plans for France's nine most energy-intensive sectors. Together, the sectors comprise two thirds of France's total industrial emissions, making their transition vital to meeting France's goal of net zero by 2050 (compared to 2015 levels).

Each plan consists of four components setting out the key levers for decarbonisation for each sector, developed in close collaboration with industry stakeholders:

- Technological — e.g. energy efficiency, CCS
- Financing — e.g. investments, technology abatement costs, cost structure (opex/capex)
- Market/Employment — demand shifts, jobs/skills, business models
- Public and Private Action Plans — taxes/subsidies, EU policies, private finance

While many pathways published to date focus primarily on the technologies needed to accelerate decarbonisation, ADEME's project adopts a more comprehensive overview that covers considerations related to markets, costs, financing and jobs. Ultimately, the intention is to lead to the formulation of "public-private" actions and policies that can accelerate the transition of these key sectors.

The development of the pathways is organised into four phases — scoping, survey of the industry, scenarios, courses of action. As part of scenario development, the levers outlined above are fed into the decarbonisation trajectory and investment timeline for relevant sectors.

Following the rollout of the pathways, ADEME developed a methodological guide to support other EU Member States to develop their own sectoral transition plans. ADEME has also supported the French government in assessing and facilitating public subsidies for industrial assets, including an ArcelorMittal steel plant in Dunkirk, leveraging analysis from its steel sector transition plan.

7 For more detailed assessments of sector transition pathways in the Australian context, and the relevance of these pathways to investors, see IGCC's discussion paper 'Decarbonisation investment solutions for sectors'.

Annex 2: Case study from the EU — The Transition Pathway for the Chemical Industry

High-level assessment: EU Transition Pathways

Overall, the EU's Transition Pathways are a helpful initiative that has added value to the European industrial policy debate. However, differences in the approaches taken across the pathways and insufficient information in some areas limit the practical usefulness of the transition pathways for investors.

Looking across the published documents, it is unclear why the number of industrial ecosystems and transition pathways do not align. Additionally, nine of the pathways seem to have been developed as part of a dedicated process under the EU New Industrial Strategy. These follow a relatively consistent approach and structure, which was agreed and developed as part of a dialogue between the Commission and the Industrial Forum. The remaining six pathways were deemed to be covered by other relevant EU initiatives, action plans, strategies and, in the case of the electronics ecosystem, even an individual piece of legislation.

This approach has led to discrepancies in the level of information provided and how it is presented across the pathways. There are also inconsistencies in how the pathways were developed. For example, ten of the pathways were informed by Commission staff working documents and public consultations but five were not.

Some of the documents referenced as covering transition pathways also pre-date the 2021 European Climate Law and the EU's legally binding 2050 climate neutrality and 2030 55% greenhouse gas emissions reduction targets. For example, the Energy Intensive Industries transition pathway is said to be covered by the Masterplan for a competitive transformation of EU energy-intensive industries, which was published in 2019 before the shocks of the COVID-19 pandemic and the energy crisis brought on by the Russian invasion of Ukraine.

The Transition Pathway for the Chemical Industry

One of the most comprehensive transition pathways published by the European Commission covers the chemicals industry, which was released in January 2023. Taking this as the highest quality available example for the EU, the below case study assesses it against the high-level principles developed by investors for sector decarbonisation roadmaps as set out in the main section of this paper.

The transition pathway for the chemical industry sets out a list of over 150 actions, grouped under 26 topics, to be implemented by relevant stakeholders within an agreed timeframe.

The topics are presented as a roadmap composed of:

- **An action-oriented component**, grouped under three cross-cutting themes (collaboration for innovation; clean energy supply; feedstock diversification)
- **A technology component** identifying electrification, hydrogen, biomass, waste, Carbon Capture and Utilisation (CCU) & Carbon Capture and Storage (CCS), as well as process efficiency as key technological contributors to the transition pathway.
- **A regulatory component** that collects the existing legislation, including major research and innovation (R&I) initiatives, influencing digital and sustainable development of the chemical industry.

Assessment against IIGCC's principles

The EU's transition pathway for the chemical industry provides a useful overview of the contributions of the industry to the EU's total emissions and rationale for its identification as a high-impact sector. It also provides transparency over relevant EU policies to support decarbonisation and sets out a range of actions to accelerate progress, developed in consultation with industry stakeholders.

However, the pathway still contains multiple key information gaps from the investor perspective. The roadmap does not, for example, provide forward-looking information on the expected decarbonisation trajectory for the sector and associated emissions reductions targets. While it identifies relevant policy initiatives and actions, there is little detail on how they support, and interact with, the key levers for decarbonising the sector. And although the roadmap includes a section on investments and funding, it does not specify the overall financing required to support the sector's decarbonisation, or the types of financing mechanisms that will be deployed to catalyse investment.

The table below assesses the pathway against each of the key principles identified in the paper, accompanied by commentary.

1. Credible and decision useful

Principle	Rating	Commentary
Action-oriented, with clear actions for relevant stakeholders that can be transparently monitored.		A detailed action-oriented roadmap, informed by discussions with stakeholders, and covering three cross-cutting themes, is a key component of the pathway. Actions include timelines for implementation (short-, medium- and long-term) and reference the main actors responsible for implementation. However, there are no clear mechanisms for monitoring progress against the actions set out.
Supports economy-wide emissions reduction goals set out in a country's NDC and/or relevant national legislation, in line with the Paris Agreement		Identifies 2030 and 2050 climate targets as 'the next important step for the chemical industry's emission-reduction efforts, as part of the climate component of the Green Deal.' However, the roadmap does not include forward-looking information on how the sector will decarbonise and associated emissions reduction targets and milestones.
Prioritises highest impact sectors		Chemical industry identified as the third highest emitting industrial sector in the EU (925Mt CO_2 in 2021), behind only the cement and iron/steel industry. However, no detail is provided on the total % of EU emissions created by the sector, or on the anticipated emissions trajectory for the sector in a 'BAU' scenario.
Based on evidenced-based emissions reduction trajectories		References the IEA's net zero emissions scenario by 2050 and its reliance on emissions reductions from chemicals, but not explicitly incorporated into the roadmap. No references to other pathways are made (e.g. SBTi, TPI, DECHMA).
Cover emissions for all material greenhouse gases		No commentary on non-CO_2 emissions pathways and associated measures to reduce these emissions.

