Policy Toolbox for Industrial Decarbonisation

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Abstract

The *Policy Toolbox for Industrial Decarbonisation* is a repository of policy instruments available to assist governments as they design, develop and implement their strategies for industrial decarbonisation. This work, undertaken as part of the Climate Club's Work Programme, builds on the policy toolbox outlined in IEA's 2022 Achieving Net Zero Heavy Industry Sectors in G7 Members report, with the addition of further details on the instruments and considerations for implementation.

A robust industrial decarbonisation policy strategy is likely to include multiple different instruments, as governments choose the instruments that are most suited to their individual circumstances and objectives. The report draws on comparative policy analysis to discuss the main considerations and best practices for a wide range of policy instruments, as well as opportunities for international collaboration. It provides examples of relevant policies applied around the world.

The Policy Toolbox is divided into three broad areas with nine categories in total that group policy instruments according to their objectives. These broad areas are: **Framework fundamentals**, including (1) Establishing plans and policies for long-term GHG emissions reductions and (2) Mobilising finance and investment; **Targeted actions for specific technologies and strategies**, including (3) Managing existing assets and near-term investment, (4) Creating a market for near-zero emissions materials production, (5) Developing technologies, and (6) Accelerating material efficiency and circularity; and **Necessary enabling conditions**, including (7) International co-operation and a level playing field, (8) Infrastructure planning and development, and (9) Tracking progress and improving data.

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Overview

Description and purpose

This report is intended to serve as a detailed Policy Toolbox – a repository of policy instruments – that can be used by Climate Club members and other governments as they design, develop, implement and refine their strategies for industrial decarbonisation. The foundation for the report is the policy toolbox outlined in IEA's 2022 Achieving Net Zero Heavy Industry Sectors in G7 Members report, which is referred as "the IEA Policy Toolbox" hereafter.

The IEA Policy Toolbox comprises multiple elements that the IEA considers relevant to an effective and comprehensive industrial decarbonisation strategy. These are grouped into three broad areas:

- **Framework fundamentals**, which refers to broader policies and plans that provide a long-term signal for decarbonisation and strategies to mobilise financing.
- **Targeted actions for specific technologies and strategies**, which encompasses measures taken to ensure that the required low- and near-zero emissions technologies are developed, a market is developed for such technologies, high-emitting production stock is addressed, and that demand for materials is optimised.
- **Necessary enabling conditions**, which include having a sufficiently robust framework for international co-operation, support to develop adequate enabling infrastructure, and the proper mechanisms to collect data and track progress.

Independently of the intended pace of the transition and the specific policy instruments that each country may wish to implement, ultimately government action under all three of these areas is likely to be necessary for a successful transformation of the industrial sector. Further, stakeholder collaboration is a necessary driving force for advances across all of the areas. This includes governments and industrial producers and associations taking a lead role, but also collaboration with other important actors including materials users, financial institutions and investors, technology suppliers, startups, trade unions, researchers and non-governmental organisations. The necessary level of collaboration will vary depending on the policy instruments, but in general terms, the more involved and committed the various actors in the process are, the greater the likelihood of policies being effective.

The purpose of the Policy Toolbox is to serve policy makers. It is intended to become a go-to hub to support governments in designing and fine-tuning their strategies. It can also serve as a reference for other stakeholders, such as private

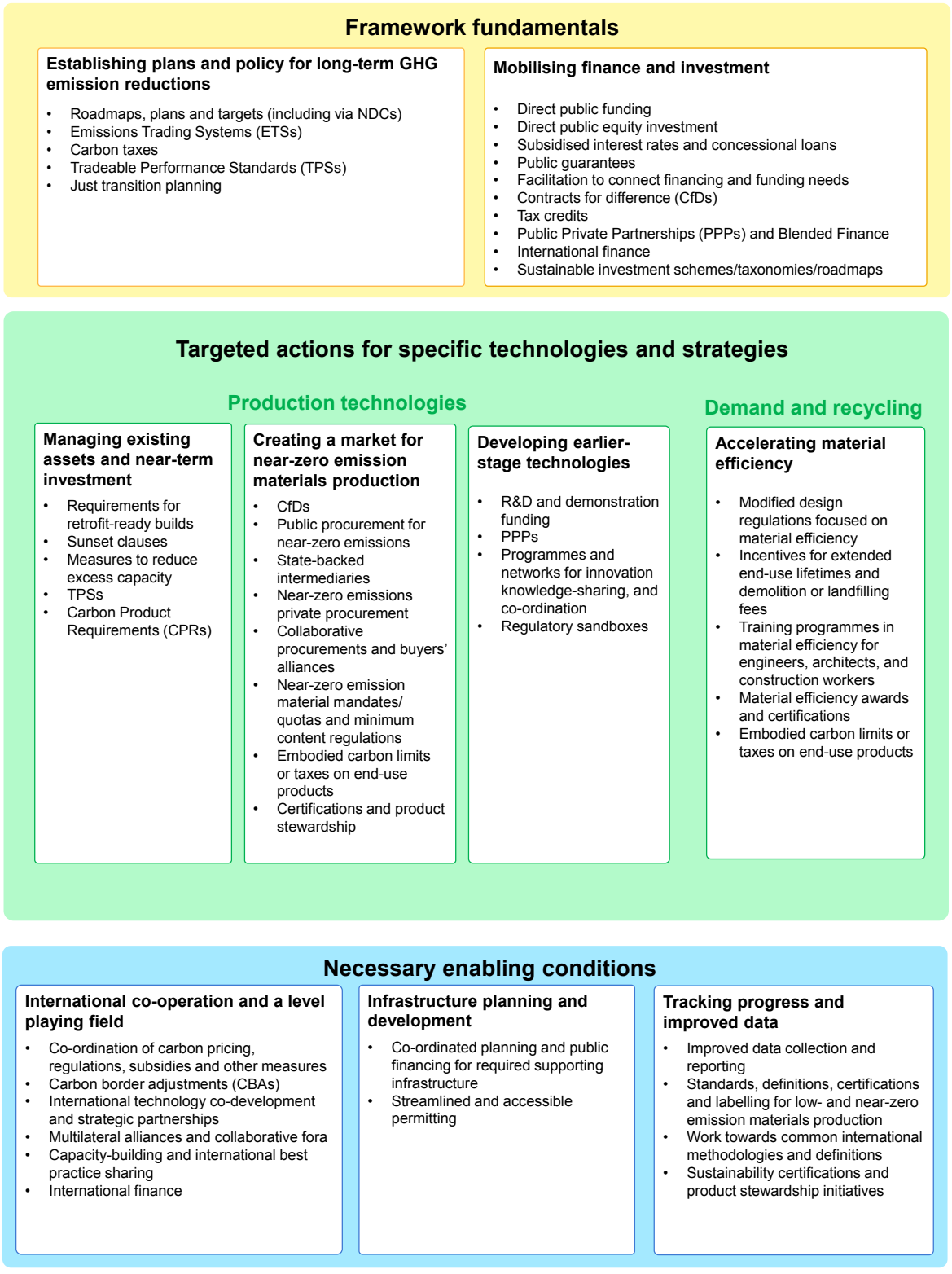
sector producers or taxpayers more broadly, to better understand the policies implemented by different governments and their implications. The toolbox primarily targets deep emissions reductions towards the achievement of long-term, internationally aligned government objectives but incremental emissions reductions will also be necessary in parallel and will need to be addressed by the overall policy strategy. It is technology-agnostic, aiming to provide a guide and springboard for different countries as they develop policies tailored to their diverse resource endowments and local conditions.

Users may wish to employ the menu (Table of contents) to navigate to the areas that are most of interest – as a toolbox, the report is not necessarily intended to be read from top to bottom. On the first level of the menu that users see when opening the toolbox, there will be an overview of the key categories, showing how they inter-relate and complement each other.

By navigating through each of these categories, users will be able to access a concise analysis of each policy instrument, including its benefits and key considerations for implementation. To complement this, each policy instrument comes with a list of reference policies to provide examples of practical implementation. This list draws from the steel and cement policy-mapping exercise conducted by the OECD and IEA for the Climate Club and does not claim to be exhaustive.

The Policy Toolbox allows the user to take an in-depth look into policy instruments of interest. This approach aims to provide an intuitive and accessible tool to policy makers by presenting a compilation of concise information at different levels of granularity, and thereby helping them to focus on the topics relevant to their strategies. Policy makers may use this toolbox for research, comparison and design of strategies, as well as for inspiration for implementation.

Figure 1 A policy toolbox for decarbonisation of heavy industries



Source: Adapted from IEA (2022), Achieving Net Zero Heavy Industry Sectors in G7 Members.

Methodology

Starting from the IEA Policy Toolbox, this report analyses and provides further detail on the policy instruments under each of the three major groups in the toolbox. The policy categories and instruments are analysed based on the questions in the Structure described below. Examples for each policy instrument are included, based on the Policy mapping.

As with any policy analysis, this methodology involves a certain level of expert judgement that is grounded in the IEA's long-standing experience in global energy policy analysis. It also leverages the strategic exchanges of the Climate Club regarding best practices and policy experiences of a large and diverse group of countries. The aim is to not be prescriptive, but rather to present the different aspects for policy makers to consider when choosing and designing policy instruments. The approach intends to open a discussion, describing the circumstances that could render each policy instrument more or less suitable and the considerations for implementation.

Key indicators for policy implementation

Policy making involves making considerations across a variety of different factors, in order to select and design instruments that provide the best likelihood of achieving multi-faceted policy objectives. To aid these complex considerations, aspects of this analysis utilise four key indicators – outlined below – that policy makers may consider as they develop their policy approach. These indicators draw from criteria commonly used by researchers, academics and policy makers themselves when considering policy choice and design.

The indicators are relevant to the selection of policy instruments, as some instruments may, by their very nature, be more likely to perform well on certain indicators. They can aid governments to reflect on relevant considerations as they decide which instruments may be suitable for their context and objectives, and how to design the chosen instruments. These indicators are therefore used in two main ways in this analysis. First, within the overviews of policy categories, the questions and responses implicitly draw on these indicators to weigh the likely advantages and performance across instruments. Second, for each instrument, best practices across the indicators are provided to aid in policy design.

The indicators are as follows:

- **Effectiveness:** To be effective, policy selection and design should take into account the defined policy objective(s), and how likely an instrument is to achieve those objectives, or to contribute to achieving them alongside other instruments. Some policy instruments – either due to their fundamental characteristics or their

particular design – are more likely to result in the desired objective(s) than others. The objective(s) of each policy will be decided by each government. One possible objective may be achieving a particular level of emissions reductions. There may be various other objectives that instruments related to the industrial transition can contribute to, such as developing certain technologies, or social or economic objectives related to energy and industrial sector employment.

- **Simplicity:** This indicator refers to practical feasibility in terms of logistics and administrative processes, and to the ease of monitoring and enforcing the measure. To some degree, this indicator will be affected by whether the policy is compulsory or voluntary, since compulsory policies will require substantially more efforts for monitoring and enforcement. At the same time, some compulsory policies are relatively easy to implement and monitor. Policy selection and design can consider how, all else equal, it would be possible to take a simpler approach.
- **Stakeholder acceptability:** This indicator refers to the ease of implementing the policy from the point of view of political and social acceptance, taking into account all relevant stakeholders and aiming to maximise fairness. This includes both the process of passing the policy into law (if applicable) by gaining buy-in among both citizens and sectoral stakeholders, and also enforcing the measure without major social opposition or non-compliance. Sometimes the policies that represent the most effective path to reach emissions reductions goals may result in short-term negative impacts for some stakeholders, which can present a barrier to policy adoption and implementation. Adequate communication and stakeholder consultation can help in this regard. Stakeholder acceptability will also depend on country-specific circumstances and policy-making norms. Taking into account stakeholder views, distributional effects, fairness, social justice and other socio-economic impacts is important to policy choice and design, including considering specific ways to minimise negative impacts.
- **Economic efficiency:** This indicator refers to the cost of policy implementation relative to the expected benefits in terms of achieving the policy objective(s). For example, it could be measured as the effect on the desired goal (which may, for example, be measured in terms of emissions reduction) per unit of money spent. All else equal, policy makers typically seek to design policies that have the highest impact at the lowest possible cost to government budgets and society as a whole. Economic efficiency will, to some extent, be impacted by variables that are external to the policy itself, such as the availability of adequate infrastructure, the impact of other policies, economic cycles, external shocks, etc. For this reason, economic efficiency might not always be simple to measure. Moreover, high economic efficiency does not necessarily guarantee that a policy is effective in substantially advancing decarbonisation goals – for instance, implementing carbon pricing might be cost-efficient, but if the price is not high enough, the targeted reduction in emissions will likely not take place. Selecting and designing policies generally requires optimising costs while also ensuring the policy objective(s) can be achieved.

Policy mapping

This toolbox also draws upon the mapping of steel and cement policies that was performed by the OECD and the IEA during 2024 for the Climate Club. These policies fall within the categories and instruments outlined above, and represent examples of policy instruments applied in different countries. The policies that were included in the mapping exercises correspond to the largest producing countries of steel and cement in the world, and to other notable policy examples in Climate Club member countries. The policy mapping will be published as a non-exhaustive database for users access examples of the different policy instruments discussed in this report.

The mapping exercises are by no means exhaustive – they are not being updated in real time, nor do they present all the existing policies of any given country. The policies listed in this toolbox therefore only constitute illustrative examples of each policy instrument. However, please note the interactive and dynamic nature of this toolbox – the Climate Club Secretariat welcomes proposals for new policies that members wish to see included.[1]

Structure

Overarching structure

As illustrated in Figure 1 above, the Policy Toolbox has nine categories, which are grouped in three broad areas as follows:

- **Framework fundamentals:** including 1.1 Establishing plans and policy for long-term GHG emission reductions and 1.2 Mobilising finance and investment.
- **Targeted actions for specific technologies and strategies:** including 2.1 Managing existing assets and near-term investment, 2.2 Creating a market for near-zero emissions materials production, 2.3 Developing technologies, and 2.4 Accelerating material efficiency and circularity.
- **Necessary enabling conditions:** including 3.1 International co-operation and a level playing field, 3.2 Infrastructure planning and development, and 3.3 Tracking progress and improving data.

[1] Members can access a form that they can complete with the policies they propose to have added to the Cement and Steel Policy Mapping. The completed form can be sent to secretariat@climate-club.org for review by the Secretariat.

Policy categories

Each of the nine categories of the Policy Toolbox opens with an introductory section, which includes the following standardised questions:

- What is the purpose of this category?
- What critical role does this category serve in an overall industrial decarbonisation strategy?
- What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Policy instruments

The toolbox uses a standardised structure for the **analysis of each policy instrument.** This includes the following fields:

- **Description:** Simplified explanation of what each instrument entails, its objectives and key features.
- **How could this policy instrument target deep emissions reductions:** This discusses whether the instrument can be used for deep emissions reductions and/or for incremental emissions reductions, and which design considerations may increase targeting of deep emissions reductions.
- **When is this policy instrument suitable:** This section analyses the reasons why the policy instrument may be used and the circumstances under which it is likely to be effective.
- **What needs to be considered before implementation:** This section analyses the considerations that a government might undertake when implementing the instrument. These may refer to the broader policy framework, pre-existing infrastructure, processes or policies that should be carried out in parallel, etc.
- **Best practices:** A comment on best practice for four key indicators is included, so as to provide brief recommendations on how to design the policy instrument for the greatest likelihood of success. As mentioned in previous section, the analysis of the policy instruments is based on the following indicators: effectiveness, simplicity, stakeholder acceptability, and economic efficiency.
- **How can international collaboration improve the efficiency of this** instrument: this section highlights the areas where the policy instrument could benefit from international co-operation. If relevant, these areas could be: knowledge-sharing, access to international financing, international co-operation agreements, infrastructure-building, international definitions, standards and certifications, commercial agreements.
- **Examples of governments that have implemented this type of policy instrument:** This section lists illustrative examples of the policy instrument. Many of these policies are based on the steel and cement policy-mapping exercises (see above).

1. Framework fundamentals

Framework fundamentals are the foundation for the industrial decarbonisation strategy of the country. This can include policies designed to send a long-term signal to markets on decarbonisation (e.g. carbon pricing) and publicly communicated action plans, as well as policies to mobilise finance and investment.

1.1. Establishing plans and policy for long-term GHG emission reductions

What is the purpose of this category?

Plans and policies in this category are intended to establish a clear, strong, predictable long-term policy signal for emission reductions. This includes both policies that lay out the intended path forward – roadmaps, plans and targets formally communicated by governments (including just transition planning) – and incentive and/or regulatory policy instruments that send a broader signal for emissions reductions without targeting specific technologies or strategies, like carbon pricing (either emissions trading systems [ETSs] or carbon taxes), as well as tradeable performance standards (TPS). Policies can be written into law or formally expressed in writing by the government and can have more or less binding goals.

The purpose of roadmaps, plans and targets is to set and detail the overall direction of the country's industrial decarbonisation strategy and, in some cases, the direction for specific subsectors. Meanwhile, mandatory policies like carbon pricing or TPS are valuable for providing a long-term market signal that incentivises producers and consumers of industrial materials to pursue emissions reductions.

Roadmaps, plans and targets could be implemented prior to or together with carbon pricing and/or TPS. For a comprehensive environmental and social strategy, roadmaps/plans/targets would preferably include plans related to just transition. Alternatively, just transition plans could be developed in parallel and later integrated into the broader industrial decarbonisation strategy.

It is very important to note that instruments in this section, while critical to any policy framework, are likely not sufficient on their own to decarbonise the industrial sector. Targeted policies and supporting strategies will probably also be needed to focus on overcoming specific challenges, instrumentalising long-term goals,

and addressing developments or phases of the transition. For instance, RD&D and early deployment of new technologies may need to be addressed by separate and more targeted policies (covered in the Targeted actions for specific technologies and strategies and the Necessary enabling conditions sections).

What critical role does this category serve in an overall industrial decarbonisation strategy?

The key objective of policy instruments in this category is to provide different stakeholders (including industrial producers, consumers, intermediaries, trade partners and society in general) with information and certainty about the intended long-term direction of travel. Moreover, these instruments also provide the framework and required incentive structure under which stakeholders will have to operate over the long term. Just transition planning, in particular, can provide foresight and support to both employers and employees regarding their future collaboration and the way the workforce will be retrained to adapt to new production technologies.

Industrial decarbonisation roadmaps, plans and targets can serve as the backbone of and precursor to many other policies. In addition, implementing carbon pricing mechanisms (either through an ETS or through carbon taxes), as well as TPS, sets the direction of travel by providing consumers and producers of the materials concerned with economic incentives to change the way they operate.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key questions for governments deciding on which instrument (or set of instruments) in the area of establishing plans and policy for long-term GHG emission reductions would be better suited to their industrial decarbonisation strategies include the following:

What are the government's budgetary and resource considerations?

Compared to other categories, instruments in this category might necessitate government spending connected to the design and administrative organisation (e.g. related to discussing and designing the plans and pricing systems, and implementing monitoring bodies). However, these expenses are not related to direct investment in technologies or actual changes to production systems themselves. Instead, all the instruments in this category set the rules for other stakeholders to then make those investments.

Challenges related to policy instruments in this category may therefore be more related to generating broader consensus on the desired direction of travel of the country/region, rather than on devoting a certain government budget to these initiatives. Public sector costs for the design and implementation of these policies tend to be relatively low compared to other expenses related to the energy transition, meaning that budgetary constraints may be less of a hurdle.

However, it will be important that the government secures the right expertise and capacities to develop these policies. This might entail hiring experts or engaging the right consultants to develop the work, connecting with different stakeholders or even drawing learnings from other countries' experiences.

What is the likelihood of the instrument achieving the desired objective?

Some policy instruments may have more direct impact on emissions than others. It is likely that instruments that work under a voluntary or indicative framework, such as roadmaps/plan/targets – even with stringent requirements – would have a smaller effect than compulsory ETSs or TPSs.

How may these policies be perceived by different stakeholder groups?

Policy instruments that aim at establishing plans and policy for long-term GHG emission reductions are likely to be acceptable to different stakeholder groups as long as they (i) are aligned with society's priorities and climate goals, and (ii) do not present any perceived unfair treatment or overly negative impacts to any specific sector or entity. Private sector stakeholders may find it useful to gain clarity from governments as to the long-term direction of travel, in order to manage their budgets and plan future investments.

In general, mandatory policies like carbon pricing (either through an ETS or through a carbon tax) or a TPS are likely to face higher scrutiny from affected stakeholders than roadmaps/plans/targets. This is because the successful implementation of a carbon price that is sufficiently high or a regulation that is sufficiently stringent to drive industrial decarbonisation could directly impact the profitability of companies, while roadmaps/plans/targets might have less direct impact in this respect. Therefore, clear communication as to what the purpose of the policy is, consultations with diverse stakeholders prior to launching the policy, and careful design that takes into account any difficulties for stakeholders, will increase acceptability.

What is the complexity associated with implementing each policy instrument?

The process of creating a roadmap or plan, or of setting targets (whether at the overall strategic level or specific to just transitions matters), generally necessitates the formation of a team of experts (of representatives from the government and/or external consultants) that will analyse the situation of the country, conduct consultations with relevant stakeholders and draft a document with proposals and recommendations. The publication of roadmaps, plans and targets may therefore have a relatively limited administrative burden, as long as the required expertise can be brought on board. The process of implementing roadmaps or plans can become more complex, as the proposed goals must be paired with a clear indication of the steps to achieve them and the required monitoring and control mechanisms. The complexity of the implementation will largely depend on whether there are any mandatory requirements associated with roadmaps/plans/targets. Those that are run on a voluntary basis tend to be simpler in terms of monitoring and control, although this could be associated with a lower likelihood of achieving the targeted objectives.

Carbon prices established through either an ETS or a carbon tax entail a rather complex design process, since the positions of diverse stakeholders have to be evaluated, measurement mechanisms have to be designed and tested, and legal instruments have to be approved. The design of an ETS tends to be more complex than that of a carbon tax, because it implies the creation and monitoring of a new system, while a carbon tax can often rely on the existing tax collection structure.

Moreover, once the carbon price is in place, the monitoring required for an ETS can entail a high administrative burden, and may be further complicated as the carbon price fluctuates in real time. At times, the system might require government intervention, especially if the price of allowances is not at the desired level. Conversely, the administrative burden of a carbon tax is mainly related to tax evasion, where governments tend to already have established bodies for control.

In comparison, TPS, if well designed, have the advantage of clearly delineating a timeframe for emission rates to decrease progressively over time. This can provide market players with the necessary foresight to build their business cases for innovation investments. Input from governments will still be needed to set up the tradeable permits system, to monitor compliance with the standards, and to ensure the transparency of the tradeable part of the system.

What are the timing considerations?

In order to meet their objectives related to achieving net zero emissions by mid-century, countries will likely have to make investments, build public infrastructure,

raise capital, and even adapt their legislation. The sooner a long-term plan and policy framework is proposed by the government and formally accepted politically, the sooner the rest of the low- and near-zero industrial initiatives (both public and private) will follow.

Even if governments do not have full clarity on all the steps needed to achieve the net zero emissions goal, formally establishing plans where there is agreement, at least, can help mobilise policies and investment in this direction. Not doing so could delay action and increase costs in the longer term. It is therefore advisable that governments establish and publish their long-term targets, even if more concrete roadmaps, plans and implementation policies follow only at a later date.

1.1.1. Roadmaps, plans and targets

Description

Roadmaps, plans and targets set out the objectives that a government wants to achieve and indicate the direction that all other policies will follow. Roadmaps typically include long-term objectives, whereas detailed plans focus on nearer-term objectives, and targets may be either short- or long-term. Moreover, governments might indicate how their roadmaps/plans would adjust to future extraordinary situations (e.g. technology advancements or resource availability) in order to achieve the proposed targets and goals.

In addition, these policy instruments can target different levels, such as the industry sector overall, specific subsectors (e.g. steel, cement, chemicals), certain enabling conditions such as infrastructure (e.g. clean hydrogen; carbon capture, utilisation and storage [CCUS], low-emissions electricity), or specific aspects of the industrial decarbonisation process (e.g. just transition plans, financing plans, trade plans). Some roadmaps/plans/targets might also include technology needs assessments (TNA) to support industrial decarbonisation goals.

Roadmaps, plans and targets could also be framed as part of broader decarbonisation targets that are often included in legislative provisions. For many countries, their Nationally Determined Contributions (NDCs) under the 2015 Paris Agreement set the long-term decarbonisation goals for their economies. NDCs can be key in marking the mid-century goals of the industrial sector, but given that, in many cases, industrial decarbonisation targets and plans are not explicitly mentioned within NDCs, countries might want to develop roadmaps/plans/targets specifically tailored to the industrial sector (and specific ones for subsectors such as steel and cement production) that are based on broader NDC goals. An alternative (and complementary) option would be to include industrial decarbonisation targets and plans within the NDC revision process in 2025 (also known as NDCs 3.0).

How could this policy instrument target deep emissions reductions?

If the aim of policy makers is to support deep emissions reductions and full decarbonisation, the roadmap or plan, or similar target-setting document, should be sure to include strategies and objectives for early deployment and long-term scale-up of zero emissions technologies. Ideally, they should also include clear quantifiable objectives. When roadmaps, plans or targets are not explicit in their objectives and the ways to achieve them, they may result in incremental emissions reductions only. In other words, short-term emissions reductions targets might instead be more easily met by other measures, such as more modest energy and material efficiency improvements, or increasing use of scrap for steel production, or supplementary cementitious materials for cement, that will be unable to fully decarbonise the sectors in the longer term. If developed collaboratively, roadmaps, plans and targets can also be a tool to bring stakeholders together around a common vision and shared goals.

When is this policy instrument suitable?

- When used to set the direction in the absence of an existing strategy, as well as when updating existing policies to align with net zero emissions goals.
- To specify objectives for the industrial sector (or subsectors such as steel and cement) within a broader national decarbonisation plan, or commitments aligned with global goals, such as NDCs or Long-Term Low Emission Development Strategies (LT-LEDS).

What needs to be considered before implementation?

- Consistency with other national, regional and local targets.
- Consistency with the institutional framework and with the capacities of the government.
- Development of the implementation strategy, including exploration of which policy instruments may be used to enable technology pathways and meet targets.
- Establishing the appropriate stakeholder network and responsibilities (within ministries and governing bodies) to ensure ownership of and responsibility for the objectives. This could include defining decision-making processes with timelines and decision trees.
- Gathering perspectives and gaining buy-in from diverse stakeholders to help secure commitment to implementation and, ideally, support for maintaining objectives, even when administrations change.
- Creation and enforcement of efficient monitoring systems to track progress under the roadmap, plan or target.

Best practices

Effectiveness

- Include elements that bind the government to its commitments and/or ensure follow-up into full policy development. This generally happens when various considerations are in place, for example that:
- Roles and responsibilities within a government are clearly defined within the roadmap or plan.
- There is a set plan of action with checkpoints at predefined dates.
- Results are quantitatively measurable, and data is easy to access.
- There is an earmarked budget designated to the accomplishment of the goals.
- There is a body in charge of monitoring the progress of the policy.
- There are mechanisms to ensure there is no strong deviation from the plan's objectives.

Simplicity

- Provide stakeholders involved in the process ownership of their tasks, both during the design process of the roadmaps/plans/targets as well as during its implementation.
- Ensure goals are easy to measure, allowing the government to efficiently track progress.
- Implement monitoring and reporting procedures for goals that draw on the strengths and structure of existing government departments/institutions, where available.
- Clearly outline the timeline for the different steps in the plan, and establish clear accountability processes for reporting non-compliance with the timeline.

Stakeholder acceptability

- Enable discussion spaces and clearly communicate the roadmaps, plans and targets.
- Design roadmaps, plans and targets that consider all stakeholders, and engage representatives of each impacted stakeholder group in the design.
- Engage stakeholder groups that commit to long-term support of the roadmaps/plans/targets, ensuring perennity and continuity of the set objectives, even as administrations change.

Economic efficiency

- Roadmaps, plans and targets that follow the best practices outlined under the effectiveness criterion will tend to have a high economic efficiency, given that their costs are generally only related to the design and monitoring of the policy, and

their potential impact in driving change is high (NB: this does not consider capital expenditures [such as investments in infrastructure], nor the operating costs of actually implementing the roadmap/plan/target).

- Roadmaps, plans and targets that are technology-neutral to the extent possible, in that they do not prefer one solution or technology over another if both can achieve the given objective, are more efficient in terms of enabling the achievement of industry transition objectives with the least cost to society. This does not mean, however, that governments may not target specific technologies or solutions, if those are deemed as critical to progress towards the desired objectives (for instance, following TNAs).

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- By sharing their experiences in engaging stakeholders, considering technology options, designing roadmaps, plans or targets, implementing them and then measuring results, governments are able to learn from each other. Governments could consider reviewing the roadmaps, plans and targets of other countries in the process of developing their own.

Access to international financing

- Some national governments and international organisations may be open to providing financing for the development of roadmaps, plans and targets by other countries with the aim of advancing industrial decarbonisation goals. In this case, financing arrangements are often accompanied by expert advice on the design of the roadmap, plan or target.

Examples of governments that have implemented this type of policy instrument

- Australia's National Hydrogen Strategy (2024).
- Brazil's National Policy for Industrial Decarbonisation (PNDI) (2024).
- Brazil's National Low-Carbon Hydrogen Policy (Law 14948/2024) (2024).
- Canada's Roadmap to Net-Zero Carbon Concrete by 2050 (2022).
- Chile's Roadmap for the Development of the Low-Emissions Cement Industry (2020).
- Chile's Roadmap for the Development of the Low-Carbon Steel Industry (2020).
- The People's Republic of China's (hereafter "China") 14th Five-Year Plan for Industrial Green Development (2021).
- China's Guiding Opinions on Promoting the High-Quality Development of the Iron and Steel Industry (2022).

