Green Finance and Investment

Mechanisms to Prevent Carbon Lock-in in Transition Finance

OECD

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BETTER POLICIES FOR BETTER LIVES

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Foreword

In 2022, the Intergovernmental Panel on Climate Change (IPCC) warned that the continued installation of unabated fossil fuel infrastructure will "lock in" GHG emissions for decades to come. Keeping the Paris Agreement's goal of limiting the global temperature rise to 1.5 °C within reach requires a dramatic acceleration of investment towards low- and zero-emission technologies. However, countries around the world continue to invest in fossil fuels, either for energy security reasons or even as a part of their net-zero strategies.

In this context, transition finance as a means to enable decarbonation of high-emitting industries has grown in importance over recent years to complement more narrow green finance approaches that focus on activities that are already considered as low-carbon. Transition finance focuses on emission-intensive industries where low-carbon technologies might not always be fully feasible today, so carbon lock-in is an important risk increasingly factored in. Financiers, investors, and corporates may hesitate to engage in transition investments, for fear they could be perceived as greenwashing. Currently there is limited guidance for financiers and corporates to reduce or avoid this risk.

This report, *Mechanisms to Prevent Carbon Lock-in in Transition Finance*, takes stock of how carbon lock-in risk is addressed in existing transition finance approaches, financial instruments, and relevant public and private investment frameworks and methodologies. The report then proposes ways to strengthen mechanisms to prevent carbon lock-in in transition finance policy frameworks.

Developed by the OECD Secretariat for the Working Party on Climate Investment and Development of the Environmental Policy Committee, this report builds on previous OECD work on green and transition finance, especially the 2022 *OECD Guidance on Transition Finance*. The Guidance sets out key elements and good practice on what constitutes a credible corporate climate transition plan. Since its publication, the Guidance has informed and influenced key international policy initiatives, such as the 2022 G20 Transition Finance Framework and several G7 Communiqués, as well as domestic frameworks including the European Commission's recommendation on transition finance and the UK Transition Plan Task Force Disclosure Framework.

Governments and market actors must ramp up transition finance and investment to meet their net-zero commitments. This report aims to support policymakers and regulators that have developed or are considering developing transition finance policies, such as standards for transition finance related instruments, frameworks for corporate transition plans, or broader climate-related disclosure frameworks. The OECD stands ready to support governments, foster international dialogue and convergence, and ensure that transition finance credibly advances the global net-zero transition.

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Table of contents

FIGURES

TABLES

BOXES

Abbreviations and acronyms

ACMF	ASEAN Capital Markets Forum
ACT	Assessing low-Carbon Transition initiative
ADB	Asian Development Bank
ADEME	Agence de l'environnement et de la maîtrise de l'énergie
AEC	Absolute Emissions Contraction
APLMA	Asian Pacific Loan Market Association
ASEAN	Association of Southeast Asian Nations
BAT	Best-available technologies
BIS	Bank for International Settlements
BF	Blast furnace
CapEx	Capital expenditure
CCGT	Combined cycle power plant
CCUS	Carbon capture, utilisation and storage
CHP	Combined heat and power plant
CO_2	Carbon dioxide
CBI	Climate Bonds Initiative
CDP	Carbon Disclosure Project
CIF-ACT	Climate Investment Funds Accelerating Coal Transition
COP	Conference of the Parties
DNSH	Do-No-Significant-Harm
DRI	Direct-reduced-iron
EBRD	European Bank for Reconstruction and Development
ECB	European Central Bank

EIB	European Investment Bank
EIC	Economic Intensity Contraction
EMDE	Emerging markets and developing economies
EPA	U.S. Environmental Protection Agency
EPOC	Environment Policy Committee
ESG	Environmental, Social and Governance
ESMA	European Securities and Markets Authority
ETM	Energy Transition Mechanism
EU	European Union
FCA	UK Financial Conduct Authority
FSA	Japan's Financial Services Agency
FT	Financial Times
GDP	Gross Domestic Product
GFANZ	Glasgow Financial Alliance for Net Zero
GFIT	Green Finance Industry Taskforce
GHG	Greenhouse gas
I4CE	Institute for Climate Economics
ICMA	International Capital Markets Association
IEA	International Energy Agency
IFC	International Finance Corporation
IIGCC	Institutional Investors Group on Climate Change
ILO	International Labour Organization
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent power producer
IPSF	International Platform on Sustainable Finance
IRENA	International Renewable Energy Agency
ISSB	International Sustainability Standards Board
JETP	Just Energy Transition Partnership

KPI	Key Performance Indicator
LGX	Luxembourg Green Exchange
LMA	Loan Market Association
LSTA	Loan Syndications and Trading Association
LTS	Long-Term Climate Strategy
MAS	Monetary Authority of Singapore
MDB	Multilateral development bank
METI	Ministry of Economy, Trade and Industry (Japan)
MtCO2e	Metric tons of carbon dioxide equivalent
MSME	Micro, small and medium-sized enterprise
NDC	Nationally-Determined Contribution
NGFS	Network for Greening the Financial System
NZE	Net-zero emissions
OECD	Organisation for Economic Co-operation and Development
OJK	Otoritas Jasa Keuangan
OpEx	Operational expenditure
PATH	Paris Alignment for Counterparties
PPA	Power Purchase Agreement
Q1	First quarter
Q3	Third quarter
RBC	Responsible Business Conduct
R&D&I	Research, development, and innovation
RRF	Recovery and Resilience Facility
SBTi	Science Based Targets initiative
SDA	Sectoral decarbonisation approach
SEBI	Securities and Exchange Board of India
SEC	Securities and Exchange Commission
SFWG	Sustainable Finance Working Group
SLB	Sustainability-linked bond

SLL	Sustainability-linked loan
SPO	Second-party opinion
SPT	Sustainability performance target
TCFD	Task Force on Climate-related Financial Disclosures
TPT	Transition Plan Taskforce
UN	United Nations
UK	United Kingdom
US	United States
UNFCCC	UN Framework Convention on Climate Change
VRE	Variable renewable energy
WPCID	Working Party on Climate, Investment and Development
WWF	World Wildlife Fund

Executive Summary

To support a global net-zero transition, all sectors of the economy, and especially high-emitting ones, need to rapidly decarbonise. To help fund their decarbonisation process, the concept of transition finance has been gaining traction over the past years, complementing existing green finance efforts by governments, donors, and Multilateral Development Banks (MDBs), to make private finance flow to more sustainable activities.

Transition finance focuses on raising and providing funds to decarbonise high-emitting economic activities and industries that currently do not have a fully feasible zero- or near-zero emission alternative. An increasing number of jurisdictions are beginning to put forward elements of transition finance policy frameworks, such as transition taxonomies and requirements on company transition plans.

Given this focus, a key question in transition finance is how to ensure the alignment of eligible investments with the temperature goal of the Paris Agreement. The debate largely focuses on investments involving fossil fuels, such as assets using unabated fossil fuels in energy-intensive industry sectors, and lending to companies with fossil fuel assets.

These investments bear a high risk of 'carbon lock-in'. Carbon lock-in occurs when fossil fuel infrastructure or assets (existing or new) continue to be used, despite the possibility of substituting them with low-emission alternatives, thereby delaying or preventing the transition to such alternatives. To prevent carbon lock-in to the extent possible, and ensure the environmental integrity of transition finance, relevant investments must be carefully selected and carried out with appropriate safeguards in place.

Existing approaches and policy frameworks for transition finance emphasise the need to avoid carbon lock-in, but largely do not set clear guidance or criteria on how to do so. In the absence of consensus on how to avoid lock-in, finance may be directed to projects that do not have sufficient safeguards in place to ensure alignment with the temperature goal of the Paris Agreement. Similarly, corporates seeking transition financing may fear accusations of greenwashing.

The concept of carbon lock-in is a recurring theme in discussions around policy and financing for climate change mitigation. Existing public and private finance and investment frameworks and tools reflect to varying degrees the growing importance of carbon lock-in risk. However, as the window of opportunity to stay within the Paris temperature goal is closing, the issue of lock-in risk and questions on how best to mitigate it will need to take centre stage.

Building on the *OECD Guidance on Transition Finance: Ensuring Credibility of Corporate Climate Transition Plans*, this report provides an analysis and overview of relevant mechanisms to prevent carbon lock-in, taking inspiration from both private and public finance and investment frameworks and tools. It presents key findings and good practices to support policymakers in developing comprehensive and credible transition finance definitions and frameworks, as well as standards for relevant financial instruments, that can effectively reduce carbon lock-in. Key findings include:

- Transition finance definitions can be strengthened by providing clarity on how to assess feasibility as part of eligibility criteria, and by taking a long-term approach in the assessment.

- National sectoral emissions pathways can guide technology roadmaps, robust transition taxonomy criteria, and similar tools, as well as allowing companies to develop credible net-zero plans and targets.
- Sunset clauses for use of fossil fuels can reduce carbon lock-in risk for assets where a fuel switch is planned to ensure alignment of the asset with the Paris temperature goal.
- For assets where a fuel switch is needed to achieve alignment with the Paris temperature goal, flanking measures that ensure the switch happens in a timely manner can contribute to preventing carbon lock-in.
- The development of standards and policy frameworks for sustainability-linked instruments is necessary to address emerging loopholes which increase the risk of lock-in of related investments.

These key findings are relevant to policymakers and regulators who have developed or are considering developing transition finance policies (for example, taxonomies, roadmaps, or guidance), standards for green, transition and sustainability-linked debt, frameworks for corporate transition plans, or broader climate-related disclosure frameworks. In collecting good practices that are relevant to each part of the transition finance ecosystem (definitions, asset-level requirements, entity-level tools and guidance, standards, and frameworks for relevant financial instruments), the report aims to support policymakers and regulators in developing holistic and robust transition finance policy frameworks.

1. Overview

Transition finance has grown in importance over recent years to enable decarbonation of high-emitting industries, complementing more narrow green finance approaches that focus on activities that are already considered as low-emission. This Chapter explains why carbon lock-in is a key risk in transition finance and summarises the key findings and good practices to strengthen mechanisms to prevent carbon lock-in in transition finance policy frameworks. The chapter also presents the background, scope and aim of this report.

1.1. Background and context

In April 2022, the Intergovernmental Panel on Climate Change (IPCC) concluded that the continued installation of unabated fossil fuel infrastructure will "lock in" GHG emissions.[1] According to the IPCC, projected cumulative future CO_2 emissions over the lifetime of existing and currently planned fossil fuel infrastructure without additional abatement will exceed remaining cumulative net CO_2 emissions in pathways that limit warming to 1.5°C (>50%) with no or limited overshoot. They are approximately equal to total cumulative net CO_2 emissions in pathways that limit warming to 2°C (IPCC, 2022[1]). This means that already today, existing and planned fossil fuel assets are largely inconsistent with the temperature goal of the Paris Agreement of "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (UNFCCC, 2015[2]).

In a "net zero emissions by 2050" (NZE) scenario, updated IEA modelling indicates that between 2021 and 2050 coal demand declines by 90%, oil declines by around 80%, and natural gas declines by more than 70% (IEA, 2022[3]). In this scenario, the remaining fossil fuels are used exclusively for the following purposes:

- In the production of non-energy goods where carbon is embodied in the product (e.g., fertilisers),
- in plants with carbon capture, utilisation and storage (CCUS), and
- in sectors where low-emissions technology options are scarce (e.g., aviation) (IEA, 2021[4]).

However, the IEA shows that annual investment in assets that produce and use fossil fuels continues to be on a rising trend. Global net income from oil and gas production reached a record high of USD 4 trillion in 2022, double 2021 levels (IEA, 2023[5]). Global coal investment increased to USD 135 billion in 2022, a 20% increase with respect to 2021 levels, and is expected to further increase in 2023. According to the IEA, the risks of locking in fossil fuel use are increasingly clear, as fossil fuel investment in 2023 is more than double the levels required to meet much lower demand in IEA's NZE scenario (IEA, 2023[5]). According to Wood Mackenzie, new global oil and gas discoveries in 2022 drove exploration to the highest value creation in over a decade (Wood Mackenzie, 2023[6]). It is estimated that fossil fuel financing[2] from the world's 60 largest banks reached USD 5.5 trillion over the period of 2015 to 2022, with average annual financing amounting to USD 781 billion (Rainforest Action Network (RAN) et al, 2023[7]).

These levels of fossil fuel finance and investment run contrary to the IEA's 2021 Net Zero by 2050 Roadmap, which concluded that no fossil fuel exploration and no new oil and gas fields are required beyond those that have already bee8n approved for development in 2021. Similarly, under this scenario, no new coal mines or mine extensions are required beyond what currently exists, and no new unabated coal plants should be approved for development (IEA, 2021[4]). Since the 2021 Roadmap was published, oil and gas demand rose and additional oil, gas and coal projects have reached final investment decisions, which would result in 25 Gt of emissions if operated to the end of their lifetime (around 5% of the remaining carbon budget for 1.5 °C) (IEA, 2022[3]).

Despite the clear evidence that investment to scale up low- and zero-emission technologies is urgently needed to achieve the Paris Agreement temperature goal, net-zero pathways of countries around the world continue to rely on the use of fossil assets in the short term. Moreover, the risk for fossil fuel producer countries (especially EMDEs) of being locked into carbon-intensive development trajectories has increased with Russia's war of aggression against Ukraine. As crude oil and natural gas prices have risen significantly, while demand for fossil fuels and related consumption subsidies have remained high (IEA, 2023[8]), there are few incentives for producer countries to reduce fossil production and exports (OECD, 2022[9]).

According to IEA's updated NZE scenario, declining fossil fuel demand can be met through continued investment in existing production assets without the need for any new long lead time upstream

conventional projects, provided that reducing fossil fuel investments is accompanied by clean energy investments and policy action to reduce energy demand (IEA, 2022[3]). New fossil fuel infrastructure projects will need to be compensated by even deeper emission reductions, making the later stages of the net-zero transition more challenging and creating a risk that targets move out of reach.

The IEA recognises that some natural gas infrastructure investments may be necessary in the transition to net zero, such as to support intermittent energy generation and to replace more emitting energy sources in industry until low-emission solutions are fully feasible and scalable. However, investments in energy generation likely need to be limited to supporting the objective of balancing electricity grids, rather than investing into natural gas as a baseload source of power (IEA, 2022[3]; FrontierEconomics, 2021[10]). In addition, the role of natural gas will change rapidly in the next decades and will vary significantly across regions, countries, and sectors. According to IEA's 2022 Sustainable Africa Scenario, natural gas will continue to play an important role for the fertiliser, steel and cement industries and water desalination in Africa (IEA, 2022[11]). In Southeast Asia, natural gas plays an important role in enabling the move away from coal in power generation and to replace oil and biomass as a source of heat in industry. But in the IEA's Sustainable Development scenario, natural gas use in Southeast Asia will decrease over time and after 2030 will switch from bulk generation to supporting the integration of variable renewables through the provision of different system services (IEA, 2022[12]).

Moreover, to be in line with a 1.5°C goal, global GHG emissions need to peak before 2025, with rapid and wide-reaching emissions reductions across all sectors needed during the subsequent decades until 2050 (IPCC, 2022[13]). This implies that unabated natural gas use must remain short-term. Natural gas infrastructure should be retired, repurposed, or retrofitted to utilise exclusively renewable and zero-emission fuels or be otherwise brought in line with a Paris-aligned net-zero trajectory through the use of low- or zero-emission technologies across the full value chain. Given that the lifetime emissions of existing and planned investments in fossil fuel infrastructure are today consistent with 2°C pathways (IPCC, 2022[1]), any additional natural gas investments, even if they remain short-term, have to be coupled with additional abatement and possibly the early retirement of other high-emitting assets. This is particularly important if 1.5°C is to remain within reach.

Against this background, any investment involving fossil fuels and any lending to companies with fossil fuel assets have a high risk of carbon lock-in[3] and must therefore be carried out with the appropriate safeguards in place (Box 1.1 below presents a definition and examples of carbon lock-in and how it differs from the concept of stranded assets). Carbon lock-in can come about as a result of technical, economic, political, or institutional factors. Whenever government or market actors have stakes in fossil fuel assets, there is an incentive to continue operating the asset until the end of its useful life, given that the construction is by then a sunk cost (OECD, 2022[14]; FrontierEconomics, 2021[10]).

Considering the tension between the financial interests of fossil fuel asset owners and the need to avoid carbon lock-in, intense debate continues among policymakers, industry, and civil society on whether certain investments in fossil fuel assets and infrastructure can be considered as necessary for the net-zero transition and sustainable development, and therefore eligible for transition finance. Such investments include, for example, those that deploy emissions abatement technologies, refurbishments, and retrofits across existing (and potentially new) fossil assets and infrastructure.

1.2. Carbon lock-in is a key risk in transition finance

In setting out elements of credible corporate transition plans, the *OECD Guidance on Transition Finance: Ensuring Credibility of Corporate Climate Transition Plans* aims to unlock the capital flows required to reach net zero and reduce the risk of greenwashing in transition finance. The Guidance proposes to anchor transition finance transactions (use-of-proceeds and general-purpose instruments, such as sustainability-linked bonds (SLBs)), including their Key Performance Indicators (KPIs) and Sustainability Performance

Targets (SPTs), in entity-wide corporate climate transition plans. Annex B recaps the ten key elements of credible corporate climate transition plans set out in the Guidance.

The Guidance identifies carbon lock-in as one of the main factors contributing to risks of greenwashing in transition finance, which in turn can hamper the development of this market (OECD, 2022[14]). Investments that increase the risk of lock-in will ultimately undermine net-zero transition efforts, even if they may result in short-term emissions reductions (OECD, 2022[14]; Tandon, 2021[15]). To be credible, transition finance needs to tackle the risk of carbon lock-in.

This report reviews and compares mechanisms to prevent carbon lock-in that are currently being used in transition finance policy frameworks and approaches and relevant financial instruments. Recognising that the risk of carbon lock-in is not limited to private sector investment and transition finance but has also been a recurrent theme in public sector climate mitigation policy and related financing and investment for some time, the report draws lessons from Paris-alignment methodologies of Multilateral Development Banks (MDBs), and public investment frameworks, notably state aid.

Box 1.1. Carbon lock-in and stranded assets: two sides of the same coin

What is carbon lock-in?

Carbon lock-in occurs when fossil fuel infrastructure or assets (existing or new) continue to be used, despite the possibility of substituting them with low-emission alternatives, delaying or preventing the transition to near-zero or zero-emission alternatives.

There are several types of investments that can increase the risk of carbon lock-in, and there are ongoing debates regarding their degree of environmental integrity, such as:

- Efficiency improvements and carbon capture, utilisation and storage (CCUS) investments in coal assets;
- Gas assets and infrastructure like transmission and distribution networks; domestic gas boilers; power generation plants like combined cycle power plants (CCGTs); and power, heating and cooling generation plants like combined heat and power plants (CHPs);
- Industrial plants that currently mainly rely on fossil fuels, such as blast furnaces that are used to generate high-temperature heat required for heavy industry production processes.

How does carbon lock-in relate to asset stranding?

Carbon lock-in is linked with but distinct from asset stranding. There are various recognised definitions of asset stranding, but no universally agreed view. Existing definitions have in common that stranded assets involve economic loss, asset devaluations, or write-downs prior to the end of an asset's anticipated useful economic life. Definitions differ with regards to the reasons for the loss, with some, for example, emphasising climate policy (IEA, 2013[16]), while others take a broader view and highlight "changes in the market and regulatory environment" (Carbon Tracker, 2017[17]), or "changes in legislation, regulation, market forces, disruptive innovation, societal norms, or environmental shocks" (Generation Foundation, 2013[18]) more broadly (see (OECD/IEA, 2017[19]) for a detailed overview of existing definitions).

For the purposes of this report, the definition of stranded assets put forward by the Smith School of Enterprise and the Environment at the University of Oxford, which can be considered the common denominator across existing definitions, is used. Under this definition, stranded assets are assets that "have suffered from unanticipated or premature write-downs, devaluations, or conversion to liabilities" (Caldecott, Howarth and McSharry, 2013[20]).

Asset stranding and carbon lock-in are two risk factors attached to fossil fuel investments. Asset stranding is predominantly an economic and financial risk for the asset owner, rather than a factor undermining the net-zero transition. Lock-in risk, on the other hand, makes investments susceptible to criticisms of greenwashing, as they could ultimately undermine net-zero transition efforts. Asset stranding and lock-in risk can work in opposing ways whereby investments are structured in a way as to protect from asset stranding risk, while increasing lock-in risk (such as, when providing contractual certainty around revenues).

Source: Authors.