Cover relevant upstream and downstream emissions		Sets out several recommended actions to improve levels of data on chemicals, including the development of Chemical Data Spaces. Detail on emission accounting scope and methods is required, such as on end-of-life emissions accounting (e.g. cradle to grave or closed loop)
Set a clear deadline for the relevant sector's decarbonisation, underpinned by interim targets and milestones		No detail on sector-specific emissions reduction targets.
Take into account the interactions between sectors		Some recognition of reliance on electrification and actions to increase the supply and availability of clean energy. Competition for biomass resources also highlighted.
Set out key interdependencies and potential trade-offs		Focuses primarily on reducing unsustainable dependencies on countries outside of the EU. Actions account for enhanced supply and value chain resilience and managing circular processes. Technology roadmap highlights EU initiatives supporting technological transition. Actions grouped by Technological Readiness Levels (TRLs) which assess the maturity of technologies but no clarity on how these specific technological solutions will be deployed and scaled. Some useful detail on CCS deployment, including barriers to deployment and recommendations to increase development of infrastructure that promotes recycling and re-use.
Account transparently for a sector's 'locked-in' future emissions		No detail on locked-in emissions, including decommissioning or transition of gas-run assets and associated timelines.
Informed by stakeholder dialogue		Extensive engagement with European chemical sector stakeholders, and transparency actions recommended by stakeholders. However, unlike with other ecosystem transition pathways, there was no formal public consultation.
Reviewed on a regular basis and updated as necessary		Pathway states that it may be updated to take account of new developments and the evolution of EU legislation. However, no further detail is provided on potential processes and timeframes for doing this.
Provides transparency on underpinning data		Lacks granular detail on underpinning data on emissions pathways, technology deployment, total investment and financing needs.

2. Policy mechanisms

Principle	Rating	Commentary
Overview of current anticipated policy mix impacting the sector's decarbonisation, including how policies support key decarbonisation levers.		Regulatory roadmap component of the pathway sets out existing legislation influencing developments in the chemical industry. It also sets out timeframes for development/adoption of incoming policies. Technology roadmap provides an overview of initiatives supporting technological deployment (including policy) and associated actions. But little detail on how EU policies support these levers.
Overview of policy, regulatory market barriers		Some commentary on barriers to decarbonisation and actions to address them but lack sectoral specificity.
Details on the fiscal and market incentives and policies that will make decarbonisation cost-competitive		Regulatory roadmap includes references to policies that create the necessary financial incentives to reduce emissions, including the Carbon Border Adjustment Mechanism (CBAM) and energy taxation measures. However, there is no reference to the EU ETS in the transition pathway, despite it being one of the EU's main policy tools for decarbonising industry.
Assessments of the maturity of relevant technologies and their capacity to be scaled		The included technology roadmap features a series of actions across the initiatives to support the industry's technological transition, grouped by Technological Readiness Levels that assess the maturity of relevant technologies.
Phase-out dates for environmentally harmful policies and incentives		Minimal commentary on phase out of harmful substances and relevant policies to accelerate phase-out.
Consideration of wider macroeconomic context		Roadmap includes numerous actions for enhancing resilience and coherency across the value chain. Also includes recommendations for enhancing skills and increasing jobs and assesses societal impacts.
Quantification of anticipated impact of policies on sectoral decarbonisation		No quantitative assessments of the impact of EU policy initiatives on technology deployment or emissions reductions.
Transparent explanations of policy processes		Overview of relevant policy initiatives does not provide detail on governance and oversight of these policies.
Transparency over data underpinning policy development		No clear information provided about the data underpinning policy development, for example no assessments on the quantitative costs and benefits of decarbonisation policies, associated financing requirements and the assumed role of marked-led forces.

3. Financing mechanisms

Principle	Rating	Commentary
Assessment of total public and private investment needs		No assessment or estimates of total funding required to decarbonise the sector.
Breakdown of investment need by sub-sector and technology		Some commentary on estimated total investments needed to develop low-carbon technologies in the chemical industry (EUR 218 – 238bn). Also highlights additional investment needed to fully deploy these technologies. No granular detail on the types of technologies that need to be deployed, or breakdown of finance needed.
Prioritisation of investments based on impact on emissions reductions		No prioritisation of investment requirements based on impact in emissions reductions.
Mapping of investment needs to most relevant sources of finance		No mapping of investment needs to the most relevant sources of finance.
Transparency over relevant public and private financial instruments to support decarbonisation		Some discussion of financial instruments that can support decarbonisation (e.g. chain-of-custody models) and public funding opportunities. Some detail on main barriers to investing in the chemical sector's decarbonisation (e.g. scaling up 'first of a kind' solutions; regulatory uncertainty; high capex and opex). But no accompanying information on policy/financing mechanisms to address barriers.
Tracking of investment flows		No reference to tracking investment flows to monitor progress and identify financing gaps.
Engagement with stakeholders to identify investment opportunities and relevant sources of finance		Sets out a series of actions to support increased investment towards the sector's decarbonisation and improved access to public and private funding, as identified by stakeholders. However, actions are relatively high-level and unquantified, and it is unclear whether there are mechanisms in place for ongoing dialogue.

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