- China – Henan's Steel Targets (2023).
- China's Action Plan for Green and Low-Carbon Transformation of Hunan Manufacturing Industry (2022-2025) (2022).
- China – Jiangxi Province's "1269" Action Plan (2023-2026) for the Modernization of Key Manufacturing Industrial Chains (2023).
- The European Union's Industrial Carbon Management Strategy (2024).
- The European Union's Net-Zero Industry Act (part of the Green Deal Industrial Plan) (2024).
- The European Union's Clean Industrial Deal (2025).
- France's Industry Decarbonisation Roadmap for Cement (2021).
- Germany's Action plan for a strong steel industry in Germany and Europe (2020).
- Indonesia's Law 3 concerning Industry (2014).
- Indonesia's Government Regulation 14 concerning the National Industrial Development Master Plan 2015 –2035 (2015).
- Italy's National Hydrogen Strategy (2024).
- Japan's Sector-Specific Technology Roadmaps – Technology Roadmap for "Transition Finance" in Iron and Steel Sector (2021).
- Japan's Sector-specific Investment Strategies (2023).
- Korea's Industrial Technology Innovation Promotion Act (2019).
- Korea's Strategy for Technology Innovation for Carbon Neutrality (2021).
- Korea's Steel Industry Development Strategy for Transition to Low-Carbon Steel Production (2023).
- Mexico's Second Regulation of the Energy Transition Law (2017).
- The Netherlands' Roadmap on Carbon Removals (to enter into force in April 2025).
- The Netherlands' National Climate Plan (to enter into force in April 2025).
- Sweden's Fossil Free Sweden (2015).
- The Republic of Türkiye's (hereafter "Türkiye") Green Growth Technology Roadmap (2021).
- Türkiye's Industrial Emissions Strategy (2023).
- Türkiye's Regulation on the Management of Industrial Emissions (to enter into force in December 2025).
- Türkiye's Low Carbon Pathway for Cement Sector (2022).
- Türkiye's Low Carbon Pathway for Steel Sector (2022).
- The United Kingdom's Industrial Decarbonisation Strategy (2021).
- United States – California's SB 596 – Net-Zero Emissions Strategy for the Cement Sector (2021).
- Ukraine's Technology Needs Assessment and Action Plan (2021).

1.1.2. Emissions trading systems (ETSs) (carbon pricing instrument)

Description

Also known as a cap-and-trade system, an emissions trading system (ETS) is a market-based mechanism for industrial emitters to incorporate the externality cost of the carbon emissions they generate. The scope of industrial emitters covered by the policy is defined by each jurisdiction (generally sector-based) and is applied at the installation level (industrial facility). An ETS is one of the two major methods of explicit carbon pricing (the other being carbon taxes, see below) that work under the principle that emitters should pay for their emissions (the "polluter pays" principle).

Through an ETS, the government defines a certain level of emissions that the country or region wants to set as a limit, either overall or for specified sectors. Based on this limit, a fixed number of emissions rights/allowances/permits is issued by the government, and companies can only emit carbon for the emissions rights they possess. Companies are allowed to then trade these rights based on their needs – highly emitting entities would typically buy emissions rights, while companies that achieve reductions in their emissions would likely be able to sell these rights. This creates a market. Efficient ETSs usually set a schedule for the limit on emissions (the "cap") to decline over time (based on the target emissions for each period). In turn, this creates scarcity and – if the price of emission rights is sufficiently high – firms will have an economic incentive to try to reduce their emissions. Over the medium term, these tradeable permits create incentives for carbon emitters to switch to technologies that are less carbon-intensive, thereby encouraging industry-wide innovation as well as a scale-up in the adoption of these technologies, likely resulting in a reduction of their costs. In addition, given that an ETS generates government revenues through the auction of emissions allowances, the resulting funds can, in turn, be used to provide funds for emerging technologies or for other industrial decarbonisation purposes (although this is not the main goal of the policy instrument). Note that if the ETS is properly designed, government revenues from auctions will likely decrease over time, as fewer new allowances will have to be auctioned.

In many countries and regions, even though some sort of carbon market exists, certain industries, like steel and cement, are exempted from it (mainly by receiving free allocations). The rationale for providing free allocation to certain stakeholders might be related to the initial coverage of the system – many countries start by covering only the power sector, given that it is the highest emitter – or to exposure to trade, given that trade-exposed sectors might be at a disadvantage compared

to foreign competition that is not subject to carbon pricing in other jurisdictions (a phenomenon known as "carbon leakage", as discussed below). Further arguments for exemptions may include current unavailability of the necessary technologies to reduce emissions in that particular activity or to a combination of these factors. The incorporation of highly emitting sectors into an ETS is what could create an impact on the decarbonisation of heavy industry – for instance, by levelling the playing field between higher and low-emissions technologies, including consideration of both direct (e.g. from on-site fuel combustion) and indirect emissions (e.g. from electricity use).

Some ETSs are based on the emissions intensity of each product. In this Policy Toolbox, these are referred to as Tradeable performance standards (TPSs), which are covered as an instrument for establishing plans and long-term GHG emissions reductions. Note that some ETSs allocate free allowances based on best-performing installations, thus integrating a TPS into the policy and therefore maintaining incentives for innovation within the industries receiving free allocations.

How could this policy instrument target deep emissions reductions?

ETSs act on both incremental and deep decarbonisation reductions. They provide technology-neutral and cost-effective emissions reductions incentives. If the price of allowances is sufficiently high, maintaining business-as-usual emission-intensive production techniques will represent a higher cost for companies and will thus change the abatement cost efficiency logic. In turn, this could incentivise deep decarbonisation reductions through the switch to more innovative technology.

To most effectively drive deep emissions reductions, an ETS would lay out the future long-term trajectory of emissions reductions/certificate availabilities as early as possible, so that producers have greater certainty and can take into account estimated future carbon prices when they make investment decisions. If auction schedules are designed such that the amount of allowances gets progressively scarcer, the price would typically increase over time, and reach sufficiently high levels to enable near-zero emission technologies to compete with conventional high-emitting technologies. Moreover, based on expected future allowance prices, companies can evaluate the business case for switching to low-emitting technologies.

When is this policy instrument suitable?

- For governments that want to assign a price to carbon emissions and prefer to establish certainty on emissions reductions by setting an emissions cap (vs. the fixed price provided by a carbon tax). This further allows the government to gather information on market expectations regarding what the carbon price level should be.

- An ETS is flexible in terms of its coverage – it could initially cover a few sectors and then be expanded to other sectors.
- An ETS has the advantage of providing an adaptation trajectory for emissions-intensive trade-exposed ("EITE") industries, as initial implementation could occur with some free allocation of allowances, which would reduce the economic burden relative to other policies where a price must be paid for all emissions. In this way, countries that do not want to impact the competitiveness of their EITE industries could design an ETS that would give industries the possibility of progressively implementing technological changes. These sectors would only be asked to pay for allowances once the jurisdiction has implemented a policy to allow for fair competition with foreign jurisdictions that have a lower carbon price (please refer to the International co-operation and a level playing field category for a discussion on the instruments that could address this issue).

What needs to be considered before implementation?

- **Policy design:** Technical decisions regarding the following should ideally be made in advance of launching the ETS: actual cap to be implemented, the reduction factor or schedule, the use of proceeds from auctions, any rules around use of offsets (if allowed), and the penalties for non-compliance. Additionally, governments might have to create or designate institutions to be in charge of market oversight.
- **Emissions monitoring:** Monitoring, reporting and verification (MRV) and enforcement of the mechanism. This includes selecting an appropriate methodology for emissions accounting, ideally drawing from already existing and commonly used methodologies (e.g. International Organization for Standardization [ISO] standards, Environmental and Carbon Footprint methods, Environmental Product Declarations, and Digital Product Passports as well as internationally recognised emission accounting frameworks, e.g. Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories). Note that capacity-building for industry, as well as for governments, could be instrumental to an MRV system.
- **Free allocation:** Any assignment of free allocations and exemptions should be carefully considered, including their purpose, fairness and duration. Note that an overallocation of free allowances could result in windfall profits for companies operating emissions-intensive technologies. Ideally, a clear timeline should be agreed at the beginning of the scheme and respected throughout time, giving foresight to stakeholders.
- **Price level:** There is a risk that the initial allocation of allowances, combined with changes in the market and market expectations, as well as the evolution of technologies, results in prices that are too low (likely under situations of overallocation of free allowances) to create a real incentive for decarbonisation. In such cases, the government might need to intervene (either through open market operations or through the modification of the rules of the scheme) to correct the

price. These interventions could include setting price floors (and maybe ceilings), and having the government buy allowances if the floor is trespassed (or selling allowances if the price is above the ceiling and there is a view that this is unfair). Governments such as the European Union have established market stability reserves for these open market operations. This logic assumes that the government's goal is that the price of emissions rights is high enough to incentivise the broad adoption of clean energy technologies in industry, and ideally innovation among market players. Some estimates indicate that for steel, cement and aluminium industries, closing the cost gap between deep decarbonisation technologies and conventional ones would require a carbon price of approximately USD 200/t CO_2-eq. The most ambitious carbon pricing systems today have allowances trading at around USD 100/t CO_2-eq.

- **Carbon leakage:** There is a risk that higher production costs (given the incorporation of emissions costs via the tradeable rights) result in the displacement of highly emitting production outside of the jurisdiction implementing the carbon pricing. This is known as "carbon leakage" and essentially neutralises any reduction in emissions resulting from carbon pricing in one jurisdiction through the increase of emissions in another jurisdiction with lower carbon pricing (or none) (please refer to Climate Club exchanges on carbon leakage and other spillover effects for further detail). For this reason, many countries have granted free allowances for EITE industries, at least initially. Nevertheless, over the long run, free allowances could result in a weaker signal to the market and would not incentivise deep decarbonisation in these industries. Countries seeking to promote deep decarbonisation in their EITE industries could look to mitigate the risk of carbon leakage through increasing collaboration at the international level to come up with solutions that represent a win-win for stakeholders inside and outside the country/region applying the ETS (please refer to the International co-operation and a level playing field category for a discussion on the instruments that could address this issue).
- **Distributional impacts:** As mentioned, ETSs work under the polluter pays principle, meaning that industrial emitters have to internalise the externality cost of their emissions. Therefore, the burden of the cost increases associated with allowances falls entirely on the private sector (which might pass it through to the consumer). Policy makers should evaluate if there is a need for this measure to be complemented with some sort of financial assistance (see Mobilising finance and investment for options) or recycling of the revenues collected under the ETS back to the regulated sectors, particularly for free allocations that can be traded.
- **Complementary policies:** While carbon pricing is important to provide a long-term signal for decarbonisation, on its own it is likely insufficient to drive the development and initial scale-up of innovative near-zero emissions technologies, particularly in earlier years when prices are lower. To do so, it would need to be complemented with other targeted policy measures (see for example, Creating a market for near zero emissions materials production and Developing technologies sections of the toolbox).

- **Governance:** ETSs should have the institutional framework and the necessary supporting structure to ensure the functioning of the policy and its perennity, despite changes in governments. Without a clear market signal that the ETS will be a long-term system, companies will not make the necessary efforts to decarbonise.

Best practices

Effectiveness

- Ensure mechanisms are in place to avoid the price remaining too low. The ETS could establish clear rules for intervention by the government in case the market drives the carbon price to low levels (such as through market stability mechanisms), and ideally would have a clear schedule for reductions in allowances over the long term.
- If there are free allocations and the objective is full decarbonisation, the ETS should include a clear schedule for the phase-out of free allocations for all regulated sectors, as well as how other measures will be concurrently implemented to avoid carbon leakage.

Simplicity

- Clearly outline the emissions measurement methodology, ideally using or building from already existing and well-accepted methodologies to avoid additional reporting burden.
- Enable easy access to the market to all participants.
- It may be easier to focus initially on large emitters, perhaps setting thresholds for inclusion within the ETS based on total emissions by plant. Once the largest emitters are covered, the rest of the companies could follow.

Stakeholder acceptability

- Engage representatives of each impacted sector (including civil society) in the design of the ETS. Industry consultations and engagement should also continue throughout the implementation phase of the ETS.
- Be transparent in the use of proceeds from initial auctions and consider uses that aid any parties that may be disproportionally impacted by the policy (e.g. funding recycled back to regulated industries to aid in their decarbonisation strategies and for accelerating the just energy transition).
- Consider distributional effects, particularly if companies are expected to pass through part of the cost increase to consumers. Propose mitigation policies if deemed necessary.

Economic efficiency

- Strong design of the ETS should avoid large government expenditures in stabilising the market. These expenditures should be related to monitoring market players and enforcing rules, and could be funded by the revenues from the auctions.
- A reserve to make open market operations (market stability mechanisms) might be necessary to ensure system stability. Clear rules as to how this reserve will be managed should be proposed after consultation with financial and actuarial experts.
- To the extent possible, designing the coverage and measurement methodologies of the ETS, as well as any exemptions, in a way that is technology-neutral, and does not favour one sector over another, would help promote the least costly methods of reducing emissions.
- In parallel to designing the ETS, governments may need to plan for the use of proceeds of auctions. In general, recycling revenues back to impacted stakeholders via policies that would further encourage deep decarbonisation practices (e.g. subsidies for new technologies, infrastructure improvements, etc.) would not only provide a stronger impulse for decarbonisation, but would also show policy consistency and credibility.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Already-implemented ETSs can provide learning for other ETSs, including on successful features, as well as on features that worked less well.
- International fora like the Climate Club that allow for strategic discussions between countries on how to deal with carbon leakage can be valuable for policy makers in designing and implementing ETSs. These exchanges might include building an understanding of the need for strengthened and increasing carbon prices and the promotion of standards for effectiveness in ETS design.

International co-operation agreements

- International agreements to link one ETS to another one can address carbon leakage challenges.

International definitions, standards and certifications

- Use of internationally interoperable emissions measurement methodologies would reduce burden for companies that need to comply with an ETS in addition to other instruments or certification systems used on international markets. This would also build international robust data.

Examples of governments that have implemented this type of policy instrument

A few examples of countries implementing ETSs are listed below. For a more detailed overview of carbon pricing policies around the world, some of which cover the industry sector, see, for example, the World Bank dashboard on carbon pricing instruments.

- Austria's National Emissions Trading Act (2022) – Covers emissions not covered by the EU ETS.
- (Canada) Quebec's Cap and Trade System (2013).
- China's 14th five-year plan for industrial green development [ETS to be extended to industry] (2021).
- The European Union's ETS (2005).
- Germany's Fuel Emissions Trading Act (BEHG) (2021) – Note that this policy affects industrial producers (such as steelmakers and cement producers) only as long as they are not part of the EU ETS (avoiding double pricing).
- India's Perform, Achieve, Trade (PAT) Scheme (2011) – This policy is for energy use and not specifically for emissions. Nevertheless, it is used as a basis for building India's Carbon Trading System (CTS).
- Indonesia's ETS (2023).
- Korea's ETS (2015).
- Mexico's ETS (2019).
- Switzerland's ETS (2008).
- The United Kingdom's ETS (2021).

1.1.3. Carbon taxes (carbon pricing instrument)

Description

Carbon taxes are instruments through which the cost of products incorporates the externality cost of the carbon emissions they generate. Carbon taxes are one of the two major methods of explicit carbon pricing (the other being an ETS, see above) that work under the principle that emitters should pay for their emissions (the "polluter pays" principle). The tax is typically levied on emissions of covered sectors, in the form of a price applied to the carbon content of the products. Note that other designs are possible in which only emissions above a certain level or benchmark are taxed (which would render it very similar to a TPS, see below). Compared to an ETS, where the limit on the amount of emissions is fixed, carbon taxes have a fixed price per unit of emissions, but the final amount of emissions is variable. Over the medium term, a sufficiently high carbon tax (or even one that is scheduled to increase over time) should create the needed incentives for carbon

emitters to switch to technologies that are less emissions intensive and should also encourage industry-wide innovation.

In many countries and regions, even though some sort of carbon tax exists, certain industries like steel and cement are exempted from it. Exemptions might be related to the initial coverage of the tax – many countries start by only taxing the power sector, given it is the highest emitter – or to exposure to trade, given that trade-exposed sectors might be impacted by foreign competition that is not subject to carbon pricing in other jurisdictions. The incorporation of highly emitting sectors into carbon tax systems could impact the decarbonisation of heavy industry.

Note that this section refers to domestic carbon taxes that are implemented with the aim of reducing local emissions. For international carbon taxes in the form of levies used to avoid "carbon leakage" from imports, please refer to Carbon border adjustments for further detail.

How could this policy instrument target deep emissions reductions?

Carbon taxes act on both incremental and deep decarbonisation reductions. If the established carbon tax is sufficiently high, the cost of maintaining highly polluting production techniques will represent a large burden for companies, thus incentivising deep emissions reductions through the switch to more innovative technology.

To be most effective in driving deep emissions reductions, a carbon tax scheme should lay out the future long-term carbon price trajectory as early as possible, so that producers have greater certainty and can take into account future carbon prices when they make investment decisions. Ideally, the price would typically increase over time (although many systems currently keep them static for long periods) and will need to reach levels that are sufficiently high to enable near-zero emission technologies to compete with conventional high-emitting technologies.

When is this policy instrument suitable?

- In countries that want to ensure a certain carbon price is achieved or is not exceeded. In contrast to an ETS, carbon taxes do not face the challenge of fluctuating carbon prices.
- From the perspective of public budgets, carbon taxes have the advantage of generating income for the government, which could be used for purposes such as funding decarbonisation programmes, including for the taxed sectors.
- Carbon taxes might be a preferred carbon pricing mechanism compared to an ETS if administrative burden is a concern, since levying a carbon price may be administratively simpler to implement than a carbon market. Note that trying to

imitate certain features of an ETS (for instance, by granting tax exemptions similarly to the way in an ETS may include free allocations) could render the carbon tax scheme quite complex and require a larger administrative structure.

What needs to be considered before implementation?

- **Stakeholder acceptance:** Tolerance of an additional tax, particularly in countries that already have a high tax burden or whose industries are not used to paying taxes related to environmental matters.
- **Emissions monitoring:** Monitoring and enforcement of the mechanism. This includes selecting an appropriate methodology for emissions accounting, ideally drawing from already existing and commonly used methodologies (e.g. ISO standards).
- **Exemptions:** Carefully establishing rules and timing for any exemptions, considering their fairness, and enforcing them.
- **Price level:** Ensuring that the carbon price trajectory increases at a level suitable to achieve the desired emission reductions.
- **Carbon leakage:** There is a risk that higher production costs (given the incorporation of emissions costs via the tax) result in the displacement of highly emitting production outside of the jurisdiction implementing the carbon pricing. This is known as "carbon leakage" and essentially neutralises the decrease in emissions resulting from carbon pricing in one jurisdiction through the increase of emissions in another jurisdiction with lower (or no) carbon pricing. Some countries are trying to mitigate the risk of carbon leakage through carbon border adjustment mechanisms, as well as via other international co-operation agreements (please refer to the International co-operation and a level playing field category for further discussion on relevant policy instruments).
- **Distributional impacts:** The burden of the cost increases due to taxes falls entirely upon the private sector (and ultimately consumers, if these taxes are passed through to them). Policy makers may wish to evaluate if this measure should be complemented with some sort of financial assistance (see Mobilising finance and investment for options). Furthermore, the government could evaluate whether the tax will be passed through to consumers and whether it is necessary to have some sort of compensation mechanism (for industrial materials, analysis shows that the additional cost pass through may end up being a relatively small portion of the final product cost, so in many cases compensation may not be needed, but this is still important to evaluate during the policy development process). Moreover, to evaluate distributional impacts, it will be important to see where in the value chain the tax is applied.
- **Complementary policies:** While carbon pricing is important to provide a long-term signal for decarbonisation, on its own it is likely insufficient to drive the development and initial scale-up of innovative near-zero emissions technologies, particularly in earlier years when prices are lower. As such, carbon pricing would

need to be complemented by other targeted policy measures (see, for example, the Creating a market for near-zero emissions materials production and Developing technologies sections of the toolbox).

Best practices

Effectiveness

- Ensure the price level increases at a rate sufficient to achieve the desired emissions reductions.
- Ensure the correct mechanisms are in place to avoid carbon tax evasion.
- If there are tax exemptions for any sectors, the carbon tax policy should outline a clear schedule for the phase-out of exemptions for all affected sectors.

Simplicity

- Clearly outline the emissions measurement methodology and ideally use or build from already existing and well-accepted methodologies to avoid added reporting burden. Make sure the carbon tax is aligned with the rest of the tax framework.

Stakeholder acceptability

- Engage representatives of each of the impacted sectors in the design of the carbon tax.
- Be transparent in the use of proceeds from tax collection, and consider uses that aid any parties that may be disproportionally impacted by the policy (e.g. funding recycled back to regulated industries to aid their decarbonisation strategies).
- Be transparent in the price trajectory of the tax to improve credibility and foresight.

Economic efficiency

- There is an optimal carbon price that will generate adequate incentives for deep emissions reductions without hindering economic activity. Proper monitoring of policy might require a certain flexibility on the pricing, especially at the beginning.
- Given that the objective of the carbon tax is not government revenues (tax collection is only a consequence of it), governments should not establish the tax based on the optimal tax collection level, but rather on the optimal emissions reduction level. Still, governments should plan for the use of proceeds of these revenues. In general, recycling revenues back to impacted stakeholders via policies that would further encourage deep decarbonisation practices (e.g. subsidies for new technologies, infrastructure improvements, etc.) would not only provide a stronger impulse for decarbonisation, but would also show policy consistency and credibility.

- To the extent possible, design the carbon tax coverage, measurement methodologies and any exemptions in a way that is technology-neutral, and does not favour one sector over another, to help promote the least costly methods of reducing emissions.

How can international collaboration improve the efficiency of this instrument?

Commercial agreements

- Commercial agreements between local producers and foreign buyers that would guarantee a certain amount of industrial products are purchased by a foreign country (either because these are low-emissions goods or because there is some other condition attached to the exchange) can be used to mitigate carbon leakage risks.

International definitions, standards and certifications

- Use of internationally interoperable emissions measurement methodologies would reduce burden for companies needing to comply with this instrument, as well as other instruments or certification systems used on international markets.

Examples of governments that have implemented this type of policy instrument

A few examples of countries implementing carbon taxes are listed below. For a more detailed overview of carbon pricing policies around the world, some of which cover the industry sector, see for example the World Bank dashboard on carbon pricing instruments.

- Canada's Output-Based Pricing System (OBPS) Regulation, Under the Greenhouse Gas Pollution Pricing Act (2018).
- Colombia's Carbon tax (2016).
- Mexico's Carbon tax (2014).
- Sweden's Carbon tax (1991).
- Switzerland's CO_2 levy (2008).

1.1.4. Tradeable performance standards

Description

Tradeable performance standards (TPS) are requirements for all production to meet a declining emissions intensity level on average. This is a mandatory compliance system. A tradeable certificate system is established so that the

performance level is met on average by all. As such, if companies have production techniques that result in lower rates of emissions than the benchmark level, they are able to sell their remaining certificates to other companies that have abatement needs greater than the level set by the standard. The TPS therefore results in the creation of a market as companies seek to comply with the standards. Compared to an ETS, this market-based mechanism works on the basis of a cap on the rate of emissions per unit of production, instead of on a cap on total emissions on a system-wide basis. Otherwise, the instrument would in effect be relatively similar to an ETS with free allocation of allowances below a benchmark.

TPS are sector-based, as they rely on an emissions intensity for a specific type of production or facility. They are typically adjusted over time to become more stringent, thus indicating the direction of travel towards industrial transition goals.

How could this policy instrument target deep emissions reductions?

TPS act on both incremental and deep emissions reductions. The more stringent the requirement, the higher the likelihood that deep emissions reductions will be addressed. Once the permitted rate of emissions is sufficiently low, the cost of maintaining highly polluting production techniques will represent a large burden for companies (as they require more certificates and as these certificates become scarcer and thus more expensive). Over time, this will incentivise deep decarbonisation reductions through the switch to more innovative technology. In particular, the earlier the full trajectory of emissions intensities reduction requirements is made clear, the greater the signal to markets to take into account the long-term objective in their investment decisions.

When is this policy instrument suitable?

- For governments that want to set an economic incentive for emissions reductions but prefer to avoid setting additional taxes. This system results in higher-emitting companies implicitly subsidising lower-emitting companies and does not pose an economic burden on the government.
- A TPS system can be tailored to the specific sector(s) to be targeted. Sector-specific TPS can accommodate for the characteristics of each product and can be adjusted according to the goals set for each sector.
- Setting a clear scheme with well-staggered milestones for the standards to evolve over time towards the decarbonisation end goal provides foresight to companies. Such a scheme can be particularly useful for sectors that have long-lived capital and high investment costs, and in which demand can change significantly depending on the price of the product.

What needs to be considered before implementation?

- **Policy design:** Technical decisions regarding the following should ideally be made in advance of launching the TPS: actual limits to performance level to be implemented, the reduction factor or schedule, the use of proceeds from auctions, and the penalties for non-compliance. Additionally, governments might have to create or designate institutions to be in charge of oversight.
- **Emissions monitoring:** Monitoring and enforcement of the mechanism. This includes selecting an appropriate methodology for emissions accounting, ideally drawing from already existing and commonly used methodologies (e.g. ISO standards).
- **Exemptions:** Any assignment of exemptions should be carefully considered, including their purpose, fairness and duration. Ideally, a clear timeline has to be agreed upon at the beginning of the scheme and respected over time, providing foresight to stakeholders.
- **Price level:** There is a risk that the initial benchmarks set by the TPS, combined with changes in the market and evolution of technologies, results in prices that are too low to create a real incentive for decarbonisation. In such cases, the government might need to adjust the benchmarks. Ideally, there should be a predefined schedule for the changes in the requirements, so that market players have more foresight and can make investment plans.
- **Carbon leakage:** There is a risk that higher production costs (given the incorporation of emissions costs via the tradeable certificates) result in the displacement of highly emitting production outside of the jurisdiction implementing the carbon pricing. This is known as "carbon leakage" and essentially neutralises the decrease in emissions due to carbon pricing in one jurisdiction through the increase of emissions in another jurisdiction with lower (or no) carbon pricing. Some countries are trying to mitigate the risk of carbon leakage through carbon border adjustment mechanisms, as well as via other international co-operation agreements (see the International co-operation and level playing field category for further discussion on relevant policy instruments).
- **Distributional impacts:** Note that the burden of the cost increases due to TPS falls entirely on the private sector. Policy makers should evaluate if there is a need for this measure to be complemented with some sort of financial assistance (see Mobilising finance and investment for options), or recycling of the revenues collected under the ETS back to the regulated sectors.

Best practices

Effectiveness

- Ensure mechanisms are in place for the emissions-intensity benchmark to continue decreasing. This should be done through a well-planned schedule to increase the benchmark requirements, driving a decrease in emissions.

- Where possible, avoid granting exceptions to companies. If exceptions are granted, make sure there is a clear mechanism to apply for exceptions and a strict timeline for the expiration of such exceptions.

Simplicity

- Clearly outline the emissions measurement methodology and ideally use or build from already existing, well-accepted methodologies to avoid additional reporting burden.

Stakeholder acceptability

- Engage different stakeholders in the design of the TPS programme, and build understanding of their cost structures to evaluate realistic benchmarks and develop a sufficiently stringent schedule for the adjustment of the benchmarks that is tailored to the industry in question.

Economic efficiency

- A well-designed TPS system should avoid large expenditures by the government. If the policy is properly designed, costs for the government once the policy is active should be limited to monitoring and ensuring compliance, while the market itself should drive the innovation necessary for emission rates to decrease progressively.
- To the extent possible, ensure the emissions measurement methodologies used, and any exemptions, are technology-neutral to help promote the least costly methods of reducing emissions.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful TPS systems can serve as the basis for other TPS systems in different countries or sectors.

International definitions, standards and certifications

- Use of internationally interoperable emissions measurement methodologies would reduce burden for companies that need to comply with this instrument as well as other instruments or certification systems used in international markets.
- Common international understanding on definitions for low-emissions and near-zero emissions for materials, such as steel and cement, will enable a more transparent TPS system by clearly establishing the end goals as well as the intermediate objectives.

Commercial agreements

- Commercial agreements between local producers and foreign buyers that would guarantee a certain amount of industrial products are purchased by a foreign country (either because these are low-emissions goods or because there is some other condition attached to the exchange) can be used to address carbon leakage risks.

Examples of governments that have implemented this type of policy instrument

- Examples from other sectors:
- The United States' New Fuel Economy Standards (2024).

1.1.5. Just transition planning, support mechanisms, and skills redevelopment and training

Description

Just transition planning, support mechanisms, and skills redevelopment and training include all policies that aim to ensure that no-one is left behind as a result of industrial decarbonisation transitions. The United Nations Framework Convention on Climate Change (UNFCCC) defines a just transition framework as one that can create "more decent jobs, including, as appropriate: anticipating impacts on employment; adequate and sustainable social protection for job losses and displacement; skills development; and social dialogue, including the effective exercise of the right to organise and bargain collectively".

The objectives of these policies include: 1) assuring that employees of highly emitting plants that are shut down or refurbished can acquire the necessary skills for a smooth re-insertion into the labour market; 2) addressing any difficulties for communities that experience migrations due to the closure or opening of plants in certain locations; 3) ensuring that locations impacted by the transition have the appropriate infrastructure and that the livelihoods of urban or rural communities in these locations are not negatively impacted; and 4) addressing the needs of any sectors not directly linked to industrial decarbonisation plans but affected by them, among others.

How could this policy instrument target deep emissions reductions?

Retraining workers to acquire the necessary skills to manage and operate new technologies related to deep emissions reductions will allow for a smoother

transition for communities. Moreover, training the workforce for these purposes sufficiently in advance of any closures will avoid bottlenecks in future production of low-emissions and near-zero materials.