Key elements of the OECD Guidance relate to target-setting and implementation steps, as well as using relevant supporting tools, such as taxonomies, technology roadmaps, and sectoral emissions pathways. The latter are being developed (e.g. by the IEA and the Network of Central Banks and Supervisors for Greening the Financial System (NGFS)) and applied (e.g., by the Transition Pathway Initiative and the Science Based Targets initiative (SBTi), amongst others) to assess whether an asset or company is in line

with a selected decarbonisation or net-zero trajectory. However, such emissions pathways have mainly been developed at macro level (e.g., at global or regional level) and accounting for country-specific considerations remains challenging (Noels and Jachnik, 2022[21]; OECD, forthcoming[22]). Technology roadmaps (also sometimes referred to as "technology pathways" or "investment pathways"), build on emissions scenarios by providing a forward-looking perspective on technologies that are needed to decarbonise a given sector, including the relevant timelines. Their use also remains limited for the moment, with the most prominent example being the sectoral roadmaps developed by Japan's Ministry of Economy, Trade and Industry and Ministry of Land, Infrastructure, Transport and Tourism. The roadmaps today cover ten high-emitting sectors in Japan (METI, 2023[23]).[4] Lastly, transition taxonomies aim to account for transition considerations through eligibility criteria such as: sunset clauses, limiting eligibility of economic activities to a specific timeframe; and future-proofing requirements, to ensure that assets and infrastructures use technologies which enable them for the use of low-carbon and renewable alternative energy sources in the future. This remains insufficient as it does not guarantee that fossil assets will ultimately be transitioned to near-zero or zero-emission alternatives.

To further help mitigate carbon lock-in risk, the OECD Guidance concludes that companies should in addition identify in their transition plans existing assets and infrastructure, as well as planned investments, that are at risk of carbon lock-in and put in place mechanisms to prevent this risk from materialising. To this end, the Guidance analyses existing mechanisms to prevent carbon lock-in in transition finance and concludes that further work is needed to strengthen such mechanisms and broaden the suite of solutions that market actors have at their disposal to prevent lock-in.

1.3. Aim and scope of the report

This report proposes ways to strengthen mechanisms to prevent carbon lock-in in transition finance. The proposed mechanisms can be applied at economic activity or project level (e.g., as part of taxonomies), at the level of a corporate's climate transition plan (e.g., as part of climate-related disclosure or transition planning requirements), and as part of KPIs and SPTs of relevant financial instruments (e.g., standards or labels for SLBs). The aim of the report is to support the scaling up of the transition finance market by helping market actors and policymakers identify ways to increase the environmental integrity and credibility of transition finance, given its importance in supporting the net-zero transition, especially in EMDEs.

The report is relevant to policymakers and regulators that have developed or are considering developing transition finance policies (for example, taxonomies, roadmaps, or guidance), standards for green, transition and sustainability-linked debt, frameworks for corporate transition plans, or broader climate-related disclosure frameworks.

The report is structured as follows:

- Chapter 2 looks at transition finance definitions and the role that feasibility assessments play in setting eligibility criteria, which subsequently impact the degree of carbon lock-in risk and environmental integrity of those definitions. The chapter concludes that the risk of lock-in in transition finance approaches can be reduced by providing clarity on how to assess feasibility as part of eligibility criteria, and by explicitly taking a long-term approach in the assessment.
- Chapter 3 analyses existing mechanisms to prevent carbon lock-in across relevant private and public sector financing and investment frameworks, and summarises good practices. It proposes ways to strengthen mechanisms deployed in transition finance frameworks, such as in taxonomies, pathways, technology roadmaps, and transition plans.
- Chapter 4 focuses on relevant debt instruments, notably green, transition and sustainability-linked bonds, and analyses the extent to which the structure and requirements of these instruments can

contribute to increasing the lock-in risk of the projects and entities that they finance. It provides key findings and good practices on reducing carbon lock-in using transition financial instruments.

1.4. Overview of key findings of the report

Transition finance approaches emphasise the need to avoid carbon lock-in, but largely do not set clear criteria on how to do so. Consequently, questions relating to carbon lock-in are an important reason why market actors are hesitant to engage in transition financing. In the absence of consensus on how to avoid lock-in, corporates seeking transition financing may fear accusations of greenwashing - i.e., claims that they might use green, transition or net-zero labels for their offer of products and services while directing capital to high-emitting activities that delay rather than advance the net-zero transition. While several of the existing transition finance approaches highlight the need to avoid locking activities in high-emission pathways, limited guidance exists on ways in which financiers and corporates can practically prevent this risk.

The following section summarises this report's key findings and good practices on how addressing carbon lock-in risk can enhance credibility of transition finance frameworks.

Carbon lock-in considerations in transition finance definitions: the role of feasibility assessments

Transition finance focuses on providing funds to decarbonise economic activities and industries that currently do not have a fully *feasible* zero- or near-zero emission alternative. Therefore, for policymakers to define which activities and industries should be eligible for transition finance in their jurisdiction, it is necessary to assess the *feasibility* of zero- and low-emission substitutes.

How feasibility is assessed, such as whether a long-term approach is taken in the assessment and how much weight is given to institutional and political factors, fundamentally affects technology selection:

- Institutional and political factors can effectively outweigh technological or environmental factors in determining feasibility, and therefore eligibility. This can allow for technologies that are incompatible with the temperature goal of the Paris Agreement to be selected as being eligible for transition finance, even in cases where lower-emission alternatives are technologically feasible.
- Similarly, economic feasibility assessments may only assess short-term costs, rather than considering future transition risk and projecting costs over the lifetime of the asset. In such cases, a technologically feasible low-emission option may be assessed to be economically infeasible and potentially lower cost over the longer term. See Box 1.2 below for a summary of key findings and good practices related to the role of feasibility assessments.

Box 1.2. The role of feasibility assessments in transition finance: Key findings and good practices

Transition finance definitions can be strengthened and made more transparent by providing clarity on how to assess feasibility as part of eligibility criteria, and by explicitly taking a long-term approach in the assessment.

Transition finance approaches that credibly prevent carbon lock-in will provide a more detailed definition of what feasibility entails, notably by specifying the need to:

- Take into account project costs in 2030 and beyond, using an appropriate net-zero scenario;
- Take into account future costs of reinvestment in order to achieve net zero;
- Appropriately assess and monetise transition risk, including by projecting it over a longer time horizon (2030 and beyond), as it may not immediately materialise; and
- Explicitly acknowledge and address potential challenges related to institutional and social feasibility, which may affect economic feasibility, for example by providing adequate support, social protection, training, and reskilling to impacted workers, households, and communities.

Carbon lock-in considerations in financing and investment frameworks

The concept of carbon lock-in is not exclusive to transition finance and is a recurring theme in discussions around policy and financing for climate change mitigation. It is particularly important to consider the concept of carbon lock-in when designing public or private investments in energy production and use. Existing frameworks and tools guiding such investments reflect to varying degrees the growing importance of carbon lock-in risk. However, as the window of opportunity to stay within the Paris temperature goal is closing, the issue of lock-in risk and questions on how best to mitigate it will take centre stage as stakeholders develop relevant financing frameworks and tools.

To date, some mechanisms to prevent carbon lock-in have been developed and applied in some public and MDB finance and investment frameworks, as well as in transition finance frameworks for private finance and investment. Integrating the following existing good practices in transition finance policies (see Box 1.3) has the potential to significantly strengthen the environmental credibility of transition finance.

Box 1.3. How financing and investment frameworks address carbon lock-in: Key findings and good practices

Standards and frameworks for credible corporate climate transition plans, with net-zero targets based on the Paris temperature goal, are key tools to preventing carbon lock-in in transition finance.

In the absence of frameworks for credible corporate climate transition plans, there will continue to be uncertainties in transition finance with respect to greenwashing and carbon lock-in. This uncertainty can be addressed if jurisdictions and market actors step up efforts to put in place standards and frameworks for developing and disclosing credible corporate climate transition plans, identifying sources of carbon lock-in risk, and ways to address it.

National sectoral emissions pathways can guide technology roadmaps, robust transition taxonomy criteria, and similar tools, as well as allowing companies to develop credible net-zero plans and targets.

When emission pathways are based on a country's net-zero target and developed for each sector, they can provide a robust basis for companies to set their own net-zero targets and develop transition plans, as well as for policymakers to develop taxonomy criteria, technology roadmaps, and similar tools.

Excluding the most emission-intensive energy sources from eligibility for transition finance enhances the credibility of transition finance frameworks.

Providing clear guidance on which investments are not eligible for transition finance, due to them not being in line with the Paris temperature target, can enhance the credibility of transition finance frameworks and will avoid uncertainty for companies and investors.

Actions to future-proof transition investments can include setting requirements with technical specifications that enable infrastructure for the use of low-emission and renewable fuels.

To strengthen their credibility, transition finance frameworks will benefit from including requirements for supported assets to be future-proof and comply with technical specifications to enable the transport and use of low-emission fuels in the future.

Sunset clauses for use of fossil fuels can reduce lock-in risk for assets where a fuel switch is planned to ensure alignment of the asset with the Paris temperature goal (e.g., a switch from natural gas to low-emission hydrogen).

To ensure that natural gas assets containing requirements to be future-proof actually carry out the switch to low-emission fuels, it is paramount to set a sunset clause that will limit the eligibility for support and allow the eventual phase out of the fossil fuels.

For assets where a fuel switch is needed to achieve alignment with the Paris temperature goal, flanking measures to ensure the switch can happen in a timely manner can contribute to preventing carbon lock-in.

Flanking measures, that give credibility to future-proofing requirements and sunset clauses in transition finance frameworks, include:

- Accompanying research, development, and innovation investments, as well as investments to support the supply of the future low-emission fuel that is expected to be used after the sunset date;
- Contracts of supply for the low-emission replacement fuel to be agreed within a specified timeframe, ideally within three years of the initial investment;
- Detailed plans and binding timeframes setting out a strategy of how the low-emission fuel will be used by the company benefitting from transition finance.

It is important to establish a date for early retirement of assets that cannot be retrofitted or refurbished to be consistent with net zero, accompanied by a strategy to finance the retirement.

To be credible, transition finance frameworks can specify additional requirements for the managed phaseout of high-emitting assets. This could include specific phase-out plans as part of transition plan frameworks, outlining how the phase-out is aligned with any net-zero or climate-related strategy, how just transition considerations are integrated, key milestones such as phase-out timing, key metrics and targets, disclosure of progress, governance mechanisms, related capital expenditure (CapEx) plans and key assumptions and uncertainties as part of the plan.

Carbon lock-in considerations in transition financial instruments

A wide range of financial instruments are relevant to transition finance, namely green, transition and sustainability-linked bonds and loans. Box 1.4 below summarises key findings and good practices on how carbon lock-in risk can be addressed when designing frameworks for transition financial instruments. Relevant transition financial instruments include green bonds that finance transition activities, transition bonds and sustainability-linked bonds (SLBs).

Green and transition bonds are generally used to raise finance for specific green or transition projects. Therefore, individual issuances do not necessarily signal that issuers have a credible and whole-of-entity transition strategy in place to transform their business models and operations and drastically reduce their emissions. This is a source of greenwashing risk in particular where bonds finance projects that reduce but overall still have high emissions. In addition, individual issuances that are not directly anchored in an overarching transition plan or strategy and not aligned with existing taxonomies or other relevant classification systems cannot be considered a proxy for an entity's transition efforts. To avoid lock-in, it is necessary to situate such projects within a wider transition plan and show how they are, over the long-term, in line with a Paris-aligned pathway.

While green bond standards and green taxonomies broadly converge on the definition of green eligible activities, some differences persist, which can create greenwashing and carbon lock-in risks. In the transition bond space, currently still very limited in size, lock-in risks are highly present, given the lack of definitions and eligibility criteria for what constitutes a transition bond.

The uptake of SLBs by a wide variety of issuers across sectors indicates that the instrument has potential to be used for a whole-of-economy, cross-sectoral transition. At the same time, evidence suggests that there are emerging loopholes and potential penalty-minimising behaviour in SLB structures. Moreover, KPIs and metrics used in SLB issuances in high-emitting sectors are not always consistent with an ambition to transition a company towards credible low-emission pathways.

Box 1.4. Addressing carbon lock-in risks in transition financial instruments: Key findings and good practices

Clearly distinguishing between green and transition eligible activities will make frameworks for transition financial instruments more credible. Credibility can also be enhanced by linking frameworks with corporate transition plans, and by using ambitious KPIs and SPTs that are linked with key milestones designed to prevent carbon lock-in.

The credibility of SLB frameworks can be enhanced by anchoring them in and providing details about the corporate climate transition plan, as well as by using meaningful Paris-aligned emission reduction-related KPIs and SPTs. In line with the OECD Guidance on Transition Finance, it is important that such KPIs and SPTs include all emission scopes, both absolute and intensity targets and not overly rely on offsets. In cases where offsets are used as a last resort option, sufficient details on their reliability and use will be provided.

To reduce the risk of lock-in, it is important that green and transition bond frameworks and standards clearly distinguish between green and transition eligible activities, in line with applicable taxonomies or other relevant eligibility requirements disclosed by the issuer.

Where they finance transition activities or projects involving fossil fuels, such as natural gas-based energy production for a limited period (when blending with or before switching to 100% renewable or low-emission gases), credibility can be ensured through additional verification requirements and reporting on forward-looking indicators like sunset requirements and flanking measures. The same logic applies to investments in efficiency improvements of fossil fuel assets, or ammonia co-firing in coal-fired power plants, where explicit and detailed information on key milestones to achieve net zero should be reflected in KPI and SPT requirements.

The development of standards and frameworks for SLBs is necessary to strengthen the credibility of this instrument and address emerging loopholes which increase the risk of lock-in of related investments.

Standards and oversight are needed to ensure that verification and SPO providers follow the highest quality standards available and ensure the credibility, integrity, and ambition of SLB frameworks and related KPIs and SPTs. In a credible SLB framework, standalone ESG metrics and scores will not be used as KPIs and SPTs. It is important that penalties are set in a way that provides adequate incentives for the issuer to achieve its sustainability targets.

Eligibility criteria of standards and frameworks for transition financial instruments should be regularly updated and reassessed as factors affecting feasibility evolve.

Wherever green or transition eligible projects include activities that are emission-intensive because of feasibility hurdles, feasibility should be regularly reassessed in case technological, economic, regulatory, or political and social conditions change over time.

Wherever innovative and not fully tested and scalable net-zero technologies are used, details should be provided on the associated Capital Expenditure (CapEx) required, the feasibility of the technology used and any foreseen limitations, constraints, and uncertainties to their application.

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Notes

[1] In this context 'abatement' refers to interventions that can substantially reduce GHG emissions, e.g., by capturing 90% or more of emissions from power plants.

[2] The analysis includes the world's 60 largest banks by assets according to Standard & Poor's. The report assessed banks' involvement in corporate lending and underwriting transactions (including project finance, where data was available). All deals marked as "green" were removed from the dataset, whereas those designated as "sustainability-linked" or "sustainability" were included (Rainforest Action Network (RAN) et al, 2023[7]).

[3] Other terms that are frequently employed, often interchangeably, are "emissions lock-in", "emissions-intensive lock-in", and "carbon-intensive lock-in". The terms "emissions lock-in" and "emissions-intensive lock-in" differ from the others in that they refer to all greenhouse gases (GHGs), thus not only carbon

dioxide, despite often being used in the context of describing carbon lock-in. This report will use the term "carbon lock-in" to align with existing literature and because it will not deep dive into different GHGs.

[4] Emissions pathways are distinct from scenarios and models, though the terms are sometimes used interchangeably: Climate mitigation scenarios are a "coherent set of quantitative projected pathways", with each pathway providing a future trajectory (based on a set of assumption) for a specific variable, such as emissions, GDP, natural resource use, etc. Therefore, an emissions pathway forms part of a climate mitigation scenario. Climate change mitigation scenarios, on the other hand, "are the output of models". For more details on climate scenarios and emissions pathways used in the financial sector, please refer to (OECD, forthcoming[22]).

2. Carbon lock-in considerations in transition finance definitions: the role of feasibility assessments

This chapter analyses the evolving landscape of transition finance definitions and approaches and identifies common core concepts across them. A key core concept in transition finance is that it supports the decarbonisation of high-emitting industries and activities with no feasible low-emission alternative. The chapter focuses on the role that definitions of feasibility and related assessments play in eligibility for transition finance. It analyses how different ways to define feasibility and feasibility assessments can potentially increase carbon lock-in risk within existing transition finance approaches. The chapter concludes with key findings and good practices on how feasibility assessments can be conducted to improve the climate impact of technology selection and prevent carbon lock-in risks.

2.1. The evolving landscape of transition finance definitions

Transition finance has grown in importance over recent years, with several jurisdictions and market actors presenting their own approaches to defining transition investments (Tandon, 2021[1]). Its growing popularity is largely due to the perceived limitations of narrower sustainable and green finance approaches[1], which have been criticised for being binary, static, and unable to fully support a whole-of-economy net-zero transition and for leaving emerging markets and developing economies (EMDEs) behind (see, for example, (OECD, 2022[2]; OECD, 2022[3])).

Given the plurality of actors operating in this space, existing definitions of transition finance differ not only in the stringency and granularity of their eligibility criteria, but also in how and where those criteria apply: for example, transition taxonomies usually apply eligibility requirements at the economic activity level to define what can qualify as a "transition activity". Guidance on corporate transition strategies, on the other hand, will mostly focus on the level of the corporate entity and set criteria for credible entity-wide net-zero plans or related sustainability and climate disclosures. Lastly, standards for transition financial instruments will specify the required Key Performance Indicators (KPIs) and related metrics (including, in some cases, taxonomy-related criteria) at the level of the financial instrument (OECD, 2022[2]).

When they are designed to be compatible, these different types of requirements can reinforce each other as part of a holistic approach to financing the net-zero transition: A corporate entity could develop and publish a net-zero transition plan, using a relevant climate-related reporting standard (e.g., based on a legal requirement such as in the United Kingdom (UK) or the European Union (EU), or using an international standard like the one being developed by the International Sustainability Standards Board (ISSB)). The environmental integrity and credibility of that plan can be strengthened by using a taxonomy or equivalent climate alignment tool to guide capital expenditures (CapEx). Lastly, the KPIs and metrics used in the plan to measure progress towards targets can be reflected in the issuance documents of relevant financial instruments, for example sustainability-linked bonds (SLBs) (OECD, 2022[2]).

The *OECD Guidance on Transition Finance* concludes that to scale up the transition finance market, greenwashing and carbon lock-in risks need to be reduced to provide assurance to market actors to engage in transition finance transactions. The Guidance is predominantly focused on corporates and their climate transition strategies because a robust corporate climate transition plan can provide a good basis for credible transition finance transactions and financial instruments (OECD, 2022[2]).

In this context, after reviewing existing approaches, the Guidance proposes a working definition of transition finance as "finance raised or deployed by corporates to implement their net-zero transition, in line with the temperature goal of the Paris Agreement and based on corporate climate transition plans". While useful for the specific purposes of the Guidance, this definition may not be applicable in the same way in other contexts, like taxonomies, technology roadmaps, or financial instruments. These tools may instead require definitions that are focused on economic activities or specific assets, technologies, or portfolios.

Taxonomies may provide separate definitions for green and transition economic activities, including through traffic light or tiered approaches that classify transition activities in an "amber" or "tier 2" category (see, for example, the Association of Southeast Asian Nations' (ASEAN) and Singapore's taxonomies (ASEAN Taxonomy Board, 2023[4]; Monetary Authority of Singapore, 2023[5])). The former, in a climate change mitigation taxonomy, will usually focus on the low- or zero-emission nature of the activity today. Definitions of transition economic activities, on the other hand, must be forward-looking as the activity is not yet zero-emission but needs to get onto a path to become zero-emission. Existing transition taxonomies tend to use backward-looking concepts such as "Best-Available-Technology" (BAT)[2] or similar notions of "best performance in the sector or industry", in the absence of viable or feasible low-carbon alternatives (see, for example, (European Parliament and Council of the European Union, 2020[6]; South African National Treasury and IFC, 2022[7])). They may focus on facilitating significant emissions reductions, or

generating fewer emissions compared to an alternative (see, for example, (OJK, 2022[8]; Green Finance Industry Taskforce, 2022[9]; Government of Canada, 2022[10])). This may be coupled with safeguards like the requirement to prevent carbon lock-in (see, for example, (European Commission, 2022[11]; South African National Treasury and IFC, 2022[7]; Government of Canada, 2022[10])) and ensuring that the investment does not hinder the development of low-carbon alternatives, such as a clear end date for eligibility (see, for example, (ASEAN Taxonomy Board, 2023[4]; Green Finance Industry Taskforce, 2022[9])).