When is this policy instrument suitable?

- Industrial decarbonisation policies will inevitably impact those directly or indirectly employed in industrial facilities. New skills will be required, while some existing skills will become obsolete. To ensure a smooth transition and ensure that no-one is left behind, plans and support mechanisms for staff to continue to participate in newly decarbonised industries will be needed.
- A focus on developing workforce skills (via different types of training programmes) will avoid unnecessary displacement of workers and will ensure industries are able to hire the talent they need.
- Particularly relevant for countries/regions where industrial companies are among the largest employers.
- Particularly relevant for regions that are expecting to experience large migrations due to industrial decarbonisation transitions.

What needs to be considered before implementation?

- Engagement with industrial companies, understanding their priorities and internal implementation challenges.
- Engagement with trade unions, understanding their priorities and challenges, particularly in countries with strong trade unions.
- The policies should incorporate timing considerations with regards to how fast the transition will take place in relation to how fast the workforce can be retrained.
- Local and regional migration challenges must be considered, especially in countries where the resource endowment might make it natural for some sites to grow and others to decrease in importance.

Best practices

Effectiveness

- Make sure just transition strategies and measures are included within broader roadmaps, plans and targets. If they are not included within such strategies, they should at least be referenced.
- Include a just transition within the guiding principles for other industrial decarbonisation policies.
- Ensure there are clearly defined roles and responsibilities within the government to advance the just transition agenda together with other industrial decarbonisation developments.

- Ensure there is an earmarked budget designated to the accomplishment of just transition goals. This could perhaps include funding for a body in charge of monitoring the progress of the policy.

Simplicity

- Ensure stakeholders involved in the process have ownership of their tasks.
- Clearly outline the timeline for the different steps in just transition plans.
- Just transitions goals should include goals that are easy to measure (e.g. hours of training, certifications for workforce, etc).

Stakeholder acceptability

- Enable solutions-oriented discussion spaces where workers, unions, industrial producers, individuals of affected communities, and the general public are invited to present their views, making sure that women are properly represented and engaged at all steps.
- Engage representatives of each impacted stakeholder group in the design of the just transitions policies.

Economic efficiency

- Economic efficiency will depend on the specific objectives of the just transition plans and on who will bear the burden of the policy (i.e. if the government will subsidise the retraining of the workforce or if it will force companies to internalise that cost via regulation).

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- By sharing their experiences in engaging stakeholders, designing just transition plans, implementing them and then measuring results, governments are able to learn from each other.

Access to international financing

- With the purpose of advancing industrial decarbonisation goals, some governments and international organisations may be open to providing financing for the development of just transition plans. Often, financing arrangements are accompanied with advice from experts on the design of such policies.

Examples of governments that have implemented this type of policy instrument

- The European Union's Just Transition Fund (2021).
- The European Union's Net-Zero Industry Act (part of Green Deal Industrial Plan) (2024).
- The European Union's European Steel Skills Agenda (ESSA) (2019).
- Indonesia's Climate and Carbon Collaboration and Consultation House (RK2IK) (2023).
- Just Energy Transition Partnerships (JETP) (2021) – supported by the European Union, the United Kingdom, the United States, Japan, Germany, France, Italy, Canada, Denmark and Norway. Funded countries include South Africa, Indonesia, Viet Nam and Senegal.

1.2. Mobilising finance and investment

What is the purpose of this category?

Funding will be a key element of a country's overall industrial decarbonisation process. The refurbishment of plants and the incorporation of new technologies and related new infrastructure will require large deployments of capital with long-term investment horizons. At least initially, these investments will be high-risk since they entail a bet on technologies that have not yet been widely deployed at commercial scale. Government support can therefore play an important role in enabling these investments, even with limited funding, either by directly funding some initiatives and/or by creating the conditions for the private sector to do so.

Funding and investment are also crucial as some investments may inadvertently generate stranded assets if new, less emissions-intensive technologies become commercially available and cannot be easily implemented in existing facilities. In addition to mobilising capital towards the roll-out of near-zero emissions technologies in new assets, it will also be essential for countries to develop and implement robust transition finance mechanisms that will allow for the deployment of technologies that are not compatible with full decarbonisation at the outset, but that could be adapted in the future to be net zero compatible, or of technologies that – while technically capable – may not operate in near-zero emissions mode immediately. For instance, the construction of a fossil fuel direct reduced iron (DRI) plant that is transitioned over the course of the next 10 years to be run fully on low-emissions hydrogen could be an investment aligned with an ultimate goal of net zero emissions, in spite of not being near-zero on launch.

Mobilising funds is a particular challenge for emerging markets and developing economies (EMDEs): the intrinsic high risk of industrial decarbonisation

investment projects is added to high sovereign risk, resulting in higher costs of capital overall. Sovereign risk is generally related to structural characteristics, with regards to both the economic and/or political contexts, which provide less foresight to investors and thus discourage them from making long-term capital commitments. In this respect, international co-operation can play a key role in improving the global financial architecture and lending schemes for EMDEs.

This category can be complemented by the Financial Toolkit developed by the OECD for the Climate Club. This work provides an overview of economic, de-risking and financing instruments (many of which are covered in this category of the Policy Toolbox) and also presents certain case studies based on policies implemented in both EMDEs and developed economies.

What critical role does this category serve in an overall industrial decarbonisation strategy?

A sound strategy to mobilise investment towards net zero compatible technologies is an important and necessary complement to other broader policies such as carbon pricing, as well as targeted policies such as those for demand creation. The majority of the transformations needed for heavy industry to target deep emissions reductions are capital-intensive, have long-term investment horizons, and entail high risk, which stalls private sector investment. Government policies are therefore important to provide foresight to investors and guarantee certain levels of returns, thus reducing the cost of capital and resulting in the creation of stronger investment cases overall.

Action under this category can not only catalyse targeted actions for specific industrial technologies, but can also substantially contribute to building the necessary enabling conditions to unlock private investment. This includes infrastructure development, which typically requires additional co-ordination efforts across multiple stakeholders and often across different jurisdictions. The modernisation or construction of infrastructure that is external to industrial plants, but nevertheless essential for their functioning (e.g. ports, roads, electricity grids, CO_2 transport pipelines and storage facilities, etc.), requires large amounts of capital. Regardless of whether this infrastructure is constructed and operated by the public or private sector, governments' ability to mobilise capital for these purposes will have a very strong influence on how fast the transition can advance.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key considerations for a government to analyse in order to decide which instrument(s) in the area of finance and investment support are best suited to their industrial decarbonisation strategies include the following:

What are the government's budgetary constraints?

Governments may want to consider whether the policy instrument would represent a burden for the public budget, and what amount of government expenditure is justifiable in light of other policy priorities. Policy instruments that imply large and lengthy investments with public funds (particularly for R&D projects that might not result in the desired outcomes) might be less acceptable to society in the presence of competing needs for funding. Such instruments include direct public investment, direct public equity investment, public private partnerships (PPPs), concessional loans, and (to a certain extent) tax credits. A strategy that aims to generate strong incentives for private capital mobilisation could boost investment in industrial decarbonisation projects, while requiring less public funding. In certain circumstances, implementing programmes that require large public investments may also mean that the government has to take on debt, which would also require further consideration.

It may be easier to implement policies that require less public budget, both in terms of the opportunity cost of funding areas other than industry and public acceptance. However, the ability of such policies to mobilise firm investments could be less certain. In other words, policy instruments such as public guarantees, facilitation to connect available financing and needs for funding, Contracts for Difference (CfD), and sustainable investment schemes and taxonomies will likely have a more indirect impact on investment, and might not achieve the exact desired results. For example, a CfD programme improves the foresight that a company might have in developing a certain technology, but if the company is not able to access financing at the beginning of the project, the project will simply not happen, independently of how convenient the CfD scheme is. In this instance, the CfD scheme may need to be paired with other complementary finance mechanisms.

What is the government's ability to steer investments by the private sector towards the targeted technologies, such as those for deep emissions reductions?

This question also refers to whether it is the government that should decide which industrial decarbonisation projects to prioritise or if it should rather encourage the

private sector to do so. Some of the policy instruments within this category are more effective at fostering deep emissions reductions than others. Policy instruments that imply direct disbursement of funds by a certain entity (such as direct public investment, direct public equity investment, public private partnerships [PPPs], blended finance, and international finance supporting the global transition) will have clearly measurable results. Such policies will result in deep emissions reductions as long as the projects that are being funded through these policies are truly targeting those goals. For instance, if a government invests a certain amount of money in subsidising CCUS projects at a certain number of cement plants, the result in terms of amount of captured emissions will be very predictable and measurable. In contrast, policy instruments such as subsidised interest rates, concessional loans, public guarantees, facilitation to connect available financing and needs for funding, CfD, tax credits and sustainable investment schemes and taxonomies tend to have outcomes that are less clear. These policies can aim to broadly direct the market towards a certain point, but targeting a specific level of emissions reduction will be more difficult given that there is less certainty on how much funding will effectively go to industrial decarbonisation projects. In order to achieve more concrete results, governments could enhance these policies by: 1) providing foresight to investors in terms of the regulatory framework; 2) providing sufficient economic incentives to make the cost of investing in deep emissions technologies comparable to the cost of investing in traditional technologies; 3) reducing price risk; and 4) lowering the opportunity cost of investing now rather than investing in the future.

It is usually more costly for a government to make direct investments than to incentivise the private sector to make those investments. It will therefore be useful for governments to assess whether direct funding could be replaced by measures that push the private sector to make investments that would not happen otherwise. This is extremely hard to measure, as it relies on a counterfactual, but understanding the motivation behind investment decisions can guide governments' policy choices.

How will these policies be perceived by different stakeholder groups?

Policy instruments that aim to mobilise finance and investment will likely experience greater acceptability from stakeholders when there is no perception of unfair treatment given to any specific sector or entity. Such policy instruments often aim to economically support companies when they are forced to internalise the cost of the emissions they generate. As long as this support is perceived as compensating the higher costs of modernising the production fleet, and is seen as being applied fairly to all relevant sectors, policies tend to be accepted. Acceptability is largely dependent on each particular policy in its intended context.

For example, the acceptability of a tax credit depends on certain characteristics of the policy, such as the rate of the tax credit, the conditions for eligibility, the overall amount of tax collection that would be sacrificed, and so on.

What is the complexity in implementing each policy instrument?

It will be important for governments to consider the broader implications (beyond industrial decarbonisation) that a policy may have and how simple it is for the different stakeholders to foresee the impact that the policy will have on them. Implications beyond industrial decarbonisation projects can include issues related to market distortions, distributional effects, and environmental degradation, among others. A lack of clarity on the implications of a certain policy can act as a barrier to implementation.

In general, the leaner the structure of the policy instrument and the fewer the stakeholders involved, the less time it will take to decide whether to move forward or not. For instance, a policy of direct public funding by the national government for the refurbishment of a steel plant can be simpler than a public private partnership involving multiple partners, operated as a special purpose vehicle and incurring debt to an international finance organisation. With regards to the latter policy instrument, the implications for different stakeholders can be more complex to predict. Nevertheless, the trade-off between simplicity and effectiveness of the policy must be analysed – to achieve certain outcomes, governments might need to roll out programmes that are rather complex.

What timing considerations need to be taken into account?

To have the best chance of achieving internationally aligned government objectives for net zero emissions by 2050, key investment decisions should ideally be made before 2030 or shortly thereafter, given that industrial technologies generally have useful lives of more than 20 years. The role of governments in quickly mobilising finance and facilitating effective mechanisms to reduce the risk of these investments therefore becomes central. Governments can do this by either directly funding and managing industrial decarbonisation projects and/or by providing the economic incentives for private investors to develop and manage these initiatives (e.g. concessional loans, subsidies or tax credits, among others) – which may have less predictable timing. Governments should therefore consider factors relating to the timing of investments when deciding which policy instruments to use. For instance, if the government believes that a certain investment is needed immediately, policy instruments such as direct public funding, PPPs, or concessional loans might be more effective at quickly mobilising projects, compared to instruments that set a framework to potentially improve business cases (e.g. tax credits, public guarantees, or sustainable investment

schemes). Note that the mentioned approaches can be complementary: while the first unlocks early-stage projects, building a framework with the right incentives for private sector investors is a crucial step in mobilising capital at a larger scale.

1.2.1 Direct public funding

Description

Direct public funding includes subsidies or grants provided to industrial producers to support them to incorporate decarbonisation technologies. It can also be used to support R&D at different stages. Note that this policy instrument specifically refers to amounts of money that do not have to be repaid.

This instrument is typically used when the aim of the government is to step in and support transformation processes for which the private sector either does not have a risk appetite or faces substantial challenges in accessing financing.

How could this policy instrument target deep emissions reductions?

If the objective of policy makers is to ensure support for deep emissions reductions and full decarbonisation, public funding should be targeted at investments in near-zero emissions technologies, making this a condition for recipients.

In some cases, funding might be used to support shorter term incremental emissions reductions on the path to deep emissions reductions. If this is the case, the conditions for the funding should clearly state that investment is in technologies that could later transition to full near-zero emissions, for example. Funding may even include different instances of disbursement based on the achievement of the stated incremental emissions reductions – i.e. funding is allocated in several stages, each of which is conditional on the accomplishment of the goals set for the preceding stage.

When is this policy instrument suitable?

- Direct public funding can cover a broad range of purposes, spanning from the support of R&D of technologies under development (even, for example, within universities) to the deployment of large-scale technologies.
- Direct public funding will be effective in contexts where the project risk is so high that the private sector is either not willing to step in, or where its participation is insufficient. In particular, public funding can be useful when employed strategically to partly fund large projects for which not enough private capital can be raised: by reducing the amount of private capital required, projects can come to fruition, which in turn can help mobilise further private capital.

- By getting initial projects off the ground, direct public funding can be an effective way to kick-start the creation of markets for low- or near-zero materials.

What needs to be considered before implementation?

- **Budget:** Direct public funding implies a burden on government budgets, so the relevance of the funding must be evaluated in light of other policy priorities. Given e use of taxpayers' money, there might be public acceptance issues if the society does not consider this to be a good use of public funds. Effective public communication of the policy will therefore be an important part of implementation.
- **Guidelines:** Transparency on the process of providing direct public funding is very important. Clear guidelines on which entities can be beneficiaries of the policy and which projects will be supported are key elements to ensure that funds go to projects that will contribute to the industrial decarbonisation process and make efficient use of limited public funds.
- **Requirements:** Requiring measurable results from the use of proceeds and setting timelines for their achievement will help ensure the effectiveness of the policy. A monitoring process both on-site and at product-level (if relevant) should then follow.

Best practices

Effectiveness

- Ensure that any funded projects have clearly defined objectives that are in line with what the government is aiming to achieve through the funding (e.g. the level of emissions reductions targeted by the policy).
- Establish mechanisms to measure their progress and checkpoints to monitor project development.

Simplicity

- Clearly establish conditions for eligibility for public funding.
- Simplify funding application processes, for example through one-stop shops for various government funding programmes.
- Clearly outline the processes for the disbursement of project funds.

Stakeholder acceptability

- Be transparent in the amount of funds given to each project, and clear and fair on criteria for project selection. Make public information about the projects' objectives and timelines, their progress and the benefits that can be obtained from them.

Economic efficiency

- Perform thorough financial analysis on the funded projects, including their potential impact on emissions (where pertinent). Evaluate different scenarios (including worst-case outcomes) and only fund projects that entail a level of risk acceptable to the government.
- Public funding can be most useful if targeted at projects that would otherwise have difficulties in moving forward, so that they lead to "additional" benefits and represent an efficient use of public funds. Thorough analysis should be undertaken to ensure careful allocation of funds.
- For R&D projects, in particular, the economic efficiency should be measured at the portfolio level, rather than the individual project level, since some projects might not render the expected results. Projects not being successful is part of the risk that investments in R&D entail, so this should not necessarily be regarded as a loss.

How can international collaboration improve the efficiency of this instrument?

Access to international financing

- Direct public funding can be assisted by international loans and financing agreements (coming from either the private or multilateral sectors) with the government.

International co-operation agreements

- International co-operation agreements can allow public funding to draw upon the capacities of other countries (such as technological or human resources) for the effective use of public funds.

Examples of governments that have implemented this type of policy instrument

- Australia's Carbon Capture Technologies Program (2023).
- Canada's Low Carbon Economy Fund (2017, replenished in 2022).
- Canada's Subsidy for energy efficiency refurbishments of ArcelorMittal Canada facilities (2018).
- Canada's Subsidy for energy efficiency refurbishments of EVRAZ North American facilities (2019).
- Canada's Federal funding for steel companies to phase out coal-based steelmaking (2021).
- Egypt's Pollution Abatement Project Phase III (2017).
- The European Union's Research Fund for Coal and Steel (RFCS) (2021).

- The European Union's Innovation Fund (2019).
- The European Union's Important Projects of Common European Interest (IPCEI) programme (2018).
- The European Union's Clean Industrial Deal (2025).
- France's Programme for Investments of the Future (2021).
- Germany's CO_2 Avoidance and Use in Raw Material Industries (call for funding applications) (2021).
- Germany's KlimPro-Industrie (measure of the Research for Sustainability - FONA Programme) (2024).
- India's Promotion of Research & Development in Iron & Steel (2010).
- Italy's Piano Transizione 5.0 (2024).
- Sweden's Industrial Leap (2018).
- Türkiye's Renewable Energy Resource Area (YEKA) (2016).
- The United Kingdom's Industrial Strategy Challenge Fund (ISCF) (2016).
- The United Kingdom's Industrial Decarbonisation Challenge (2019).
- The United Kingdom's Industrial Energy Transformation Fund (IETF) (2019).
- The United Kingdom's Programme for Research and Innovation in Steel and Metals (PRISM) (2020).
- The United States' Carbon Capture Program (2019).
- The United States' Energy Awards for Clean Hydrogen Technologies (2019).
- The United States' Carbon Capture Demonstrations Projects Program (2022).

- The United States' Industrial Emissions Demonstrations Program – within the Inflation Reduction Act (2022).
- The United States' Industrial Heat Shot (2022).

1.2.2 Direct public equity investment

Description

Direct public equity investment is a way of supporting the development of new technologies, with the government becoming an investor in projects in which not enough private investors want to participate. This policy instrument implies investing in companies for all the activities that the company pursues, or for specific projects (generally done via a legal structure called a special purpose vehicle [SPV], see When is this policy instrument suitable? for further detail). The government then holds a stake in these companies, which can result in future government revenues if the company becomes profitable, but also presents the risks inherent to the operation of the company or SPV.

How could this policy instrument target deep emissions reductions?

To ensure that the investment targets deep emissions reductions, equity investment should be focused on the scale-up of near-zero emission technologies.

When is this policy instrument suitable?

- Direct public equity investments can be used both for the support of R&D of new technologies at early stages or for the deployment of large-scale technologies at later stages of development.
- Direct public equity investments will be effective in contexts where the project risk is so high that the private sector is not willing to step in, or where private sector participation is not sufficient.
- Compared to granting or lending funds for such projects, direct public equity investment can be suitable when all the following conditions are met: 1) the project is open to having a public shareholder; 2) the government is willing and able to take a more active role in the management of the project (as this would likely, at a minimum, require the government to assign a director to the company's board of directors); and 3) the government is looking to maintain its involvement for the medium to long term. Sometimes it may be the case that the company cannot take on debt, so equity participation might be the only alternative the government has to support a certain initiative.
- This policy instrument can be effective to kick-start the creation of markets for low- or near-zero emissions materials, by getting initial projects off the ground.
- This instrument can also be justified in cases where – given that the government has a different investment horizon to the private sector and that profitability measures might be impacted by different factors – some projects might sometimes be convenient for the public sector purely from an investment perspective, even though they might not be attractive to private investors who are looking for faster economic returns.
- If needed, investments could be made through a specific SPV. SPVs are legal entities that ring-fence funds for a specific purpose (in this case, the investment in the deep decarbonisation project that the government is looking to participate in) and that would be separated from the government's balance sheet. This could provide the advantage of enhancing the credit profile of the project and guaranteeing that the funds within the SPV would not be used for other government expenditures.

What needs to be considered before implementation?

- Direct public equity investment creates a burden for the government's budget at the moment the investment takes place, so its relevance has to be evaluated in light of other policy priorities. Given the use of taxpayers' money, there may be public acceptance issues if society does not agree with the investments.

However, if the project succeeds and becomes profitable, holding a stake can result in revenues for the government. If the project is not successful, it could result in losses for the government. Effective risk assessment and public communication of the policy will therefore be important elements in implementation.

- The transparency of the process of providing direct public equity investment is very important. Clear guidelines on which entities can be beneficiaries of the policy and which projects will be supported are key elements to ensure that funds go to projects that will contribute to the industrial decarbonisation process and to make efficient use of limited public investment capacity.
- Requiring measurable results from the use of proceeds, and setting timelines for their achievement, will ensure the effectiveness of the policy, backed by monitoring of how proceeds are used and what the results are in terms of site- and product-level emissions data.

Best practices

Effectiveness

- Clearly outline the conditions under which the government will invest in a certain project, and ensure projects are aligned with what the government aims to achieve through the investment (e.g. the level of emissions reductions targeted by the policy).
- Monitor the progress of the investment and ensure that a person assigned by the government can participate on the board of directors (if applicable) of the companies responsible for the projects.

Simplicity

- Clearly establish conditions for projects to be eligible for public investment.
- If the programme is extended to multiple applicants, simplify funding application processes, for example through one-stop shops for various government funding and investment programmes.
- Clearly outline the processes through which the initial investment will take place and the role the government will play in the project (i.e. what level of influence it will have on operational decisions).

Stakeholder acceptability

- The transparency of the process of becoming a public investor is very important to ensuring acceptability. The rationale for each investment has to be clearly communicated, together with the expected outcomes.

Economic efficiency

- Perform thorough financial analysis on the investment project, including its potential impact on emissions. Evaluate different scenarios (including worst-case outcomes) and only invest in projects that entail a level of risk that is acceptable to the government.
- For any R&D projects pursued via SPVs, especially, the economic efficiency should be measured at the government's portfolio level, and not at the individual project level, since some projects might not render the expected results. Funding unsuccessful projects is part of the risk that R&D investments entail, so this should not necessarily block investment.

How can international collaboration improve the efficiency of this instrument?

Access to international financing

- Direct public equity investment can be assisted by international loans and financing agreements (coming from either the private or multilateral sectors) with the government.

International co-operation agreements

- International co-operation agreements can allow public equity investment to leverage capacities of other countries (such as technological or human resources) for the effective use of public funds.

Commercial agreements

- International commercial agreements between local producers and foreign buyers that guarantee that a certain amount of industrial products is purchased by a foreign country (either because they are low-emissions goods or because there is some other condition attached to the exchange) can ensure demand for a certain technology or product produced by the investment project.

Examples of governments that have implemented this type of policy instrument

- Australia's Clean Energy Finance Corporation (CEFC) (2012).
- Canada's Clean Growth Program (2020-2022).
- India's Venture Capital Fund for Energy Efficiency (VCFEE) (2017).

1.2.3 Subsidised interest rates and concessional loans

Description

Some industrial decarbonisation projects may not be able to secure the necessary funds through commercial and corporate bank loans, either because of the risk they entail, or because the interest rate that a commercial or corporate bank would provide is too high for the project to be profitable. To ensure the industrial decarbonisation investment takes place, the government can provide a loan at an interest rate below what the market would provide, or that has better conditions for the borrower. Government requirements for the application to a loan can be adjusted to be less stringent than those used by commercial and corporate banks. This could help finance all or part of the investment.

Subsidised interest rates are rates offered by public banks, or by public entities acting as banks that are below what the market would offer to a project with a certain risk profile.

Concessional loans are loans (in this case, from the public sector) that either have lower interest rates and/or that offer better conditions for the borrower. These conditions may include, among others, extended maturity (longer times for repayment), better-staggered amortisation (i.e. designing a more convenient schedule for repayment in instalments, generally with most of the capital being repaid towards the end of the life of the contract), more flexible covenants (i.e. less stringent requirements that borrowers have to comply with), and easier access conditions.

How could this policy instrument target deep emissions reductions?

To ensure that the projects that have been granted concessional loans target deep emissions reductions, loans should be explicitly aimed at projects involving the early deployment and/or the long-term scale-up of near-zero emission technologies.

When is this policy instrument suitable?

- In contexts where the government would like to incentivise certain industrial decarbonisation initiatives, but where the government does not intend (or does not have the necessary budget) to fully fund them.
- For projects for which the loan can reasonably be expected to be repaid. Even though such a programme would take into account a certain percentage of defaults on an aggregated basis, conditions for the credit should allow for a tolerable level of risk.

What needs to be considered before implementation?

- By providing loans to these high-risk counterparts, the government is highly exposed to delays in payments or defaults. Moreover, a lower interest rate might mean that the government is running into a loss by lending funds. The government needs to be willing and able to take on these risks. However, compared to direct public funding, the principal tends to be recoverable, so this policy generally requires less government budget overall.
- If the government is not instrumenting this policy through a public bank, then the public agency that carries out the programme would need to effectively act as a bank. It would therefore need to establish relevant departments to implement the loan and monitor the credit provided (including front desking, risk, legal, etc.).

Best practices

Effectiveness

- Clearly outline credit conditions.
- Credit agreements should detail the industrial decarbonisation goals targeted and how the project is likely to contribute to them as part of stipulations on the use of proceeds and in the credit's covenants (the conditions set in the credit agreement).

Simplicity

- Provide transparency on the process of application for the credit, with clear timelines.
- Use standardised credit agreements.
- Simplify funding application processes, for example through one-stop shops for various government funding programmes.

Acceptability by stakeholders

- Provide easily accessible information for the public to learn about the credit programme.
- Establish fair and transparent rules for selecting projects eligible for credit.

Economic efficiency

- Perform thorough financial analysis on the investment project, including its potential impact on emissions, before approving a credit. Evaluate different scenarios (including worst-case outcomes) and only grant concessional loans to projects which entail a level of risk that is acceptable to the government.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful concessional finance programmes can serve as the basis for other similar programmes around the world. Conditions of the local credit market must be taken into account.

Access to international financing

- Investment through concessional loan programmes can be assisted by international loans and financing agreements (coming from either the private or multilateral sectors) with the government.

Commercial agreements

- International commercial agreements between local producers (the ones to be granted the concessional loans) and foreign buyers that would guarantee a certain amount of industrial products are purchased by a foreign country (either because they are low-emissions goods or because there is some other condition attached to the exchange) can ensure demand for a certain technology or product produced by the project receiving a concessional loan.

Examples of governments that have implemented this type of policy instrument

- Australia's Clean Energy Finance Corporation (CEFC) (2012).
- Brazil's Nova Indústria Action Plan for Industrialisation 2024-2026 (2024).
- Germany's KfW Energy Efficiency Financing for Industry (2019).
- Germany's Federal Funding for Energy and Resource Efficiency in the Commercial Sector (EEW) (2021).
- Türkiye's Industrial Decarbonization Investment Platform (2024).

1.2.4 Public guarantees

Description

A public guarantee is a formal assurance that a public institution will respond economically in the name of the borrower in the case of default on a loan (typically from the private sector, though also possible for loans provided by other public or multilateral entities).

How could this policy instrument target deep emissions reductions?

Public guarantees should explicitly aim to support projects for the early deployment and/or the long-term scale-up of near-zero emission technologies to ensure that any projects granted public guarantees target deep emissions reductions.

When is this policy instrument suitable?

- Given that new technologies imply inherent risks and, in the case of deep industrial decarbonisation, projects are typically large and single-asset, investments tend to be high-risk. In order to reduce credit exposure to projects deemed high-risk, financiers may require a guarantee, which could be provided by the public sector. Such a guarantee helps to mitigate the risk and enables projects to secure the finance needed.
- If the project is located in an EMDE, in many cases the risk profile increases based on the sovereign risk, which is the financial risk related to doing business in a certain country. Therefore, policies that facilitate guarantees to these projects will make them more bankable or better suited for any type of financing arrangement.
- The suitability of the measure for a particular project will depend on the quality of the project and how well aligned it is with the government's industrial decarbonisation priorities.

What needs to be considered before implementation?

- A risk-benefit analysis of the project has to be performed before a public entity agrees to act as a guarantor, including a stringent credit assessment of the project concerned (see below). Given the limited public funds that can be used to guarantee projects, the government should evaluate if the project it is guaranteeing is in line with its industrial decarbonisation strategy.
- Acting as a guarantor could also imply a certain strain on government finances if the guaranteed party defaults, so governments should evaluate the likelihood of default and any potential losses this could result in.
- Having sufficiently creditworthy public guarantors: the government agency that acts as guarantor should be able to respond with its assets in case the company defaults on its payments.
- In the case that the public entity is acting as a guarantor for an investment in another country, foreign exchange risk and broader country risks should also be considered.

Best practices

Stringency

- Eligibility criteria for public guarantees should be clearly set out prior to application. Guarantees should target projects that are well aligned with the government's decarbonisation objectives, for example that are likely to achieve a targeted level of emissions reductions.
- Public guarantees should be capped to limit the government's credit exposure.

Simplicity

- Simplify application processes, for example through one-stop shops for various government funding programmes.

Stakeholder acceptability

- Allow easy access for the public to learn about the guarantee conditions.
- Follow fair and transparent rules for project selection.

Economic efficiency

- Perform thorough financial analysis on the investment project before approving a guarantee, and assess the project's potential impact on emissions. Evaluate potential downside cases and only grant guarantees to projects that present a level of risk that is manageable for the government.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful public guarantee programmes can serve as the basis for other similar programmes around the world. The conditions of the local credit market must be considered, including the legal framework, political risk and other specific risks of operating in that jurisdiction.

Access to international financing

- Cross-border guarantees could help advance industrial decarbonisation projects in EMDEs, particularly when local governments are not able to provide guarantees.

Commercial agreements

- International commercial agreements between local producers (requesting the public guarantee) and foreign buyers can ensure demand for a certain technology or product produced by the project covered by a public guarantee.

Examples of governments that have implemented this type of policy instrument

- The European Union's InvestEU Programme (2021).
- The European Union's Clean Industrial Deal (2025).
- Sweden's Credit guarantees for green investments (2021).

1.2.5 Facilitation to connect available financing and needs for funding

Description

Governments can facilitate physical or virtual spaces for innovators to connect with financiers. This can be done through formal programmes that not only gather representatives from both sides of the market, but also provide advisory services to help projects improve their business cases and bankability.

How could this policy instrument target deep emissions reductions?

Within innovative projects, including those involving new near-zero emission technologies, developers typically do not have a clear roadmap for how to make their project attractive to financiers. At the same time, there are many entities in the market looking to finance certain types of innovation projects that are unable to reach their potential clients or partners. Public bodies can respond to these needs by establishing mechanisms or platforms to facilitate exchange between projects seeking funding and sources of available funding focused on technologies that can achieve deep emissions reductions, thus helping to create a market.

When is this policy instrument suitable?

- For markets that are not yet developed, and for investments that are not bankable on a wide scale.
- It is especially suited to contexts where the government has knowledge of players on both sides of the financing market who have expressed a difficulty in closing transactions.
- This instrument may be a useful way for governments to facilitate private sector agreements without deploying considerable public sector funding; it could work

well when there is likely to be private sector interest in investments, but the market is simply so new that relevant players find it difficult to connect.

What needs to be considered before implementation?

- Establishing an expert team to assess projects and advise developers on how to position their projects in order to access financing.
- A platform or marketplace to connect available financing and needs for funding will become more effective the more deals are closed. If, after some time, the platform does not deliver on this, potential developers and financiers may stop participating. It will be important to consider how to maintain engagement over time.
- Considering pairing such a platform with opportunities for some support through public finance – such as public guarantees (see above) – may help reduce risk for private sector actors and help secure deals.

Best practices

Effectiveness

- The larger the number of players in the market created by the government, the higher the chances of successful connections.
- The more transparent the programme is (e.g. using seamless online tools, clearly displaying information about the projects and conditions for credit, increasing communication among participants), the higher the chances of successful connections.
- Methods for clear evaluation and transparency on project characteristics, such as emissions reductions achievable, could help provide certainty to market players and increase the likelihood of closing deals.

Simplicity

- Allow projects and investors easy access to the (virtual or physical) platform.
- Have dedicated personnel to guide stakeholders on both sides.

Stakeholder acceptability

- Allow easy access for the public to learn about the facilitation programme.
- Offer equal and fair opportunities for access to the platform by private sector actors.

Economic efficiency

- The cost of building the platform (physical or virtual) to connect project developers with financiers can be relatively small compared to the number of projects that

could gain investment. If efficiently carried out and targeting projects likely to achieve substantial emissions reductions, this instrument has the potential for high economic efficiency.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Extensive experience in building these connection platforms on industrial decarbonisation is lacking, so governments could benefit from sharing experiences, as well as from the experience of multi-stakeholder or non-governmental organisations.

Access to international financing

- Platforms to connect available financing and needs for funding could benefit from international financiers that could potentially help fund projects. On the international financiers' side, programmes like these could help them enter markets where they do not have a presence, particularly in some EMDEs that might be more difficult to access.

Examples of governments that have implemented this type of policy instrument

- Climate Club/United Nations Industrial Development Organization (UNIDO) Global Matchmaking Platform (2024).
- The European Union's European Hydrogen Bank (2022).
- The European Union's InvestEU Programme (2021).
- Türkiye's Industrial Decarbonization Investment Platform (2024).

1.2.6 Contracts for difference

Description

A Contract for Difference (CfD) acts as a hedge for the price of an underlying asset, which might be carbon allowances (known as Carbon Contracts for Differences [CCfDs]), electricity prices, or any other commodity or material price. CfDs provide a solution for volatile markets in which building an investment case is complicated by the difficulty of estimating future prices of a certain input that the company needs to buy, or of the product it is selling.

Under a CfD scheme, the government sets a guaranteed "strike price" over a long-term horizon (e.g. 20 years) for a certain underlying asset or input, such as

electricity. CfDs can provide foresight to companies pursuing deep decarbonisation with regards to the level at which they will be able to trade their carbon allowances, electricity or any other input or product. In the case that the underlying asset is something that the industrial producer has to sell (e.g. carbon allowances or materials), if the actual (spot) price of the underlying asset falls below the strike price, the government pays the difference between the strike and spot price to the company. Conversely, if the spot price is higher than the strike price, the company pays the difference between the spot price and the strike price to the government. In the case that the underlying asset is something that the industrial producer buys (e.g. electricity or other inputs), payments would flow in the opposite direction.

In the context of the energy transition, CfDs have been used most frequently in the electricity sector, to guarantee a particular market price for electricity sold. The policy has more recently been proposed as an option for the industrial sector – while initial uses have focused on the carbon price and prices of key inputs (electricity, hydrogen), other designs may also be possible, such as guaranteeing a particular price for materials sold.

How could this policy instrument target deep emissions reductions?

If the policy objective is to ensure support for markets that enable deep emissions reductions, CfDs should specifically be targeted towards projects that present a sound business case for the development or use of a deep emissions reduction technology.

When is this policy instrument suitable?

- An important risk facing developers of industrial decarbonisation projects is uncertainty about the long-term price environment, for example the volatility and potential decline of the carbon price at which they will be able to sell their ETS allowances. Without clear visibility on these prices (which constitute an important part of cost savings), many companies are unable to provide a sound business case allowing them to access financing. A CfD acts as a hedge through which the government absorbs this price risk.
- CfDs can even be used to guarantee more beneficial prices than the market, at least for a certain period, until low-carbon alternatives become a more competitive option compared to fossil fuels.
- CfDs can be particularly useful for governments aiming to create a market for low-emissions and near-zero materials, especially for materials for which current demand is still difficult to estimate, and in environments where there are likely to be fluctuations in key prices (e.g. ETS and/or electricity prices).

- For governments that are sufficiently economically robust to take on the risk of price variations that could result in large payments to multiple counterparties at the same time (i.e. multiple large out-of-the-money positions).
- For economies where commercial and corporate banks do not provide this service on the private side, or where there is not yet an appetite for this level of risk.

What needs to be considered before implementation?

- Large and very sudden variations in price of the underlying asset (e.g. carbon or electricity) may result in a significant (and quite unpredictable) strain on the government's financial position. Robust market risk assessments are needed, especially given that the government will act as the single counterparty to multiple developers that will likely face the same price trends.
- Creation of a team to scan candidates and assess the risk profiles of beneficiaries. Conditions should be stringent enough (for instance, requiring a certain credit rating, guarantees, or proving certain financial ratios that would show solvency) to ensure the robustness of the programme.
- Financial operation of these products, with dedicated human resources to structure the transactions and then monitor the positions.
- If CfDs are offered to different sectors, targeted allocation among sectors should be considered, since some sectors might have lower abatement costs and could potentially crowd out the initial auctions. In such cases, differentiated CfD auctions might need to be considered.

Best practices

Effectiveness

- If the target is to support technologies that can provide substantial emissions reductions, ensure that only projects that can prove a deep emissions reduction pathway have access to CfD auctions.

Simplicity

- Make requirements for companies easy to understand.
- Facilitate access to the CfD auctions.

Stakeholder acceptability

- Allow easy access for the public to learn about the programme.
- Engage different sectors in the design of the CfD programme and build understanding of their cost structures to evaluate if there should be differentiated CfD programmes for each sector. Aim for fair and transparent processes for allocation of benefits among potentially relevant stakeholders.

Economic efficiency

- Employ strong technical teams to best estimate the strike price and to properly outline eligibility criteria.
- Target support to technologies where risks are truly high and projects would be unlikely to go ahead otherwise, to ensure efficient usage of public funds. This is especially important for a policy like a CfD, where there is a long-term commitment of public funds.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful CfD programmes can serve as the basis for other similar programmes around the world. Conditions of the local credit market must be considered.
- There is not a great deal of experience in implementing CCfDs, in particular. If countries that have implemented them are willing to share their learnings, many other countries could benefit.

Access to international financing

- CfD programmes can be assisted by international loans and financing agreements to the government.

Examples of governments that have implemented this type of policy instrument

- France's CCfD (2024).
- Germany's Directive on the promotion of climate-neutral production processes in industry through climate protection contracts (2024).

1.2.7 Tax credits

Description

A tax credit is a tax benefit given by the government to producers who contribute to emissions reduction (e.g. via CCUS technology or low-emissions electricity) or who produce low-emissions fuels such as low-emissions hydrogen. Such a credit could also be envisioned for near-zero or low-emissions materials like steel or cement. Beneficiaries of these programmes are entitled to tax credits for a fixed period of time (e.g. 20 years). In some countries, these tax credits can be claimed by a tax equity investor, which would be a third-party investor that provides funds at the beginning of the project and then recovers the investment by being

accredited with the tax credits. Some schemes are production-based (i.e. the amount of tax credit depends on the amount of carbon captured or the amount of low-emissions hydrogen produced), while others are investment-based (i.e. tax credit per monetary unit of investment in these technologies).

How could this policy instrument target deep emissions reductions?

If the policy objective is to support deep emissions reduction projects, tax credits should be reserved for projects that present a sound business case for the development or use of a deep emissions reduction technology. Projects should comply with certain pre-established requirements (e.g. achieving a certain level of emissions reductions, CO_2 capture, low-emissions hydrogen production).

When is this policy instrument suitable?

- A tax credit has the same effect as a subsidy, by increasing the revenues (or decreasing tax payments) associated with the production of a certain low-emissions fuel (e.g. low-emissions hydrogen) or low-emissions material, or by decreasing the cost of the capture of emissions (e.g. CCUS). Tax credits have the benefit that they do not represent a deduction from the government's current budget (except for rare cases where reimbursements are allowed), though they imply lower future revenues – although the overall effect on budget is similar, tax credits may be more acceptable to taxpayers than direct subsidies.
- For technologies that are already been proven technically, but whose high cost dissuades investors.
- In countries where direct subsidies may be unacceptable to taxpayers. This is related to the fact that the government's current budget is not impacted by tax credits – there is no government expense related to them (unless tax refunds are allowed). However, tax credits imply foregone tax revenues in the future. Given timing considerations and the disposable budget available to governments, tax credits might be more feasible and more acceptable to taxpayers than direct subsidies.
- A scheme where the rate of the tax incentive decreases over time could be suitable for certain contexts (e.g. where technology learnings have good potential to result in cost decrease) and might incentivise further efficiencies and innovation.
- When there is concern about carbon leakage, since the risk of carbon leakage presented by this policy instrument is relatively low, given that tax credits favour near-zero technologies without penalising high-polluting ones.

What needs to be considered before implementation?

- The timeframe for the policy is important. An expiration date for tax credits has to be set and clearly communicated. The underlying assumption behind this type of

instrument is that the cost of these technologies will decrease as the market grows – i.e. the low- or near-zero emissions technology starts to develop with economies of scale and other features that make it competitive. Usually, tax credit programmes are long-term (10 or 20 years, or more), but they do need to have an announced endpoint so as to avoid supporting technologies once they become economically viable.

- A tax credit implies foregone government revenue. The impact of this measure on the public budget has to be assessed, especially if the tax credit is offered to all eligible projects and the total number of projects that will be eligible is difficult to estimate in advance.
- Monitoring and verifying the companies' reported emissions reductions over time.

Best practices

Effectiveness

- If the policy objective is to incentivise the scale-up of near-zero emission technologies, only projects that can prove a deep emissions reduction pathway should be eligible for tax credits.
- In the case that the tax credit scheme is production-based, set up a system to properly track and monitor production to ensure compliance. Standardised reporting requirements would ease the process.

Simplicity

- Make application procedures and other requirements for companies easy to understand.
- Ensure the approval of the application to the tax credit scheme is done in parallel to any permitting processes for the project.
- Integrate the tax credit scheme with other existing tax schemes to reduce the administrative burden for both the recipients and for the government bodies involved. Include eligibility for the credit in any programmes to simplify processes for public funding, such as via one-stop shops for various government funding programmes.

Stakeholder acceptability

- Allow easy access for the public to learn about the scheme.
- Engage different sectors in the design of the tax credit scheme and build understanding of their cost structures to evaluate if there should be differentiated tax credit programmes for each sector. Ensure fairness and transparency in eligibility criteria.

Economic efficiency

- For production tax credits, the economic efficiency should typically be high, given that the amount of foregone tax revenue should be proportional to the amount of production. However, it is important to evaluate whether this near-zero or low-emissions production would still have happened without the tax credit, such that credits lead to "additional" benefits and represent an efficient use of public funds. A way of mitigating risk to economic efficiency is to establish a fixed period of time (e.g. 10 years) for the tax credits to be claimed.
- For investment tax credits, it is important to include clauses related to the continuation of operations, and even to only allow the credits to be claimed periodically, as the project continues to operate.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful tax credit systems can serve as the basis for other tax credit systems around the world. Local tax specificities have to be considered, as well as international tax rules and agreements.

Examples of governments that have implemented this type of policy instrument

- Canada's Clean Economy Investment Tax Credits (2024).
- The United States' Section 45Q tax credit for CCUS (2018).
- The United States' Clean Hydrogen Production Tax Credit – Inflation Reduction Act (2022).

1.2.8 Public private partnerships and blended finance

Description

When governments are unable (either for financial or technical reasons) to carry out industrial decarbonisation projects alone, partnership with financial institutions can be a way to ensure projects materialise. Two types of collaborative approaches that governments might take are outlined below:

- A public private partnership (PPP) is a mechanism through which the government works together with a private entity to pursue an infrastructure or procurement project. The commitments and responsibilities of the private and public parts are tailored to each PPP and reflected in a PPP agreement. Often, PPPs go a step

further than public equity investments, in that the public sector not only has a financial stake in the project, but is involved in the planning and project development.

- Blended finance is the combination of public funds with development and/or philanthropic funds for a specific project, which would likely also include contributions from the private sector. The OECD defines blended finance as "the strategic use of development finance for the mobilisation of additional finance towards sustainable development in developing countries". Blended finance may be implemented through a PPP, or otherwise simply as a grant.

How could this policy instrument target deep emissions reductions?

To ensure that the projects carried out under PPPs or blended finance target deep emissions reductions, if that is the policy objective, they should be explicitly aimed at the early deployment and/or the long-term scale-up of near-zero emission technologies.

When is this policy instrument suitable?

- PPPs allow governments to leverage the expertise and capital of private entities for the development of public infrastructure projects. Through long-term contracts, private companies can provide the capacity (both technical and financial) for industrial decarbonisation projects that the government alone would otherwise be unable to provide. Meanwhile, involvement of the government may also facilitate the development of large infrastructure projects (e.g. CO_2 transport and storage) for which it may be difficult for the private sector to move forward alone. The capacities of the public and private sector can be complementary, particularly for large-scale and innovative industrial projects.
- Blended finance combines development and philanthropic finance with private funds to help carry out projects, particularly in EMDEs. Without such partnerships, certain industrial decarbonisation projects might not be viable because the private sector on its own would likely not be willing to take certain risks. These risks could be related to general sovereign risks, but also to resource availability, institutional and legal instability, and foreign exchange volatility, among many other factors.
- These instruments can also be helpful where there is an appetite among development and philanthropic entities to finance industrial decarbonisation initiatives, but their capital alone is not sufficient and needs to be complemented with public funds.

What needs to be considered before implementation?

- How contract terms and the concessions made to private companies will incorporate environmental protections, particularly because these are long-term agreements that often provide access to valuable local natural resources.

- Such agreements are always long-term, so the risk of the investment partner not complying with the terms of the agreement has to be properly assessed.
- For blended finance in particular, some principles proposed by the OECD could guide the design of the policy. These are: anchoring the use of blended finance to a development (and an industrial decarbonisation) rationale; ensuring that the policy effectively helps mobilise commercial finance; tailoring the policy to local characteristics; focusing on strong and lasting partnerships; and monitoring transparency and results.

Best practices

Effectiveness

- Ensure only projects that can prove a deep emissions reduction pathway are candidates for PPPs and blended financing, if the policy objective is to incentivise net zero compatible technologies.
- Establish checkpoints to monitor project development.

Simplicity

- Clearly establish conditions for eligibility.
- Clearly outline the processes for the disbursement of project funds.

Stakeholder acceptability

- Be transparent in the use of funds and the amounts given to each project. Provide public access to information about the projects' objectives and timelines, their progress, and the benefits that are expected to be obtained.
- When the project implies the management of natural resources, especially, ensure clear communication of what the concessions to the private or multilateral parties are (e.g. granting access to certain lands or natural resources; exemptions from certain rules; expedited procedures, etc.).

Economic efficiency

- Perform thorough financial analysis on the funded projects. Evaluate potential downside cases and only fund projects that entail a level of risk acceptable to the government.
- Target projects that would have substantial challenges in moving forward without public involvement, to ensure that public funds are used effectively.

How can international collaboration improve the efficiency of this instrument?

International co-operation agreements

- Such agreements can allow the project to benefit from the capacities of other countries (such as technological or human resources) for the effective use of public funds.

Infrastructure-building

- Some international/cross-border infrastructure could be useful for material transportation or access to renewable energy sources (depending on the project itself).

Examples of governments that have implemented this type of policy instrument

- The European Union's Horizon Europe scheme (2021).
- The European Union's Clean Steel Partnership (CSP) (2021).
- Saudi Arabia's Saudi Green Initiative (SGI) (2021).
- The United Kingdom's Transforming Foundation Industries scheme (2020).

1.2.9 International finance to support the global transition

Description

International finance includes governments and development agencies or banks providing capital (either in the form of loans or grants) for industrial decarbonisation initiatives, primarily in EMDEs. It includes direct development aid.

Support from development agencies or banks can also encompass technical support, often provided together with funding but also provided alone as an advisory service.

How could this policy instrument target deep emissions reductions?

To ensure that international financing targets deep emissions reductions, the projects funded should be explicitly aimed at the early deployment and/or the long-term scale-up of near-zero emissions technologies.

When is this policy instrument suitable?

- International finance can help fill investment gaps in countries that face challenges in funding their own projects or accessing private financing. This may be particularly necessary in emerging markets that have the potential to become important industrial decarbonisation players.
- To support the development of low-carbon markets in EMDEs.
- Acting as a finance provider may be particularly suitable for countries that wish to position themselves in a long-term international commercial partnership within the supply chain for low-emissions products or materials – e.g. investments by a future consumer country in a potential producer country.
- Providing technical assistance for decarbonisation policy development in EMDEs may have the advantage for the donor of helping to increase global ambition for industrial decarbonisation more widely. Ultimately, this could contribute to levelling the playing field for all countries seeking to decarbonise, and helping to avoid carbon leakage. Technical assistance in establishing policy conditions may be just as critical as international finance targeted to actual capital investments. This is because sometimes the local government might not have the tools to canalise those funds into achieving the desired industrial decarbonisation objectives.

What needs to be considered before implementation?

For the funders:

- For capital investments, the projects should be aligned with the funder's industrial decarbonisation priorities. Contractual terms of the financing agreement should ensure that there are mechanisms to guarantee the achievement of the proposed industrial decarbonisation goals. Therefore, terms should include project monitoring, not only during construction, but also throughout the operation of the asset.
- Compatibility of the project with local laws must be verified.
- For loans, foreign exchange risk and broader sovereign risks must be considered.
- For contributions to technical assistance, ensure that policy development goals are clear and will provide real added value, and seek ways to involve affected stakeholders in the process.

For recipients:

- In the case of loans, the social, environmental, and monetary returns must be fully evaluated before committing to a long-term contract. It is important that such project does not put the country at risk of significant financial strain.
- The project should be evaluated in the light of other developmental priorities and financing needs.
- For technical assistance, ensure the objectives target a clear gap where international assistance can offer the most benefits.

Best practices

Effectiveness

- Contractual terms of the financing agreement should ensure that there are mechanisms to guarantee the achievement of the proposed industrial decarbonisation goals, whether the agreement is for capital investment or technical assistance.

Simplicity

- Clearly list in the project's contractual agreement the conditions and obligations of the recipient and provider of the funds.
- Clearly outline the processes for the disbursement of project funds.

Stakeholder acceptability

- Be transparent in the use of funds, and provide public access to information about the projects' objectives and timelines, their progress and the benefits they expect to obtain. It is important to note that the projects should provide a certain return (either economic or be aligned with policy objectives) both for the international funders as well as the recipients – this may well be related to the quota of international aid that a certain government or international organisation plans to provide.
- When the project involves the management of natural resources, especially, ensure transparent communication on the concessions to foreign parties.

Economic efficiency

- Perform thorough financial analysis on the funded projects. Evaluate different scenarios (including worst-case outcomes) and only provide loans to projects that entail a level of risk that is acceptable to the financier.
- Ensure technical assistance is targeted at policy development that could benefit substantially from international assistance, to make best use of available funds.

How can international collaboration improve the efficiency of this instrument?

International co-operation agreements

- International co-operation agreements can allow capital projects to benefit from the capacities of other countries (such as technological or human resources) for the effective use of public funds.

Infrastructure-building

- Some international/cross-border infrastructure could be useful for material transportation or access to renewable energy sources (depending on the project itself), which could ultimately benefit the operations of low- and near-zero emissions plants.

Examples of governments that have implemented this type of policy instrument

- Egypt's Industrial Energy Efficiency (IEE) Project (2013) – benefited from support via UNIDO programme.
- Mexico's General Law on Climate Change (LGCC) (2022) – benefited from financial support from the United States.
- Türkiye's Green Industry Project (2023) – benefited from support via a World Bank programme.
- Türkiye's Green Industry Project (2023) – benefited from support from the World Bank.
- Türkiye's Industrial Decarbonization Investment Platform (2024) – benefited from support via a European Bank for Reconstruction and Development programme, in partnership with the World Bank Group and International Finance Corporation.

1.2.10 Sustainable investment schemes, taxonomies and roadmaps

Description

Sustainable investment schemes, taxonomies and roadmaps can serve as tools to indicate which investments and activities can be considered environmentally sustainable and/or consistent with a pathway towards internationally aligned government objectives for net zero emissions. These schemes, taxonomies and roadmaps could be incorporated into regulatory frameworks to set the principles, rules and procedures that investors should follow to invest in or raise capital for a project focused on environmental sustainability. Schemes, in particular, are pooled investments that enter a certain category (in this case, "sustainable") defined by the government, and for which investors could be eligible for tax benefits. Sustainable investment schemes, taxonomies and roadmaps include, for example, schemes for green bonds, sustainability-linked bonds and loans, and transition bonds and loans.

These frameworks outline what is considered a sustainable investment. In some cases, this may include a focus on “transition” finance, which clarifies which investments are compatible with a transition towards government objectives for net zero, even if they may not be for fully decarbonised technologies. Additionally,

such schemes provide detail for investors on the risks they can expect and the protections they have when making such an investment.

How could this policy instrument target deep emissions reductions?

By specifically differentiating between investments in incremental and deep emissions reductions, sustainable investment schemes, taxonomies and roadmaps could improve the enabling conditions for deep emissions reductions. Such a distinction would enable individuals and firms to target deep emissions reductions when they are making their investments or providing capital for others to invest. While such instruments can provide useful guidelines, detailed analysis of individual projects and potential investments will be also important to determine the level of emissions reductions that are achievable.

For transition finance, provisions could be included to ensure alignment with technologies or projects that could transition over time to become fully near-zero emissions, rather than projects that will only ever be capable of achieving partial emissions reductions.

When is this policy instrument suitable?

- Clear taxonomies, roadmaps or legal frameworks provide visibility and clear guardrails as to which investments and financial products can be operated to achieve industrial decarbonisation goals. They can be useful in many contexts for governments to provide guidance for the private sector.
- This instrument may be particularly important for economies with a reasonably large number of financial players in the market, and of industrial companies listed in their exchanges.
- It can be particularly important in economies with large financial markets, where the total amount of investments that could be prone to “greenwashing” is larger in monetary terms than in countries with smaller financial markets.

What needs to be considered before implementation?

- If such taxonomies or roadmaps are mandatory, effective monitoring procedures should be developed to ensure that taxonomies/roadmaps continue to meet objectives. Even for voluntary guidelines, there is a need to understand the impact and use, and make sure that investors are not misled to invest in projects that do not live up to advertised claims about decarbonisation.
- Regular reviews of the taxonomies and investment schemes are needed to ensure they can adapt to the rapidly changing technologies in the market – for instance, the definition of “transition finance” today might be different from the definition just a few years ago.

Best practices

Effectiveness

- The more inclusive the sustainable investment schemes and taxonomies/roadmaps are in terms of the amount of financial products that they include, the better they will enable direct investments towards the most sustainable options for all potential investments.
- Ensure the ambition of the scheme matches the intended policy objectives; for example, by ensuring that “transition” finance schemes have precise guidelines that are in line with the latest emissions reduction or decarbonisation objectives.

Simplicity

- The more inclusive the sustainable investment schemes, taxonomies and roadmaps are in terms of the amount of financial products that they include, the simpler they will be for financial operators. Differentiated financial products are easy to create, so the more the scheme/taxonomy/roadmap characterises these investments, the more transparent the system will be.

Stakeholder acceptability

- Engage diverse stakeholders from both the financial sector and the industrial sector in the design of the schemes/taxonomies/roadmap.

Economic efficiency

- The cost of designing and establishing a sustainable investment scheme, taxonomy or roadmap can be relatively small compared to the number of projects that could access capital as a result. If effectively carried out, this instrument has the potential for high economic efficiency.
- Sustainable investment schemes will be most efficient in leading to emissions reductions if they present clear guidelines over the long term to help redirect investments in a way that avoids stranded assets. A transition finance scheme should clarify the full trajectory of what would be compatible with a net zero pathway based on the latest robust scientific evidence, so that investors can take into account the long-term horizon and profitability in their investment decisions.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful sustainable investment schemes/taxonomies/roadmaps can be replicated by other countries or serve as the basis for their own schemes/taxonomies.

International co-operation agreements

- International co-operation agreements could be used to recognise the sustainable investment schemes/taxonomies of one jurisdiction in another one. This would allow international investors to refer to schemes/taxonomies that are already well-known to them and ease the process of making investments across jurisdictions.

International definitions, standards and certifications

- International definitions, standards and certifications provide more transparency to the framework. Clear and credible definitions on what is considered a "sustainable" financial product can lead to higher confidence in the robustness of these schemes. In turn, this could help increase investments in promising industrial decarbonisation initiatives.

Examples of governments that have implemented this type of policy instrument

- China's Guideline for Energy Efficiency Credit (2015).
- China's 30-60 Goals for Green Bonds (2022).
- The European Union's Sustainable Finance Disclosure Regulation (SFDR) (2023).
- The European Union's Green Bond Standard (2023).
- Japan's Climate Transition Bond Framework (2023).
- Japan's Sector-Specific Technology Roadmaps – Technology Roadmap for "Transition Finance" in Iron and Steel Sector (2021).

2. Targeted actions for specific technologies and strategies

Policies that target particular technology areas and strategies are an important part of a robust policy framework for industrial decarbonisation. They complement and reinforce broader GHG reduction policies by ensuring adequate incentives are in place for the different strategies needed, and helping overcome barriers that are specific to certain strategies. Without them, market signals may be insufficient to push forward the various actions needed.

There are two broad groups of targeted policies. The first is for technologies for the production of industrial products, and includes strategies to: 1) help transform and better manage emissions from high-emitting conventional technologies; 2) create markets that enable early and progressive deployment of near-zero and low-emissions technologies; and 3) to develop and bring innovative near-zero emissions technologies to commercial scale. The second group comprises policies targeting demand for and use of industrial products, in order to maximise efficiency of use and recycling.

2.1 Managing existing assets and near-term investment

What is the purpose of this category?

In order to achieve internationally aligned government objectives for net zero emissions by mid-century at a systemic level, existing emissions-intensive production facilities can either be refurbished to become compatible with near-zero trajectories, or decommissioned and replaced by new low-emissions technologies. However, existing steel and cement plants are unlikely to be replaced with low- or near-zero emissions technologies all at once, due to the need to recoup a return on investments made, a lack of capital, time related to construction, lack of a trained workforce, and/or lack of the necessary resources or infrastructure, among other reasons. Therefore, to pursue industrial decarbonisation in an economically efficient and orderly manner, governments may consider putting in place policies that progressively reduce emissions from high-emitting conventional technologies and instead channel investments to low- and near-zero emissions technologies.

This category includes policies that establish requirements for retrofit-ready builds and major refurbishments, sunset clauses that establish deadlines for the operation of high-emitting technologies, and measures to reduce excess capacity, as well as Tradeable Performance Standards (TPSs) and Carbon Product Requirements (CPRs).

The purpose of this group of measures is to ensure that high-emitting technologies are gradually modified to become low-emissions, or are otherwise phased out, without creating major constraints for production or financial distress for companies, or harming the workforce.

What critical role does this category serve in an overall industrial decarbonisation strategy?

This category is particularly relevant both to industrialised countries that have long-standing production fleets, and to emerging economies that are expecting rapid growth in production in the next few years. With regards to the former, many existing plants may employ high-emitting technologies, representing a large part of the steel and cement production of the country, and may also employ many people. Simply shutting down these production sites could have a large impact on economic activity, but if countries want to fully decarbonise, they will at some point need to address these high-emitting facilities. It will not be sufficient to create new low- or near-zero emissions production sites – it will also be necessary to eventually transform or shut down existing sites. The alternative would be that emissions are ultimately not sufficiently reduced, and excess capacity could impact competitiveness.

Meanwhile, in emerging economies that are rapidly adding capacity, it will be important for producers to take into account future emissions constraints. In the short term, it may not yet be possible to build fully near-zero emission facilities, as many of the relevant technologies are still being demonstrated at commercial scale and costs may be high. Nonetheless, policies can take into account the future transformation of newly built facilities, to avoid stranded investments at a later date.