Recognising the ways in which taxonomies and other transition finance approaches differentiate transition finance from sustainable or green finance, the *OECD Guidance on Transition Finance* proposes the following distinction:

- Sustainable and green finance tools and frameworks tend to define what is *already* sustainable, green or net-zero, whereas
- transition finance focuses on the *dynamic* and *forward-looking* decarbonisation or greening process of an entity or activity and its pathway towards becoming sustainable, green or net-zero at a pre-defined future point in time.[3]

Notwithstanding this conceptual distinction, for most issuers of green or transition finance products, both approaches are necessary to reach net zero, especially in high-emitting sectors: to achieve the commitments in a company's net-zero plan, both use-of-proceeds instruments financing economic activities defined as green or sustainable (such as green bonds or sustainability bonds), as well as general purpose corporate finance instruments (such as sustainability-linked bonds) are likely needed (ICMA, 2023[12]). Concretely, both transition and green investments can be relevant to achieve a decarbonisation strategy: a steel company, for instance, may wish to issue a green bond to fund a renewable energy installation or an electrification project, while also issuing a sustainability-linked bond for overall energy efficiency improvements that may involve non-renewable energy sources, at least in the short term.

Core concepts in transition finance

Several core concepts in transition finance are shared across a range of market actors and jurisdictions. Transition finance is particularly relevant to:

- high-emitting industries and activities, where zero- or near-zero emission substitutes are not yet fully *feasible*,[4] but
- where corporates can reasonably be expected to reach net zero in the future, based on a long-term, credible climate transition plan (OECD, 2022[2]).

Due to the focus of transition finance on emission-intensive industries and activities that currently lack feasible low-emission alternatives, carbon lock-in is a core concept common to most transition finance definitions and approaches (Tandon, 2021[1]; OECD, 2022[2]). While several of the existing approaches highlight the need for transition finance to avoid locking activities in high-emission pathways, limited guidance exists on ways in which financiers and corporates can practically prevent this risk.

While there is broad consensus on the core concepts on transition finance, their high-level nature and openness to interpretation can lead to significant variation in which activities and investments should qualify for transition finance. This has contributed to a mushrooming of transition finance initiatives over the last two years, with heterogenous definitions of what can qualify as a transition investment. This heterogeneity, in turn, may lead to real and perceived greenwashing risks in transition finance. A key element driving this heterogeneity is a lack of consistency in how the concept of "feasibility" is assessed, which feasibility factors and dimensions are considered, and over what timeframe.

2.2. Navigating the concept of feasibility

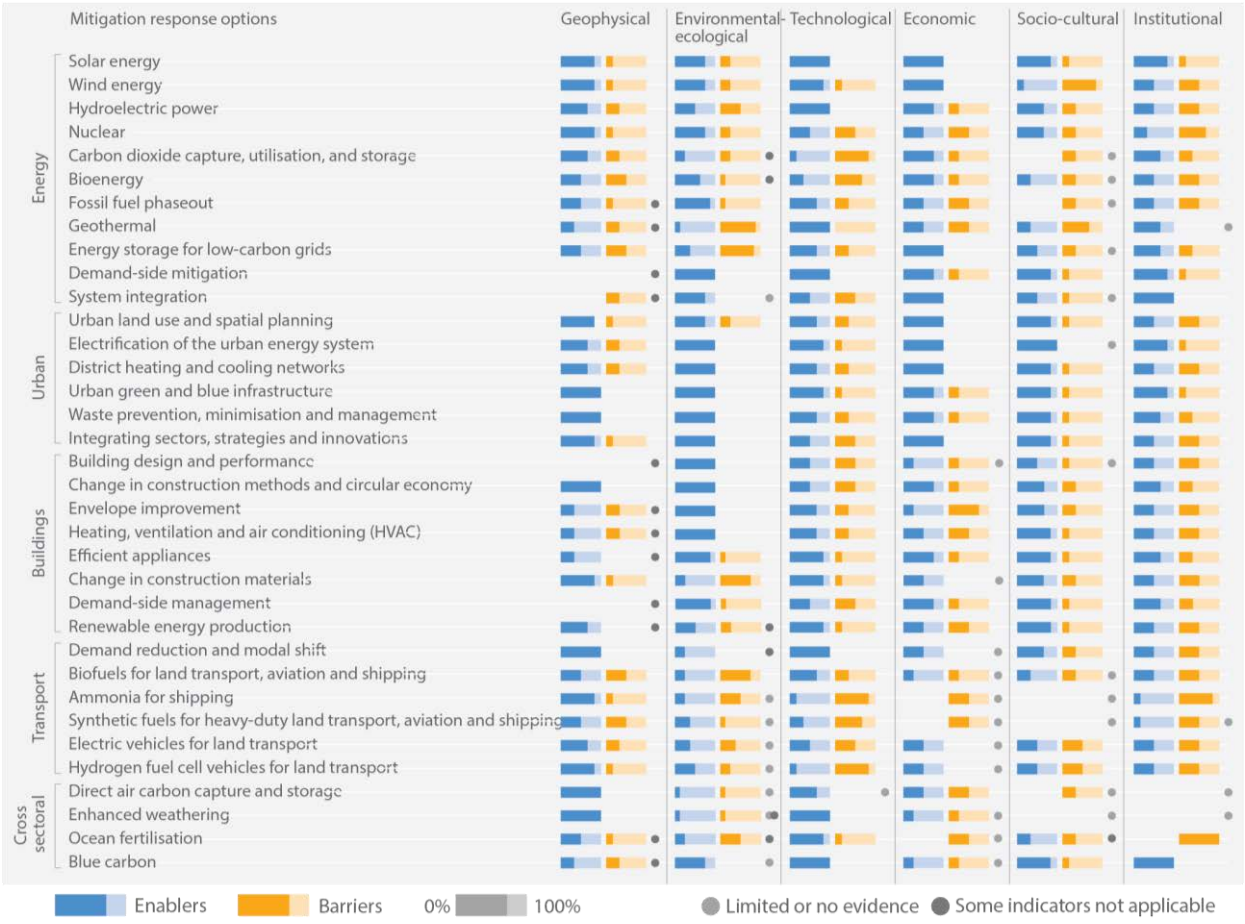
As noted, transition finance is considered most relevant for sectors, industries, and activities where there is *no feasible low-carbon alternative*. Feasibility therefore is central to assessments of eligibility, which in turn influences carbon lock-in exposure. Depending on how much weight is given to institutional factors and whether a long-term approach to economic feasibility and related cost analysis is taken, eligibility for transition finance can vary. These considerations have significant implications for the environmental integrity of different transition finance approaches and the degree to which they lock activities and assets in high-emitting pathways.

The importance of economic and institutional feasibility

In the context of climate policy, the term "feasibility" broadly refers to the potential for a mitigation action to be implemented. According to the Intergovernmental Panel on Climate Change (IPCC), feasibility can be influenced by several context-specific factors, which constrain or enable the implementation of various mitigation options. The relevance of these factors can change over time. The IPCC identifies six feasibility dimensions: geophysical, environment-ecological, technological, economic, socio-cultural, and institutional (see Figure 2.1 below on feasibility barriers and enablers by sector and mitigation response option). Strengthening enabling conditions, such as through finance, policy, institutional capacity, or technological innovation is necessary to increase the feasibility of different climate change mitigation options (IPCC, 2022[13]; IPCC, 2022[14]).

According to the IPCC, most feasibility challenges for mitigation options are of institutional or economic nature, rather than technological or geophysical (IPCC, 2022[14]). Feasibility, especially economic feasibility, is a dynamic concept, meaning it can be enhanced, for example, through continued investment and technology support, as has been the case for renewable energy production over the last decades. Conversely, a lack of economic feasibility can become a self-fulfilling prophecy, as investment is directed away from less economically feasible low-carbon technologies due to their price, subsequently making them less competitive. This tendency may be exacerbated by institutional constraints and political decisions, such as when continuing the use of fossil fuel subsidies.

Figure 2.1. Feasibility barriers and enablers by sector and mitigation response option



Source: (Pathak et al., 2022[15]), Technical Summary. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, doi: 10.1017/9781009157926.002

Not all countries have the same capacity to strengthen enabling conditions or to do so uniformly across all sectors in the economy. As a result, the potential to implement low-carbon mitigation options varies between sectors and regions of the world. The IPCC considers that feasibility challenges are highest in emerging economies, at least over the short- to medium-term (IPCC, 2022[14]). Eligibility determinations under different transition finance approaches reflect this uneven distribution of feasibility challenges, as eligibility of investments in some sectors and regions may be driven by more short-term economic and institutional constraints.

This can, for example, be seen in the heterogeneity of decarbonisation pathways for the steel sector around the world. Previous OECD analysis highlights differences across countries along various indicators, for example asset structure, access to natural resources and renewable energy, and level of innovation. Different starting points, in terms of emission intensity, the choices in low-carbon technologies and the pace of transformation towards near-zero emission steel all increase the variation of countries' decarbonisation pathways for steel (OECD, 2023[16]).

How economic feasibility is assessed impacts the environmental integrity of technology selection, especially in industry

Economic feasibility is a key determining factor for criteria-setting in transition finance (Tandon, 2021[1]) and is used to select eligible technologies or projects for support. The time horizon taken into consideration for the feasibility assessment can affect technology selection. If a long-term perspective is taken in assessing economic feasibility, the assessment can support plans to use potentially transformative technologies and avoid that an asset becomes locked into high-emitting technologies. This is especially important when comparing low-carbon technologies (such as carbon capture use and storage (CCUS) and low-carbon hydrogen[5]) with solutions with lower emission reduction potential (such as energy efficiency improvements in existing production plants) that are less costly today but risk hindering the future deployment of or switch to low-emission alternatives.

Based on existing net-zero scenarios, evidence suggests that net-zero technologies will be a better value in 2030, compared with emissions-intensive alternatives (Race to Zero, 2021[17]). But market uptake of less mature low-carbon technologies, notably CCUS and low-carbon hydrogen, remains limited as these technologies are initially costlier than their high-emission counterparts. This is, amongst others, due to high upfront capital costs and higher perceived risks because of the technology's novelty (Cordonnier, forthcoming[18]). Particularly in industry, there continues to be a high risk that new investment in emissions-intensive technologies and solutions will continue, since, for instance, energy efficiency improvements in existing plants result in almost immediate production cost savings due to lower energy demand and a relatively short payback period. Continued investment in unabated fossil fuel infrastructure over the coming years will continue to increase feasibility risks, i.e., the likelihood of negative economic feasibility findings for potentially transformative technologies (IPCC, 2022[13]).

Support for transformative zero-emission technologies, on the other hand, is more cost-effective when costs are projected over the lifetime of the asset, take into account negative externalities, future transition risk due to policy changes, and subsequent additional investment needs associated with a future switch to a near-zero or zero-emission alternative (European Commission, 2021[19]; OECD, 2022[2]; Cordonnier, forthcoming[18]). The IPCC recognises the need for taking a long-term view for the assessment of economic feasibility to ensure the environmental integrity of technology selection, when including "costs now, in 2030 and in the long term" as part of their economic feasibility indicators (IPCC, 2022[14]). Box 2.1 includes current estimates showing that the cost of net zero is lower than the cost of inaction and that transition risk will become increasingly important in cost assessments.

In the context of heavy industry, carbon lock-in is a key risk as heavy industry facilities are long-lived, capital intensive and currently high-emitting. The IEA recommends that renewal of relevant existing high-emitting assets in G7 countries should be very carefully considered, given the long lifetimes of assets in these sectors: for example, blast furnaces and cement kilns have an average lifetime of 40 years (IEA, 2022[20]). Such plants are often refurbished at around the 20- or 25-year mark to extend their lifetimes. It is thus an important decision point when aiming to avoid carbon lock-in. According to the IEA, 90% of steelmaking and 80% of cement production capacity in the EU is over 20 years old, with similar figures in the United States (US). This suggests that investments in new assets or refurbishments and retrofits of existing assets can make use of a rare window of opportunity today to put in place mechanisms that will minimise lock-in in the future.

For example, investing in incremental improvements in high-emitting assets such as coal plants is not always compatible with net-zero pathways and can lead to lock-in. This risk can be mitigated when taking a longer-term perspective and using appropriate metrics to situate any incremental improvements in risky fossil fuel assets within a series of retrofits (and if necessary, eventual retirement or repurposing) that can eventually transition an asset to zero- or near-zero emissions (IEA, 2022[20]).

Similarly, taking a short-term perspective to assessing feasibility can have a negative impact on an economy's capacity to leapfrog, which is particularly relevant to EMDEs. Leapfrogging refers to accelerated development marked by the skipping of less efficient and polluting technologies through the faster adoption of more advanced ones (OECD, 2022[2]). This is more difficult and costly when economies are already locked-in to emissions-intensive infrastructure.

Box 2.1. The cost of net zero is lower than the cost of inaction.

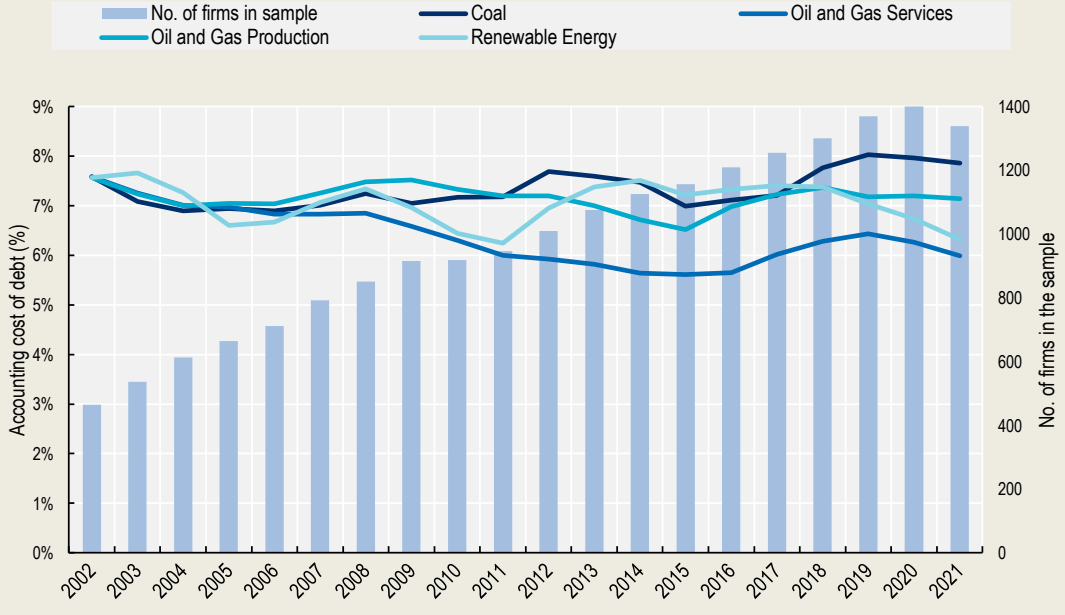
To transform the global economy to achieve net zero emissions by 2050, based on research by the Network for Greening the Financial System (NGFS), McKinsey estimates that a total of USD 9.2 trillion in annual average spending on physical assets is required. This includes current spending on low-emission assets (USD 3 trillion), a reorientation of current spending away from high-emission assets (USD 2.7 trillion), and additional funds to invest in more low-emission assets (USD 3.5 trillion) (McKinsey, 2022[21]). At the same time, reaching net zero by 2050 could bring gains of USD 43 trillion by 2070, while unchecked climate change could cost the world economy USD 178 trillion over the same period (Deloitte, 2022[22]).

Anticipated regulatory costs and market opportunities associated with climate change are beginning to be reflected in financial markets:

- Analysis by ECB staff in 2022 found that transition risk premia in euro area equity markets have increased since the Paris Agreement (Bua et al., 2022[23]);
- A similar trend can be observed in the cost of capital for renewables, compared with the cost of capital for fossil fuels: in Europe, where climate policy is most advanced, low-carbon electric utilities have a lower cost of capital than high-carbon ones, which suggests that low-carbon policies in Europe have been successful at decreasing risk for those projects and technologies. The gap is larger for equity than for debt, which might indicate that transition risk is starting to be priced in. Similarly, coal mining has the highest cost of capital globally (Zhou et al., 2023[24]). See Figures 2.2 and 2.3 below.

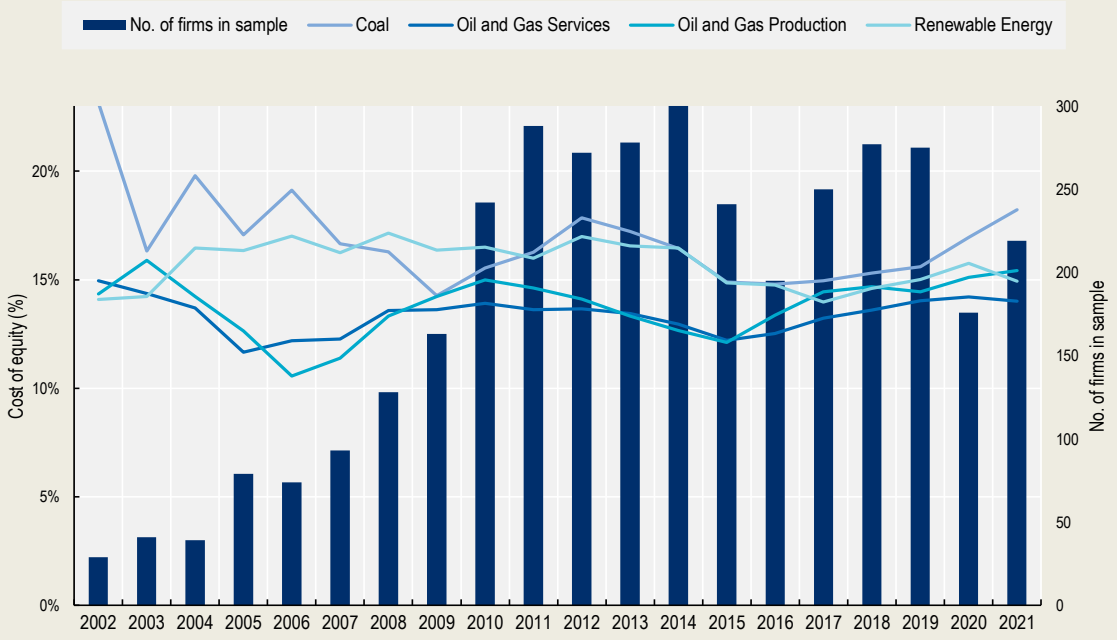
These findings suggest that as climate policy towards net zero is continuing to advance, transition risk will become increasingly important in cost assessments.

Figure 2.2. Accounting cost of debt, global Trend TRBC classification



Source: (Zhou et al., 2023[24]), Energy Transition and the Changing Cost of Capital: 2023 Review, https://sustainablefinance.ox.ac.uk/wp-content/uploads/2023/03/ETRC-Report-2023_March.pdf

Figure 2.3. Cost of equity, global trend TRBC classification



Source: (Zhou et al., 2023[24]), Energy Transition and the Changing Cost of Capital: 2023 Review, https://sustainablefinance.ox.ac.uk/wp-content/uploads/2023/03/ETRC-Report-2023_March.pdf

Institutional and social feasibility are likely key factors influencing eligibility under existing transition finance approaches

Most transition finance approaches cite technological and economic feasibility as key determining factors for eligibility. However, another important variable in the decision-making process appears to be institutional and social factors.[6] Notably, such factors are acknowledged as key limiting variables in the choice of mitigation options by the IPCC (IPCC, 2022[14]).

Political and social considerations can be key drivers of carbon lock-in risks (Frontier Economics, 2021[25]). As such, they can influence decision-making on feasibility, which in turn can determine eligibility for transition investments and activities. Political and social feasibility are closely interconnected and are impacted by factors such as employment and income implications, and presence of interest groups. Research suggests that in some cases, decarbonisation options may be technically and economically feasible but difficult to realise due to political feasibility concerns (Patterson et al., 2018[26]). Social feasibility can be affected by considerations related to environmental justice,[7] for instance, ensuring access to energy for all, sustaining the livelihood of impacted workers and communities, meaningfully involving all people in decision-making processes and, more broadly, protecting vulnerable people from the impacts of climate change, air pollution and other environmental factors.

For example, the financing of unabated natural gas assets for domestic energy production is unlikely to be the only technologically and economically feasible option, given the existence of low-carbon and renewable alternatives. Alternatives may include building energy efficiency, installation of heat pumps, or generation

of heating, cooling and power, using renewable energy sources (European Commission, 2021[19]), though their upfront capital costs may still be relatively high in some EMDEs. Unabated natural gas may, however, still be chosen due to institutional factors, including political acceptability and administrative constraints such as a lack of a policy and legal framework for renewables development, investment, and deployment.