Policies in this category should ideally be implemented together with other targeted actions that aim at developing new and less emissions-intensive production technologies, as well as actions to create markets that enable the deployment of near-zero and low-emissions technologies. This would accelerate the possibilities for existing facilities to transition to be low-emissions, as well as for new builds to incorporate low-emissions technologies. Moreover, these policies could be included within larger roadmaps or long-term plans and be combined with policies to help finance changes to industries. This category of policies can provide

important reinforcements since broader policies, such as carbon pricing, may not always provide sufficient certainty or strong enough incentives to mobilise investments in capacity in the short term that fully account for the targeted longer-term trajectory.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key questions for governments deciding on which instrument (or set of instruments) in the area of managing existing assets and near-term investments would be better suited to their industrial decarbonisation strategies include the following:

How may these policies be perceived by different stakeholder groups?

The policy instruments in this category, in one way or another, aim at setting emission limits that incentivise producers to change their production practices. If producers perceive these policies as negatively impacting their profits or future plans, without support from the government to carry out these changes, implementation of the policies may raise concerns from stakeholders. There may also be opposition from the workforce, if it appears that the policies will put their future employment possibilities at risk.

The government could propose several compensation mechanisms in the form of complementary policies (which can even be presented as a single policy) to increase the acceptability of these measures. These mechanisms include financing policies to facilitate adoption of alternative low-emissions technologies and compensate for increased costs associated with compliance, or retraining programmes (just transition plans) that ensure that workers are carefully considered in the process.

If the government has the capacity to provide financial support to companies, policies related to requiring retrofit-ready builds and major refurbishments or reductions of excess capacity are more likely to be accepted by producers. Where sunset clauses are used, financial compensation mechanisms might be useful if the deadlines for ending operation are before the end of the useful lives of the plants.

Conversely, if the government does not have the financial capacity to support companies in their transition, measures like TPSs or CPRs operating at a systemic level may be seen as being less targeted to specific companies, and may therefore

be considered more acceptable. These policies provide more flexibility to firms as to how to achieve the required emissions levels. In particular, TPSs give companies the possibility to buy compliance permits in the case that they are not ready to make investments in lower-emissions technologies in the short term.

While acceptability of these policies will depend to a large extent on the economic burden on companies, it will also depend on the perceived need for change among companies. In some contexts, companies might see a strong need and perhaps even a competitive and reputational advantage to having near-zero compatible plants (and as something that they will have to inevitably face), while in other contexts, firms might see a need to prioritise other projects that are not related to decarbonisation. To assess acceptability, governments may discuss these measures with industry to understand their views and then evaluate whether any compensating measures are needed.

What are the timing considerations?

Heavy industry plants, such as those for steel and cement, tend to have investment cycles of around 20 years. Enforcing policies that would prevent companies from locking in investments in high-emitting technologies would help accelerate the path towards net zero. Likewise, not implementing policies that promote the transformation or reduction of high-emitting capacity might miss the opportunity to change direction at the end of a typical investment cycle, and thus result in investment in regular refurbishments that would either build a case for retaining the high-emitting capacity, or ultimately result in stranded assets. This highlights the importance of addressing policies in this category as early as possible.

Based on the above rationale for avoiding a lock-in of high-emitting assets, governments might want to prioritise policies that directly set requirements on the installed capacity (establish requirements for retrofit-ready builds and major refurbishments, sunset clauses, and measures to reduce excess capacity) over those that have a more indirect effect on decisions surrounding the existing capacity (TPSs or CPRs).

What is the complexity associated with implementing each policy instrument?

In terms of practical implementation, policies in this category could be divided into two groups: (i) one that would entail the government monitoring the production sites and checking that they comply with the set rules (including requirements for retrofit-ready builds and major refurbishments, sunset clauses, and measures to reduce excess capacity); and (ii) another in which the government would set

product standards and monitor compliance (including TPSs and CPRs). In the case of TPSs, the role of the government would also include regulating the market for the sale and purchase of the standards.

The complexity and administrative burden of these two groups will depend on the stringency and frequency with which these monitoring procedures are carried out. Governments should weigh their technical expertise to carry out these controls and, if necessary, build the teams to implement these policies. Governments could potentially outsource the process to third-party technical controllers, although many governments prefer to have monitoring capacity within their own teams.

What are the government's budget constraints?

As mentioned above, the choice of policy to manage existing assets and near-term investments may be influenced by the government's capacity to provide financing mechanisms to compensate companies for the investments required to comply with new requirements.

2.1.1 Requirements for retrofit-ready builds and major refurbishments

Description

Through regulation, governments can set requirements for new production sites, as well as for major refurbishments of existing sites. For new sites, these requirements may stipulate that only facilities that are retrofit-ready (that is, have a plan and technical capabilities to switch to near-zero emissions or low-emissions technologies when they become available) can be built out. For existing plants, this may involve requiring that any extension of plant lifetimes through major refurbishments incorporates near-zero or low-emissions technologies.

How could this policy instrument target deep emissions reductions?

Requirements that are easy to implement are often those related to energy efficiency and incremental emissions reduction. However, to address deep emissions reductions, requirements can be set which factor in expected progress in different near-zero technologies in the years ahead. For example, retrofit-ready requirements could account for how near-zero emissions technologies could be incorporated at a later date, even though they may not yet be available. By setting requirements looking towards future production, governments can incentivise producers to plan ahead and avoid locking in investments in high-emissions technologies.

When is this policy instrument suitable?

- This policy instrument could be particularly pertinent both for countries with relatively aged production plants (with measures mostly related to refurbishment measures), and for countries that are expecting a strong expansion of their steel and cement industries in the near to medium term.
- It would be advisable to accompany this policy with funding measures to enable compliance. Financing policies such as subsidies or tax exemptions can complement requirements for retrofit-ready builds and refurbishments, thus allowing producers to build stronger investment cases.

What needs to be considered before implementation?

- **Technical requirements:** assessment and enforcement of the requirements, to ensure that the new-build or retrofit has the appropriate planning and technical considerations (e.g. space to later incorporate new technologies).
- **Financial assessment:** Implementation of this policy has to take into account the financial strength of industrial players to carry out refurbishments or construction of retrofit-ready plants, which are capital-intensive. If such a measure is expected to strain finances, complementary policies to fund investments could be considered, such as subsidies or tax exemptions (see Mobilising finance and investment for options).
- **Timing:** For refurbishments, the policy has to take into account the potential impact of any resulting production outages. A thorough refurbishment schedule has to be planned with relevant industry players.
- **Flexibility:** The right balance needs to be found between requirements that are too simple and requirements that are overly prescriptive. They should allow for a certain level of flexibility and consider all potential cases.
- **External infrastructure:** Infrastructure outside the production sites, such as CO_2 transport pipelines, electricity grids etc., also needs to be considered once the requirements are designed. Governments should evaluate if there is a need for any public infrastructure investments to enable these measures.

Best practices

Effectiveness

- Ensure the policy covers all production plants in the sector. Where possible, avoid granting exceptions to companies. If exceptions are to be granted, ensure there is a clear mechanism to apply for them and a strict timeline for their expiration.
- Establish a clear set of technical guidelines and a rigorous process to assess compliance with the requirements. Retrofit-ready requirements should be based on robustly demonstrable steps and design considerations for later retrofit, rather than vague plans that are still at the theoretical level.

Simplicity

- Establish clear rules to determine how a certain facility should be built or refurbished to meet the requirements.
- Ideally, the policy would be integrated with existing permitting processes to streamline application and assessment procedures.

Stakeholder acceptability

- Engage representatives of each impacted stakeholder group in the design of the policy. Perform market consultations to understand the state of existing plants, planned investments, and the financial robustness of the impacted companies.

Economic efficiency

- Well-designed requirements for retrofit-ready builds and refurbishments should avoid large expenditures by the government. If the policy is properly designed, costs for the government once the policy is active should be limited to assessing relevant permit applications, while the market itself should drive investment in these changes at the plant level.
- The policy should be technology-neutral, in that retrofitting to any technology that meets the required emissions performance considerations is acceptable.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful policies related to requirements for retrofit-ready builds and refurbishments can provide valuable insights for the implementation of other policies in different countries or sectors. Though each country or sector will have its own specificities, the response to these requirements in different locations or sectors can help to inform the design of new policies elsewhere.

Access to international financing

- Requirements for retrofit-ready builds and refurbishments can be assisted by international loans and financing agreements to the plants that are affected by such regulation. International finance could not only play a role in directly financing these plants, but also in providing other ways of reducing the risks associated with investment (e.g. by fixing input or output prices through hedging arrangements or provisions of guarantees).

Infrastructure-building

- In very particular cases where infrastructure that is external to the plant acts as a barrier to investment and where international infrastructure could resolve the limitation (e.g. for plants close to international borders), international infrastructure could play a role in aiding such requirements to succeed.

International definitions, standards and certifications

- Low- and near-zero emissions definitions for materials such as steel and cement could facilitate more transparent retrofit-ready building and refurbishment policies by clearly showing the end goals as well as the intermediate objectives.

Commercial agreements

- International agreements between governments to only allow purchases of goods produced under certain types of facilities/technologies can help create a better case for this type of regulation.

Examples of governments that have implemented this type of policy instrument

- Canada's Federal funding for steel companies to phase out coal-based steelmaking (2021) – to comply with requirements under the 2020 Bill C-12, the Canadian Net-Zero Emissions Accountability Act.
- China's Conversion of Exhaust Heat and Pressure (2006).
- China's Capacity replacement measures to restrict the addition BFBOF and encourage scrap-EAF development (2021).
- The European Union's Best Available Techniques (BAT) Reference Document for Iron and Steel Production (2013).
- The European Union's Industrial and Livestock Rearing Emissions Directive (IED 2.0) (2011).

2.1.2 Sunset clauses

Description

In the context of this Policy Toolbox, sunset clauses entail the establishment of a specific date beyond which a certain high-emitting technology can no longer operate. This means that after this deadline, a defined set of high-emitting plants must be either retrofitted to incorporate lower-emissions technologies or shut down. Such policies could also be used to prohibit new capacity additions with high-emitting technologies beyond a set date.

How could this policy instrument target deep emissions reductions?

This policy could target deep emissions reductions by setting emissions thresholds that are sufficiently stringent, and including additional requirements where necessary, or making use of complementary incentives to ensure that compliance targets investments in transformational technologies. This would prevent the possibility of compliance through implementation of only modest process improvements that reduce emissions just below the required emissions threshold, particularly if that emissions level is not very stringent.

When is this policy instrument suitable?

- This instrument is particularly pertinent to countries with a large number of plants operating with high-emitting technologies, and especially where it is common practice for these to be refurbished to extend lifetimes (e.g. unabated blast furnace-basic oxygen furnace [BF-BOF] steel plants). Conversely, for countries where substantial new capacity is anticipated, such a policy could be used to steer the direction of new additions (see also 2.1.1 Requirements for retrofit-ready builds and major refurbishments, which is a slightly different but related approach).
- Sunset clauses act to prohibit certain high-emitting production technologies, but they are normally implemented in such a way as to give affected producers sufficient time to refurbish their plants to incorporate low-emissions technologies, if desired.

What needs to be considered before implementation?

- To help maintain the competitiveness of affected industrial producers, the policy should take into account the financial strength of industrial players to invest in low-emissions technologies (either via refurbishments or new builds), which are capital-intensive. If the assessment indicates that many producers would struggle to face such capital costs, complementary policies to fund these investments could be considered (see Mobilising finance and investment for options).
- If an objective of the policy is that certain plants close down, and provided that the government does not intend to reduce production, alternative production measures should be evaluated, and policies to incentivise the buildout of new and less emissions-intensive plants should be implemented. Otherwise, the government should expect the missing production to be replaced with imports that comply with the desired emissions levels.
- Before implementing sunset clauses, the government should evaluate the impact of permanent shutdowns or temporary halts in production due to refurbishment on total production. If this could cause bottlenecks in the economy, the government may need to re-evaluate the proposed schedule.

- The effects that permanent or temporary shutdowns would have on employment have to be carefully evaluated. Governments might want to consider pairing this policy instrument with Just transition planning, support mechanisms, and skills redevelopment and training.

Best practices

Effectiveness

- Implement clear rules and timelines with emissions thresholds to determine which plants should be retrofitted to incorporate low-emissions technologies or be shut down, and when. Do not leave it to uncertain guidelines that are subject to interpretation, but rather base rules on numerical values.
- Where possible, avoid granting exceptions to companies. If exceptions are to be granted, make sure there is a clear mechanism for application and a strict timeline for their expiration.

Simplicity

- Establish clear rules backed by emissions thresholds per unit of production to determine when and how a certain facility should be retrofitted or shut down.
- Include a clear timeline, with as much advance notice as possible, that indicates the dates when certain technologies will need to be phased out to give foresight to industrial players. This can be connected with policies including Requirements for retrofit-ready builds and refurbishments.

Stakeholder acceptability

- Engage representatives of each impacted stakeholder group in the design of the policy. Perform market consultations to understand the state of existing plants, planned investments, and the financial robustness of the affected companies.
- Complement the policy with other instruments to ease the impact on producers, such as just transition measures, financial assistance to adopt low-emissions technologies, and intensified RD&D support to develop the required near-zero and low-emissions technologies in time.

Economic efficiency

- Strong policy design should avoid large expenditures by the government. If the policy is properly designed, costs for the government once the policy is active should be limited to monitoring and controlling.
- Where possible, the policy should be technology-neutral and instead base requirements on emissions performance. For example, if a particular furnace type can be adapted to substantially reduce emissions (e.g. through carbon capture

and storage), the emissions performance achievable would be the main consideration for the sunsetting requirements rather than the furnace type itself, which may reduce costs.

How can international collaboration improve the efficiency of this instrument?

Access to international financing

- To enable investments in low-emissions technologies rather than continued investments in high-emissions ones, sunset clauses can be complemented with international loans and financing agreements to the producers that are being affected by such regulation. International finance could play a role not only in directly financing plants, but also in providing other ways of reducing investment risk (e.g. by fixing input or output prices through hedging arrangements or provisions of guarantees).

Infrastructure-building

- In particular cases where infrastructure that is external to the plant acts as a barrier to investment and where international infrastructure could resolve this limitation (e.g. for plants close to international borders), international infrastructure could play a role in aiding such requirements to succeed.

International definitions, standards and certifications

- Low- and near-zero emissions definitions for materials such as steel and cement could enable more transparent policy on sunset clauses by clearly showing the end goals as well as the intermediate objectives.

Examples of governments that have implemented this type of policy instrument

- Examples from other sectors:
- Canada's Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations (2012).

2.1.3 Measures to reduce excess capacity

Description

Measures to reduce excess capacity include policies that either promote the phase-out of unused and high-emitting production capacity; impose barriers to the buildout of high-emitting plants, which might become stranded assets before mid-century; or remove subsidies or other supports that may be enabling firms to

maintain capacity that would otherwise not be competitive. These measures might include Sunset clauses specifically related to excess capacity, or other economic disincentives such as fees or increased taxes on excess capacity. Measures might specifically target a reduction of the highest-emitting and less efficient capacity, in order to achieve emissions reductions benefits alongside broader objectives related to the functioning of markets.

Excess capacity in industrial production reduces profit margins, as it represents a cost that is not paired with unit revenues. Over the medium to long term, this provides less profit for companies with excess capacity to invest in new technologies. At the system level, excess capacity can result in lower prices for industrial products, which further affects profitability and can hamper fair global competition. Overall, excess capacity can end up distorting supply chains and global markets for industrial products, posing strain on certain companies and impacting their workers. This financial strain on supply chains can, in turn, also hamper other firms' abilities to invest in lower-emissions technologies and capacity. Measures to reduce excess capacity can help remedy this situation, and international co-operation on such measures is important given the global nature of industrial markets.

Some countries may have in place subsidies that generate incentives to increase or maintain high-emissions capacity that would otherwise not have been built or kept online. Such distorting subsidies and the non-market-driven excess capacity they result in affect the financial performance of firms and the overall level of emissions of the sector. Efforts to remove such subsidies are a type of measure to help reduce excess capacity.

How could this policy instrument target deep emissions reductions?

While this policy instrument targets emissions reductions directly by avoiding the buildout of and/or reducing the maintenance of high-emissions excess capacity, it also does so indirectly, by helping to create stronger financial and enabling conditions for investment in transformational near-zero and low-emissions technologies.

When is this policy instrument suitable?

- This policy instrument is particularly pertinent to countries with an old and/or high-emissions industrial production mix with capacity that is underutilised. It is also pertinent to countries where high-emissions capacity may be growing or maintained at a rate that is higher than that needed to meet demand, due to operation of state-owned enterprises and/or the use of subsidies.

What needs to be considered before implementation?

- Confirm that the capacity being targeted is long-term excess capacity and not excess capacity resulting from a specific circumstance that is likely to be temporary – e.g. an economic recession, seasonal changes, any external shock that could reasonably be expected to change.

Best practices

Effectiveness

- Implement clear rules to determine what is considered excess capacity (including date of last use, volume thresholds, utilisation rates, type of technology, projections of future use, etc.), and how to manage such capacity. Try to base decision rules on numerical values.
- Where possible, avoid granting exceptions to companies. If exceptions are to be granted, make sure there is a clear mechanism for application and a strict timeline for their expiration.
- Avoid granting subsidies that are likely to aid buildout or maintenance of high-emissions excess capacity. If there is a belief that the existing subsidies to the industrial sector are generating distortions to the market, carefully assess whether they are producing incentives to support underutilised capacity, and if so, propose plans to reduce or eliminate them.

Simplicity

- Include a timeline that indicates the dates when certain excess capacity should be phased out. The procedure should include dates for an evaluation by regulators, as well as a plan for the decommissioning of the excess capacity.

Acceptability by stakeholders

- Engage representatives of each affected stakeholder group in the design of the policy. Perform market consultations to understand the state of existing plants, planned investments, and the financial robustness of the impacted companies.
- Complement the policy with other policy instruments to ease potential effects on affected producers, such as just transition measures.

Economic efficiency

- Strong policy design should avoid large expenditures by the government. If the policy is well designed, costs for the government once the policy is active should be limited to monitoring activities (e.g. assessing relevant plants).
- Target the oldest and highest-emitting and/or lowest-efficiency plants, so that reducing excess capacity has both financial and emissions benefits.

- If the government has identified subsidies that favour the buildout or maintenance of excess capacity, propose a plan to reduce and/or dismantle them. This would reduce government expenses and should be done at a relatively low cost.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful measures related to reducing excess capacity could provide valuable insights for the implementation of other measures in different countries or sectors (including improved monitoring of excess or underutilised capacity). Though each country/sector will have its own specificities, the response to these requirements in other locations or sectors can serve as a basis in the design of the policy elsewhere. International dialogues to share experiences can help advance the implementation of these measures.
- International fora that bring together governments to discuss approaches on how to deal with excess capacity, such as the Global Forum on Steel Excess Capacity (GFSEC), can bring innovative and collaborative solutions to this shared challenge.

International definitions, standards and certifications

- International standards regarding what constitutes excess capacity could aid the implementation of this policy.

Examples of governments that have implemented this type of policy instrument

- China's Action Plan for Carbon Dioxide Peaking Before 2030 (2021).
- China's Ban on net capacity additions (2021).
- Global Forum on Steel Excess Capacity (established in 2016) – this includes the guiding principles and policy recommendations of the Berlin Ministerial Report (2017).
- Malaysia's 2-year Moratorium to update steel industry direction (2023).

2.1.4 Tradeable performance standards

See 1.1.4 Tradeable performance standards (TPSs) in the section on "Establishing plans and policy for long-term GHG emission reductions".

2.1.5 Carbon Product Requirements

Description

Carbon Product Requirements (CPRs) are regulatory requirements for producers of a certain material or product to ensure that carbon emissions fall below a certain predefined threshold. The impacted goods are generally intermediate products such as steel, cement or chemicals, rather than end-products. This is a mandatory compliance system. CPRs work very similarly to 1.1.4 Tradeable performance standards (TPSs), except for the fact that they are not tradeable.

CPRs can be sector-based and can be adjusted over time to become more stringent, thus indicating the direction of travel towards governments' net zero emissions goals. The objective is to incentivise innovation and to phase out high-emitting technologies.

CPRs could eventually be combined with carbon pricing by requiring facilities that emit above the established threshold to pay for those emissions.

How could this policy instrument target deep emissions reductions?

CPRs can act on both incremental and deep emissions reductions. The more stringent the requirement, the higher the likelihood of deep emissions reductions. Once the allowed rate of emissions is sufficiently low, the cost of maintaining highly polluting production techniques will represent a large burden for companies as they will have to invest in technological changes to comply with the requirement or buy emissions certificates (in the case that the policy allows for it). Over time, this will incentivise deep decarbonisation reductions through the switch to more innovative technology. If the schedule of reductions is outlined sufficiently far into the future, this would help make clear the need to invest in transformational technologies, rather than complying with near-term requirements alone. This is particularly important to prevent stranded investments that only meet short-term requirements and do not consider the full long-term trajectory.

When is this policy instrument suitable?

- A CPR system can be tailored to the targeted sector(s). Sector-specific CPRs can accommodate for the characteristics of each product and can be adjusted according to the goals set for each sector.
- Setting a clear and well-staggered scheme for the standards to evolve over time towards government objectives for net zero provides foresight to companies. Such a scheme can be particularly useful for sectors that have long-lived capital and high investment costs, and for which demand can change significantly depending on the price of the product.

What needs to be considered before implementation?

- **Emissions monitoring:** MRV and enforcement of the mechanism includes selecting an appropriate methodology for emissions accounting, ideally drawing from already existing and commonly used methodologies (e.g. ISO standards).
- **Coherence with existing regulation:** Ensure that CPRs do not conflict with any existing codes or standards.
- **Exemptions:** Ideally, clear rules and timelines should be agreed at the moment of implementing the CPRs and respected over time, providing foresight on the scheme. Any assigned exemptions should be carefully considered, including their purpose, fairness and duration.
- **Stringency level:** There is a risk that the initial benchmarks set by the CPR are not stringent enough to generate substantial emissions reductions. In such cases, the government might need to adjust the benchmarks. Ideally, there should be a predefined schedule for the changes in the requirements, so that companies have better foresight and can make investment plans. One way to design CPRs is to make the initial requirements relatively easy to comply with, and then have them ramp up over time so that companies' adaptation progresses smoothly.
- **Carbon leakage:** If CPRs are only applied internally, there is a risk that highly emitting production that does not comply with the CPR is displaced outside of the jurisdiction implementing the CPR. This is known as "carbon leakage" and can neutralise the decrease in emissions due to the CPR system in one jurisdiction through the increase of emissions in another that has lower requirements (see Climate Club exchanges on carbon leakage and other spillover effects for further detail). CPRs could be used as international mechanisms, if applied to imports, which could at least partially help reduce the risk of carbon leakage as a result of domestic policies. Some countries are trying to mitigate the risk of carbon leakage through international co-operation agreements and other measures (please refer to the International co-operation and a level playing field category for further discussion on policy instruments in this regard).
- **Distributional impacts:** the burden of the cost increases due to CPRs falls entirely on the private sector. Policy makers should evaluate if this measure needs to be complemented with some sort of financial assistance (see Mobilising finance and investment for options).

Best practices

Effectiveness

- Where possible, avoid granting exceptions to companies. If exceptions are to be granted, ensure there is a clear mechanism for application and a strict timeline for the expiration of such exceptions.
- Establish a well-planned schedule to reduce the emissions thresholds in the CPR, with notification to regulated entities well in advance, driving a fall in emissions.

Simplicity

- Clearly outline the emissions measurement methodology, ideally drawing from existing and widely used methodologies (e.g. International Organization for Standardization [ISO] standards).

Stakeholder acceptability

- Engage different stakeholders in the CPR programme design and build understanding of their cost structures to evaluate realistic benchmarks and a sufficiently stringent schedule for the adjustment of the benchmarks that apply to the industry.

Economic efficiency

- A well-designed CPR system should not incur large expenditures by the government. If the policy is properly designed, costs for the government once the policy is active should be limited to monitoring and controlling, while the market itself drives the innovation necessary for the emission rates to decrease progressively.
- Given than CPRs are relatively inflexible, in that they do not have a tradeable component, they might be best used as a backstopping signalling mechanism. Setting a trajectory that is reasonably achievable and announced far enough in advance can give producers sufficient time to plan for the transition, and ideally to avoid inefficient investment choices (e.g. avoiding major investments in near-term incremental reductions to stay under the CPR, when it may be better to instead invest in transformational technologies which could take slightly longer to implement).

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful CPR systems can serve as the basis for other CPR systems in different countries or applied to different sectors.

International definitions, standards and certifications

- Definitions for low- and near-zero emissions for materials, such as steel and cement, will enable a more transparent and credible CRP system by clearly showing the end goals as well as the intermediate objectives.

International co-operation agreements

- International co-operation agreements to co-ordinate CPR systems would allow for a more effective implementation of the instrument and reduce the administrative burden for companies operating in different countries.

Commercial agreements

- Commercial agreements between governments, whereby they adhere to certain CPRs, could be used to partly address carbon leakage risks.

Examples of governments that have implemented this type of policy instrument

- The United States' General Services Administration CPRs applied to public procurement (low embodied carbon material requirements) (2023).

Discussion of potential application to industry sector:

- Agora Industry (2024) A vision for international trade in CO_2-intensive materials.

2.2 Creating a market for near-zero emissions materials production

What is the purpose of this category?

In many cases, low- and near-zero emissions materials are not yet produced at a commercial scale that can compete with materials produced with conventional high-emissions technologies, meaning that consumers do not yet have the option to purchase these materials. At the same time, potential demand and willingness to pay for such materials is not yet entirely clear, and so many producers are hesitant to make the investments necessary to produce them. This category therefore includes all policies that aim at increasing either the demand or the supply of low- and near-zero industrial materials, particularly in the more difficult and riskier stage of early deployment, and therefore ultimately aim to shift the market towards such materials.

From a policy standpoint, there are several measures that can be taken to help generate demand for these materials, and to provide sufficient price stability and long-term foresight to mobilise investments in technologies that will enable market creation. These include public procurement for near-zero and low-emissions materials, state-backed intermediaries, incentives for near-zero emissions private procurement, support for collaborative procurement and buyers' alliances, sustainability certifications and product stewardship initiatives, as well as

Contracts for Difference (CfDs). Other policies can target scale-up of supply of near-zero emissions materials, such as mandates/quotas, minimum content regulations and embodied carbon limits on end-use products. Some of these policy instruments might serve multiple purposes. Ultimately, the objective of these policies is to create clear market signals to producers that there will be firm demand for these materials, in spite of potentially higher costs, and/or that their investment in near-zero emissions capacity will be supported with incentives or made competitive via regulatory means.

What critical role does this category serve in an overall industrial decarbonisation strategy?

This category is at the core of the industrial decarbonisation strategy because it deals directly with the operations of producers and with building the market conditions for scaling up low- and near-zero emissions materials. However, if these targeted policies do not fit into a wider industrial decarbonisation strategy (including long-term plans, availability of capital, R&D support, and other infrastructure and legal bases), they may be insufficient on their own.

When these overarching conditions are in place, the main role of this category of policy instruments is to, on the one hand, provide a good indication of what the future demand for low- and near-zero materials will be, so that potential producers can improve their investment cases. On the other hand, these policies aim to ensure that supplies will be sufficient to meet demand for materials needed to get low- and near-zero goods to end consumers. The importance of this category of instruments is therefore in facilitating market growth by reducing the risks perceived by both buyers and sellers.

This category of instruments is particularly important in the earlier stages of market formation, when risks and costs are typically highest. In the longer term, other policies may take a more prominent role in driving market development, such as if carbon prices reach levels that are sufficient to make near-zero emissions materials competitive with their high-emissions counterparts.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key questions for governments deciding on which instrument (or set of instruments) in the area of creating a market for near-zero emissions materials production would be better suited to their industrial decarbonisation strategies include the following:

How may these policies be perceived by different stakeholder groups?

The policy instruments in this category aim to provide foresight to market players on what the future demand and supply for low- and near-term emissions materials will be, and to overcome barriers to market development. Policies that provide such foresight have costs that might be borne in part by the state (and which will have to consider taxpayers' priorities), and in part by the private sector (which will have to find in such policies the right economic incentives to be willing to bear these additional costs).

The burden of policy instruments like public procurement for near-zero and low-emissions materials, state-backed intermediaries, and Contracts for Difference (CfDs) provided by public entities mostly falls on the government. Therefore, the decision to pursue these policies must be weighed against other budgetary priorities. The cost to the government of policies like incentives for near-zero emissions private procurement or support for collaborative procurements and buyers' alliances will depend on the specific design of the policy, but their weight on national budgets would tend to be lower than that of the three policy instruments mentioned above. Consideration of what taxpayers consider to be an appropriate use of their tax money, along with proper communication of these measures, will be key for implementation.

Conversely, policy instruments such as near-zero emissions material mandates/quotas and minimum content regulations; embodied carbon limits on end-use products; and sustainability certifications and product stewardship initiatives essentially create requirements for producers. Their cost will typically be borne by the private sector. The government will therefore need to evaluate whether these policies should be complemented with other policies to ease the burden on companies and potentially increase acceptability.

What is the complexity associated with implementing each policy instrument?

The policy instruments within this category could be divided between: (1) those where the government directly funds or otherwise supports demand creation (such as public procurement for near-zero and low-emissions materials, state-backed intermediaries, incentives for near-zero emissions private procurement, support for collaborative procurements and buyers' alliances, sustainability certifications and product stewardship initiatives); and (2) those where the role of the government is more related to monitoring and ensuring compliance with the regulation (such as near-zero emissions material mandates/quotas and minimum content regulations, embodied carbon limits on end-use products).

The implementation of policy instruments within the first group would usually entail the evaluation of which materials and/or initiatives to spend budget on, updating procurement practices, and agreeing on definitions for 'low-' and 'near-zero' emissions materials. Meanwhile, the implementation of policy instruments in the second group, which would entail a more active monitoring role, might mean that the government would have to set up long-term control mechanisms and manage them. These tasks might each present different levels of complexity depending on the resources and capacities of the government implementing them.

As a risk-reducing financial policy instrument, the design of a CfD and its implementation may be more complex than monitoring the CfD, which is related to putting in place the proper mechanisms to follow the execution of the contract over time and make any required modifications, as needed.

What are the government's budget considerations?

As mentioned, some policy instruments will require more direct disbursements than others, and governments might want to consider their options in light of total available budget and potential other uses.

What is the coverage of the policy instrument?

In selecting different instruments, it is important to consider the portion of the market that can be covered. For example, a government might evaluate what portion of the country's demand comes from public or private purchases, and how both of these segments could be aided. Furthermore, some instruments may be useful in providing very substantial support to a small portion of the market to overcome the higher risks for first movers (e.g. through CfDs), while other instruments could align incentives more broadly across the market with less substantial support (e.g. near-zero emissions materials mandates).

2.2.1 Contracts for difference (CfDs)

See 1.2.6 Contracts for difference (CfDs) in the "Mobilising finance and investment" section.

2.2.2 Public procurement for near-zero and low-emissions materials

Description

By using the purchasing power of public bodies (or affiliated organisations), governments can support early and growing markets for near-zero and low-

emissions materials, such as steel and cement. Given that governments are often a large (or, in some countries, the single largest) consumer of construction materials, public procurement policies for near-zero and low-emissions materials not only help to offer consistency with national near-zero commitments, but also provide very important support for low- and near-zero emissions materials. Such a positive demand signal will tend to generate economies of scale and improve the business cases of materials producers, allowing them to more easily shift to low- and near-zero emissions industrial processes. Over time, this should incentivise innovation and competition, and ultimately bring down the price of low- and near-zero emissions products.

How could this policy instrument target deep emissions reductions?

Public procurement for near-zero and low-emissions materials has the potential to be tailored specifically to support the deployment of innovative near-zero technologies. Governments can allow for piloting or demonstration in their procurement practices, and even purchase goods that have not yet reached the market. In other words, public procurement can provide explicit support to pre-commercial near-zero technologies.

Governments could also set specific requirements for meeting a portion of their purchases with near-zero emissions materials. Even if this is initially only a very small portion, it would send a signal of willingness to take on the additional costs and risks of early deployment. This may include considerations and requirements to ensure at least part of procurement is met with transformational technologies (e.g. near-zero emissions iron or clinker production), rather than with already existing conventional production that uses input materials that are naturally less emissions-intensive (e.g. scrap-based steel production or cement with a high portion of supplementary cementitious materials). Meanwhile, communicating future procurement requirements as far in advance as possible, ideally with increasing ambition over time, would help provide confidence to markets sufficiently in advance. To enable such policies, it is essential to enhance evaluation metrics, including indicators focused on both life-cycle emissions and whether production has achieved deep emissions reductions.

When is this policy instrument suitable?

- To support the creation of an early market for low- and near-zero emissions materials, helping to build confidence in bringing supply online and reducing the costs of more innovative technologies. These programmes can even start with small experimental purchases and then increase to cover larger areas of public procurement, ramping up ambition.

- Public procurement instruments are particularly effective where the government directly influences a large share of construction and infrastructure development (according to the Industrial Deep Decarbonisation Initiative [IDDI], governments account for 25% of steel and 40% of concrete demand globally).
- Public procurement for near-zero and low-emissions materials could also help facilitate the development of similar measures in the private sector, with government enabling the necessary supporting architecture (e.g. emissions data collection, definitions and labelling systems). Moreover, this policy instrument also gives the government the opportunity to support employment in low- and near-zero emissions materials markets.
- This policy instrument is also important for setting an example for others through consistency with the general industrial decarbonisation public position and any long-term decarbonisation goals.

What needs to be considered before implementation?

- **Procurement guidelines:** Updating and applying procurement guidelines across government departments and agencies, which will require the appropriate training of procurement officials and incorporation of their needs as guidelines are developed.
- **Emissions data collection, labelling and standards and definitions:** Collecting consistent and verifiable data to inform procurement decisions, including detailed product-level emissions data and, if appropriate, accompanied by labelling systems. Clear definitions or taxonomies around what is considered low- and near-zero emissions could facilitate implementation, allowing state entities to demonstrate their near-zero emissions procurement practices. International definitions, standards and certifications could simplify the process.
- **Budget:** Low- and near-zero emissions products will, in many cases, be more expensive than traditional products. This likely therefore implies somewhat increased costs for public procurement, which should be evaluated in light of other budgetary priorities.
- **Availability:** Design of procurement policies might consider including clauses that procurement requirements are subject to availability of such materials, or certain caps on the cost premium. This would enable governments to make more ambitious commitments to support the scale-up of transformational technologies, without the risk of not being able to meet them in the event that sufficient near-zero emissions production is not ready in time at reasonable costs.
- **Infrastructure:** It will be important to assess whether the required enabling infrastructure for low- and near-zero emissions materials, production processes and transport of inputs is in place. If not, the government may consider facilitating the infrastructure needed for local production or the import of such final products or inputs for their production.

- **Just transition:** In countries where the government is a large buyer of materials, public procurement policies must also be considered in light of the effects they could have on employment in the sector, and any need for workforce skills development.
- **Carbon leakage and trade considerations:** The risk of carbon leakage associated with public procurement measures will depend on their stringency – unless very stringent, risk should likely be relatively low, since measures are incentive-based and only affect a portion of production. Nevertheless, to reduce risks, the policy should ensure that the same procurement rules used for domestic purchases are also applied to imports. This can also help ensure that public procurement for near-zero and low-emissions materials does not result in barriers to trade.

Best practices

Effectiveness

- Where possible, avoid granting exceptions for the purchases of materials. Exceptions should only be granted if accessing low- or near-zero emissions material at a reasonable cost can be demonstrated to be impossible (where possible, what is considered a reasonable cost should be defined in the initial policy). If exceptions are granted, ensure there is a strict timeline for revision of such exceptions.
- If an objective is to reduce emissions, consideration should be given to how to support transformational technologies, rather than already existing conventional production that has naturally lower emissions (see above).

Simplicity

- Clearly outline the emissions measurement methodology, where possible drawing on existing widely used standards and labelling systems (e.g. ISO standards, Environmental Product Declarations [EPD]).
- Clearly explain the eligibility criteria.
- Integrate into existing procurement procedures and processes that procurement officials are familiar with, as far as possible.

Stakeholder acceptability

- Be transparent with taxpayers and the general public on the amount of funds used for each purchase. Provide public access to information about the projects' objectives and timelines, their progress and the benefits that can be obtained from them.

Economic efficiency

- The burden of this policy instrument is borne entirely by the government. Public procurement for near-zero and low-emissions materials programmes will have a directly measurable impact on the emissions related to the government's activities, and can also encourage the development of innovative technologies.
- Seek to purchase the lowest-cost available material that achieves the targeted emissions performance level, regardless of the technology used. The exception to this would be if a policy objective is to incentivise scale-up of transformational technologies, then preference could be given to technologies that are not already commonly used in the market and/or that enable decarbonisation of emissions that are hard-to-abate (e.g. clinker or iron production).

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful public procurement for near-zero and low-emissions materials programmes can provide learnings for other programmes.

Access to international financing

- With the purpose of advancing industrial decarbonisation goals, some governments and international organisations could be open to providing financing to support public procurement for near-zero and low-emissions materials programmes. Often, financing arrangements are accompanied by expert advice on the design of such policies.

International definitions, standards and certifications

- Public procurement measures may employ taxonomies around what type of materials are considered low- and near-zero emissions. If internationally recognised definitions can be used, this will not only simplify the work of the government, but it will also provide the programme with more credibility and accessibility at the international level and simplify compliance for producers operating in international markets.

Commercial agreements

- International commercial agreements between governments could allow for beneficial treatment of the low- or near-zero emissions materials covered by the scheme. This way, governments could purchase foreign goods that comply with the requirements of their public procurement for near-zero and low-emissions materials programmes. If these low- or near-zero emissions materials are not produced locally, such agreements could expedite the implementation of public procurement policies.

Examples of governments that have implemented this type of policy instrument

- Australia's Environmentally Sustainable Procurement Policy and Reporting (2024).
- China's 14th Five-Year Plan for Raw Material Industry Development (2021) – includes a commitment to increase the government's "green procurement" efforts.
- China's Green Building Materials Procurement Policy (2022).
- The European Union's Ecodesign Directive for Sustainable Products Regulation (ESPR) (2024) [requirements for steel currently under consideration].
- The European Union's Construction Products Regulation (CPR) [requirements for concrete and cement currently under consideration].
- The European Union's Clean Industrial Deal (2025).
- Germany's Climate Protection Public Procurement Law Transformation Act (2024). – includes a CO_2 shadow price for public procurement.
- Japan's Act on Promoting Green Procurement (2025) – an amendment to include steel requirements in this policy is currently under public consultation.
- Türkiye's Communiqué regarding Low Carbon Emissions in Public Procurement Contracts to Promote the Use of Green Cement (2024).
- The United Kingdom's Steel Public Procurement Guidance (2023).
- Colorado's (United States) Measures to Limit Global Warming Potential for Certain Materials Used in Public Projects (2021).

2.2.3 State-backed intermediary purchasing

Description

State-backed intermediary purchasers are entities that purchase low- or near-zero emissions materials from private producers and then sell them to private industrial consumers at a price that is in line with traditional materials. In this way, state-backed entities absorb the cost premium (or part of it) and cover the price volatility risk related to the production of low- or near-zero emissions materials.

These intermediaries can even sign long-term offtake agreements with low- or near-zero emissions materials producers, thus giving those producers more foresight on their future sales. In turn, the intermediaries can sell the materials via short-term agreements. They can therefore act as liquidity providers – creating demand and increasing the number of transactions in order to develop a market.

How could this policy instrument target deep emissions reductions?

To target deep emissions reductions, state-backed intermediaries should be mandated to buy only near-zero emissions materials, or sufficiently low-emissions materials that would require use of transformational technologies. Rules to define these categories should be strictly enforced.

When is this policy instrument suitable?

- State-backed intermediaries can be most useful in contexts where the cost premium of near-zero emissions materials is significant, which may be particularly the case during early deployment.
- For governments that are willing to indirectly subsidise certain low- and near-zero emissions materials. This may work particularly well for materials for which the government has substantial demand for its own procurement (e.g. certain steel products), or if it is deemed complex to integrate ambitious targets or long-term offtake agreements into existing public procurement processes.
- It is particularly pertinent for materials for which near-zero emission production methods have recently reached commercial phase, or are close to doing so, but do not yet have a significant number of customers.

What needs to be considered before implementation?

- **Budget:** The creation of state-backed intermediaries implies a burden on government budgets, so the relevance of the policy has to be evaluated in light of other priorities, and the economic costs assessed. Given that this is taxpayers' money, there might be public acceptance issues if the society does not consider this to be a good use of public funds. Effective public communication of the policy will therefore be an important element of implementation.
- **Offtake risk:** The state-backed intermediary absorbs all the offtake risk, meaning that they could find themselves in a situation where they are buying the materials and not finding subsequent buyers. This risk would be higher in cases where the entity absorbs only a portion of the cost premium, since it is more likely that – in this case – buyers choose to purchase lower-cost, higher-emissions materials instead. This risk has to be evaluated in light of the government's financial ability to respond.
- **Guidelines:** The transparency of the process of providing offtake agreements is very important. Clear guidelines on which entities can be beneficiaries of the policy and what requirements their products have to comply with are key elements for the proper functioning of the process. Eligibility criteria should also include a financial assessment of the participants, particularly in cases where there is a lag between the payment and the delivery of the materials.

Best practices

Effectiveness

- Ensure only projects that can prove a deep emissions reduction pathway can be counterparties to an offtake agreement.

Simplicity

- Make requirements for both supplying and purchasing companies easy to understand.
- Simplify the process for firms to participate in the programme, for example through one-stop shops for applications.
- Clearly outline the emissions measurement methodology that should be used to prove eligibility for a potential offtake agreement.

Stakeholder acceptability

- Provide public access to information about the offtake agreements. Be transparent in the amount of funds at risk for each transaction.
- Involve relevant stakeholders in the process of developing the instrument to ensure fair procedures are established, and clearly communicate eligibility guidelines.

Economic efficiency

- Evaluate the risk taken in each offtake agreement and at portfolio level, to make best use of government funds.
- Ensure the process is competitive among sellers (e.g. through an auction process), so that there is an incentive to reduce the cost premium of near-zero emissions materials to the extent feasible.

How can international collaboration improve the efficiency of this instrument?

Access to international financing

- State-backed intermediaries can be assisted by international loans and financing agreements with the government. Governments could even decide to fund these entities together with other multilateral organisations or non-governmental organisations, using a blended finance arrangement.

International definitions, standards and certifications

- Employing clear and internationally accepted near-zero and low-emissions definitions for materials such as steel and cement would allow a more transparent decisions on which companies to enter offtake agreements with.

Commercial agreements

- If the country that backs the intermediary is looking to support low- and near-zero emissions materials in other countries (likely advanced economies supporting emerging markets and developing economies [EMDEs]), the entity could sign commercial offtake agreements with companies in other countries.

Examples of governments that have implemented this type of policy instrument

- Germany's support for Hintco, a subsidiary of H2Global.

2.2.4 Incentives for near-zero emissions private procurement

Description

Policies that promote near-zero emissions procurement in the private sector could include economic incentives such as tax reductions or credits for companies that purchase certain materials. Such incentives could also be given directly to producers of near-zero emissions materials to enable a reduction in their market price, thus making it easier to sell to private sector buyers. Economic incentives are particularly relevant for the procurement of materials produced with pre-commercial or recently commercialised near-zero technologies.

How could this policy instrument target deep emissions reductions?

Incentives for near-zero emissions private procurement have the potential to be tailored to support the deployment of innovative near-zero technologies and materials produced using these technologies. In their procurement practices, firms can allow for piloting or demonstration instances, and even purchase goods that have not yet reached the market (pre-commercial near-zero technologies).

When is this policy instrument suitable?

- May be a next step for countries that already have strong near-zero emissions public procurement policies in place, such that public procurement practices could serve as the reference for the private sector and be a stepping-stone for

widespread minimum procurement standards in the market. Meanwhile, for governments that have limited ability to adopt ambitious public procurement requirements (e.g. due to existing requirements for least-cost procurement that are difficult to shift in the short term), incentivising private procurement of near-zero emissions materials could provide an alternative method of support.

- This instrument could be of particular interest to countries with a large number of public services that are under private concessions, or where a substantial portion of the infrastructure is constructed under public private partnerships (PPPs). Promoting near-zero emissions procurement practices under these schemes could be the starting point for expanding these practices to the rest of the private sector.

What needs to be considered before implementation?

- **Budget:** For economic incentives that imply disbursements by the government or foregone tax revenue, the relevance of the policy has to be assessed in light of other policy priorities and the economic costs evaluated. Given that this is taxpayers' money, there might be public acceptance issues if society does not consider this to be a good use of public funds. Effective public communication of the policy will therefore be an important element in the implementation.
- **Standards and definitions:** Clear definitions or taxonomies around what is considered low- and near-zero emissions could facilitate the policy when used to determine the eligibility of private sector purchases for incentives. International definitions, standards and certifications could simplify the process in this regard. This may include, for example, encouraging the private sector to use labelling systems like EPDs in their procurement policies, to enable eligibility for incentives.
- **Infrastructure:** In order to implement policies that would incentivise near-zero emissions private procurement, governments should assess whether the required enabling infrastructure for low- and near-zero emissions materials and production processes and the transport of inputs is in place. If not, the government may consider facilitating the infrastructure needed for local production or the import of such final products or inputs for their production.

Best practices

Effectiveness

- If economic incentives are granted to support near-zero emissions private procurement, eligibility criteria for such benefits should be clearly outlined well in advance to give companies sufficient time to adjust their practices.
- Such incentives should target ambitious requirements and/or thresholds for materials, in order to mobilise changes in procurement practices towards supporting deep emissions reductions, rather than being directed towards procurement choices that might already be in existence for some companies.

Simplicity

- Clearly state the emissions performance levels required for different materials to be eligible for incentives. Low- and near-zero emissions definitions could help in this respect.
- If a certification system for promoting near-zero emissions private procurement is to be implemented, make sure that the requirements and procedures are easy for companies to follow.

Stakeholder acceptability

- Engage different stakeholders in the programme design and build understanding of their cost structures to evaluate realistic incentives and/or fair requirements for the industry.
- Make sure that end consumers are aware of the policy and how it will impact the products they buy.

Economic efficiency

- In the case that economic incentives are granted by the government, a thorough analysis of the impact that certain measures could have in incentivising procurement of certain low- and near-zero emissions materials should be performed. Particularly for pre-commercial technologies, the economic efficiency should be measured at the portfolio level, and not at the individual project level, since some projects might not render the expected results.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful policies to promote near-zero emissions private procurement can provide learnings for other programmes.

Access to international financing

- With the purpose of advancing industrial decarbonisation goals, some governments and international organisations could be open to providing financing to support near-zero emissions procurement programmes in the private sector. This could be done through direct financing of the private firms, or by financing governments to implement economic incentives for companies that follow certain procurement practices.

International definitions, standards and certifications

- Near-zero emissions private procurement measures should be ideally accompanied by internationally accepted and comparable definitions or taxonomies around what type of materials are considered low- and near-zero emissions. The use of internationally recognised definitions, where available, will not only simplify near-zero emissions private procurement processes for actors operating on international markets, but also provide the companies' procurement practices more credibility.

Commercial agreements

- International commercial agreements could allow for beneficial treatment of the low- or near-zero emissions materials that companies are looking to purchase through the near-zero emissions procurement practices incentivised by their governments. If these materials are not produced locally, such agreements could support efforts to source materials via imports and/or boost local production.

Examples of governments that have implemented this type of policy instrument

An example from the transport sector:

- The European Union's Emissions Trading System [ETS] provision of free allowances for airlines using sustainable aviation fuels.

Additional discussion of relevant instruments and examples from other sectors can be found in:

- Industrial Transition Accelerator (2024), Green Demand Policy Playbook (section 3.8).

2.2.5 Support for collaborative procurements and buyers' alliances

Description

A group of producers can form an alliance or consortium to buy a certain amount of low- or near-zero emissions materials. Such collaborative procurement can be done by collectively signing a contract or offtake agreement that aggregates the demand of all the buyers in the alliance/consortium. The government can facilitate these alliances by helping establish them, helping develop standardised contracts with the legal protections necessary to give participants security, and even by participating in these alliances as a public sector purchaser.

How could this policy instrument target deep emissions reductions?

Collaborative procurement has the potential to be tailored specifically to support the deployment of innovative near-zero emissions technologies through demand creation. Through collective contracts and offtake agreements, the group of purchasers can allow for piloting or demonstration instances and even purchase goods that have not yet reached the market (pre-commercial near-zero technologies).

When is this policy instrument suitable?

- This system provides better foresight into the level of demand for low- and near-zero emissions materials (both in terms of volume and time) and can be particularly relevant for pre-commercial technologies, or those that have just reached commercialisation. This, in turn, will indirectly incentivise investment in new technologies.
- Mainly for markets with a substantial number of potential buyers of a low- or near-zero emissions material, but where each of these buyers alone is not large enough to steer the decarbonisation pathway of the sector.
- Easier to implement in markets where producers know each other well and have fluid communications, or in tandem with programmes to facilitate this.
- If collaborative procurement for other goods and services is a common practice, collaborative procurement of low- and near-zero emissions products could be incentivised by leveraging positive experiences in other sectors and existing legislation.
- If collaborative procurement is already a common practice in the public sector, implementation in the private sector could leverage the existing public model.

What needs to be considered before implementation?

- **Collusion risk:** While collaborative procurement can support low- or near-zero emissions technologies, it can also provide price negotiation power to buyers. The government should ensure that these practices do not end up being collusive and that the buyers' alliance/consortium respects antitrust laws.
- **Standards:** Consideration should be given to how standards (e.g. definitions for low- and near-zero emissions materials) could be used to set criteria for eligible purchases.

Best practices

Effectiveness

- Collaborative procurement should have strict and ideally ambitious rules for the products being purchased, which could make use of existing standards and definitions, where available.

Simplicity

- Clearly state what emissions performance levels for different materials are considered eligible. Definitions for low- and near-zero emissions materials could help in this respect.

Acceptability by stakeholders

- If the government is part of the alliance or consortium, engage all buyers that are part of the alliance/consortium in the design of the procurement rules.
- Enforce antitrust laws to make sure that the alliance or consortium does not hinder competition on the market.

Economic efficiency

- Unless the government forms part of the buyers' alliance/consortium, then the only cost for the government relates to administrative aspects it takes on, e.g. designing the framework for these contracts to be valid, ensuring contracts are within the law, etc. This measure has the potential to boost demand for low- and near-zero materials at a relatively low cost to the government.
- If the government forms part of the consortium, the economic efficiency will depend on the ultimate results of the collaborative purchases. Focusing on emissions performance and taking a technology-neutral approach could help ensure that the lowest-cost – yet still transformational – processes are supported.

How can international collaboration improve the efficiency of this instrument?

Access to international financing

- With the purpose of advancing industrial decarbonisation goals, some governments and international organisations could be open to providing financing to support collective procurement programmes. This could be done through direct financing to buyers, or by financing the innovative pre-commercial technologies that will produce the products to be sold to these buyers' alliances.

International co-operation agreements

- Collaborative procurement or buyers' alliances could work at an international level.

International definitions, standards and certifications

- Collaborative procurement should be ideally accompanied by definitions or taxonomies around what type of materials are considered low- and near-zero emissions. Use of internationally recognised definitions, where available, would simplify near-zero emissions private procurement processes for actors operating on international markets, and would provide the alliances' procurement practices more credibility.

Examples of governments that have implemented this type of policy instrument

- The First Movers Coalition, initiated in 2021 in partnership with the United States government.

2.2.6 Near-zero emissions material mandates/quotas and minimum content regulations

Description

A near-zero emissions material production mandate or quota sets a growing minimum market share for near-zero emissions steel, cement and other materials production, thereby establishing a lead market through regulation (similar to a renewable portfolio standard or a zero-emission vehicle mandate). Such a mandate could include a tradeable certificates scheme, so that the requirement is met on average throughout the market, while individual producers or purchasers who do not meet the requirement could purchase certificates from those who exceed it (as for an ETS). The regulation would require increasing performance over time – for example, requiring shares of low-emissions production at various performance levels in the near term, and gradually phasing in requirements for near-zero emissions production.

The regulation could be applied either on the production side, requiring producers to sell a growing share of near-zero emissions production, or on the consumption side, requiring product manufacturers in key demand sectors (e.g. automobiles, construction) to purchase a growing share of near-zero emissions production. The latter formulation is sometimes referred to as a minimum content regulation. Applying such regulations on the consumption side should enable product manufacturers to more easily pass through the cost to end-users; however, the policy may be more administratively complex due to larger number of actors involved and the need to pass emissions information along the value chain.

In some cases, material mandates can start to be implemented for public procurement, or for certain subsectors, before being extended to the rest of the market.

How could this policy instrument target deep emissions reductions?

If the regulatory requirements are stringent enough, they will target deep emissions reductions. That is, if the policy focuses specifically on near-zero emissions production or ambitious levels of low-emissions production, it should target deep emissions reductions.

On the other hand, if a company is able to comply with the regulation through incremental emissions reductions alone, then there is room for the requirements to be more ambitious. Similarly, if requirements could be easily met with already existing conventional production that is naturally lower emissions due to the input materials used (e.g. scrap-based steel production, cement production relying on a large share of conventional supplementary cementitious materials), it will be important to consider including relevant definitions and requirements to incentivise scale-up of transformational technologies (e.g. near-zero emissions iron or clinker production).

When is this policy instrument suitable?

- Mandatory quotas can be implemented in contexts where demand does not yet exist for a certain low- or near-zero emissions material. These quotas can be adjusted over time to increase the level of ambition of the policy, while also giving time for the necessary technology to be deployed at a larger scale.
- In contexts where the technology necessary for compliance is already commercially available. If this is not the case, such regulations can be announced well in advance to help support accelerated progress, with an implementation date that is practically achievable based on reasonable rates of progress for relevant technologies.
- For countries wanting to spur early development of the required infrastructure and supply chains for near-zero emissions materials.
- Adoption may be most feasible for countries that are accompanying these measures with financing policies that support the shift to production techniques that facilitate compliance with the materials mandates.

What needs to be considered before implementation?

- **Monitoring:** The costs of reporting on and monitoring enforcement. If the policy is formulated as having a tradeable mechanism, this would include setting up a tradeable certificates system/market.

- **Standards:** This policy requires selecting an emissions measurement methodology and definitions for the near-zero and/or low-emissions levels targeted. Ideally these would be based on internationally accepted and comparable standards, and cover the full lifecycle of the materials.
- **Financial support:** The implementation of this policy should take into account the financial strength of industrial players to comply with the regulation, which might imply high capital investments. If such a measure is expected to cause financial strain, complementary policies to help fund these investments should be considered.
- **Infrastructure:** Implementation will rely on having enabling infrastructure for low- and near-zero emissions production processes in place. If not, the government may need to consider how to facilitate development of the infrastructure for the local production or the import of such final products, or inputs for their production.
- **Supply chain integration:** Integrated supply chains allow for straightforward compliance tracking. Countries where supply chains are less integrated might consider a monitoring system that ensures the regulation is respected. In line with this, governments may choose to implement near-zero emission material mandates and minimum content regulations together with robust chain of custody mechanisms (e.g. book and claim systems) to be able to properly track compliance with the regulatory requirements.
- **Flexibility:** A balance has to be found between requirements that are simple and requirements that are overly normative. The design of requirements should consider allowing for a certain level of flexibility and consider all cases, perhaps through a tradeable mechanism.
- **International competitiveness:** There is a risk that placing emissions reductions requirements on domestic production could impact competitiveness on international markets, particularly if similar requirements are not placed on imported production. This risk could be considerably mitigated for a near-zero emissions material mandate by using a tradeable certificates scheme, as all domestic producers can thus contribute a small amount through purchase of compliance certificates in support of the initially small share of near-zero emissions production. However, if the policy continues to increase in stringency over time, eventually competitiveness concerns may increase. Some countries are trying to mitigate such risks by also applying requirements to imported products, such as through carbon border adjustment mechanisms (please refer to the International co-operations and a level playing field category for a further discussion on other policy instruments).

Best practices

Effectiveness

- Establish a clear timeline for requirements to increase in stringency well in advance, to give companies sufficient time to comply.

- For maximum effectiveness, apply the policy across all producers or buyers throughout the supply chain in the relevant sector. Where possible, avoid granting exceptions to companies. If exceptions are to be granted, make sure there is a clear mechanism for applications, and a strict timeline for the expiration of such exceptions.

Simplicity

- Clearly outline the emissions measurement methodology and definitions used.
- Include a timeline that indicates the dates at which certain quotas or product requirements have to be achieved. There should be sufficient foresight for companies to plan their investments accordingly.

Stakeholder acceptability

- Engage representatives of each impacted stakeholder group in the design of the policy. Perform market consultations to understand the cost structure, planned investments, and financial robustness of the companies affected.
- Perform an overall market analysis to understand if and how the new requirements might create bottlenecks and might place strain on certain producers. If deemed necessary, put in place funding or finance provisions to help regulated producers in the initial stages of scaling up near-zero emissions production.

Economic efficiency

- Using a tradeable certificates system would help make the policy as efficient as possible. This would allow producers using the lowest-cost near-zero emission production possible to trade their certificates to higher-emitting producers, allowing the market to scale up as the certifications progressively get more expensive. In turn, this would encourage more producers to shift to transformational technologies, rather than requiring all individual producers to have a certain minimum share of near-zero emissions production.
- Basing the policy on emissions performance requirements, rather than the type of technology, would help the policy to be met in the most cost-effective way. However, if the policy goal is to help scale up transformational technologies, requirements should consider provisions so that the policy is not simply met by existing production that is naturally low-emissions due to the input materials used (e.g. scrap-based steel).
- Strong regulation design should avoid large expenditures by the government. If the policy is properly designed, costs for the government once the policy is active should be limited to monitoring and controlling, while the market itself should drive investment in these changes at the production level.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Already adopted near-zero emission mandates and minimum content regulations can provide learnings for other policies in different countries or sectors. Though each country/sector will have its own specificities, the response to these requirements in other locations or sectors can serve as a basis for the design of the policy.

Access to international financing

- Requirements relating to materials can be assisted by international loans and financing agreements for the producers that are affected by such regulation. This is particularly pertinent for producers that have to make large investments in order to comply with the regulations.

International definitions, standards and certifications

- Use of internationally accepted, comparable and interoperable definitions for low- and near-zero emissions for materials such as steel and cement will allow a more credible and transparent regulatory framework for materials and make compliance easier for actors operating on international markets.

Commercial agreements

- International commercial agreements between producers and buyers to only allow purchases of materials that are compliant with certain regulations can help reinforce this measure.

Examples of governments that have implemented this type of policy instrument

- Proposed in academic research: Triggering Investment in First-of-a-Kind and Early Near-Zero Emissions Industrial Facilities.

2.2.7 Embodied carbon limits or taxes on end-use products

Description

Embodied carbon policies take into consideration all the emissions resulting from the production of an end-use product, such as a car or a building. Such policies either introduce regulation to set limits on embodied carbon (e.g. maximum

quantity of embodied carbon per unit of floor area in a building), and/or tax emissions that exceed these limits.