The continued uptick in demand and investment in natural gas seems to confirm this. According to the IEA, new oil and gas resources approved for development are expected to increase by 25% in 2023, relative to 2022, mainly for natural gas (IEA, 2023[27]). The IEA expects investments in unabated fossil fuel supply to increase by more than 6% in 2023, reaching USD 950 billion, of which more than half is going to upstream oil and gas. Oil and gas upstream CapEx is projected to continue to increase through 2025 and 2030 (IEF, 2023[28]), 500 GW of natural gas-fired power plants are planned or under construction, and new Liquefied natural gas (LNG) import and export terminals with a total capacity of 1.3 billion tonnes are under development (Kemfert et al., 2022[29]). At the same time, the current energy crisis increased concerns about the future cost and availability of natural gas and therefore its reliability to serve as a transition fuel (IEA, 2022[30]). In IEA's Stated Policies Scenario, IEA's scenario with the highest gas consumption, natural gas demand rises by less than 5% between 2021 and 2030 and then remains flat from 2030 to 2050, with growth in emerging market and developing economies offset by declines in advanced economies. In IEA's Announced Pledges Scenario, by 2030 demand is 10% lower than 2021 levels. In the Net Zero Emissions by 2050 Scenario, demand is 20% lower by 2030, relative to 2021 levels, and is 75% lower than 2021 by 2050 (IEA, 2022[30]).

Another example of factors influencing institutional feasibility in the power sector is the presence of long-term Power Purchase Agreements (PPAs)[8], which often have rigid clauses. According to the IEA, some PPAs include clauses allowing the seller to source power from different sources if demand is met at the agreed volumes and price. This would allow the replacement of electricity produced by, e.g., an unabated coal power plant with electricity from renewables or other low-emission sources. However, some PPAs have rigid provisions on the minimum levels of generation from a specific plant, thus creating risks of contractually locking in emissions from the current coal power plant fleet (IEA, 2022[30]). The IEA shows that PPAs risk locking in a significant share of coal-fired generation. Another major factor influencing institutional feasibility in coal-fired power generation relates to the fact that most of their operations are shielded from market competition, because they are often financed by state-owned utilities. For example, approximately 60% of current coal power plants in EMDEs are financed by state-owned utilities (IEA, 2022[30]).

2.3. Key findings and good practices for transition finance methodologies and definitions

Transition finance definitions can be strengthened and made more transparent by providing clarity on how to assess feasibility as part of eligibility criteria, and by taking a long-term approach in the assessment.

Including the concept of feasibility in transition finance definitions, when setting eligibility criteria, is likely necessary to distinguish transition finance from green or sustainable finance, where low-carbon options are, by definition, readily available. Transition finance definitions, on the other hand, need to identify in which cases low-carbon alternatives are not possible, which is the role of the feasibility assessment.

Taking a long-term perspective in feasibility assessments and explicitly stating which feasibility dimensions were considered can help strengthen the environmental integrity of technology selection and reduce carbon lock-in risks. Concretely, transition finance approaches that credibly prevent carbon lock-in will provide a more detailed definition of what feasibility entails, notably by specifying the need to:

- Take into account project costs in 2030 and beyond, using an appropriate net-zero scenario;

- Take into account costs of reinvestment in order to achieve net zero;
- Appropriately assess and monetise transition risk, including by projecting it over a longer time horizon (2030 and beyond), as it may not immediately materialize; and
- Explicitly acknowledge and address potential challenges related to institutional and social feasibility, which may affect economic feasibility, for example by providing adequate support, social protection, training, and reskilling to impacted workers, households and communities.

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Notes

[1] It is worth noting that while green finance is indeed narrow in its scope, the term 'sustainable finance' generally refers to finance for all sustainability objectives, whether economic, environmental or social, thus often encompassing green and transition finance.

[2] While the concept of 'Best-available technology' or 'Best-available technique' (BAT) to prevent and control industrial emissions and pollution has different interpretations across the world, the EU definition is the most widely referenced one. According to that definition, "BAT" generally refers to techniques that can be implemented at scale, "under economically and technically viable conditions, taking into consideration the costs and advantages" (OECD, 2020[31]). BAT-associated environmental performance levels are based on "the range of emission levels obtained under normal operating conditions using a best available technique" and are fundamentally based on the performance of existing installations (OECD, 2020[31]).

[3] This distinction acknowledges that transition finance could be applied to several environmental and social objectives, despite to-date being for the most part focused on climate mitigation (net-zero) goals.

[4] In the context of transition finance, the term "viable" and "feasible" are sometimes used interchangeably. Reflecting the broader use of the term "feasibility" in the climate change mitigation context and related IPCC definitions, this report will utilise the terms "feasible" / "feasibility".

[5] Currently, there is no standard classification of hydrogen based on a transparent and universally accepted methodology (Cordonnier and Saygin, 2022[32]). In the context of this report, "renewable hydrogen" refers

to hydrogen produced using renewable energy sources. Hydrogen is often referred to as “low-carbon” when associated lifecycle emissions are below a specific threshold, which varies across jurisdictions. As a cross-cutting energy vector, hydrogen can be used to decarbonise end-use sectors like heavy industry or maritime and air transport, and integrate higher shares of variable renewable energy (VRE) sources (such as solar and wind) into the energy system.

[6] “Institutional feasibility” refers to factors like political acceptance, institutional capacity, and legal and administrative capacity, as affecting the possibility to implement different mitigation options.

[7] The US Environmental Protection Agency (EPA) defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, colour, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (EPA, 2007[33]).

[8] Power Purchase Agreements (PPAs) are “contracts that set the terms of sale of power between two entities over a defined period, usually years or decades, and help to underpin the financing required for a power generation project” (IEA, 2022[30]).

3. Carbon lock-in considerations in financing and investment frameworks

This chapter provides an overview of existing financing and investment frameworks that consider the risk of lock-in and that contain mechanisms to mitigate that risk. The overview includes relevant frameworks for both public and private finance and investment, notably: environmental State aid guidelines, Paris alignment methodologies of Multilateral Development Banks (MDBs), as well as transition finance tools and frameworks designed to increase private finance in the net-zero transition. The analysis shows gaps in existing transition finance approaches for private finance when it comes to mechanisms to prevent lock-in. The chapter proposes ways to strengthen them, taking inspiration from mechanisms that can be found in public finance approaches.

3.1. Carbon lock-in considerations in selected public and private investment frameworks and tools

The concept of carbon lock-in is not exclusive to transition finance and is a recurring theme in discussions around policy and financing for climate change mitigation. It is particularly important to consider when designing (public or private) investments in energy production and use. Existing frameworks and tools guiding such investments reflect to varying degrees the growing importance of carbon lock-in risk. However, as the window of opportunity to stay within the Paris temperature goal is closing, the issue of lock-in risk and how best to mitigate it can be expected to take centre stage as stakeholders develop relevant financing frameworks and tools.

To date, there are broadly two areas where mechanisms to prevent lock-in have been developed and applied:

- Public sector approaches:
  - Domestically, such as in the context of state aid policies and recovery funds in the European Union (EU);
  - Internationally, such as for investments by international financial institutions (which can be extended to either public or private entities and used to mobilise additional commercial resources), notably Paris alignment methodologies developed by Multilateral Development Banks (MDBs) and those associated with energy transition mechanisms;
- Private sector approaches, notably in transition finance tools and frameworks developed by public and private actors (globally, but with a higher concentration of approaches in Asia).

Public finance approaches

European Commission State Aid Guidelines

The 2022 European Commission Guidelines on State aid for climate, environmental protection and energy are, to date, the only state aid framework that explicitly requires the consideration of carbon lock-in risk. They require that state aid measures bring about positive effects on the supported economic activities, including with regards to the net-zero transition and environmental protection. The positive effects of state aid measures must outweigh any negative effects of the investment (e.g., on competition and trade). This requirement includes the consideration of the EU Taxonomy criteria, including the “do no significant harm” (DNSH) principle, which means that supported economic activities cannot do significant harm to any of the six environmental and climate objectives set out in the EU Taxonomy (climate change mitigation, climate change adaptation, pollution prevention and control, circular economy, protection of water and marine resources, protection of biodiversity and ecosystems).

The Commission Guidelines specify that aid measures directly or indirectly involving fossil fuels “are unlikely to create positive environmental effects and often have important negative effects”, meaning they are unlikely to be eligible for state aid, including on DNSH grounds. This includes new natural gas investments unless it can be shown that there is no carbon lock-in effect. The absence of lock-in can be demonstrated through a “national decarbonisation plan with binding targets”, or through “binding commitments by the beneficiary to implement decarbonisation technologies […] or replace natural gas with renewable or low-carbon gas or to close the plant on a timeline consistent with the [EU’s] climate targets”. The latter implies a clear reduction in fossil fuels, including a reduction of 66-71% by 2050 in the use of unabated natural gas compared to 2015 (European Commission, 2022[1]).

The European Union's Recovery and Resilience Facility

A similar approach is taken in the Recovery and Resilience Facility (RRF), set up by the European Commission in 2020 to support European Member States in the recovery from the negative economic and social impacts of the COVID-19 pandemic. The European Commission, as part of the RRF's requirement to respect the principle of DNSH across all investments and reforms supported by the fund, provides additional guidance on how to prevent carbon lock-in in the case of fossil fuel investments.[1] Notably, all investments or reforms involving liquid or solid fossil fuels are excluded from support, while measures involving natural gas need to comply with additional criteria (European Commission, 2021[2]).

Criteria for natural gas power and heat/cool production limit support to "Member States that face significant challenges in the transition away from carbon-intensive energy sources", which refers to countries that currently have a very emission-intensive energy system (e.g., those that are heavily dependent on coal for energy production). They also require that measures are in line with the EU's 2030 and 2050 emissions targets, that the asset be future-proof (by installing technological solutions that enable the use of renewable and low-carbon gases by the asset), and either adherence to a lifetime emissions threshold for the asset, or the introduction of additional "flanking measures" to help ensure the asset is deployed in a manner that prevents lock-in. Flanking measures have to include national strategies and related commitments for the development of low-carbon gases like hydrogen, "the simultaneous closure of a significantly more carbon-intensive power plant" (notably, coal- or oil-fired) "with at least the same capacity" as the new asset, a credible national trajectory to reach 2030 renewables targets, and concrete accompanying reforms and investments to increase the share of renewables (see Box 3.1 below for further details and examples on the use of flanking measures for future-proofing).

Network investments (transmission networks and distribution infrastructure, including for domestic heating) can be supported, if they are future-proof (i.e., enabled for the transport or storage of renewable and low-carbon gases). Similarly, domestic gas boilers can be supported as part of wider energy efficiency or building renovation programmes, if those programmes lead to a significant decrease in GHG emissions,[2] and a significant improvement in air pollution and public health. This could be the case, for example, when replacing coal- or oil-based heating systems and boilers with gas-based heating systems or boilers.

Box 3.1. Flanking measures to support future-proofing

What are flanking measures?

The concept of "flanking measures" (or "flanking policies") refers to complementary measures that can ensure or enhance the effectiveness of a given policy or investment (PPMi, 2019[3]). In an environmental policy context, flanking measures can contribute to building the right enabling environment for investments to be future-proof, or combine several investments in a manner that makes them future-proof, and notably effective in preventing carbon lock-in.

Flanking measures that improve the enabling environment usually take the shape of government reforms, such as through national industrial decarbonisation strategies, electricity market reform, phase out of fossil fuel subsidies, amongst others. In the absence of government intervention, market actors can still make use of this concept to future-proof their investments, notably by carrying out accompanying investments in support of the initial investment. The below examples cover possible public and private interventions in energy, transport, and industry.

Flanking measures are useful in preventing lock-in in high-emitting sectors (energy, transport, industry)

Flanking measures are relevant for transition finance and for preventing lock-in because they:

- allow the decision-maker to take a longer-term and more holistic perspective on decarbonising high-emitting sectors, when low-carbon alternatives are not yet feasible; and
- prevent greenwashing when it comes to investments that comply with low-carbon criteria but will likely not be operational and fully implemented without additional interventions.

Energy

A gas transmission network can be theoretically future-proof if it is built to be able to transport hydrogen as well as fossil gas, and if it complies with the technical specifications on turbines, materials, and other key criteria. However, without a sufficient and steady supply of hydrogen, the network may end up transporting fossil gas, despite not being intended for that purpose. An example of a flanking measure would be policies and investments to ensure hydrogen supply. This could be done through accompanying reforms, like the adoption of a national hydrogen strategy, or investments into the hydrogen production value chain.

Transport

Similarly, to avoid increased emissions from higher traffic associated with the construction of new roads, flanking measures can be put in place to support the shift to cleaner modes of transport. This could be done by way of accompanying investments in rail and public transport, equipping roads with low-carbon infrastructure (such as charging stations for electric vehicles), putting in place appropriate road access or congestion charges, and wider reforms to facilitative broader access to public transport.

Industry

To reduce emissions in steelmaking, coking-coal-based blast furnaces (BFs) can be replaced with direct-reduced-iron (DRI) that use natural gas as a feedstock or reducing agent. DRI plants can be converted to run on low-emission hydrogen. Like the lock-in risks in the energy sector, one of the key challenges to ensure that DRI plants are future-proof is to ensure a sufficient supply of low-emission hydrogen. To prevent risk of carbon lock-in in this case, flanking measures could include accompanying investments by the company into the hydrogen production value chain, such as investments to ensure enough electrolysers come on-stream to support a fuel switch of the company, as well as accompanying government reforms to build up the hydrogen value chain.

Source: Authors.

MDB methodologies to assess alignment with the Paris Agreement

In 2017, MDBs committed to align their financial flows with the objectives of the Paris Agreement and to develop a joint approach to assess such alignment. In 2023, they published joint methodological principles for assessment of alignment with the Paris Agreement (for both mitigation and adaptation) of several types of financing, such as direct and policy-based investment lending operations, intermediated financing and general corporate purpose finance (World Bank, 2023[4]). Such principles are relevant to transition finance approaches as they directly apply to high-emitting activities and explicitly focus on addressing carbon lock-in risk.

The joint MDB assessment of direct investment lending operations and their alignment with the mitigation goals of the Paris Agreement is comprised of two main steps. The first one is a "uniform assessment", i.e., a screening using lists of "universally aligned and universally non-aligned" activities,[3] which are periodically updated, moving further away from higher-emitting activities over time (World Bank, 2023[5]). If an activity falls under the "universally aligned" list, then it can be considered aligned and therefore lock-in risks are negligible. The second step applies to activities whose classification is unclear and consists of a "specific assessment", i.e., a second screening based on specific criteria.[4] Two of the criteria used for the specific assessments closely relate to lock-in risks. The first is whether the activity prevents opportunities to transition to Paris-aligned activities, or primarily supports or directly depends on non-aligned activities in a specific country/sectoral context. The second assesses whether the activity is economically unviable, when considering the risks of stranded assets and transition risks in the national and sectoral context. Other criteria include consistency with relevant Nationally Determined Contributions (NDCs), Long-Term Climate Strategies (LTS) or national economy-wide, sectoral, or regional low-GHG strategies, and sectoral pathways (World Bank, 2023[5]).

The methodological principles for other types of financing are broadly similar to those for direct lending, with some adjustments to account for the specificities of the different financing approaches. For example, for intermediated lending, an MDB can choose whether to assess Paris alignment at transaction level or at counterparty level and follow a similar approach to that outlined above. In case an MDB's use of eligible proceeds includes investments that may lead to potential carbon lock-in, then the MDB should "demonstrate that at the time of investment either (i) the risks within the eligible use of proceeds have been addressed or reasonably managed, or (ii) the counterparty commits to verifiable management practices to ensure that carbon lock-in and transition risks are managed before the end of the investment tenor, as applicable" (World Bank, 2023[6]).

In the case of general-purpose corporate finance, if a counterparty supports universally non-aligned activities, it can still be classified as "aligned" if "the MDB finance is structured with the objective of decarbonising the counterparty in line with the principles of Sustainability-Linked Finance". If the counterparty engages in "high-emitting sectors",[5] then it is subject to a further screening which includes a lock-in risk assessment if the MDB financing is long-term. In this case, to be considered Paris-aligned, the transaction must either be structured as a sustainability-linked bond or loan, or the counterparty must commit to develop and implement a Paris alignment pathway which shall explicitly include how carbon lock-in risk is addressed. The counterparty must report to the MDB periodically on the progress of development and implementation of the pathway (World Bank, 2023[7]). It is worth noting that while sustainability-linked instruments are promising instruments that create financial incentives for corporates to set and reach credible emission reduction targets, these instruments can also create lock-in and greenwashing risks if adequate safeguards are not in place – this issue is further explored in Chapter 4.

Due to differences in mandates, policies, and strategies across MDBs, the methodological principles could be operationalised in different ways (World Bank, 2023[4]). Since the methodological principles do not provide detailed guidance, frameworks, or metrics to assess potential lock-in risk, each MDB might follow a different approach. Building on the joint principles, some MDBs have already developed their own Paris alignment approaches, which address lock-in risk to different extents – see Box 3.2 below for further details

on how existing MDB own methodologies on Paris alignment tackle lock-in risks. Existing methodologies can provide a useful reference for other MDBs that have not yet developed a definitive methodology on addressing lock-in. For example, as described in Box 3.2 below, it is important to consider whether and how a project's commercial arrangements and broader market conditions may increase lock-in, and to factor in long-term cost assessments in lock-in evaluations (EBRD, 2022[8]). In case high lock-in risk is identified, the MDB can require the client to adopt a credible climate transition plan to address the risk and include such provisions in legal covenants (World Bank, 2023[9]).

Box 3.2. How do MDB's own Paris Alignment methodologies deal with carbon lock-in risk?

EBRD

EBRD's Paris Alignment methodology includes a carbon lock-in test as one of the criteria of the "specific assessment" (the second screening) (EBRD, 2022[8]). The test requires "assurance that the project does not enable an emissions-intensive asset to continue operating when economically preferable, lower-carbon options could replace it". The lock-in test looks at project-specific criteria as well as at the circumstances and conditions under which the project is taking place: if the investable asset will cease to operate in an emission-intensive manner in (approximately) less than 10 years, or if it complies with additional criteria, the risk of lock-in is considered low.

Beyond project-specific criteria, the lock-in test also involves an analysis of the project's commercial arrangements that may increase lock-in (such as long-term contracts guaranteeing operation at high utilisation rates), the market structure of the project itself (such as the lack of a regulatory framework to attract low-carbon options or the project's dominant market position that would deter market entry), and the broader project context (such as decarbonisation or carbon pricing policies in the jurisdiction in which the project is operating). Lastly, where a project has significant emissions, the EBRD assessment includes a long-term cost assessment, looking at the project's cost structure, compared with the costs of future low-carbon alternatives. Specifically, this can involve an assessment of sunk costs and how they affect the overall cost of the project, compared with a low-carbon alternative.

World Bank

According to the World Bank's own methodology for Paris Alignment of investment project financing, if a financial institution's portfolio is exposed to carbon lock-in risks and does not have adequate institutional processes in place to address them, then the institution will be required to adopt and implement a set of measures to assess and reduce those risks (World Bank, 2023[9]). The World Bank can embed these in legal covenants, monitor them throughout the project implementation, and provide technical assistance as needed.

EIB

The EIB also has a framework for Paris Alignment for Counterparties (PATH), to help their clients (corporate and financial intermediaries) align their operations over time with the goals and principles of the Paris Agreement (EIB, 2022[10]). The PATH Framework focuses on companies for which the need to align is most acute, namely those in high-emitting sectors and those operating in contexts of high climate vulnerability. The PATH Framework does not explicitly address the risk of carbon lock-in, but requires eligible, high-emitting companies to have a public decarbonisation plan with "a mid-term, rolling, quantitative emission reduction target and options over a longer time horizon to achieve carbon neutrality towards mid-century". Any potential role of offsetting must be clearly defined and must take into account the interests of social partners. For companies that either do not have adequate plans or are not verified by independent organisations, the Framework contractually requires them to develop and publish an "alignment strategy" within one year of the contract signature, with flexibility provided for companies outside the EU with challenging enabling environments. Failure to comply with this contractual obligation would constitute a breach of contract.

Financing early retirement and repurposing of fossil fuel-fired power plants: ADB's Energy Transition Mechanism

Long-lived infrastructure that cannot be adapted to low-carbon and zero-emission pathways are at risk of getting stranded and creating carbon lock-in. According to the IPCC, evidence suggests that without

carbon capture, the worldwide fleet of coal- and gas-fired power plants would need to be retired about 23 and 17 years earlier than expected lifetimes, respectively, in order to limit global warming to 1.5°C and 2°C (IPCC, 2022[11]).

The Energy Transition Mechanism (ETM) is an initiative developed by the Asian Development Bank (ADB) to catalyse public and private capital to accelerate the transition from carbon-intensive coal-based power plants to clean energy in ADB's developing member countries. Eligible activities include: (i) reducing emissions from coal-fired power plants through early retirement or repurposing of such plants for clean energy; (ii) increasing the share of clean energy, including through support for enhanced grid capacity; (iii) helping countries develop and enact policy and regulatory measures to accelerate the shift from coal to clean energy; and (iv) supporting a just transition. To mobilise resources for ETM activities, ADB set up a new multi-partner trust fund, the Energy Transition Mechanism Partnership Trust Fund (ADB, 2023[12]).

The ETM will include two financing vehicles: (i) a carbon reduction fund, which will be devoted to early retirement or repurposing of coal-fired power plants on an accelerated timeline; and (ii) a clean energy fund, which will focus on new clean energy investments in generation, storage, and grid upgrades (ADB, 2022[13]).

The ETM started with three pilot countries: Indonesia, the Philippines, and Viet Nam. It now has been extended to Pakistan and Kazakhstan (see Box 3.3 below). Retirement projects could have severe negative socioeconomic impacts, such as direct job losses in retired plants, indirect job losses in industries within the coal-value chain and in the informal sectors that depend on it, and potential slowdown of economic activity along the supply chain. For this reason, the ADB is implementing safeguards to avoid, minimise, mitigate or compensate potential adverse impacts of projects on the environment and affected people, for example through retraining and reskilling programs for vulnerable workers, in many cases women (ADB, 2022[14]).

Box 3.3. Latest activities of ADB's Energy Transition Mechanism (ETM)

Indonesia

In Indonesia, ADB signed a Memorandum of Understanding in 2022 with Cirebon Electric Power, an independent power producer (IPP), and other partners to explore the early retirement of the first coal-fired power plant under the ETM programme. The planned transaction would retire a 660-megawatt coal power plant in Western Java. ADB is supporting the design and operation of Indonesia's ETM Country Platform, which oversees the broad structure of energy transition activities in Indonesia and future programs to accelerate the retirement or repurposing of coal-fired power plants. ADB is also supporting the development of Indonesia's investment plan under the Climate Investment Funds Accelerating Coal Transition (CIF-ACT) program, which received approval to receive USD 500 million of concessional capital in October 2022. ADB is also providing institutional support for the Indonesian Just Energy Transition Partnership (JETP) secretariat, which will coordinate the implementation of the JETP.

Philippines, Viet Nam, Pakistan and Kazakhstan

In the Philippines, Viet Nam, Pakistan, and Kazakhstan, the ADB is conducting feasibility studies to analyse the viability of early retirement and/or repurposing of high-emitting fossil fuel-powered plants. Unlike in Indonesia, the Philippines, and Viet Nam, the priority for Pakistan is to transition away from oil- and diesel-fired power plants, although coal-fired power plants will likely be addressed as part of ETM's pre-feasibility study.

Note: This box is based on an ADB public update on ETM activities as of April 2023.
Source: (ADB, 2023[15])

Private finance approaches: transition finance tools and frameworks

As transition finance has gained in prominence over the last years, an increasing number of taxonomies have begun integrating transition considerations into their eligibility criteria. In this process, it has become clear that while activity-level criteria are useful to prevent greenwashing in green-labelled use-of-proceeds instruments, activity-level approaches need to be complemented by entity-wide strategies and tools like scenarios and emissions pathways. This is necessary to ensure that an entity-wide process of decarbonisation is taking place, in addition to individual green investments, which may be limited to a specific portion of the business.

It is important to note that taxonomies were initially developed to define what can qualify as a green economic activity for the purposes of use-of-proceeds instruments, notably green and climate bonds. The first jurisdiction to develop such a system was China, with its 2015 "Green Bond Endorsed Project Catalogue" (OECD, 2020[16]) and the first market actor was the Climate Bonds Initiative (CBI) which developed a taxonomy as part of its Climate Bonds Standard and Certification Scheme in 2013 (CBI, 2023[17]). The specific aim was to put in place a system that could help ensure the environmental credibility and integrity of green-labelled use-of-proceeds instruments. Therefore, taxonomies had to have an economic activity, project, or asset focus.

While carbon lock-in is an important risk in transition finance, not all existing frameworks explicitly address it. Several frameworks can be considered "hybrid" approaches, as they tend to combine mechanisms that can be found in activity-level or entity-level approaches. Examples of "hybrid" approaches include notably Japan's Basic Guidelines on Climate Transition Finance by the Ministry of the Economy, Trade, and Industry (METI), the Ministry of the Environment, and the Financial Services Agency (FSA) (FSA, METI

and Ministry of Environment, Japan, 2021[18]), and ICMA's Climate Transition Finance Handbook (ICMA, 2020[19])".[6]

Activity-level approaches: taxonomies

Several taxonomies[7] explicitly cover transition activities to various degrees, including the Association of Southeast Asian Nations (ASEAN) Taxonomy (ASEAN Taxonomy Board, 2023[20]), Canada's Taxonomy Roadmap (Government of Canada, 2022[21]), the EU Taxonomy (((European Commission, 2021[22]) and (European Commission, 2022[23])), Indonesia's Green Taxonomy (OJK, 2022[24]), Korea's K-Taxonomy (InvestKorea, 2022[25]), Malaysia's principles-based taxonomy (Bank Negara Malaysia, 2021[26]), Singapore's traffic light taxonomy (Monetary Authority of Singapore, 2023[27]), and South Africa's Green Finance taxonomy (National Treasury, 2022[28]).

Taxonomies most commonly deploy a combination of three mechanisms to prevent lock-in when defining *transition economic activities* for the purposes of climate change mitigation:[8]

- **Exclusion and eligibility criteria**: Most taxonomies contain technical screening criteria or similar requirements to delineate the expected level of environmental performance of economic activities to be eligible for inclusion in a given taxonomy. In addition, some taxonomies, such as the EU Taxonomy and the ASEAN Taxonomy, exclude some activities from eligibility. Similarly, some taxonomies define activities as part of traffic light systems, as in the case of the Singaporean and Indonesian taxonomies (European Union, 2020[29]; ASEAN Taxonomy Board, 2023[20]; Monetary Authority of Singapore, 2023[27]; OJK, 2022[24]).
- **"Future-proofing" of carbon assets**: This approach calls for ensuring that newly built or retrofitted gas infrastructure is enabled for the use of near-zero and net-zero technologies, notably hydrogen. This approach is taken, for example, by the EU Taxonomy, when requiring that power generation plants that use fossil gas are designed to be able to use renewable or low-carbon fuels (European Commission, 2022[30]).
- **Sunset clauses:** Under this approach, the relevant activity is only counted as a transition activity until a specific date (e.g., 2030) and must comply with a new set of more stringent criteria thereafter to continue qualifying as part of the taxonomy. Examples include a certain level of blending with renewable or low-carbon gases, or a complete fuel switch to a low-carbon or renewable gas, as part of investments in natural gas infrastructure. Sunset clauses are used in the ASEAN Taxonomy, the EU Taxonomy, the South African Taxonomy, and the Singaporean Taxonomy (ASEAN Taxonomy Board, 2023[20]; European Commission, 2021[22]; European Commission, 2022[30]; Monetary Authority of Singapore, 2023[27]; National Treasury, 2022[28]). The Singaporean Taxonomy does this by way of a traffic light system, defining "green", "amber", and "red" activities based on their compatibility with net zero by 2050, with "red" activities being ineligible under the Taxonomy, while "amber" activities are, in most instances, eligible until 2030 (Monetary Authority of Singapore, 2023[27]). To avoid carbon lock-in, in the Singaporean Taxonomy the amber category is relevant only for *existing* transitioning infrastructure and activities, whereas any *new* activity (whether a new power plant, a new building, etc.) must meet the green criteria. The ASEAN Taxonomy has a tiered system, with a 2030 sunset date for "tier 3" activities, a later 2040 sunset date for "tier 2" activities, and no sunset date for "tier 1" activities, reflecting the various levels of environmental performance of the activities that are covered by each tier (Monetary Authority of Singapore, 2023[27]).

Entity-level approaches: transition plan initiatives

In addition to defining transition activities, some taxonomies are starting to integrate an entity-focused approach to issue of the lock-in. An entity focus is partially reflected in the principles-based taxonomy developed by the Green Finance Industry Taskforce (GFIT) for the Monetary Authority of Singapore: in the

context of fossil fuel financing, it emphasises the importance of the "broader environmental strategy of businesses", including pathways, implementation plans, and targets to meet climate objectives (Monetary Authority of Singapore, 2023[27]). The same entity-level approach is also reflected in the Canadian Taxonomy Roadmap Report, which has issuance requirements as part of its proposed taxonomy: issuing companies have to set targets (net zero by 2050 or earlier, in addition to a 2030 interim target, as well as additional targets between 2030 and 2050), develop a net-zero transition plan, follow annual reporting requirements and prepare climate disclosures "in compliance with emerging […] international standards" (Government of Canada, 2022[21]).

In addition to the broadening of taxonomy approaches, the last years have seen a mushrooming of new purely entity-focused approaches in transition finance, which revolve around corporate transition plans and related corporate climate disclosures. The development and disclosure of credible corporate climate transition plans has been limited to date. According to CDP, which holds a large corporate climate disclosure database, in 2022, 22% of the over 18,600 disclosing organisations reported that they had already developed a 1.5°C-aligned climate transition plan (CDP, 2023[31]). However, of these 4,100 organisations, only 81 (that is, 0.4% of the full sample) reported sufficient detail to all key indicators that align with a credible climate transition plan. Moreover, only 9% of the full sample of disclosing companies reported that their transition plan was publicly available.

Several regulatory initiatives are emerging at national and regional level, setting out expectations on the need for companies to develop and publish climate transition plans, for example in the UK, Switzerland, EU, and Japan. The *OECD Guidance on Transition Finance* provides an analysis of these initiatives, including a detailed mapping in Annex B of the Guidance, as well as presenting 10 elements of credible corporate transition plans (OECD, 2022[32]). It builds on existing initiatives but additionally puts forward elements that have remained underexplored by other frameworks, notably by highlighting the importance of companies assessing whether there are existing parts of their business that are at risk of carbon lock-in (see Annex B of this report for a summary of the ten key elements of credible corporate transition plans set out in the Guidance). Initiatives launched prior to the publication of the Guidance, for the most part, did not explicitly cover the issue of carbon lock-in. Since the publication of the OECD Guidance, which has fed into the work of the G20 Sustainable Finance Working Group (SFWG), the SFWG has recognised the importance of reducing lock-in risk as part of their high-level principles for "approaches to identify transition activities or investment opportunities" (G20 Sustainable Finance Working Group, 2022[33]). Similar notions have also been picked up by the G7 in various communiqués since, emphasising the importance of preventing lock-in in transition finance, citing the OECD Guidance as a key reference in this context (G7, 2023[34]; G7, 2023[35]). Similarly, the recently published European Commission Recommendation on Transition Finance highlights the importance of preventing lock-in and builds on elements from the OECD Guidance (European Commission, 2023[36]).

Despite the limited explicit recognition of lock-in risk and the need to reduce it, entity-level approaches do implicitly put in place mechanisms that can ultimately help prevent lock-in:

- **Long-term net-zero targets:** Requirements for company transition plans can significantly reduce carbon lock-in risk, especially if they include a long-term net-zero target. Where that net-zero target is based on an emissions pathway and underlying scenarios aligned with the temperature goal of the Paris Agreement, carbon lock-in risk can be significantly reduced (see, for example, (International Platform on Sustainable Finance, 2022[37]; CBI, 2020[38]; WWF, 2022[39]; OECD, 2022[32])). This is generally accompanied by additional requirements or recommendations to put in place interim targets, with overall alignment with an emissions pathway that is based on a credible and science-based scenario (see, for example, (International Platform on Sustainable Finance, 2022[37]; Transition Plan Taskforce, 2022[40]; OECD, 2022[32])).
- **Strategy, actions, and implementation steps:** To support the implementation of the transition plan, most existing approaches emphasise the importance of setting out a clear strategy on the

specific steps and actions the company intends to take to achieve the objectives of the transition plan. This often includes risks and opportunities, as well as any possible limitations, constraints, and uncertainties with regards to the achievement of the plans targets (see, for example, (CDP, 2021[41]; International Platform on Sustainable Finance, 2022[37]; OECD, 2022[32]; TCFD, 2021[42]; Transition Plan Taskforce, 2022[40]).

A notable example of a standard for company transition plan that would include an explicit lock-in assessment is the latest version of the European Sustainability Reporting Standards, in particular the standards related to climate change (ESRS E1). The latter includes a qualitative assessment of the potential locked-in GHG emissions as one of the elements that an undertaking shall disclose as part of its transition plan for climate change mitigation. The lock-in assessment concerns the undertaking's assets and products. It must include "an explanation of if and how these emissions may jeopardise the achievement of the undertaking's GHG emission reduction targets and drive transition risk, and if applicable, an explanation of the undertaking's plans to manage its GHG-intensive and energy-intensive assets and products". In particular, when disclosing such information on lock-in, the undertaking must include the cumulative locked-in GHG emissions associated with key assets from the reporting year until 2030 and 2050 in tCO2eq as well as those associated with the direct use-phase GHG emissions of sold products in tCO2eq (European Commission, 2023[43]).

Further guidance on specific emission lock-in indicators in relation to the development of corporate transition plans can be found in the Assessing low-Carbon Transition (ACT)'s methodologies, available for a wide range of sectors. The ACT is an initiative founded by the French Environment and Energy Management Agency (ADEME) and CDP, which supports and assesses companies' readiness to transition to the low-carbon economy using future-oriented, sector-specific methodologies. ACT's methodologies provide a tool and calculation method to assess emission lock-in. The lock-in related indicators in ACT's generic methodology highlight the importance of measuring absolute GHG emissions of a company's existing and planned assets over time (up to 2050), comparing it with science-based pathways and related emission budgets (ACT, 2021[44]).

Portfolio-level approaches: investment strategies guided by portfolio alignment metrics

Lenders and investors have a wide range of investment strategies at their disposal to move their portfolios towards low-emission pathways, including pre-investment (exclusion, screening, tilting and thematic investment) and post-investment strategies (divestment, either temporary or full, and engagement, including through proxy voting). Such strategies are commonly used in Environmental, Social and Governance (ESG) investing and, depending on how they are applied, they can avoid locking portfolios into high-emission pathways. There is continued debate around the effectiveness of such strategies. Exclusion of fossil fuel-related investments and divestment from them can be considered some the most direct ways to avoid locking portfolios into long-lived, high-emitting assets. However, they might not be the most effective as they do not necessarily starve such assets from capital, and do not provide incentives to undertake corrective action to decarbonise or retire them early (Edmans, Levit and Schneemeier, 2022[45]). They may also fail to provide capital to companies that have high emissions today but are credibly committed and engaged in the net-zero transition by decarbonising their business model and operations (IPSF, 2022[46]). For example, (Edmans, Levit and Schneemeier, 2022[45]) show that tilting can be more effective than divestment.

Portfolio alignment metrics can be used to guide decisions on which investment strategy shall be applied and assess the level of alignment of portfolios with the temperature goal of the Paris Agreement.[9] Well-designed portfolio alignment metrics can in principle support a whole-economy transition, minimising the risk of disorderly wholesale divestment from high-emitting sectors and companies that will continue to be important for economic activity (IPSF, 2022[46]). (Noels and Jachnik, 2022[47]) developed an approach to analyse climate-alignment assessment methodologies for the financial sector across four dimensions: (i)

asset class coverage, (ii) GHG performance metrics (including targets), (iii) climate change mitigation scenario(s) used, and (iv) the approach to assess alignment at the financial portfolio level. The analysis identified common practices and opportunities for improved and more comprehensive financial sector alignment assessments. The paper finds that climate-alignment methodologies for several asset classes, such as private equity, real estate, and infrastructure are underdeveloped. Such gaps could undermine the environmental integrity of climate-alignment assessments and their results. Moreover, the choice of scenario and related range of assumptions and characteristics, as well as the temporal coverage of a GHG performance metric play an important role in the alignment assessment results.

Well-designed Paris alignment metrics, based on asset class-specific methodologies, can allow investors to identify which companies can be classified as already aligned with a pathway for a certain temperature outcome and which instead should be subject to enhanced engagement and stewardship (Noels and Jachnik, 2022[47]). Under the OECD Guidelines for Multinational Enterprises on Responsible Business Conduct (OECD Guidelines), investors are expected to exert their leverage to the extent possible to influence their investee companies to take action to prevent and mitigate adverse climate impacts (OECD, forthcoming[48]). Engagement strategies include dialogue with corporates, shareholder resolution and proxy voting. Enhanced engagement involves increased dialogue with priority companies on the gaps toward their transition plan and targets, as well as initial and ongoing assessment of their progress against a clear delivery strategy (IIGCC, 2022[49]). This can involve regular discussions with multiple corporate functions (e.g., strategy, finance, and sustainability), to make sure expectations are aligned, including on the timeframe of engagement and planned actions in case the results are not achieved. In addition, it is important that investors set clear and constructive policies for voting on climate-related resolutions and publicly disclose their votes. OECD analysis shows how the risk-based due diligence process recommended by the OECD Guidelines can be applied by institutional investors to prevent and mitigate adverse climate impacts on society and the environment associated with their investee companies (OECD, forthcoming[48]).

Existing mechanisms to prevent carbon lock-in are unevenly applied and insufficient across transition finance approaches

Transition finance considerations are increasingly being integrated in relevant sustainable and green finance policies, which is a welcome and necessary development to ensure a whole-of-economy transition. However, key gaps remain, which contribute to the persistence of carbon lock-in risk in transition finance. Notably, most transition finance frameworks only cover a sub-set of possible elements to prevent lock-in, which is insufficient.

For example, taxonomies tend to put forward a combination of eligibility criteria, sunset clauses, and requirements to future-proof. This approach fundamentally relies on investor and corporate appetite to, respectively, use and qualify under a ‘transition label’. Unless combined with other mechanisms, it will likely be insufficient to encourage a whole-of-economy transition. Under this approach, an activity is counted as a transition activity until a specific date (e.g., 2030) and must comply with a new set of more stringent eligibility criteria thereafter. This can provide an impetus to financial market participants and corporates for whom labelling an investment as ‘transition’ is important, to continue improving the performance of emission-intensive assets until such a point where they have near-zero or zero emissions.

However, to incentivise a whole-of-economy transition, such approaches will likely be insufficient and can increase risk of carbon lock-in: assets are generally built before the sunset date, under less stringent eligibility criteria with regards to emissions, and presumably will continue to operate, irrespective of whether they comply with more stringent criteria after the sunset date, unless they are stranded. Moreover, calibrating the correct date for sunsetting is challenging, as it would need to be set in a manner that complies with the IPCC finding that global emission need to peak before 2025 (IPCC, 2022[11]). Similarly, future-proofing requirements technically prepare an asset for the use of low-emission and renewable fuels,

but the operator does not have an obligation to switch to those fuels in accordance with sunset dates. The main incentive to do so is to keep the 'transition' label throughout the lifetime of the asset, which may be insufficient. Moreover, the ability to carry out such a fuel switch fundamentally depends on the supply of low-emission and renewable fuels. But the initial investment does not consider possible supply side problems, such as insufficient production of low-emission hydrogen.

So far, the use of flanking measures in transition finance is very limited. The EU Taxonomy is one example, as it requires certain flanking measures for natural gas investments, such as a deadline of 2035 to switch to 100% renewable or low-carbon fuels (European Commission, 2022[50]). However, no explanation is provided as to whether this date was selected based on a credible 2050 net-zero pathway. Moreover, there are limited additional, explicit mechanisms required as part of the taxonomy criteria, notably with regards to renewable or low-carbon gas supply, to ensure that the switch can happen at the right time. In addition, there is no assurance that the investee company has developed a broader transition plan or has reflected the plan in its business strategy. Similarly, the Singaporean Taxonomy contains provisions that can provide some assurance that lock-in risk is to an extent prevented in the industry sector. According to the current version of the taxonomy, iron and steel production facilities are classified as "amber" if they: (i) are implementing all necessary actions to meet the green category criteria by 2030 at the latest (for instance, if based on fossil gas, it needs to meet the green criteria for carbon capture, usage and storage (CCUS)); (ii) are currently capturing at least 20% of emissions and (iii) have a 1.5°C-aligned transition plan (Monetary Authority of Singapore, 2023[27]).

Entity-focused approaches also do not yet describe in a sufficient level of detail how to prevent carbon lock-in as part of a corporate transition plan. Not all entity-level frameworks require companies to put in place long-term net-zero targets, nor do they all require alignment with the Paris temperature target. Similarly, while most do specify that companies should put in place interim targets and implementation steps, they lack granularity with regards to how this should be done for specific assets that are at risk of carbon lock-in.