Such a policy is similar to a minimum content regulation in that it is applied to end-use products; however, it does not require specific shares of near-zero or low-emissions for specific materials. As such, it provides a weaker signal for scale-up of innovative near-zero emissions steel or cement, as the requirements could instead be met by switching to different lower-emissions materials (e.g. wood), or using already existing conventional production that has lower emissions (e.g. scrap-based steel production). Nevertheless, such a policy can provide some market signals for low-emissions materials, particularly as stringency increases.

How could this policy instrument target deep emissions reductions?

If the regulatory requirements are stringent enough, they will target deep emissions reductions. In contrast, if companies are able to comply with the regulation through incremental emissions reductions alone, then there is room for the requirements to be more ambitious.

When is this policy instrument suitable?

- Embodied carbon limits on end-products can accommodate for the characteristics of each product and can be adjusted according to the goals set for each sector.
- For governments wanting to send a broad signal for emissions reductions from industrial products, which could be met through various means (material efficiency, material switching, reduced material production emissions). The government may choose to complement this instrument with other targeted policies focused on scaling up near-zero emission production.
- May be easier to implement in countries that are accompanying these measures with financing policies to support the shift to production techniques that allow for compliance with these requirements.
- For governments particularly concerned about international competitiveness, applying regulations on end-use products that are not highly traded could reduce potential risks to competitiveness for materials producers operating on international markets, since end-use requirements would apply equally to both domestically produced and imported materials.

What needs to be considered before implementation?

- **Evolution of standards:** Establishing a clear scheme for the standards to evolve over time towards government objectives for net zero, with the timeline set well in advance, provides foresight to companies. A scheme that progressively sets more

ambitious embodied carbon limits on end-products can be particularly helpful in sectors where demand can change significantly depending on the price of the product.

- **Embodied emissions monitoring:** Monitoring, reporting and verification (MRV) and enforcement of the mechanism. This includes selecting an appropriate methodology for emissions accounting, ideally drawing from existing commonly used methodologies (e.g. ISO standards).
- **Exemptions:** Any assignment of exemptions should be carefully considered, including their purpose, fairness and duration. Ideally, clear rules and timelines should be agreed at the moment of implementing embodied carbon limits on end-products and respected throughout time, providing foresight on the system.
- **Stringency level:** There is a risk that the initial embodied carbon limits on end-products are not stringent enough to generate substantial reductions in emissions. In such cases, the government might need to adjust the limits. Ideally, there should be a predefined schedule for any changes to the limits, so that companies have better foresight and can make investment plans. One way of designing the limits is to make the initial requirements quite easy to comply with, and then have them ramp up over time to facilitate the adaptation process for companies.
- **Carbon leakage and competitiveness:** For tradeable end-products (such as cars), there is a risk that higher production costs (given the incorporation of emissions costs via the embodied carbon limits) results in the displacement of highly emitting production outside of the jurisdiction implementing the regulation. This is known as “carbon leakage”, as the decrease in emissions resulting from embodied carbon limits in one jurisdiction is neutralised by the increase of emissions in another jurisdiction with lower requirements. Some countries are trying to mitigate the risk of carbon leakage through international co-operation and other measures (please refer to the International co-operation and a level playing field category for further discussion on policy instruments in this regard). In this case, such policies would need to be applied to embodied emissions to counteract potential risks. In this case, such policies would need to be applied to embodied emissions to counteract potential risks.
- **Distributional impacts:** The burden of the cost increases due to the embodied carbon limits falls entirely on the private sector. Policy makers may need to evaluate if this measure should be complemented with financial assistance (see Mobilising finance and investment for options). Furthermore, consideration should be given to whether the cost increase is passed through to end consumers, and whether it is necessary or not to have some sort of compensation mechanism (for industrial materials, analysis shows that the additional cost often ends up being a relatively small portion of the final product costs, so in many cases compensation is not needed, but this is still important to evaluate during the policy development process). that the additional cost often ends up being a relatively small portion of the final product costs, so in many cases compensation is not needed, but this is still important to evaluate during the policy development process).

Best practices

Effectiveness

- Ensure the stringency of the policy increases over time at a rate commensurate with the emissions reductions targeted. The timeline should ideally be laid out well in advance to give companies time to comply, and to consider investment in transformational technologies required to meet longer-term requirements.
- Where possible, avoid granting exceptions to companies. If exceptions are to be granted, make sure there is a clear mechanism to apply for them and a strict timeline for the expiration of such exceptions.

Simplicity

- Clearly outline the emissions measurement methodology and any thresholds used for the embodied carbon limits.
- Include a timeline that indicates the dates when the limits will be adjusted and by how much, to provide foresight so that companies can plan their investments accordingly.

Stakeholder acceptability

- Engage different stakeholders in the design of the embodied carbon limits programme, and build understanding of their cost structures to evaluate realistic limits and design a sufficiently stringent schedule for the adjustments that is fair for the industry.
- Perform an overall market analysis to understand if and how the new requirements might create bottlenecks and could place strain on certain producers. If deemed necessary, put in place funding or finance provisions to help companies to meet the requirements.

Economic efficiency

- Strong design of the embodied carbon limits and their adjustment schedules should avoid large expenditures by the government. If the policy is well designed, costs for the government once the policy is active should be limited to monitoring and ensuring compliance, while the market itself should drive the innovation necessary for emissions to decrease progressively.
- Given that the policy by nature focuses on overall embodied emissions levels rather than specific strategies or technologies, it should already be relatively efficient at reducing emissions. In this case, having a timeline of requirements laid out sufficiently in advance will help improve the economic efficiency of the policy in the long-term, so that companies consider strategies and investments that will meet more stringent requirements over the long term, beyond the strategies that can most easily meet near-term, less stringent requirements.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful policies related to embodied carbon limits on end-products could provide learnings for other policies in different countries or sectors. Though each country and sector will have its own specificities, the response to these requirements in one location or sector could inform the design of the policy in another.

Access to international financing

- Requirements for end-use products can be assisted by international loans and financing agreements to the companies that are affected by such regulation. This is particularly pertinent for companies that have to make large investments in order to comply with the regulations.

International definitions, standards and certifications

- Use of internationally accepted, comparable and interoperable emissions measurement standards will provide a more credible and transparent regulatory framework for end-products and make compliance easier for actors operating on international markets.

Commercial agreements

- International commercial agreements between producers and buyers, to only allow purchases of materials that are compliant with certain regulations, can help reinforce the measure.

Examples of governments that have implemented this type of policy instrument

- Denmark's National Strategy for Sustainable Construction (2023).
- France's RE2020 (2020).

2.2.8 Sustainability certifications and product stewardship initiatives

Description

Sustainability-related certifications and labelling schemes provide a way to communicate to potential buyers the characteristics and performance of products. This may include labels that differentiate near-zero and low-emissions processes

and products to inform the consumer purchasing materials, or to otherwise communicate on GHG emissions performance. It may also include other sustainability considerations, such as wider environmental or social impacts.

Closely linked to certification are initiatives that promote product stewardship. Product stewardship implies handling inputs and final products in a sustainable manner throughout the supply chain. This way, both waste and carbon emissions are minimised. These initiatives cover different stages from the design of the product through to its end-of-life management.

While some sustainability certifications and stewardship initiatives are already in place, led by private sector, non-governmental or multi-stakeholder initiatives, governments could also use these tools. This could include promoting use of existing systems or, if needed, developing additional systems. Governments could promote their voluntary use or require mandatory certifications for particular actors. Use of labels for near-zero or low-emissions materials could assist government policies (e.g. public procurement), but also facilitate lead markets by helping communicate consistent and verifiable information to buyers.

How could this policy instrument target deep emissions reductions?

Certifications could specifically be tailored to address deep emissions reductions, such as through labelling that specifically recognises and promotes near-zero emissions performance, or clearly communicates when performance results in emissions that are substantially lower than is possible with conventional technologies.

When is this policy instrument suitable?

- For governments seeking to support private procurement of near-zero and low-emissions materials.
- May be easier to implement in countries that accompany certification measures with financing policies that support the shift to more sustainable production techniques.

What needs to be considered before implementation?

- **Monitoring:** If the policy requires mandatory certification, reporting and monitoring costs to enforce the policy must be considered. This includes periodical monitoring of entities that already hold certificates.
- **Coherence with existing regulation:** Ensure these certifications do not conflict with any existing codes or standards.

- **Supply chain integration:** Integrated supply chains allow for more straightforward compliance tracking. Countries where supply chains are less integrated should consider a monitoring system that ensures the certification requirements are respected at different steps in the chain.
- **Financial support:** Consider providing financial support for businesses to help them shift to technologies that would allow them to implement better product stewardship practices.
- **Infrastructure:** To implement such policies, governments may need to consider whether they need to assist with ensuring that the infrastructure required for low- and near-zero emissions material production processes is in place. If it is not, governments may need to help facilitate the development of infrastructure for the local production or import of such final products, or inputs for their production.

Best practices

Effectiveness

- Certification should require a certain level of emissions that is compatible with a trajectory towards meeting governments' objectives for net zero.
- Certification should be time-limited and be reinstated periodically.
- Making certification mandatory rather than voluntary could be more effective in driving change in markets.

Simplicity

- Establish transparent processes for applying for certification.
- Clearly outline the emissions measurement methodology.
- Streamline the process for firms that already hold a certificate and need only to renew it.

- Include provisions in any mandatory certification policies to allow compliance through any robust and eligible certification system; the government could facilitate interoperability considerations so that multiple schemes could be accepted.

Stakeholder acceptability

- Carry out consultation with different stakeholders in the design of the certification scheme and/or the selection of eligible existing schemes.
- For voluntary certification schemes, make sure end-users are aware of what the certification means.
- For mandatory certification, build understanding of the related costs for companies. Take this into consideration when setting requirements for compliance.

Economic efficiency

- Economic efficiency will largely depend on: 1) whether the certification scheme is voluntary or mandatory; and 2) how stringent the certification requirements are.
- Allowing multiple eligible compliance schemes will improve efficiency by avoiding the need for companies to certify against multiple different, albeit similar, schemes.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful certification and product stewardship initiatives can serve as the basis for other initiatives in different countries.

International definitions, standards and certifications

- Collaboration on and use of internationally accepted and interoperable near-zero and low-emissions definitions for materials such as steel and cement will allow more transparent and credible certification and product stewardship initiatives by clearly showing the end goals as well as the intermediate objectives. This would also make compliance easier for actors operating on international markets.

Examples of governments that have implemented this type of policy instrument

- Low Emission Steel Standard (LESS) – initiated by the German government (2024).

2.3 Developing technologies

What is the purpose of this category?

Policies to stimulate the development and commercialisation of new low- and near-zero emissions technologies will be instrumental in advancing industrial decarbonisation from a production point of view. While policies in this category largely focus on RD&D of pre-commercial technologies, they also include incentives for continued innovation in commercial technologies to improve performance and reduce costs.

Technologies to fully decarbonise steel and cement production are not yet available for widespread deployment in the commercial market. Overcoming the remaining innovation hurdles for near-commercial technologies, as well as

advancing earlier-stage technologies that could diversify the options available, entails considerable costs and risks. While markets for low- and near-zero emissions steel and cement are starting to develop, these markets alone are still unlikely to provide sufficient incentives and certainty for the private sector to develop emerging technologies. As such, the development of the technologies to produce these materials often needs to be supported by entities (such as government bodies) that are not looking for near-term economic returns, and are willing to absorb the potential risk of these technologies not reaching the market. The government can step in to finance, subsidise or co-ordinate the development of the technologies it sees as aiding its industrial decarbonisation pathway. Often this includes implementing policies that incentivise the private sector to also support such technologies. Over the long term, pursuing policies that favour the development of technologies can create new and competitive capabilities, helping position countries who have invested in RD&D as technology producers and even innovation leaders.

This category focuses on the technical and design aspects of the policies that seek to develop innovative decarbonisation technologies. The funding aspects that underlie these policies are covered in the Mobilising finance and investment section.

What critical role does this category serve in an overall industrial decarbonisation strategy?

The adoption and targeting of research and innovation policies usually depends on the long-term view of how each country wants to position itself in the emerging near-zero emissions economy. If a country aims to play a prominent role in the production of low- and near-zero technologies and materials, implementing policies within this category will be important, particularly those targeted at any areas where there may be a strategic advantage, or that are seen as imperative to successful implementation of a country's decarbonisation strategy.

At a global systemic level, some countries will have to implement policies in this category to help advance the development of technologies that would set the global industry on a pathway to net zero emissions. International collaboration and partnerships are valuable towards this aim, to ensure strong coverage of the range of decarbonisation options, and enable demonstration across diverse regional contexts. If a country's industrial decarbonisation strategy relies on a particular technology, but it is not implementing R&D policies to develop that technology domestically, co-ordination and partnerships with countries who are undertaking efforts on that technology will be fundamental.

As policies in this category often entail a bet on the uncertain development of technologies, they require time, as well as a certain tolerance of risk. These policies are an important complement to other broader decarbonisation policies, such as carbon pricing, which on their own are unlikely to provide sufficient incentive for the private sector to take on the high risk and costs associated with developing technologies.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key questions for governments deciding on which instrument (or set of instruments) in the area of developing technologies would be better suited to their industrial decarbonisation strategies include the following:

What are the government's budget considerations and risk appetite?

Policies in this section will often entail government expenditures with outcomes that are uncertain, or that might take longer than anticipated. This is intrinsic to any investment (public or private) in research and innovation. Therefore, when deciding to implement policies in this category, governments should be conscious of this risk and strategic in targeting funds to particular technology areas and projects/recipients. Moreover, it will be important to transparently communicate to taxpayers that part of the public budget is being devoted to activities that might not render profits.

Depending on the disposable budget and the assessment of the risk that proposed technology projects present, governments can decide to implement policies that require more or less capital. Policies where the government directly funds projects, such as funding for RD&D, are typically more costly than those where the government generates incentives for the private sector to make these investments (e.g. through programmes and networks for innovation, knowledge-sharing and co-ordination, or regulatory sandboxes). However, direct public funding of these research projects provides a higher level of certainty that they will be carried out (regardless of the outcomes). Policies in the latter group, with indirect funding, are less certain to result in real and substantial investments in these projects – ultimately it will be for the private sector to decide. In the case of PPPs, the burden on the government will depend on what its participation in the partnership is.

What are the timing considerations?

An important aspect to consider is that these policies primarily create results over the long term. Only in certain cases (e.g. direct funding targeted at large-scale commercial demonstration) are these policies likely to result in concrete applications for the industry in the shorter term.

It is more likely that policies where the government fully or partially funds the investments (RD&D funding and PPPs) will accelerate innovation processes. In contrast, policies to stimulate technological innovation by the private sector (programmes and networks for innovation, knowledge-sharing and co-ordination, and regulatory sandboxes) have a more uncertain timeframe, as there is no guarantee that the investments will even take place.

Due to the long and potentially uncertain timescales involved, it is particularly important to establish RD&D policies as early on as possible to target policies to priority areas and, where possible, to seek international co-ordination opportunities to improve efficiencies and share learnings to speed the overall innovation process.

How may these policies be perceived by different stakeholder groups?

RD&D funding, PPPs, and programmes and networks for innovation, knowledge-sharing and co-ordination are likely to be positively perceived by the industrial sector, which is receiving direct support from the government (either financial or as a co-ordinator). Concerns may be raised by taxpayers and other sectors (including subsectors within industry) that are not being supported by the policies, as they may consider that the budget could be better spent. Effective political communication with taxpayers and dialogue with other sectors can be key to addressing potential concerns.

For regulatory sandboxes, stakeholder acceptance will depend on what the policy entails, but would generally include simplifying the regulatory framework for certain producers, which may be perceived as unfair by other producers. When designing regulatory sandboxes, ensuring fair and transparent selection of recipients will be an important aspect to consider.

What is the complexity associated with implementing each policy instrument?

Policy instruments limited to funding are generally relatively straightforward to implement, with the most complex aspect being defining the eligibility criteria. In this sense, RD&D funding should, in theory, be simple to implement, unless the

government intends to have a more active role in the projects. In contrast, PPPs tend to require more hands-on involvement by the government, depending on the conditions of each PPP.

Policy instruments such as programmes and networks for innovation, knowledge-sharing and co-ordination, and regulatory sandboxes, typically imply a more active role for the government as a co-ordinator. This might result in more complex implementation, including that the government will have to be actively engaged throughout the lifetime of the policy. This contrasts with the more front-loaded engagement in the case of policies solely related to direct funding.

2.3.1 R&D and demonstration funding

Description

Public funding for R&D can be vital to the development of new low- and near-zero emissions technologies. Many of the technological advances needed for industrial decarbonisation are too large and too risky for private capital to pursue. This is where public financing can be key, especially for large-scale demonstration projects that do not render profits.

Public funding can either be directed to projects that are led and administered by the government, or flow through direct transfers to private sector firms that are looking to pursue relevant investments.

How could this policy instrument target deep emissions reductions?

The government can decide to only fund projects that aim at innovations for deep emissions reductions.

When is this policy instrument suitable?

- For projects that the private sector is not showing interest in. These are generally projects that could achieve results only in the long term, or that run a high risk of not being profitable.
- For early-stage projects, as well as those that have undergone piloting and that require funding to get to the commercialisation stage and overcome the so-called “valley of death”.
- Particularly pertinent to countries that have the research and engineering capabilities to undertake large demonstration projects or innovative projects that are not being carried out elsewhere.

- For governments whose budget can support these expenses, mainly because a positive outcome could likely only be realised over the long term. The vision for this type of policy should never be profitability, since the probability of making a profit is uncertain.

What needs to be considered before implementation?

- **Researchers and qualified personnel:** Finding the right companies and/or professionals to lead and develop these projects can be a challenge, particularly in countries that do not have large scientific programmes or where professionals with the required expertise might not be available in the local market.
- **Flexibility:** The inherent nature of RD&D projects is that scope, key performance indicators and objectives are subject to change as these projects progress. It is therefore important for the funding entity to provide support and flexibility to ensure projects succeed and provide results.
- **Infrastructure:** In order to implement such policies, governments should make sure that the basic external infrastructure to pursue the project is in place.
- **Budget:** Pursuing some of these projects can be a burden on government budget, so the relevance of the initiative must be evaluated in light of other policy priorities.
- **Monitoring:** Clear objectives for the projects should be established beforehand, as well as rigid timelines. There should be periodical monitoring to evaluate the results of each project. By closely monitoring the development of the projects, the government can better help advance its industrial decarbonisation objectives.
- **Transparent guidelines:** The transparency of the process of providing direct public funding is very important. Clear guidelines on which entities can be beneficiaries of the policy and which projects will be supported are key elements to ensure that funds go to projects that will contribute to the industrial decarbonisation process.
- **Patents and intellectual property:** It is important to have predefined rules and laws on patent ownership and intellectual property management, while simultaneously finding ways to maximise knowledge-sharing and collaboration within such agreed rules.

Best practices

Effectiveness

- Ensure that funded projects have clearly defined objectives and mechanisms to measure their progress. Establish checkpoints to monitor project development. Even if the projects do not render the desired results, ensure there are mechanisms to make sure some results are achieved and that the timelines for the projects are respected.

Simplicity

- Clearly establish conditions to determine eligibility for public funding.
- Clearly outline the processes for the disbursement of project funds. Simplify funding application processes, for example through one-stop shops for various government funding programmes.

Stakeholder acceptability

- Be transparent in the amount of funds given to each project. Provide the general public access to information about the projects' objectives and timelines, their progress, and the benefits that can be obtained.

Economic efficiency

- Economic efficiency should be measured at the portfolio level, and not at the individual project level, since some projects might not render the expected results. Having unsuccessful projects is part of the risk that RD&D investments entail, so this should not be regarded necessarily as a loss, but rather as part of the process.
- Perform thorough financial analysis of the funded projects. Evaluate potential downside cases and only fund projects that have a risk that is manageable for the government.

How can international collaboration improve the efficiency of this instrument?

Access to international financing

- RD&D funding can be assisted by international loans and financing agreements with the government or directly with the projects.

International co-operation agreements

- International co-operation agreements can allow RD&D funding to leverage capacities of other countries (such as technological or human resources).

Examples of governments that have implemented this type of policy instrument

- Canada's Energy Innovation Programme (EIP) (2016).
- Canada's Low Carbon Economy Fund (2017, replenished in 2022).
- The European Union's Processes 4 Planet (under Horizon Europe) (2021).
- The European Union's Innovation Fund (2019).
- The European Union's Clean Steel Partnership (CSP) (2021).
- The European Union's Research Fund for Coal and Steel (RFCS) (2021).

- The European Union's European Research Area (ERA) industrial technology roadmap for low-carbon technologies (2022).
- France's 2030 Investment Plan (2022).
- Germany's Development and Resilience Plan (DARP)/1.1 Decarbonisation (2021), included within 7th Energy Research Programme (2018).
- Germany's 8th Energy Research Programme (2023).
- India's Promotion of Research & Development in Iron & Steel (2010).
- India's Steel Research and Technology Mission of India (SRTMI) (2018).
- Italy's Tax credit for research and development (2024).
- The United Kingdom's SUSTAIN Future Manufacturing Research Hub (2019).
- The United Kingdom's Programme for Research and Innovation in Steel and Metals (PRISM) (2020).
- The United States' Industrial Heat Shot (2022),
- The United States' Revolutionising Ore to Steel to Impact Emissions (ROSIE) (2023).

2.3.2 Public private partnerships

See 1.2.8 Public private partnerships (PPPs) in the "Mobilising finance and investment" section.

2.3.3 Programmes and networks for innovation knowledge-sharing and co-ordination

Description

Programmes that foster exchanges between different stakeholders (including from the industrial sector, academia, regulators and investors) can accelerate technology development for industrial decarbonisation. These policies may include the creation of innovation centres, networks at universities or industry associations, or improved dialogue fostered by the government at different levels. Such policies might also be part of wider programmes, which often include financing for RD&D projects.

How could this policy instrument target deep emissions reductions?

Collaborations on emissions reductions technologies for the industrial sector are likely to mix both deep and incremental emissions reductions topics and initiatives. Programmes and networks for innovation, knowledge-sharing and co-ordination that aim to focus on deep emissions reductions should include consideration of early deployment and long-term scale-up of near-zero emission technologies.

When is this policy instrument suitable?

- Knowledge-sharing and co-ordinated action at the sectoral level can create synergies and help accelerate technological progress.
- Particularly pertinent for governments that want to implement funding programmes for R&D. Enhancing the dialogue between various stakeholders in a potentially decarbonised value chain can accelerate the process.
- These programmes can be implemented at a local, national or international level.

What needs to be considered before implementation?

- **Rules:** Rules for participation in innovation networks should be clearly stated at inception.
- **Confidential information:** There should be clear rules for safeguarding confidential information in any exchanges. The co-ordinating body should enforce them.
- **Member engagement:** A detailed agenda with pre-established periodic meetings could help build engagement among the different participants.
- **Patents and intellectual property:** It is important to have predefined rules and laws on patent ownership and intellectual property management, while simultaneously finding ways to maximise knowledge-sharing and collaboration within such agreed rules.

Best practices

Effectiveness

- Ensure the mandates of each of the programmes are properly defined at inception, and that stakeholders involved in the process have ownership of their tasks.
- Including programmes and networks for innovation, knowledge-sharing and co-ordination within broader roadmaps, plans and targets could give a larger impulse to these initiatives.

Simplicity

- Ensure the objectives/mandates of each of the programmes or initiatives is clearly communicated so that stakeholders can choose which initiative to participate in.

Stakeholder acceptability

- Engage representatives of each different stakeholder groups in the programmes and networks for innovation, knowledge-sharing, and co-ordination.

Economic efficiency

- Programmes and networks for innovation, knowledge-sharing and co-ordination can have different levels of economic efficiency depending on the exact functioning of each initiative and their costs. Nevertheless, these activities are generally not expected to be capital-intensive and could potentially render very positive results in terms of synergies among different stakeholders and in building momentum for the purpose of industry decarbonisation. Given that the results of these programmes may be relatively indirect, the final impact of the policy instrument could be hard to measure.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Collaboration can result in international programmes and networks for innovation, knowledge-sharing and co-ordination that allow stakeholders to benefit from even larger and more diverse networks.

Examples of governments that have implemented this type of policy instrument

- The European Union's Processes 4 Planet (under Horizon Europe) (2021).
- The United Kingdom's Industrial Strategy Challenge Fund (ISCF) (2016).
- The United Kingdom’s SUSTAIN Future Manufacturing Research Hub (2019).
- The United States-China Memorandum of Understanding to Increase Cooperation and Energy Efficiency in China's Industrial Sector (2007).
- The United States' Energy Star Focus on Energy Efficiency in Cement Manufacturing (2019).

2.3.4 Regulatory sandboxes

Description

Regulatory sandboxes are special frameworks for the development of innovative technologies that the government wants to target. This system allows companies to test their projects with less stringent regulatory requirements for a limited amount of time. This way, businesses can focus on technological advances and market experimentation, without regulatory barriers that may slow the development of low- and near-zero emissions technologies.

Regulatory sandboxes may include simplified permitting applications and authorisations to test near-zero technologies in controlled environments before

they get to the market. It is important to note that sandboxes should always be overseen by regulators, and do not equate to the removal of regulation, but rather represent an experimental approach to regulation that would allow for more and faster innovation. For instance, a regulatory sandbox could provide for easier access to low-emissions hydrogen or electricity inputs for companies that are testing technologies that will be fuelled by low-emissions hydrogen.

How could this policy instrument target deep emissions reductions?

Regulatory sandboxes can be used to target both deep and incremental emissions reductions. If the regulatory sandbox is designed to specifically target deep emissions reductions, it will be necessary to set rules regarding the types of technology concerned.

When is this policy instrument suitable?

- To incentivise the development of technologies that are not yet available at commercial scale.
- To alleviate the regulatory and reporting burden for companies that are looking to innovate in the low-emissions and near-zero materials markets.

What needs to be considered before implementation?

- **Eligibility requirements:** A robust definition of the activities that can be covered by the regulatory sandbox should be established, as well as clear eligibility requirements for the firms that can participate. Otherwise, there is a risk that companies that are not innovating in the targeted markets could benefit from a less rigorous regulatory framework.
- **Time:** Regulatory sandboxes should be time-bound. This would incentivise companies to develop their innovative technologies faster by solely focusing on the technical part, while limiting the need for efforts to comply with regulatory and administrative requirements.
- **Government oversight:** Appropriate legal safeguards should be implemented. There should be close government oversight of the projects to avoid threats to the environment or the population. Safety should not be compromised.

Best practices

Effectiveness

- While rules and exceptions to regulatory requirements should be pre-established, the purpose of a regulatory sandbox is to provide flexibility; mechanisms through which firms in the regulatory sandbox could request changes should be maintained.

Simplicity

- Set clear eligibility criteria for firms.
- Set clear timelines for the regulatory sandbox.

Stakeholder acceptability

- Engage different stakeholders in the sandbox design, including potential innovators as well as companies operating under traditional production methods, to make sure the policy is fair.

Economic efficiency

- Perform thorough financial analysis on the projects to be covered by the regulatory sandbox. Evaluate different scenarios (including worst-case outcomes).
- Given that the regulatory sandbox should primarily cover innovation projects, the economic efficiency should be measured at the portfolio level, and not at the individual project level, since some projects might not render the expected results. Having unsuccessful projects is part of the risk that a regulatory sandbox entails, so this should not necessarily be regarded as negative – it is part of how innovation advances.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Sharing experiences of regulatory sandboxes in different countries can improve policy design. Regulatory sandboxes face the challenge of generating the right incentives for innovators, without being overly permissive. Experiences from other countries or even other sectors (such as the IT sector) can bring valuable learnings for policy makers.

Access to international financing

- Innovation projects pursued in the context of a regulatory sandbox can be assisted by international loans and financing agreements for the producers. International finance can not only play a role in directly financing these innovation projects, but also in providing ways of reducing the risk on the investment (e.g. by fixing input or output prices through hedging arrangements or provisions of guarantees).

International co-operation agreements

- By recognising the existence of regulatory sandboxes in other countries, governments can provide special treatment (such as exemptions from certain rules and regulations or streamlined permitting approvals) to products resulting

from these regulatory sandboxes, and could allow for the later creation of a market for the products developed via the sandbox.

- Companies from different countries could be permitted and encouraged to participate in local regulatory sandboxes. This way, the sandbox system could benefit from the experience, innovativeness and diversity of foreign companies.

Commercial agreements

- Regulatory sandboxes could be complemented by international commercial agreements between producers and buyers that could help create a market for innovative technologies as they develop with this policy.

Examples of governments that have implemented this type of policy instrument

- The European Union's Net-zero Industry Act (2024).

Examples from other sectors related to energy:

- Austria's Energy.Free.Room Programme (2019).
- Singapore's Energy Market Authority Regulatory Sandbox (2024).
- The United Kingdom's Innovation Link (2017).

2.4 Accelerating material efficiency and circularity

What is the purpose of this category?

Accelerating material efficiency and circularity includes policies that promote lower total demand for basic industrial materials and, therefore, lower emissions, or otherwise reduce the need for emissions-intensive materials or inputs. Material efficiency includes strategies all along value chains – from design and construction to use-phase and end-of-life – to use materials more efficiently. The related – and sometime interchangeable – concept of circularity can be understood as the reutilisation of finished goods (e.g. avoiding the demolition of a building and giving it a different use) or as the reutilisation of inputs in the production of materials (e.g. use of scrap for steel production, or use of by-products such as supplementary cementitious materials in cement production).

Reducing aggregate demand for basic materials can play a key role in the industrial decarbonisation strategies of all countries. This category includes policy instruments that create economic incentives for companies to implement material efficiency and/or circularity practices, or that directly mandate them via regulation.

What critical role does this category serve in an overall industrial decarbonisation strategy?