Lastly, policy frameworks beyond transition finance, notably state aid rules and MDB Paris Alignment methodologies, provide for additional mechanisms that can usefully be translated into the sphere of private investment and used to strengthen transition finance frameworks. Specifically, the concept of flanking measures has the potential to significantly reduce the risk of lock-in as part of transition finance frameworks and investments, notably by giving more credibility to existing requirements and commitments for future-proofing and sunsetting.

3.2. Key findings and good practices for mechanisms to prevent carbon lock-in in transition finance frameworks

Policymakers and regulators have a wide variety of tools at their disposal to develop robust transition finance policy frameworks, irrespective of whether the use of these frameworks by market actors is voluntary or mandatory. This section summarises good practices in transition finance with respect to addressing carbon lock-in risk, as well as lessons learnt from other policy communities that have dealt with this issue, to help inform policymaking on transition finance. Integrating existing good practices and experience from public and MDB investment to prevent carbon lock-in has the potential to significantly strengthen the environmental credibility of transition finance.

Guidance, standards, or frameworks for credible corporate climate transition plans, with net-zero targets based on the Paris temperature goal, are key tools to prevent carbon lock-in in transition finance.

The recent focus on entity-level approaches in transition finance highlights one of the key challenges corporates face as part of the net-zero transition: the need for long-term planning, in the absence of complete certainty over the technology choices that are necessary to reach net zero. Developing a credible corporate transition plan is at the heart of the net zero transition. The *OECD Guidance on Transition Finance* sets out ten elements of credible corporate transition plans (see Annex B or (OECD, 2022[32]).

While all ten elements are important to ensure environmental credibility, some elements are particularly relevant to preventing carbon lock-in. Notably,

- Elements 1-5: These elements focus on setting temperature goals, net-zero, and interim targets, as well as using relevant tools, metrics, and KPIs to define actions and measure their implementation, in a manner consistent with the IPCC Special Report on Global Warming of 1.5°C. In practice, this means that a credible corporate transition plan, including its targets and implementation steps, will be aligned with a scenario and emissions pathway where net anthropogenic CO_2 emissions are reduced by 45% from 2010 levels by 2030 and reach net zero around 2050 (IPCC, 2018[51]). Additional findings emerging from ongoing OECD analysis on the use of climate mitigation scenarios will further inform target setting, transition planning, and Paris alignment assessments of the financial sector (OECD, forthcoming[52]).
- Element 10: This element focuses on ensuring transparency and relevant progress reporting, as well as verification and certification, where applicable. This is relevant because preventing carbon lock-in involves future commitments, the meeting of which is inherently uncertain. To be credible, these commitments and their implementation needs to be regularly assessed and disclosed (OECD, 2022[32]).

National sectoral emissions pathways can guide technology roadmaps, robust transition taxonomy criteria, and allow companies to develop credible net-zero plans and targets.

Emissions pathways provide a “modelled trajectory of anthropogenic emissions”, as part of a climate change mitigation scenario (OECD, forthcoming[52]). If they are based on a country’s net zero target and developed for each sector, they can provide a robust basis for the development of further policy tools. Notably, where a jurisdiction wishes to develop a transition taxonomy, the eligibility thresholds and criteria for each economic activity can be set by taking that pathway into account. In doing so, more credible and forward-looking criteria can be developed. Similarly, they can provide the basis for the development of national sectoral technology roadmaps, whereby projected technology deployment can be derived from the emissions pathways. At the same time, assessing the consistency of country-level pathways with the Paris Agreement can prove challenging due to complexities in determining global temperature outcomes for country-level pathways as well as due to the presence of global or regional supply chains in many sectors, for which global or regional pathways might be more relevant.

As outlined in the *OECD Guidance on Transition Finance* and stated in the European Commission’s Recommendation on Transition Finance, such pathways can also support companies in developing credible transition plans. Notably, companies can use national sectoral emissions pathways to set relevant and ambitious net zero and interim targets as part of their transition plans, and inform investment decision-making to achieve those targets (European Commission, 2023[36]; OECD, 2022[32])

Excluding the most emission-intensive energy sources from eligibility can enhance the credibility of transition finance frameworks.

To avoid uncertainty for companies and investors, excluding certain types of investments from support, which are not in line with the Paris temperature target, can enhance the credibility of transition finance frameworks. Most existing frameworks, both in transition finance and public or MDB investment, have exclusion criteria in place, such as for coal, oil, and certain gas investments (see, for example, (European Commission, 2021[2]; European Union, 2020[29]; Monetary Authority of Singapore, 2023[27]; EBRD, 2022[8])).

The cumulative effect of carbon lock-in resulting from governments', corporates', and financiers' individual decisions to pursue fossil fuel-related activities is potentially significant. Investments marketed as "transition investments" only account for the portion of fossil fuel investment that entities are seeking to justify as in line with net-zero targets. But the majority of fossil fuel investments and expansion is being undertaken without an effort for justification.

In this context, each decision merits scrutiny from an environmental credibility and lock-in risk perspective, bearing in mind key scientific conclusions to be reflected in eligibility and exclusion criteria:

- IEA modelling indicates that to achieve net zero by 2050, coal, oil, natural gas demand must decline significantly by 2050. In this scenario, the limited remaining fossil fuels are only used for the following purposes:
  - For the production of non-energy goods where carbon is embodied in the product (e.g., fertilisers);
  - In energy production with abatement (e.g., CCUS), notably for use by industry;[10]
  - In sectors where zero-emissions options are very limited (e.g., aviation).

Actions to future-proof transition investments can include setting requirements with technical specifications that enable infrastructure for the use of low-carbon and renewable fuels.

Following a long-term feasibility assessment (see chapter 2 for more details on the importance of long-term feasibility assessments as part of transition finance frameworks), some frameworks may still include natural gas investments, for example in industry. To strengthen their credibility, such frameworks can include requirements for supported assets to be future-proof and comply with technical specifications to enable the transport and use of low-carbon and renewable gases.

These requirements can include hydrogen readiness, though it is important that credible requirements reflect the state of the art and reality with regards to the possibilities of using and transporting hydrogen today. For now, there are limits to the possibility of using hydrogen in energy production, which is a limitation that credible criteria will recognise. Importantly, criteria will be selected so as to not give the impression that an asset will be 100% hydrogen-ready, when this is not possible in reality due to technical limitations or financing, institutional and capacity limitations in developing countries.

For example, with today's technology, gas power plants can operate at a 30-35% level of co-firing with hydrogen, although the aim of many major gas turbine manufacturers is to reach blending levels of 100% (see, for example, (Young-Kuk, Ju-Hee and Seung-Hoon, 2023[53]) and (Inoue et al., 2018[54])). Similarly, for gas transmission and distribution networks to industry and households, most jurisdictions today limit the amount of hydrogen that can be blended into the national gas grid. This is notably due to the decreasing quality of the gas as blending is increased and limitations on end use (Fraunhofer Institute, 2022[55]). For example, the European Commission proposes 5% as a safe and acceptable blending level (European Commission, 2021[56]). In addition, there are limitations on the use of hydrogen in domestic heating, as laid out in chapter 4, notably with regards to the cost to the end consumer, and efficiency. Credible

requirements on the future-proofing of assets will be transparent on these issues and recognise existing limitations.

Sunset clauses for eligibility to phase out the use of fossil gas are an effective mechanism to prevent lock-in for assets where a fuel switch is planned to ensure alignment with the Paris temperature goal (e.g., natural gas to low-emission hydrogen).

Coupled with the previous finding, where natural gas assets qualify for transition finance, and contain requirements to be future-proof, it is paramount to set a phaseout date by way of a sunset clause, as has been done by existing transition finance taxonomies in Europe and Asia (see, for example, (European Commission, 2022[23]; Monetary Authority of Singapore, 2023[27]; ASEAN Taxonomy Board, 2023[20]). Credible sunset clauses will be aligned with an IPCC reference scenario that is consistent with limiting warming to 1.5°C, or to below 2°C if 1.5°C is not possible (see element 1 of (OECD, 2022[32]) for an explanation of when a "below 2°C" can be considered credible). Where available, sunset clauses will be based on national sectoral emission pathways.

For assets where a fuel switch is planned, flanking measures to ensure the switch can happen in a timely manner can contribute to preventing carbon lock-in.

Importantly, flanking measures can give credibility to future-proofing requirements and sunset clauses in transition finance frameworks. Examples of flanking measures include:

- Accompanying investments (laid out in the company transition plan) to support the supply of the future low-carbon fuel that is expected to be used after the sunset date, such as investments in electrolyser projects to come on-stream in time for the switch. Additional research, development, and innovation investments are also needed to drive down costs and accelerate deployment of low-emission technologies, where necessary, for example CCUS.
- Contracts of supply for the low-emission replacement fuel to be agreed within a specified timeframe, ideally within three years of the initial investment: To ensure that gas investments are truly future-proof, it is necessary to have a steady supply of the selected low-emission replacement fuel. Therefore, to credibly reduce the risk of carbon lock-in attached to such investments, beneficiaries will put in place contractual arrangements with suppliers of the low-emission fuel they wish to use as a replacement for natural gas. To avoid backloading commitments, these contracts of supply will ideally be agreed at the same time as the initial investment, or within three years thereof.[11]
- Detailed plans and binding timeframes setting out a strategy of how the low-carbon fuel will be used by the company benefitting from transition finance.

To prevent lock-in, it is important to establish a date for early retirement of assets that cannot be retrofitted or refurbished to be consistent with net zero, accompanied by a strategy to finance the retirement process.

Credible transition finance frameworks will specify additional requirements for the managed phaseout of high-emitting assets, including the need for companies to set out a strategy and process for the responsible retirement of high-emitting corporate assets. This could include specific phase-out plans as part of transition plan frameworks, outlining how the phase-out is aligned with any net-zero or climate-related strategy, how just transition considerations are taken into account, key milestones such as phase-out timing, key metrics and targets, disclosure of progress, governance mechanisms, related capital expenditure plans and key assumptions and uncertainties with the plan (GFANZ, 2022[57]). Currently, there are no standardised criteria for ensuring the credibility and eligibility of a coal phaseout plan, but, at a

minimum, it should demonstrate positive environmental impact and advance an entity's and country's alignment with the temperature goal of the Paris Agreement (Kekki and Holzman, 2023[58]).

The early retirement of a high-emitting asset can be an important additional requirement for new (future-proof) gas investments that are in line with other relevant good practices, as set out above. Accompanying such gas investments with the early retirement of a plant using an emission-intensive energy source like coal can help ensure the additionality of gas investments (if it is ensured that such gas investments are on a credible path to net zero), as they replace emission-intensive assets and thus significantly reduce emissions.

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Notes

[1] Since Russia's unprovoked war of aggression against Ukraine, the RRF was extended to also include REPowerEU to help EU Member States phase out imports of Russian fossil fuels. The DNSH principle continues to apply, however targeted derogations are possible for energy infrastructure and facilities (such as investments related to Liquified Natural Gas (LNG)) if Member States and the Commission consider them necessary to ensure immediate security of supply (European Commission, 2022[59]).

[2] While the term "significant" is not defined in the Commission's guidance, an analysis of existing Recovery and Resilience Plans by Member States that contain gas boiler investments indicates that renovation

programmes needed to achieve, on average, a 30% reduction in GHG emissions (see, for example, (Council of the European Union, 2021[60]), (Council of the European Union, 2021[61]), (Council of the European Union, 2021[62])).

[3] Four types of activities are considered "universally not aligned": (i) mining of thermal coal; (ii) electricity generation from coal; (iii) extraction of peat; and (iv) electricity generation from peat (World Bank, 2023[63]).

[4] If a project falls among the "universally aligned" list of activities, it still needs to go through a specific criteria assessment if its economic feasibility depends on external fossil fuel exploitation, processing, or transport activities or on fossil fuel subsidies, or if its operations that significantly on the direct use of fossil fuels.

[5] The MDB methodological principles provide for an illustrative list of high-emitting sectors, which include activities related to fossil fuel-dependent and -based industries, energy-intensive industries (such as chemicals, iron and steel, amongst others), aviation, shipping, animal products and activities that may directly lead to or promote into areas of high carbon stocks or biodiversity (World Bank, 2023[7]).

[6] Existing OECD work provides a detailed overview and analysis of the landscape of transition finance frameworks in 2021 (Tandon, 2021[64]) and 2022 (OECD, 2022[32]).

[7] Most taxonomies are living documents and work in progress, as they require continuous update and development. The taxonomies listed here are at different stages of development, with some being more mature than others.

[8] To date, transition activities have only been defined in the climate change mitigation context and it is unclear whether the same logic can apply to other environmental objectives.

[9] Different portfolio alignment frameworks and methodologies exist, such as the Swiss Climate Scores, GFANZ Portfolio Alignment Measurement approach and the Paris Agreement Capital Transition Assessment. See (Noels and Jachnik, 2022[47]) and (IPSF, 2022[46]) for an overview of the key characteristics of these different frameworks.

[10] Noting that according to the IPCC, to not lock in GHG emissions, "abatement" should be defined as an intervention that can capture 90% or more GHG emissions from power plants (IPCC, 2018[51]).

[11] This is based on the 3-year-timeframe currently used for district heating network investments in existing green bond frameworks, taxonomies, and state aid. Investments in network upgrades sometimes require an additional investment to take place in the heat source, which is usually run by a different operator than the network, to bring it in line with environmental and efficiency requirements. The second investment has to be carried out within 3 years of the initial investment (see, for example, (European Commission, 2022[1]) and (European Commission, 2021[22])).

4. Carbon lock-in considerations in transition financial instruments

This chapter reviews financial instruments relevant to transition finance, and related frameworks developed by governments and market actors. It analyses associated greenwashing risks, and specifically risk of carbon lock-in. The chapter provides an analysis of green, transition and sustainability-linked bonds issued to date by companies in high-emitting sectors, to understand potential risks of greenwashing and lock-in of such instruments. The chapter finds that existing issuances have a risk of carbon lock-in and that frameworks for transition financial instruments can be strengthened in this regard. It sets out key findings and good practices to this end.

A wide range of financial instruments are relevant to transition finance, namely (i) green bonds and loans to raise financing for activities that are already low-emission, (ii) transition bonds and loans for activities on a credible pathway to become low-emission in the future and (iii) sustainability-linked bonds and loans to finance general purpose activities of an entity planning to transition to a low-emission and sustainable future. The sections below analyse each of these three types of instruments, highlighting their promising features, risks of carbon lock-in and greenwashing, as well as potential ways to address them.

It is worth noting that while each of three labels above are applicable both to bonds and loans, the sections below focus on bonds, even though lending instruments are as important as capital markets to raise finance for the transition. The focus on bonds is mainly due to the fact that their loan counterparts are typically arranged through private operations and are not traded, therefore publicly available information and disclosure on loans is much more limited than bonds (CBI, 2022[1]; World Bank, 2021[2]). Lessons on the use of mechanisms to prevent lock-in as part of transition finance can also be relevant to green, transition and sustainability-linked lending operations, as well as to mainstream financing of fossil fuel assets, where risk of lock-in is arguably highest and existing safeguards are rarely used.

4.1. Green bonds

In the green debt space, which is the largest and most mature thematic debt segment (CBI, 2022[1]; Refinitiv, 2022[3]), greenwashing risks are generally lower than in other market segments, as proceeds from green bonds and loans are exclusively used to (re)finance new or existing green projects (see the Glossary in Annex A for definitions of those instruments). Box 4.1 below provides details on latest trends and existing standards and principles on green bonds.

Different issuers and institutions apply existing green bond standards and principles in various ways. Most green bond issuances align with the International Capital Market Association (ICMA)'s Green Bond Principles (BIS, 2020[4]). Multilateral development banks (MDBs), which contributed to the creation of the green bond market and still play a key role as issuers, investors, and advisors, generally apply ICMA Green Bond Principles and the MDB Common Principles for Climate Mitigation and Adaptation. However, they apply existing guidance on green bonds in different ways. This has resulted in comparable but slightly different green bond frameworks among MDBs, which sometimes closely follow ICMA guidance and other times reflect MDBs' specific needs and strategic priorities (OECD, forthcoming[5]).

It is also worth noting that ICMA Green Bond Principles do not define what technologies or activities can be classified as "green" and encourage issuers to "provide information on the alignment of projects with official or market-based taxonomies, if relevant, and disclose any green standards or certifications referenced in project selection" (ICMA, 2021[6]). This means that eligibility of activities that can be financed through green bond proceeds depends on the eligibility list or taxonomy used to classify projects (if any). For example, in the European Union (EU), there is both a sustainable finance taxonomy and a green bond standard. If using the (voluntary) European Green Bond Standard (EUGBS) label, issuers will need to ensure that at least 85% of the funds raised by the green bond are allocated to economic activities that align with the EU Taxonomy Regulation (European Commission, 2023[7]).[1] See Box 3.3 in (OECD, 2023[8]) for further details on the links between the EU Taxonomy and the EUGBS. Moreover, green bond certifications, such as the one developed by CBI, provide assurance on eligible green activities as they verify that proceeds are used for activities aligned with CBI's sector-specific eligibility criteria.

Box 4.1. Green bonds: latest trends, principles, and standards

According to the Luxembourg Green Exchange (LGX) DataHub, in 2022 green bond issuances amounted to almost USD 407 billion and the cumulative issued amount over the 2019-2022 period was almost USD 1.4 trillion, with a yearly average of USD 349 billion.[2] While green bond issuances were on an upward trend until 2021, it is worth noting that they still represent a relatively small fraction (approximately 5%) of the overall bond market, which is worth USD 8.3 trillion in 2022 (Refinitiv, 2023[9]).

Green bonds are mainly issued in Europe and over half of the bonds recorded globally[3] were issued by either utility companies, banks, or real estate companies (ICMA and LGX, 2023[10]). Empirical evidence on the presence of a general "greenium"[4] for green bonds is mixed. While some studies find the presence of a greenium, though with substantial variance depending on the type of issuer, credibility of green credentials and presence of external certification (Fatica, Panzica and Rancan, 2021[11]; Kapraun et al., 2019[12]; Pietsch and Salakhova, 2022[13]), others find no greenium (Flammer, 2021[14]; Larcker and Watts, 2020[15]).[5]

Green bond proceeds have so far mostly financed activities in renewable energy and energy efficiency (IRENA, 2020[16]). A variety of principles and standards[6] for green bonds have been developed by different stakeholders, e.g., by market actors (ICMA's Green Bond Principles and Climate Bonds Initiative (CBI) Standard and Certification Scheme), by relevant actors at regional level (e.g., those of the Association of Southeast Asian Nations (ASEAN) and EU Green Bond Standard), and by jurisdictions at national level (e.g., in China, India, and Japan). In most jurisdictions, except for China, such standards are for voluntary use, so issuers have flexibility on which framework or standard they choose and apply.

While green bond standards and green taxonomies broadly converge on the definition of green eligible activities, some differences persist, which can create greenwashing lock-in risk. For example, lock-in risk can arise if green bond proceeds are used to make incremental efficiency improvements of refineries processing fossil fuels, thereby extending plant operating lifetimes (CBI, 2017[17]; I4CE, 2018[18]). The International Finance Corporation (IFC)'s updated Green Bond Framework excludes "projects where the core source of energy is based on fossil fuels and other projects that support carbon intensive activities" (amongst others) from its eligible activities (IFC, 2022[19]). However, CICERO's second party opinion of IFC's Framework highlights that IFC could further define and tighten the exclusion criteria of "core energy" fossil fuel as the absence of a specific threshold leaves room for interpretation. In addition, CICERO notes that while direct investments in fossil fuels are excluded, some projects could indirectly be exposed to fossil fuels (e.g., new buildings with fossil fuel heating, energy efficiency in industry processes), which could lead to carbon lock-in (CICERO, 2022[20]).

One notable development and step towards harmonisation of green bond frameworks is China's 2021 revision of the Green Bond Endorsed Project Catalogue, which removed carbon-intensive projects related to fossil fuels such as clean coal technology from its list of eligible green activities (CBI, 2021[21]). However, some coal mining-related activities are still included in the project catalogue, such as "land remediation, ecological restoration and environmental remediation in coal-mining subsidence areas, relocation of residents within the influenced areas and restoration and upgrading of infrastructure and public service facilities" (People's Bank of China, 2021[22]).

Uncertainty remains around the eligibility of some activities that concern gas investments, given the potential carbon lock-in risk they could create. For example, China's Green Bond Endorsed Project Catalogue includes some activities related to the construction and operation of natural gas transmission, storage, and peak load regulation facilities as part of the "efficient operation of clean energy" category.[7] There have been instances of issuances of green bonds by gas companies that used the issuance

proceeds for retrofits of existing gas distribution networks to enable integration of hydrogen, which is recognised by the EU Taxonomy as a "low-carbon economic activity" (European Commission, 2021[23]; GasNet, 2022[24]). Moreover, in the EU, blending gas with hydrogen and other renewable or low-carbon gases can be in line with the EU Taxonomy, provided that the eligibility criteria are met. In particular, the EU Taxonomy Complementary Climate Delegated Act includes some gas-related energy production activities[8] as "transition economic activities" as long as they meet one of the following criteria: "(i) lifecycle emissions are below 100gCO_2e/kWh, or (ii) until 2030, and where renewables are not available at sufficient scale, direct emissions are below 270gCO_2e/kWh or, for the activity of electricity generation, their annual direct GHG emissions must not exceed an average of 550kgCO_2e/kW of the facility's capacity over 20 years. While criterion (i) implies almost exclusive use of low-carbon or renewable gases, criterion (ii) and (iii) indicate blending of fossil gas with low-carbon or renewable gases[9], or fuel switching at a certain point during the operation of the plant. In this case, the activity must meet a set of cumulative conditions: e.g. it replaces a facility using solid or liquid fossil fuels, it ensures a full switch to renewable or low-carbon gases by 2035, and a regular independent verification of compliance with the criteria is carried out" (European Commission, 2022[25]). Similarly, China's Green Bond Endorsed Project Catalogue includes "hydrogen-incorporated natural gas pipelines" as eligible green activities, without specifying further details or thresholds (People's Bank of China, 2021[22]).

However, it is recognised that gas blending for electricity generation (notably, for use in buildings and transport) could hinder the transition of other activities for which hydrogen is currently the only viable decarbonisation technology (e.g. steel and cement production), by absorbing much of the available hydrogen production (CBI, 2022[26]; E3G, 2023[27]). Moreover, blending has limited emissions reduction potential, is less efficient than using hydrogen in its pure form,[10] and creates stranded asset risk and cost because incremental retrofits and technology replacements are required to increase blending volumes (CBI, 2022[26]). Similarly, blending hydrogen into gas grids can create additional costs to gas consumers, as low-emission hydrogen production costs are likely to remain higher than natural gas prices (IEA, 2019[28]; E3G, 2023[27]). CBI does not assess gas blending to be aligned with the Climate Bonds Principles for a Credible Transition, as blending is not considered a viable decarbonisation strategy and the only valid retrofit pathway is repurposing infrastructure for 100% hydrogen distribution (CBI, 2022[26]).

Assessments regarding the limited environmental benefits of blending natural gas with hydrogen for power generation stand in contrast with their categorisation as transition activities under some approaches. In particular, in power generation, which fundamentally affects consumers, political and social considerations may override technological feasibility factors. Similarly, without projecting costs over the long-term and considering costs of reinvestment to switch to a lower-emission alternative (like renewables) in the future, as part of a detailed economic feasibility assessment, natural gas investments may appear less costly.

It can be expected that there will soon be increased attention to carbon lock-in risk in green bond issuances, particularly given the increasing focus on greenwashing risks in sustainable finance more generally. According to the International Monetary Fund (IMF), as demand for green products is growing fast, especially from green or sustainable investors, there is a risk that issuers may greenwash projects that produce few real climate benefits. There will be a growing need for third-party verification of alignment with standards and taxonomies (IMF, 2022[29]).

In jurisdictions where taxonomies have not been developed, an alternative is additional disclosure requirements on eligible projects and impact reporting. For example, in 2023, the Securities and Exchange Board of India (SEBI) revised its existing framework for green debt securities and provided additional disclosure requirements for green bond issuers. To address risks of greenwashing, according to the new requirements, any green bond issuer shall: (i) avoid using misleading labels, hide trade-offs or cherry pick data to highlight green practices while obscuring unfavorable ones; and (ii) quantify the negative externalities associated with the use of proceeds, amongst other requirements related to maintaining high integrity standards (SEBI, 2023[30]). Moreover, while India's green securities eligibility categories are broad and do not specify specific thresholds or benchmarks, new disclosure rules (both before and after

issuance) require issuers to provide details on the criteria applied and decision-making process followed to determine eligibility, as well as details on alignment with taxonomies (if any) and with India's Nationally Determined Contribution (NDC) (SEBI, 2023[31]). After issuance, issuers are also required to provide qualitative and, where feasible, quantitative performance measures of the environmental impact of the financed projects (including methods and underlying assumptions made for such assessments). If they are not able to quantify the impact, they have to provide reasons why this is the case.

A further issue related to green bond issuances is the fact that they are generally used to raise finance for specific green projects so individual issuances do not necessarily signal that issuers have a credible and whole-of-entity transition plan in place to transform their business models and operations and drastically reduce their emissions. In addition, a significant share of green bonds is used to refinance existing debt, which raises questions for additionality and suitability to finance a credible transition (Bongaerts and Schoenmaker, 2020[32]). In light of this, ICMA's Green Bond Principles recommend higher transparency on issuer-level sustainability strategies and commitments and better positioning of green bond eligible projects within the overarching strategy (ICMA, 2021[6]).

There remains scope for harmonisation of green bond frameworks across issuers, in terms of both structure and content, to facilitate investment and increase comparability of financed projects (OECD, forthcoming[5]). Such harmonisation could mean optional additional requirements to provide detailed taxonomies or eligibility lists, criteria for project evaluation and selection, and better reporting practices with respect to use-of-proceeds and impact. Specifically, where green bonds allow the financing of transition activities or projects involving natural gas-based energy production for a limited period (such as before switching to 100% renewable or low-emission fuels), credibility can be ensured through additional verification requirements and reporting on forward-looking indicators.

4.2. Transition bonds

According to CBI, transition bond issuances amounted to USD 3.4 billion in 2022 and represented 0.4% of the thematic bond market, with most bonds being issued in Japan (CBI, 2022[33]). As of 2023, a cumulative amount of USD 11.3 billion worth transition bonds have been issued (CBI, 2023[34]).

The growth of transition bonds has been spurred by the ICMA Climate Transition Finance Handbook published in 2020, and revised in 2023 (ICMA, 2023[35]). The Handbook encourages bond issuers to align with the elements contained therein to communicate their GHG emission reduction strategy. According to the Handbook, this is relevant to green, sustainability or sustainability-linked instruments designated as "climate transition" bonds, which in some jurisdictions may also take the form of an additional, separate label (ICMA, 2023[35]).

Lock-in risks are highly present in transition bond issuances, given the lack of definitions and eligibility criteria for what constitutes a transition bond. For example, in 2021, the Bank of China (BoC) issued its first transition bond in the offshore market. To facilitate the issuance, the BoC published its Transition Bond Management Statement, which explicitly refers to alignment with the principle of avoiding carbon lock-in by ensuring to evaluate projects according to local thresholds and selection criteria, referring to the decarbonisation pathway of the countries or regions where the relevant projects are located, and by phasing out ineligible or out-of-date transition projects (Bank of China, 2021[36]). Categories of eligible projects include production and co-generation of electricity, heating and cooling from gas, as well as manufacturing of cement, aluminum, iron, steel, fertilisers and nitrogen compounds. For example, the 2021 BoC issuance's proceeds were used for natural gas co-generation projects (making up 92% of the proceeds), natural gas power generation, and cement plant waste (Bank of China, 2022[37]; CBI, 2021[21]).

In Japan, in 2021 the government published the Basic Guidelines on Climate Transition Finance, which put forward a set of (not legally-binding) considerations on key elements transition finance issuers should

disclose about their strategies, actions, and plans, in line with ICMA's Climate Transition Finance Handbook (FSA, METI and Ministry of Environment, Japan, 2021[38]). In 2023, the government also released a follow-up Guidance on Transition Finance for financiers (mainly bond issuers), with the aim of supporting effective dialogue between financiers and issuers on the execution and implementation of transition strategies and tracking progress towards decarbonisation targets (METI, 2023[39]). The government of Japan also published sector-specific roadmaps for shipping, aviation, iron and steel, chemicals, power, gas, oil, pulp and paper, cement, and automobiles. The guidelines and sectoral roadmaps have been used to develop several frameworks for transition bond issuances in Japan.

In India, SEBI's regulation on "issue and listing of non-convertible securities" considers transition bonds as a "sub-category" of their recently redefined "green debt securities" (SEBI, 2023[40]). According to this regulation, transition bonds comprise "funds raised for transitioning to a more sustainable form of operations, in line with India's Intended Nationally Determined Contributions". To increase transparency, the regulation requires issuers of transition bonds to disclose transition plans and progress of their implementation, with details on the interim targets, project implementation strategy and related use of technologies as well as mechanisms to oversee the use of proceeds raised through the bonds. In case of a revision of the transition plan, the issuer should disclose the revised plan to the stock exchange, along with an explanation of any revision (SEBI, 2023[41]).

Transition bonds are issued by entities from a wide range of sectors, including high-emitting and hard-to-abate ones. For example, there have been issuances that funded construction of gas companies' new LNG terminals and pipeline extensions (METI, 2022[42]), a high-efficiency gas-fired power generation project (DNV, 2022[43]), projects to gradually increase co-firing with hydrogen and ammonia in a coal-fired power plant (METI, 2022[44]), co-firing with black pellets in coal-fired power plants and energy saving activities in refineries (DNV, 2022[45]; METI, 2022[46]).

Hydrogen, ammonia, and hydrogen-based fuels play an important role in the net-zero transition, especially in hard-to-abate sectors, such as heavy industry and long-distance transport (IEA, 2023[47]). According to IEA's updated net-zero emission by 2050 scenario, the use of low-emissions hydrogen and ammonia in power plants and the use of carbon capture technologies can play an important role in cutting emissions from existing plants while maintaining electricity security (IEA, 2022[48]). At the same time, such activities could pose lock-in risks, based on the degree of environmental contribution of marginal or incremental efficiency improvements of fossil fuel investments. Hydrogen and ammonia production is currently mainly based on the use of unabated fossil fuels, with low-emission hydrogen having relatively high production costs, barriers to deployment and lack of infrastructure. It will require significant investment and policy measures to support its uptake and drive down costs for electrolysers and renewable energy (IEA, 2023[47]). Moreover, a number of studies have concluded that the use of ammonia as a fuel for co-firing in coal power plants has limited potential for emission reductions, cost competitiveness and technical feasibility for deployment at scale (Centre for Research on Energy and Clean Air, 2023[49]; E3G, 2023[50]). The amount of emissions associated with the production of hydrogen and ammonia varies considerably depending on the feedstock and processing route. According to one IEA report, the use of ammonia in the power sector has low overall efficiency and, even though ammonia consumption is considered to be low-emission, its production can lead to a level of emissions that could be significantly higher than that of the fossil fuels that ammonia would be replacing through co-firing (IEA, 2021[51]).

4.3. Sustainability-linked debt

Sustainability-linked loans (SLLs) and bonds (SLBs) are relatively new (first introduced in 2019) and innovative performance-based financial instruments that allow issuers to raise capital for general corporate purposes (thus their proceedings are not earmarked for specific green or sustainable activities, as is the case in use-of-proceeds bonds like green or sustainability bonds). SLLs' and SLBs' financial and structural

characteristics (such as the interest rate of a loan or coupon of a bond) vary depending on whether the borrower or issuer achieves sustainability performance targets (SPTs) for a predefined set of Key Performance Indicators (KPIs), which can cover a range of environmental and/or social targets (see the Glossary in Annex A for definitions of the different thematic bond instruments). Box 4.2 below provides details on latest trends and existing principles on SLBs.

Box 4.2. Sustainability-linked bonds: latest trends, principles, and standards

SLBs are an increasingly widespread financial instrument, issued mainly by non-financial corporates, which mostly link their SLB issuances with emission reduction-related targets (Banque de France, 2022[52]). According to the Luxembourg Green Exchange (LGX) DataHub, in 2022 SLB issuances amounted to USD 66 billion and the cumulative issued amount over the 2020-2022 period was USD 171 billion, with a yearly average of USD 57 billion (ICMA and LGX, 2023[10]).[11] SLBs are issued by non-financial corporates to a much greater extent than is the case for green bonds. 91% of SLBs were issued by non-financial corporates, especially in sectors such as utilities (24%), consumer goods (21%), industry (13%) and materials (12%), whereas the highest share of green bonds was issued by banking institutions (21%), followed by utilities (18%) and real estate companies (15%) (ICMA and LGX, 2023[10]). The ECB's decision to accept SLBs as eligible collateral for Eurosystem credit operations and outright purchases for monetary policy purposes might have contributed to the development of this market, at least in the Eurozone (ECB, 2023[53]; National Treasury, 2022[54]). More recently sovereigns entered the SLB market with first Chile and then Uruguay issuing the first sovereign SLBs (Ministry of Finance, Chile, 2020[55]; Ministry of Finance, Uruguay, 2023[56]).

Some voluntary principles guiding the use of sustainability-linked loans and bonds have been developed by market actors, namely those by ICMA (2023[57]), the ASEAN Capital Markets Forum (ACMF, 2022[58]) and the Asia Pacific Loan Market Association (APLMA), Loan Market Association (LMA) and Loan Syndications & Trading Association (LSTA) (APLMA, LMA and LSTA, 2023[59]). However, most jurisdictions have not yet developed formal standards or frameworks for sustainability-linked financial instruments, except for the Ministry of Environment of Japan that has developed Sustainability Linked Loan Guidelines (Ministry of Environment of Japan, 2020[60]).

Most SLBs are linked to targets on emission reductions and other environmental objectives. According to Refinitiv data, in 2022, 87% of SLBs had at least one KPI related to an environmental objective. Among these, 61% had KPIs related to emission reductions, with most of them (47%) having targets on either just scope 1 or scope 1 and scope 2 emissions (Refinitiv, 2022[61]).

The sustainability-linked debt market is still nascent and has been growing fast. In this context, a number of financial market actors, regulators and think tanks have raised concerns relating to greenwashing. First, concerns have been raised on the use of composite Environmental, Social and Governance (ESG) ratings as KPIs to link the financing with, as ESG scores are currently highly dependent on the assumptions used by ESG ratings and data providers (NGFS, 2022[62]; OECD, 2022[63]). For instance, the European Central Bank (ECB) does not consider improvements in ESG ratings or scores as acceptable SPTs for the purposes of determining the eligibility of assets as collateral in its credit operations or for its asset purchase programmes (ECB, 2023[53]). For this reason, issuing companies are increasingly asked to disclose and demonstrate that the emission reduction KPIs and targets they link the financing with are based on science-based pathways. However, according to Refinitiv data as of December 2022, only 1% of SLBs recorded have SBTi-verified targets (Refinitiv, 2022[61]).

Second, recent studies have found that existing SLB structures can allow for the possibility for issuers to take advantage of potentially lower costs of capital without undertaking the expected corresponding improvement in sustainability performance towards pre-set targets. Kölbel and Lambillon find that issuing

an SLB yields an average premium of -9 basis points on the yield at issue compared to a conventional bond, although this premium decreases over time. The authors find that the average SLB premium exceeds the average penalty, suggesting that penalties are likely set too low (Kölbel and Lambillon, 2022[64]). A recent IFC paper empirically tests potential structural loopholes of SLBs and finds that SLBs with coupon step-up penalties, which represent the majority of SLB issuances, are more likely to have later target dates and call options embedded (World Bank Group, 2022[65]). Setting a late target date is a simple way for an issuer to reduce the total number of higher coupon penalty payments arising from a failure to achieve sustainability targets. Similarly, calling a bond before maturity relieves the issuer from the remaining coupon payments during the bond's life, allowing to reduce or even completely avoid penalties. While it is early to assess the ambition, effectiveness, and credibility of SLBs, given the nascent stage of this market, such findings suggest the need for continued scrutiny of SLBs to address greenwashing concerns and realise their potential as a channel for environmentally credible transition finance.

SLBs are accessible for a wide range of issuers across sectors. This can be seen in issuances to date by high-emitting companies, such as those operating in the fossil fuel sector or in energy-intensive industries (namely steel, cement, and chemicals) – see the non-exhaustive list of examples in Table 4.1 below.

Table 4.1. Examples of SLBs issued by companies in high-emitting sectors

Company	Sub-sector	Country	Number of issuances	Year of issuance	Amount
Oil and gas production and exploration					
Tamarack Valley Energy	Oil and gas exploration and production	Canada	1	2022	USD 300 mn
Eneos Holdings	Oil and gas exploration and production	Japan	2	2022 2022	JPY 85 bn JPY 15 bn
Eni	Oil and gas (exploration and production, power, refining, etc)	Italy	2	2023 2021	EUR 2 bn EUR 1 bn
Polski Koncern Naftowy Orlen	Oil refinery	Poland	2	2020 2021	PLN 1 bn PLN 1 bn
Repsol	Oil and gas (exploration and production, power, refining, etc)	Spain	1	2021	EUR 1.25 bn
Oil and gas infrastructure and transportation					
Enbridge	Oil and gas pipelines	Canada	2	2021 2021	CAD 1.1 bn USD 1 bn
Kinetik Holdings	Oil and gas transportation and infrastructure	US	1	2022	USD 1 bn
Nederlandse Gasunie	Natural gas transport and infrastructure	Netherlands	2	2021 2022	EUR 300 mn EUR 500 mn
Snam	Natural gas transportation	Italy	2	2022 2022	EUR 850 mn EUR 650 mn
Worley	Oil and gas consulting and engineering	Australia	1	2021	EUR 500 mn
Utilities					
ČEZ	Electric utility	Czech Republic	1	2022	EUR 600 mn
Enel Finance International	Financing company for Enel Group (Italian electric and gas utlility)	Netherlands	22	From 2019 to 2022	Approx. USD 1 bn (on average for each issuance)
NRG Energy	Electric utility	US	2	2020 2021	USD 1.1 bn USD 900 mn
Public Power Corporation	Electric utility	Greece	3	2021 2021 2021	EUR 775 mn EUR 125 mn EUR 500 mn

Empresa Generadora de Electricidad Haina	Electric utility	Dominican Repuiblic	1	2021	USD 300 mn
Chemicals					
Braskem Idesa	Thermoplastic resins and other petrochemicals production	Mexico	1	2021	USD 1.2 bn
Henkel	Chemical and consumer goods	Germany	3	2022 2021 2021	EUR 650 mn EUR 500 mn USD 250 mn
Indorama Ventures	Intermediate petrochemicals production	Thailand	3	2021	THB 5 bn THB 3 bn THB 2 bn
Metals and mining					
Newmont Corporation	Gold mining	US	1	2021	USD 1 bn
Constellium	Aluminium	France	2	2021 2021	USD 500 mn EUR 300 mn
Jsw Steel	Steel	India	1	2021	USD 500 mn
SSAB AB	Steel	Sweden	1	2021	SEK 2 bn
Norsk Hydro	Production of aluminium and energy	Norway	2	2022	NOK 1.5 bn NOK 1.5 bn

Note: This table includes a non-exhaustive list of examples, mainly for illustrative purposes. It will be complemented by further examples in the next phase of research and data collection, for further analysis. This list includes the five largest issuances from five different countries within each sub-sector, for which a Second Party Opinion (SPO) is publicly available in English, within a sample of issuances available on Refinitiv up until December 2022.
Note: "mn" = million; "bn" = billion
Source: Refinitiv data (until December 2022), complemented by desk-based research.

The uptake of sustainability-linked bonds and loans by a wide variety of issuers across sectors indicates that the instrument has potential to be used for a whole-of-economy, cross-sectoral transition. At the same time, evidence suggests that the KPIs and metrics used in SLB issuances in high-emitting sectors are not always consistent with an ambition to transform a company and adhere to a credible low-emission pathway. According to CBI, issuers in the oil and gas sector have set targets that do not envisage to halve emissions by 2030 (as called for by the IPCC) and may significantly rely on offsetting (CBI, 2021[66]). Analysis of second party opinions (SPOs) of the SLBs in Table 2.1 indicates insufficient details regarding the use of offsets (Vigeo Eiris, 2021[67]; ISS ESG, 2021[68]; ISS ESG, 2021[69]; Vigeo Eiris, 2020[70]; Sustainalytics, 2021[71]; ISS ESG, 2021[72]).

Moreover, it is important to monitor how a company intends to achieve its pre-defined targets and to verify the actions a company takes to reach them. The structure of a sustainability-linked instrument could potentially allow a company to achieve a pre-defined target and avoid triggering a coupon step-up by selling high-emitting assets to other financers while still retaining off balance sheet liabilities in such assets (Financial Times, 2022[73]). Ex-ante, interim, and post-issuance reporting, ideally externally verified, can provide evidence on the impact and credibility of results. The ICMA SLB Principles refer to the need for post-issuance reporting to include an "illustration of the positive sustainability impacts of the performance improvement" where feasible and possible (ICMA, 2023[57]). Such reporting should detail specific projects undertaken to achieve the predefined targets as well as inputs, outputs, and outcomes that have led to those impacts. Moreover, anchoring an SLB issuance in an entity-wide credible transition plan, specifying concrete actions the company intends to take to achieve its targets and related capital expenditure (CapEx), can help to address potential greenwashing risks and provide confidence to prospective investors (OECD, 2022[74]).

In some cases, SLB financing frameworks for oil and gas companies have depicted planned marginal efficiency improvements in natural gas facilities as positive steps towards achieving emission reduction targets (S&P Global, 2021[75]; Vigeo Eiris, 2021[67]; ISS ESG, 2021[76]). However, as noted above, such improvements could result in incremental emission reductions and risk locking in further emissions in the long run. In some instances, SLB financing frameworks of oil and gas companies do not provide sufficient information on the opportunities and limitations (e.g., costs and feasibility challenges) of the use of innovative technologies (for example, on the use of bio-fuels or renewable-based hydrogen (Vigeo Eiris, 2021[67]; ISS ESG, 2021[68]). In the industry sector, CICERO explicitly mentions lock-in risk in a SPO of an aluminum company's SLB framework. It concerned some of the company's planned investments to substitute fuel oil with natural gas in an alumina refinery. According to the company, the switch was due to the lack of infrastructure that would be needed to support short-term renewable energy projects in the area of the refinery. This fuel switch would entail investments in natural gas infrastructure that would increase access to natural gas for other industries and consumers in the area. CICERO recommended that the company continually reassess local conditions and report on its efforts to promote renewable energy development while reducing lock-in effects of the switch (CICERO, 2022[77]).

Some SPOs of oil and gas companies' issuances indicated that it was not possible to assess the calibration and ambition of the emission reduction targets relative to a science-based transition pathway or to the Paris Agreement temperature goal. An often-cited reason was the lack of a sector-specific target-setting methodology for oil and gas companies by the Science Based Targets initiative (SBTi) or other methodology providers (ISS ESG, 2021[69]; ISS ESG, 2021[76]; ISS ESG, 2021[78]). SBTi is currently revising its guidance and methodologies on setting science-based targets for the oil and gas sector and has hence temporarily discontinued the validation of targets of companies in the fossil fuel sector. Some SPOs also indicated challenges in assessing and comparing the ambition of targets among industry peers, due to the use of proprietary measurement methodologies (ISS ESG, 2021[68]) or due to lack of peer data and targets (ISS ESG, 2021[69]; ISS ESG, 2022[79]).

Moreover, some SLB issuances in this sector are linked to targets related to emission reductions per unit of production (intensity targets), rather than total emissions (absolute targets), despite the issuer in some cases having set both absolute and intensity-based corporate emission reduction targets (Reuters, 2022[80]). Arnold and Toledano analysed the net zero pledges of 35 companies across seven sectors and found that oil and gas companies are the most heavily reliant on intensity targets, with all assessed oil and gas companies using either only an intensity target or a blend of absolute- and intensity-based targets (Arnold and Toledano, 2022[81]).[12]

Different approaches exist for corporates to measure their GHG emission performance, based on either absolute- or intensity-metrics. The three approaches are: (i) Absolute Emissions Contraction (AEC); (ii) the Sectoral Decarbonisation Approach (SDA); and (iii) Economic Intensity Contraction (EIC) (SBTi, 2022[82]) (see (Noels and Jachnik, 2022[83]) for further details on the three approaches). Intensity and absolute targets each have advantages and disadvantages. On the one hand, using intensity-based targets can be problematic as they are vulnerable to changes in production outputs and may hence not be good indicators of improvements in GHG emission reductions. Another issue with the use of intensity-based targets in SLB issuances is that companies might use different methodologies to calculate the denominator, even when choosing the same indicators. For example, production volume can be measured either considering sales productions, or raw production volumes. Differences in measurement practices and choice of indicators hinders comparability of intensity targets across companies and benchmarking comparisons to assess ambition. On the other hand, absolute metrics hinder comparability across firms of different sizes (Noels and Jachnik, 2022[83]). SBTi recommends that companies express targets in both absolute and intensity terms (SBTi, 2022[82]). The IIGCC Net Zero Standard for Oil and Gas stipulates that oil and gas companies can set targets based on absolute or intensity metrics but should indicate how an intensity target translates into absolute emissions and vice versa (IIGCC, 2021[84]). Based on existing guidance, both types of targets

should be used as KPIs of SLB issuances to increase environmental integrity and reduce greenwashing risks.

A further methodological issue is that in SPOs of some SLB frameworks, the assessment of the ambition and calibration of SPTs is often backward-looking, based on peers' past performance, rather than comparing it with a forward-looking, science-based pathway or long-term target specifying where the sector is supposed to be in the future. Assessments based on backward-looking performance risks creating lock-in as a marginal improvement with respect to past performance may not be sufficient to ensure that emissions are sufficiently reduced. Moreover, in some cases, SPOs of SLB issuances indicate challenges in comparing a given target with past performance due to the lack of verified historical emission data (ISS ESG, 2021[76]; ISS ESG, 2022[79]; ISS ESG, 2021[85]).

In addition, issuances of companies in hard-to-abate sectors often do not encompass scope 3 emission targets. According to CBI, 84% of SLB issuances by oil and gas companies do not include scope 3 targets (CBI, 2022[1]). This was confirmed by the analysis of SLBs' SPOs in Table 2.1. However, scope 3 emissions, for instance from the use of sold products of oil and gas companies (wherever they operate in the value chain) can account for a high share of total emissions, often more than scope 1 and 2 combined (CDP, 2023[86]). Wood Mackenzie estimates that Scope 3 emissions account for 80-to-95% of total carbon emissions from oil and gas companies (Wood Mackenzie, 2022[87]).

In a broad sense, SLBs are a relatively new and fast-developing market segment, and it is still early to evaluate their impact. However, their KPI-linked feature brings in potentially promising avenues for environmental ambition and integrity. Moving forward, agencies that provide verification of issuers' sustainability-linked financing frameworks and examine the relevance and ambition of their KPIs and targets could facilitate the transparency and growth of this market. At the same time, it is important that issuers continue to strengthen their capacity to set credible KPIs and SPTs and investors continue to build their expertise in assessing their ambition, relevance, and consistency. The environmental concerns laid out above have not prevented issuers from receiving a positive SPO on their framework. The role of verifiers and SPO providers is of critical importance since such verifications should provide assurance to investors, transparency to regulators, and efficiency in the market. Standards and oversight are needed to ensure that verification providers operate with environmental integrity.

Several jurisdictions have put forward related policies or proposals, mainly on a voluntary basis. In 2022, Japan's Financial Services Agency (FSA) released a "Code of Conduct for ESG evaluation and data providers", designed as a voluntary code on a "comply or explain" basis, to ensure the quality and transparency of ESG ratings, data and methodologies (Financial Services Agency, 2022[88]).[13] Following its release, in July 2023, FSA published the list of 17 ESG evaluation and data providers who had notified the FSA of their intention to endorse the Code of Conduct by the end of June 2023, including global major players participating in Japanese financial markets. Similarly, in 2022 the UK Financial Conduct Authority (FCA) announced the establishment of an independent group to develop a Code of Conduct for ESG data and ratings providers, proposing to introduce regulatory oversight (Financial Conduct Authority, 2022[89]). In 2023, the European Commission made a proposal for a regulation on the transparency and integrity of ESG rating activities, which would require ESG rating providers offering services to investors and companies in the EU to be authorised and supervised by the European Securities and Markets Authority (ESMA) (European Commission, 2023[90]). In 2023, SEBI proposed to introduce an enforceable regulatory and supervisory regulatory framework for ESG rating providers (SEBI, 2023[91]).

4.4. Key findings and good practices for transition financial instruments

Clearly distinguishing between green and transition eligible activities will make frameworks for transition financial instruments more credible. Credibility can be enhanced by linking frameworks with corporate transition plans, using ambitious KPIs and SPTs that are linked with key milestones designed to prevent carbon lock-in.

- To reduce the risk of lock-in, it is important that green and transition bond frameworks and standards clearly distinguish between green and transition eligible activities, in line with applicable taxonomies or other relevant classifications. Where taxonomies do not exist, transparency on eligible projects can be achieved through additional issuer disclosure requirements.
- The credibility of SLB frameworks can be enhanced by anchoring them in and providing details about the corporate climate transition plan, in line with international best practice, such as the ten key elements of transition plans laid out in the *OECD Guidance on Transition Finance.* It will also follow regulatory guidance and frameworks for transition plans, where they exist.
- As per the OECD Guidance, emission reduction-related KPIs and SPTs that are meaningful, science-based and line with the global temperature goal of the Paris Agreement can enhance the credibility of SLB frameworks. It is important that they include all emission scopes, both absolute and intensity targets and not rely on offsets. In cases where offsets are used as a last resort option, sufficient details on their reliance and use will be provided.
- Frameworks of transition financial instruments used to raise finance for fossil fuel related investments, e.g., efficiency improvements of fossil fuel assets, ammonia co-firing in coal-fired power plants, or hydrogen blending in gas networks or power plants, can be enhanced by including explicit and detailed information on key milestones to achieve net zero and this should be reflected in KPI and SPT requirements, such as:
  - Timelines for achieving the planned level of co-firing, blending, or fuel switch and their dependencies on technology development and supply evolutions (see also relevant findings and good practices on future-proofing and sunset clauses in chapter 3 for more information);
  - Flanking measures to enable the desired level of blending, co-firing, or fuel switch, such as contracts of supply or additional investments, for example into hydrogen production (see also relevant findings and good practices on flanking measures in chapter 3 for more information);
  - Timelines for the retirement of high-emitting assets, if any, and relevant effects on the company's financial strategy (see also relevant findings and good practices on early retirement of high-emitting assets in chapter 3 for more information);
  - Any other key dates or milestones that arise from the company's decarbonisation strategy and transition plan, which may be necessary to prevent lock-in;
  - Any potential feasibility challenges;
  - Reasons for not choosing a lower-emission alternative.

The development of standards and frameworks for SLBs is necessary to strengthen the credibility of this instrument and address emerging loopholes that currently increase the risk of lock-in of related investments.

- Standards and frameworks for SLBs are important tools to address emerging loopholes and potential penalty-minimising behaviour in SLB structures, such as by ensuring issuers do not intentionally set late target dates and call options. It is important that penalties are set in a way that provides adequate incentives for the issuer to achieve its sustainability targets.

- Standards and oversight are needed to ensure that verification and SPO providers follow the highest quality standards available and ensure the credibility, integrity, and ambition of SLB frameworks and related KPIs and SPTs. In a credible SLB framework, standalone ESG metrics and scores will not be used as KPIs and SPTs.

Eligibility criteria of standards and frameworks for transition financial instruments should be regularly updated and reassessed as factors affecting feasibility evolve.

- Green and transition bond frameworks (whether of jurisdictions, entities, or other market actors) typically include a list of projects that are eligible to be financed through the bond proceeds. Wherever eligible projects include activities that are emission-intensive because of feasibility hurdles, feasibility should be regularly reassessed in case technological, economic, regulatory, or political and social conditions change.
- Wherever innovative and not fully tested and scalable net-zero technologies are used (in SLBs, transition or green bonds), details should be provided on the associated CapEx required, the feasibility of the technology used and any foreseen limitations, constraints, and uncertainties to their application.

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Notes

[1] Compliance with the EUGBS is not mandatory for green bond issuers within or outside the EU, but those choosing to issue under the "EUGBS" label will have to follow its requirements. For further details on the link between the EU Taxonomy and the EUGBS, please see (OECD, 2023[8]).

[2] The issuance amounts include matured bonds.

[3] The Luxembourg Green Exchange (LGX) DataHub has global coverage of listed sustainable debt instruments (Luxembourg Stock Exchange, 2023[96]). Issuances in China's domestic market and those of certain US municipalities are not covered in the database. Issuers located in Russia are not included (ICMA and LGX, 2023[10]).

[4] The "greenium" refers to the premium that bondholders are willing to pay to invest in green securities rather than their vanilla counterparts, thus making green bonds a relatively cheaper cost of funding for issuers.

[5] A recent ECB Working Paper finds that only green bonds with external review and issued by credible companies trade at both a statistically and economically significant greenium, which seems to evolve over time and be mainly driven by retail investor demand (Pietsch and Salakhova, 2022[13]). Kapraun et al (2019[12]) find that the existence and significance of the greenium varies substantially across currencies and issuer types, with the greenium being high and significant for bonds issued by governments or MDBs or by corporates with strong green credentials. Other studies find no greenium in corporate bonds (Flammer, 2021[14]) and in municipal green bonds (Larcker and Watts, 2020[15]). Fatica, Panzica and Rancan (2021[11]) find presence of greenium for green bonds issued by MDBs and non-financial corporates but not for issuances by financial institutions. They also find that green bonds with external review benefit from a larger greenium compared to self-labeled green securities.

[6] It is worth noting that the terms "principles", "standards", "frameworks", and "taxonomies" are commonly used interchangeably though they refer to different concepts. See Box 3.2 in (OECD, 2023[8]) for further details on this.

[7] Specifically, this includes the "construction and operation of natural gas transmission, storage and transportation peak shaving facilities such as long-distance natural gas pipelines, gas storage, branch pipelines, regional pipeline networks, and liquefied natural gas (LNG) receiving stations" (People's Bank of China, 2021[22]).

[8] Namely, electricity generation from fossil gaseous fuels, high-efficiency co-generation of heat/cool and power from fossil gaseous fuels and production of heat/cool from fossil gaseous fuels in an efficient district heating and cooling system.

[9] It should be noted that the European Commission's 2021 "Hydrogen and gas markets decarbonisation package" proposes harmonised rules on gas quality, allowing for the blending with up to 5% hydrogen and access to LNG terminals and gas storage is ensured for low-carbon and renewable gases (European Commission, 2021[23]). In 2023, the Council's position on this proposal was to keep the level of blending of hydrogen into the natural gas system limited to 2% by volume (instead of 5%) (Council of the EU, 2023[97]).

[10] The IEA estimated that to satisfy a given energy demand, a 5% blend of low-carbon hydrogen into gas networks would reduce CO_2 emissions by 2% (IEA, 2019[28]). According to IRENA, blending 20% hydrogen into gas networks could achieve, at best, only 7% CO_2 emissions reduction (IRENA, 2022[98]).

[11] The issuance amounts are calculated including matured bonds.

[12] It is worth noting that they analysed a relatively small sample of companies.

[13] It is worth noting that the regulation and supervision of rating providers does not authorise assessment of the quality of every SPO they provide and it is the responsibility of users of these ratings to ultimately assess them.

Annex A. Glossary

- **Carbon lock-in** Carbon lock-in occurs when fossil fuel infrastructure or assets (existing or new) continue to be used, despite the possibility of substituting them with low-emission alternatives, delaying or preventing the transition to near-zero or zero-emission alternatives (OECD, 2022[1]).
- **Green bonds** are any type of bond instrument where the proceeds or an equivalent amount will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible green projects and which are aligned with the four core components of the Green Bond Principles (ICMA, 2021[2]).
- **Key Performance Indicators (KPIs)** are quantifiable metrics used to measure the performance of selected indicators.
- **Sustainability-linked bonds (SLBs)** are any type of bond instrument for which the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined sustainability or ESG objectives (ICMA, 2020[3]).
- **Sustainability-linked loans (SLLs)** are any types of loan instruments and/or contingent facilities (such as bonding lines, guarantee lines or letters of credit) which incentivise the borrower's achievement of ambitious, predetermined sustainability performance objectives. The borrower's sustainability performance is measured using sustainability performance targets (SPTs), which include key performance indicators, external ratings and/or equivalent metrics and which measure improvements in the borrower's sustainability profile (LMA, 2019[4]).
- **Sustainability bonds** are any type of bond instrument where the proceeds or an equivalent amount will be exclusively applied to finance or re-finance a combination of both green and social projects (ICMA, 2021[5]).
- **Sustainability Performance Targets (SPTs)** are measurable improvements in key performance indicators on to which issuers commit to a predefined timeline. SPTs will be ambitious, material and where possible benchmarked and consistent with an issuer's overall sustainability/ESG strategy (ICMA, 2020[3]).

Annex B. Ten key elements of credible corporate climate transition plans

Based on existing initiatives and good practices, the 2022 OECD Guidance on Transition Finance sets out ten key elements of credible corporate climate transition plans, which aim to align with the temperature goal of the Paris Agreement (OECD, 2022[1]). The Guidance proposes that transition finance must be grounded in credible corporate climate transition plans, to be effective in mobilising investments for the net-zero transition, while ensuring environmental integrity and preventing greenwashing.

The ten key elements are the following:

1. **Setting temperature goals, net-zero, and interim targets**: a corporate transition plan will clearly set out and explain its net-zero target and associated interim targets. Net-zero and interim targets will be science-based, consistent with an IPCC 1.5°C reference scenario, and cover all relevant greenhouse gas (GHG) emissions. Interim targets will reflect the need for global GHG emissions to peak by 2025. In certain justified circumstances, companies may choose reference scenarios consistent with limiting warming to below 2°C.
2. **Using sectoral pathways, technology roadmaps, and taxonomies**: Net-zero and interim targets will be based on available sectoral pathways, technology roadmaps, and taxonomies, where these are available. The plan will clarify how future operating and capital expenditures will be allocated to achieve these targets.
3. **Measuring performance and progress through metrics and key performance indicators (KPIs)**: Climate change mitigation-related metrics and KPIs will cover lifecycle GHG emissions and be measurable and externally verifiable. Targets and reporting will include scope 3 emissions, and any omissions will be limited, justified, and clearly explained.
4. **Providing clarity on the use of carbon credits and offsets**: The use of carbon credits and offsets will be limited and carefully explained to mitigate the risk of undermining the credibility of transition plans.
5. **Setting out a strategy, actions, and implementation, including preventing carbon-intensive lock-in**: A clear strategy and concrete actions will be outlined to achieve the company's targets, including addressing transition risks and opportunities over time. The plan will assess the risk of carbon-intensive lock-in, provide a responsible retirement plan for high-emitting assets where relevant, and establish mechanisms to prevent lock-in for existing and future assets and infrastructures at risk.
6. **Addressing adverse impacts through the Do-No-Significant-Harm (DNSH) Principle and due diligence for Responsible Business Conduct (RBC)**: Transition plans will consider not only mitigation goals but also other environmental and social objectives, ensuring no harm is done to them. Conducting risk-based due diligence based on the OECD Due Diligence Guidance for Responsible Business Conduct (RBC) can operationalise the DNSH Principle within transition plans. This helps companies identify, prevent, mitigate, and account for actual and potential adverse impacts associated with their operations, supply chain, and other business relationships.
7. **Supporting a just transition**: Measures will be taken to mitigate negative impacts on workers, suppliers, local communities, and consumers, in line with relevant International Labour

Organisation (ILO) and OECD principles and guidelines. Credible transition plans involve regular, continuous, and inclusive stakeholder engagement and social dialogue.

8. **Integrating with financial plans and ensuring internal coherence**: The transition plan will be integrated into the corporate business plan, making explicit reference to the company's financial plan. Both plans will be developed concurrently, ensuring coherence.
9. **Ensuring sound governance and accountability**: A whole-of-entity approach will be adopted to monitor and report on the design and implementation of the transition plan. The plan will be subject to senior management approval and oversight and involve all relevant stakeholders.
10. **Transparency and verification, labelling, and certification**: Progress on targets will be regularly disclosed, and third-party verification of the plan and its targets will be ensured.

References

ICMA (2021), *Green Bond Principles*, https://www.icmagroup.org/assets/documents/Sustainable-finance/2021-updates/Green-Bond-Principles-June-2021-140621.pdf (accessed on 31 May 2022). [2]

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Green Finance and Investment

Mechanisms to Prevent Carbon Lock-in in Transition Finance

Carbon lock-in occurs when high-emission infrastructure or assets continue to be used, despite the possibility of substituting them with low-emission alternatives, thereby delaying or preventing the transition to near-zero or zero-emission alternatives. Transition finance, which focuses on the dynamic transformation and decarbonisation of hard-to-abate sectors, frequently faces the issue of carbon lock-in, particularly in considerations of investment feasibility and eligibility. Despite most transition finance approaches incorporating lock-in avoidance as a core principle, existing transition instruments and approaches put in place varying or limited mechanisms to prevent lock-in.

Building on the OECD Guidance on Transition Finance, this report takes stock of how carbon lock-in risk is addressed in existing transition finance approaches (such as taxonomies, roadmaps, or guidance), financial instruments, and relevant public and private investment frameworks and methodologies. The report provides good practices on the integration of credible mechanisms to prevent carbon lock-in, address greenwashing risks and build confidence in the market. It can inform both public and private actors in the development of transition finance approaches, standards for green, transition and sustainability-linked debt, frameworks for corporate transition plans, or broader climate-related disclosure frameworks.

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