Of course, the biggest emissions reductions result from not producing materials in the first place. However, given that economic development is very closely tied to the buildout of infrastructure and therefore the use of materials, the aim of policies in this category is to accompany growth and the improvement of living standards with a strategy that is environmentally sustainable. EMDEs tend to have higher growth in per-capita demand for basic materials, in line with the process of constructing infrastructure and buildings. In EMDEs, policy instruments in this category could promote planning and strategies to use materials efficiently and avoid waste in the process of development. Once countries reach a certain level of economic development, and demand for materials mostly results from maintenance of existing stock, there is also room for policies that promote recycling and that aim to limit demand for basic materials to an efficient level.

Policies in this category are complementary to those on the production side – using fewer materials could reduce overall costs for industrial producers, given that near-zero and low-emissions often come with a premium. Employing the policies together can render the transition faster and more economical. Material efficiency policies may also help to relieve pressure on the total availability of raw materials, such as high-quality iron ore, which is more suitable for hydrogen-based steel production.

Targeted policies on material efficiency complement and reinforce broader emissions reductions policies. While broader policies like carbon pricing can create an incentive to use materials more efficiently, in many cases this may not be strong enough to maximise material efficiency, particularly as there are various complex behavioural and logistical challenges that could prevent wider uptake of material efficiency strategies. Targeted policies would help ensure that material efficiency and circularity are prioritised by the diverse range of actors needed for wider uptake.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key questions for governments deciding on which instrument (or set of instruments) in the area of accelerating material efficiency and circularity would be better suited to their industrial decarbonisation strategies include the following:

What is the likelihood of the instrument achieving the desired objective?

Governments will need to consider their objectives for reducing emissions and/or material use, and how far the particular instrument choice could influence the likelihood of achieving that objective.

On the one hand, some of the listed policy instruments act by providing economic incentives for private actors to implement changes voluntarily (e.g. incentives for extended end-use lifetimes and demolition or landfilling fees, and material efficiency awards and certifications). If private companies find that the benefits of adhering to the policy are greater than the costs of inaction, they will likely make changes that will result in emissions reductions; otherwise, they may not. In the case of supporting training programmes in material efficiency for engineers, architects and construction workers, even though there might not be a direct economic incentive, having trained personnel facilitates the process through which companies undergo change and consider material efficiency in the way they design and produce products. For all these instruments, the level of emissions reduction will be verified only afterwards, making the result of the policy less certain.

On the other hand, other instruments in this category either dictate the level of emissions allowed per product, or directly penalise emissions above a certain level (e.g. embodied carbon limits or taxes on end-use products). These policy instruments can provide policy makers a higher degree of certainty on the emissions savings that can be achieved, as companies are mandated to reduce emissions or otherwise must pay a tax or compliance penalty.

How will these policies be perceived by different stakeholder groups?

In general, policy instruments that present an economic incentive for action (incentives for extended end-use lifetimes, material efficiency awards and certifications, and training programmes in material efficiency for engineers, architects, and construction workers) are likely to be positively perceived by industrial producers and other supply chain actors who may benefit. There is, however, a chance that private sector actors not affected by the policy, or taxpayers more broadly, may consider other uses of the government's budget to be more appropriate.

More binding policy instruments, such as demolition or landfilling fees and embodied carbon limits or taxes on end-use products, might be seen by affected

stakeholders as placing the burden of emissions reductions on them. As such, there is a higher chance they may view them as unfair and may seek compensation for financial impacts.

What is the complexity associated with implementing each policy instrument?

In general, the policy instruments in this category entail relatively strong hands-on involvement by the government at the beginning for the design and initial implementation, particularly when they include changes in regulation. This is because the policies are likely to be relatively technical and detail-oriented, may focus on very specific strategies or stages of the lifecycle, may require co-ordination among actors along the supply chain, and require consideration of other important priorities (e.g. safety considerations). This will require gathering the right experts and forming the necessary teams.

Some policy instruments may also require significant government involvement over the long term, depending on how the policy is designed. Examples include when training programmes in material efficiency for engineers, architects, and construction workers are designed to be carried out by government personnel; when the evaluating committee for the material efficiency awards and certifications is composed of government officials; and when materials recycling or reuse programmes are run by the government. Moreover, regulatory and tax-based policy instruments (e.g. modified design regulations focused on material efficiency, incentives for extended end-use lifetimes and demolition or landfilling fees, and embodied carbon limits or taxes on end-use products) might require different levels of government monitoring and enforcement.

What are the government's budgetary and resource considerations?

The main policy instrument within this category that could entail direct payments by the government to companies is the incentive for extended end-use lifetimes, if implemented via subsidies. Material efficiency awards and certifications also require funding, if a monetary prize is offered, though this is not expected to represent a large portion of the government's budget.

For the rest of the policy instruments, governments should consider the costs of the human resources necessary to design, implement, and monitor these policies, which will be affected by the complexity of implementation (see the previous question).

What are the timing considerations?

In line with the first question, policy instruments that entail regulation (e.g. embodied carbon limits or taxes on end-use products) are more likely to achieve emissions reductions within a defined timeframe than those that act via economic incentives or personnel training (e.g. incentives for extended end-use lifetimes and demolition or landfilling fees, material efficiency awards and certifications, and training programmes in material efficiency for engineers, architects, and construction workers). The choice of policy instrument may therefore be influenced by the expected timeline for achievement of the policy objective.

For all policies related to material efficiency and circularity, there is a behavioural element to consider – the policies ask engineers, architects, construction workers, product users and others in the supply chain to change practices. As such, it may take time to sensitise the relevant actors to the policy and thus realise the policy's full potential. Introducing the policies early on, and perhaps including phase-in periods for any requirements or taxes, could help ease implementation and better achieve the desired objectives.

2.4.1 Modified design regulations focused on material efficiency

Description

Establishing and revising design regulations with material efficiency in mind can have a major impact on material demand, given that design sets the path for the rest of the lifecycle of products and infrastructure. This may include revisiting policies such as building codes, or creating new guidelines for manufacturers of certain products. Possible modifications to design regulations to consider include measures that encourage design to take into account life-cycle emissions (e.g. limits on embodied or life-cycle emissions, requiring upfront estimation of life-cycle emissions, durability guidelines, extended producer responsibility programmes). Modifications could also include measures to consider future suitability for re-manufacturing, refurbishment, materials reuse and, ultimately, recyclability, the latter including promotion of design to reduce contamination and enable high-quality recycled material. Finally, measures can encompass reformulation of design requirements to focus on performance rather than prescriptive requirements, without compromising safety (e.g. requirements for concrete focused on strength or other performance characteristics, rather than a fixed minimum clinker ratio).

To the extent possible, updated design regulations could give companies some flexibility on how to manage their processes and to comply, while maintaining the end goal of rendering products less emissions intensive throughout their lifecycle and more recyclable.

How could this policy instrument target deep emissions reductions?

To target deep emissions reductions, the policy should be designed to reduce to the greatest extent possible overall new materials production, particularly for materials that are currently emissions-intensive to produce, while taking into account the likely impact on overall life-cycle emissions. This can be either through product design indications for more efficient use of materials and/or through processes and networks that make the end-products easier to reuse or recycle. Optimising across various different possible material efficiency levers, and for the full lifecycle, could help to achieve the largest possible emissions reductions, rather than focusing only on smaller incremental changes in isolation.

When is this policy instrument suitable?

- This policy instrument may be particularly useful in countries where there are already design regulations based on operational emissions, but not yet on life-cycle and/or embodied emissions.
- It would also be useful in countries where building and construction codes currently have prescriptive requirements that may restrict efficiency measures and use of lower-emission materials, such as policies with fixed requirements on minimum clinker-to-cement ratios.
- Governments may consider adopting this policy along with funding measures, such as subsidies or tax exemptions, to assist companies in changing their design practices and improving their recycling practices, thus allowing them to build better investment cases. This policy instrument could also be complemented with R&D funding that is targeted to innovative ways of improving product design.

What needs to be considered before implementation?

- **Financial support:** The financial strength of industrial players to make changes to product design and manufacturing/construction processes, and to modify logistics. If such a measure is expected to cause financial strain to companies, complementary policies to fund these investments should be considered.
- **Flexibility:** The right balance has to be found between requirements that are simple and requirements that are overly normative. The requirements should allow for a certain level of flexibility and consider all cases.

- **Supply chain integration:** Integrated supply chains allow for a more straightforward implementation of changes in product design and reuse and recycling considerations.

Best practices

Effectiveness

- Make objectives for revising design policies as clear and targeted as possible, focusing first on measures that could have the largest impact on material demand and emissions from a life-cycle perspective.
- Consider establishing a system to monitor the progress made across companies. Tracking progress can act as an incentive, especially if companies wish to communicate this progress with their shareholders and/or customers.

Simplicity

- Guidelines and technical requirements should be as clear and easy to understand as possible, allowing flexibility without compromising safety.
- Sharing what pioneer companies are doing could serve as guidance for the rest of the industry.

Stakeholder acceptability

- Engage representatives of industry, manufacturers, the construction sector, intermediaries, and end consumers in the policy design. Undertake market consultations to understand the feasibility of the proposed changes from a technical, logistical, economic and safety point of view.
- Put in place robust analysis, guidelines and checks to ensure that any modifications to design do not compromise safety performance.

Economic efficiency

- Strong regulatory design focused on life-cycle emissions and recyclability should avoid large expenditures by the government. If the policy is well designed, costs for the government once the policy is active should be limited to monitoring and ensuring compliance, while the market itself drives investment in these changes.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful policies related to modified design regulations focused on life-cycle emissions, performance-based requirements and recyclability can provide

learnings for other policies in different countries or sectors. Though each country/sector will have its own specificities, the results of these policies in other locations or sectors could serve as a basis for the design of the policy.

Access to international financing

- Policies on modified design regulations focused on life-cycle emissions and recyclability could be assisted by international loans and financing agreements to companies involved.

International co-operation agreements

- International agreements promoting practices that aim to modify design regulations focused on life-cycle emissions and recyclability can incentivise market players to follow a certain path. Commitments by countries to modify the design of their products can have positive effects in other domestic markets.

Commercial agreements

- Commercial agreements between producers and buyers for the purchase of new products with a modified and less emissions-intensive design could support demand for these products.

Examples of governments that have implemented this type of policy instrument

- The European Union's Ecodesign Directive for Sustainable Products Regulation (ESPR) (2024).
- The European Union's Clean Industrial Deal (2025).
- The United Kingdom's Circular Economy Package policy statement (2020).

In addition to policies focused specifically on product design, examples of more general policies looking at circularity include the following:

- Brazil's Ecological Transformation Plan (2023).
- The European Union's Circular Economy Action Plan (2020).
- India's National Resource Efficiency Policy (2019).
- India's Steel scrap Recycling Policy (2019).
- The United States' National Recycling Strategy (2021).

2.4.2 Incentives for extended end-use lifetimes and demolition or landfilling fees

Description

Policies that provide incentives (e.g. tax exemptions or subsidies) to extend the end-use lifetime of products, buildings or infrastructure or that penalise demolitions and landfilling via fees could reduce new demand for materials like steel and cement. This could then incentivise private sector actors to pursue alternative behaviours, such as repurposing buildings rather than demolishing and building new ones, or finding innovative ways to reuse and/or recycle materials and components. Such policies could also influence design decisions in order to prioritise future repurposing, reuse and recycling.

How could this policy instrument target deep emissions reductions?

If the policy targets goods containing large amounts of materials such as steel and cement that are emissions-intensive to produce today, then it will directly target deep emissions reductions.

When is this policy instrument suitable?

- For countries that already have well built-up stocks of infrastructure that may already be decades old, this policy could help incentivise exploration of repurposing options. This policy could be accompanied by measures to guide owners and managers of buildings or other construction works on how to better maintain, refurbish and repurpose these stocks.
- Also particularly relevant for countries that are looking to expand their infrastructure and housing due to economic development or population growth needs. Setting incentives before construction takes place could allow for a longer lifecycle and durability of stocks.

What needs to be considered before implementation?

- **Safety:** Incentives to extend the end-use lifetimes of infrastructure, buildings or other products will require certainty that those extensions do not pose any risk to the users or to the population in general. This might require controls, assessments or certifications by the government or by third parties. This type of policy might, therefore, need to be accompanied by assessment, certification or permitting schemes, which would entail the creation of accountable bodies or teams (if not already established).

- **Environmental impacts:** Adopting new or higher landfilling fees should be accompanied by additional monitoring to ensure there is not also an increase in illegal disposal outside of landfills in order to circumvent fees.
- **Exceptions and criteria:** There may be some instances where demolition or landfilling are unavoidable. The policy may consider including criteria for fee exemptions, although these should be sufficiently strict to maintain the stringency of the policy overall.
- **Life-cycle emissions considerations:** In some instances, there may be a trade-off between embodied and operational emissions when extending lifetimes. For example, extending the lifetime of vehicles would slow the turnover of emissions-intensive internal combustion engines to electric powertrains, even though it would reduce use of materials. The design of incentives to extend lifetimes needs to consider such trade-offs and could, for example, target end-uses where refurbishments can be made to upgrade energy-consuming equipment in tandem with lifetime extensions, such as may be feasible during repurposing of buildings.
- **Guiding examples:** Publicly sharing what pioneer companies are doing to extend the end-use lifetimes of their buildings and products could serve as guidance for the rest of the industry.

Best practices

Effectiveness

- Target incentives towards substantive changes, such as building lifetime extensions of several decades.
- For demolition and landfilling fees, set rates sufficiently high to create an incentive for alternative choices.
- For voluntary incentives, establish a system to monitor and aggregate the progress made. For infrastructure developers or owners that are already considering extending end-use lifetimes, a system that tracks progress – even without pre-set requirements – can act as an incentive, especially if companies wish to communicate this progress with their shareholders and/or customers.

Simplicity

- Set clear guidelines on what certifications or permits are required to ensure safety when repurposing and extending end-use lifetime of products.
- Set clear rules for eligibility for incentives and for the conditions under which fees must be paid.

Stakeholder acceptability

- Engage representatives of industry, manufacturers, the construction sector, intermediaries, and end consumers in the design of the policy. Perform market

consultations to better understand the feasibility from a technical, logistical and economic point of view.

Economic efficiency

- With regards to financial incentives (e.g. tax exemptions or subsidies), the most economically efficient measures provide sufficient incentive to drive behaviours that lead to substantial lifetime extensions or other reductions in material demand that would otherwise have been unlikely to occur, while still not making the incentive too high, in order to make the best use of public resources.
- For policies based on fees (e.g. demolition or landfilling fees), costs for the government once the policy is active should be limited to monitoring and ensuring compliance. If fees are sufficiently high to incentivise changes in behaviour without causing undue burden when demolitions or landfilling are unavoidable, they should be relatively economically efficient.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Successful policies related to extending the end-use lifetimes of products or buildings/infrastructure can provide learnings for other policies in different countries or sectors. Though each country/sector will have its own specificities, the results of these policies in another location or sector could serve as a basis for the design of the policy elsewhere.

Access to international financing

- Policies for the extension of the end-use lifetimes of products or buildings/infrastructure could be assisted by international loans and financing agreements to targeted companies. This is particularly the case for policies based on economic incentives (e.g. tax exemptions or subsidies), where companies might decide to take on debt in order to invest in making the changes and then claiming these economic benefits.

International co-operation agreements

- International agreements that set guidelines for the ideal lifetime of buildings/infrastructure or consumer products can create a robust framework for domestic policies to build upon. The assurance (via formal agreements) that other countries are also committed to the same objectives can have positive effects in the domestic market (particularly for tradeable consumer goods).

Commercial agreements

- Commercial agreements between producers and buyers for the purchase of tradeable consumer goods with extended end-use lives could support the demand for these products.

Examples of governments that have implemented this type of policy instrument

- France's Anti-waste Law (2020).
- United Kingdom's Landfill tax (1996).

2.4.3 Training programmes in material efficiency for engineers, architects, and construction workers

Description

To enable mainstreaming of material efficiency considerations throughout the lifecycle of construction works and products, governments may choose to promote curriculum revisions and skills-upgrading programmes for architects, civil engineers and construction firm managers. This could help normalise considerations of material efficiency among those working in these professions, as an addition to typical considerations around cost and quality. There are many different technical and behavioural elements to improving material efficiency, such as choice of material grade, method of mixing concrete, or deciding to repurpose rather than build new, which training and knowledge-building could help increase.

Developing this type of training programme might also help avoid bottlenecks that can occur when companies try to move into more materially efficient and circular systems, either in response to their own corporate sustainability considerations or to policy measures.

How could this policy instrument target deep emissions reductions?

This policy instrument could target deep emissions reductions by including within the training programmes a specific focus on measures that are likely to achieve a step change in material efficiency, such as lifetime extension through repurposing buildings (which would entirely eliminate the need for large quantities of new materials) or design strategies that reduce large quantities of material demand without compromising safety.

When is this policy instrument suitable?

- Particularly relevant for countries/regions where there is a large manufacturing base and/or there is expected to be large growth in construction, and where the majority of the relevant workforce has likely not yet been broadly exposed to material efficiency and circularity topics.
- These programmes can be included within larger just transition plans.

What needs to be considered before implementation?

- **Stakeholder co-ordination:** Co-ordination of training programmes and curriculum development with major industrial companies to better understand their priorities and internal implementation challenges, and with expert researchers in the field to understand the latest developments and innovation.
- **Trade unions:** Consultation with trade unions, who may play a key role in the successful implementation of such programmes, particularly in countries where trade unions hold a lot of weight.
- **Financial support:** The government will need to consider whether to fully fund these programmes or to expect companies or individuals to pay for them. In the first case, the relevance of the funding has to be evaluated in light of other policy priorities. In the second, the financial ability of companies or individuals to respond to such a requirement has to be evaluated, and possible routes to offer financial support where needed should be considered.

Best practices

Effectiveness

- Engage subject matter experts in the design of the programmes.
- Define timelines for the trainings, with specific goals to be achieved.
- Make the trainings as accessible and widespread as possible, ideally formalised within existing programmes and curricula so that they become the norm for all of the workforce rather than something elective.

Simplicity

- Where possible, integrate the trainings in existing programmes and curricula, and use methods and terminologies that are familiar and specific to the different categories of workers.

Stakeholder acceptability

- Enable discussion spaces where workers, unions and industrial companies are invited to provide input on the development and implementation of such training programmes.

Economic efficiency

- Economic efficiency will depend on the specific objectives of each training programme and on who will bear the burden of the cost (i.e. if the government will subsidise the programmes for the workforce or if it will incentivise companies, individuals or educational institutions via regulation to internalise that cost). Institutionalising within existing programmes and curriculum could help improve efficiency.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- By sharing their experiences in developing training programmes and curricula, governments could learn from one another.

Access to international financing

- With the purpose of advancing industrial decarbonisation goals, some governments and international organisations could be open to providing financing for the development and implementation of material efficiency training programmes. Financing arrangements could be accompanied by expert advice on the design of such policies.

Examples of governments that have implemented this type of policy instrument

- Brazil's Ecological Transformation Plan (2023).
- The United States' Industrial Training and Assessment Centers (ITACs) training programme (2023).

2.4.4 Material efficiency awards and certifications

Description

Distinguishing best performers and innovators by providing an award or certification that they can show to their shareholders, customers and the public could be an incentive for companies and their employees to improve and innovate in material efficiency and circularity, helping to drive wider competition and innovation.

How could this policy instrument target deep emissions reductions?

In order to target deep emissions reductions, awards and certifications could specifically be awarded to companies that have achieved progress towards transformational change that could lead to deep emissions reductions, and the title of the award and/or its criteria should explicitly state this.

When is this policy instrument suitable?

- For countries that want to generate incentives for innovation and progress in material efficiency, but do not have sufficient budget dedicated to directly fund these initiatives. Although awards and certifications could be a weaker incentive than economic incentives, they could still have a positive impact on companies. Moreover, these awards could be accompanied by economic prizes to reinforce the incentive.
- For countries that have industries with enough market participants to incentivise competition and innovation.

What needs to be considered before implementation?

- **Budget and dedicated staff:** Creating an earmarked budget for the programme(s) to cover setting up staff or perhaps an expert evaluation committee, including non-governmental stakeholders, responsible for assessing competing companies and granting awards/certifications.
- **Prizes:** If awards and certifications are to be accompanied by a monetary prize, evaluate the financial feasibility in light of other budget priorities.

Best practices

Effectiveness

- Set clear criteria for the award, focused on performance and/or innovation that is truly exceptional in terms of the steps it makes towards improving material efficiency.
- Set up an expert council to evaluate companies and decide on the awards or certifications.
- Consider including an expiration date for the awards/certifications. If companies wanted to maintain their award/certification, they would need to apply periodically and undergo the evaluation process. This avoids companies claiming designations that are outdated.

Simplicity

- Clearly state eligibility criteria and how the process will be run.

Stakeholder acceptability

- Engage a broad range of experts and stakeholders to participate in the design of the policy and in the nomination of the council that will grant the awards/certifications.

Economic efficiency

- This type of policy should avoid large expenditures by the government and could potentially have a substantive impact on emissions reductions. If the policy is well designed, costs for the government should include the formation of a council to grant the awards/certifications and the promotion of the programme.
- If the awards/certifications include a financial prize, the costs will be higher, but the effect on emissions could also be more substantial. Ensuring the award targets material efficiency improvements that are truly transformational would help improve economic efficiency, as this would increase the likelihood that the award is helping promote innovation rather than rewarding already-occurring activities.

How can international collaboration improve the efficiency of this instrument?

International co-operation agreements

- Extending the award/certification to the international level could incentivise more competition and innovation.

Examples of governments that have implemented this type of policy instrument

While awards for material efficiency are still uncommon, comparable awards for energy efficiency could provide learnings and inspiration for something similar for material efficiency:

- Indonesia's National Energy Efficiency Award (2012).
- Korea's Framework Act on Resource Circulation (2016).
- Korea's CE (Circular Economy) 9 Policy (2023).
- The United States' and Canada's Energy Star Focus on Energy Efficiency in Cement Manufacturing (2019).

2.4.5 Embodied carbon limits or taxes on end-use products

See 2.2.7 Embodied carbon limits or taxes on end-use products in the section on "Creating a market for near-zero emissions materials production".

3. Necessary enabling conditions

Without certain enabling conditions in place, industrial decarbonisation policies risk not being impactful. Such conditions include international co-operation agreements to ensure a level playing field and enhance positive spillovers on technology development and knowledge-sharing; the development of infrastructure to facilitate near-zero and low-emissions technologies; and the availability and ease of measurement of emissions data.

3.1 International co-operation and a level playing field

What is the purpose of this category?

The relations between countries (whether they are trade partners, part of a regional bloc, or neighbouring countries) can have a considerable impact on the industrial decarbonisation strategy of a government, including on the policies and strategies chosen, and how effective these are. At an overarching level, the global decarbonisation agenda will be dictated by the agreements and commitments that countries make.

International co-operation on industrial decarbonisation is particularly important since industrial products are traded on competitive global markets. Strong decarbonisation policy in one jurisdiction could lead producers to move to other geographies with less stringent policies, leading to so-called “carbon leakage”. Working collaboratively to increase policy ambition on decarbonisation globally can help to alleviate this. Meanwhile, international finance can increase the capabilities of emerging markets and developing economies (EMDEs) to decarbonise.

This category includes policy instruments that either set common rules regarding carbon pricing or help level the playing field for internationally competitive markets for industrial goods through taxes and tariffs (joint carbon pricing measures and carbon border adjustments); foster international co-operation for the advancement of technologies and knowledge-sharing to bring advantages and win-win effects for countries (international technology co-development [R&D] and strategic partnerships, and capacity-building and international best practice sharing); encourage political or diplomatic dialogue to together increase and co-ordinate decarbonisation efforts (climate clubs/alliances); and increase availability of financing for industrial decarbonisation purposes (international finance).

What critical role does this category serve in an overall industrial decarbonisation strategy?

Industrial decarbonisation strategies reflect how interdependent the world has become, with supply chains spanning the globe, resource allocation reshaping the geopolitical landscape, instances of joint technology development increasing and cross-country infrastructure projects and industrial production clusters gaining importance. In this context, international rules, co-operation and agreements are needed to serve industrial decarbonisation objectives and level the playing field for countries to participate on an equal footing in shaping industrial decarbonisation, and reaping the benefits of rules-based trade in industrial products.

Efforts by a single country in isolation will not be sufficient to address industrial emissions globally. Co-ordinated action, underpinned by fluid international dialogue, is therefore a necessary enabling condition for countries to succeed in their industrial decarbonisation approaches. International co-operation has a cross-cutting effect on multiple different aspects, from the more general plans or roadmaps and the strategies chosen for policies like carbon pricing and finance mobilisation, to more specific policies to manage existing assets, develop innovative technologies or create efficiencies and circularity. Ignoring the international dimension might render efforts by a single country largely ineffectual. Meanwhile, working collaboratively can help ease and accelerate the process of industrial decarbonisation for all.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key questions for a government deciding which instrument (or set of instruments) in the area of international co-operation and a level playing field would be better suited to their industrial decarbonisation strategies include the following:

What is the likelihood of the instrument achieving the desired objective?

Many aspects of international collaboration may be seen as part of a process and a means to an eventual end – increased decarbonisation globally – even if near-term concrete outcomes may be difficult to measure.

Some policy instruments, such as joint carbon pricing measures or carbon border adjustments, can result in the implementation of an Emissions Trading System (ETS), carbon tax or tariff that can directly impact emissions. The rest of the policy

instruments may result in concrete treaties, memoranda of understanding or partnerships (in the case of international technology co-development [R&D] and strategic partnerships, climate clubs/alliances, or capacity-building and international best practice sharing) or in actual loans, grants or financing programmes (in the case of international finance to support industrial decarbonisation). However, the translation of these latter measures directly into emissions reductions will require a further step, such as when knowledge-sharing results in policy adoption by another country, or an R&D partnership results in successful development of a new technology.

Policy instruments in this category frequently serve to open up communication channels or elevate discussions to fora for international debate, connect stakeholders that did not previously have things in common, or disseminate knowledge. All these outcomes can have great value and lay the groundwork for industrial decarbonisation to advance, even if they might not render concrete, visible and easily measurable results. This is something that governments might want to take into consideration when choosing policy instruments and assessing their effectiveness.

How will these policies be perceived by different stakeholder groups?

As mentioned above, policies that do not directly provide concrete outcomes in terms of emissions reductions, or implementation of specific measures, but rather improve the overall international environment for governments and the private sector to engage on industrial decarbonisation, are likely to have a relatively high level of acceptability. Improved international dialogue and relations between different stakeholders, as well as knowledge-sharing, are generally seen as positive. Policies that result in increased international finance are, in particular, likely to be positively viewed by potential recipients.

Concerns about any of the policies in this category might be raised when a certain company, industrial group/subsector, or country, considers that the policy would negatively and unfairly impact them. Joint carbon pricing measures and carbon border adjustments, in particular, are likely to affect the costs and competitive positions of different companies (both with regards to measures taken by the countries where they operate, as well as by countries with which they trade). It will therefore be important to understand the views of the affected stakeholders, engage in effective international dialogue with them, and consider their different positions when designing and implementing these policies.

What is the complexity associated with implementing each policy instrument?

Key challenges with most of the policy instruments in this category are related to gathering relevant governmental officials and other experts to advance certain discussions, bringing these topics to the local and international debate, and reaching agreements. Instruments that involve more actors and aim to achieve more tangible outcomes are likely to be more complex and take more time, particularly given the diversity of possible interests involved, but they may result in stronger outcomes.

The overall complexity of most of these policies is likely to lie in the initial discussions and design. In general terms, the implementation of these policies is likely to be less burdensome than the actual approval and announcement of the measures.

What are the government's budgetary and resource considerations?

For certain strategic partnerships or best practice sharing, the government might have to make specific investments. In the case of international finance, donor countries will need to make direct disbursements.

However, most of the policy instruments in this category do not, in theory, imply large expenditures by governments, but rather require mobilising political will and reaching consensus – a matter that relates to the previous question on complexity of implementation. The main expenses would likely be related to gathering the right human resources to design, implement and monitor these policies, and to increasing the frequency of political or diplomatic exchanges.

What are the timing considerations?

In the case of joint carbon pricing measures and carbon border adjustments, similarly to other policy instruments in the Establishing plans and policy for long-term GHG emission reductions category, the earlier they are implemented, the more foresight different stakeholders will have. This will likely imply that action proceeds more rapidly. Likewise, the sooner international finance is granted, the more quickly projects can get off the ground.

For the rest of the policy instruments in this section, the need to move quickly may be less evident. However, it is important to note that the longer it takes for clear international rules and agreements to be established, and for relevant international dialogue to open up, the more persistent the barriers to innovative decarbonisation technologies will be.

3.1.1 Co-ordination of carbon pricing, regulations, subsides or other measures

Description

Co-ordinating policy measures among governments, and in particular finding ways to scale up ambition at comparable rates, can be a means to both increase ambition internationally and help protect against "carbon leakage". This can occur when production relocates to jurisdictions with a lower carbon price, thus generating their carbon emissions elsewhere and undermining action by the country that is setting more ambitious decarbonisation policies. Moreover, it helps protect against competitiveness concerns that can arise from differences in policy ambition internationally. This may involve agreeing to similar ambition within national instruments or even going a step further to create linked or joint instruments.

Carbon pricing is one area where co-ordinated action could be pursued, since the carbon price itself provides an obvious lever for alignment. Countries may raise the carbon price at comparable rates within their individual carbon pricing mechanisms. This could be achieved also by linking existing ETSs, ensuring that there is no carbon price differential between the countries and even enabling some amount of permit exchange between each other. Taking it a step further, joint carbon pricing measures would establish the same carbon price for a group of countries on a compulsory basis and within a commonly held system, creating a carbon market that includes more than one country. Any of these measures helps create clear incentives and a level playing field for all economic actors in these markets and prevents carbon leakage.

In addition, countries could also co-ordinate other measures to raise ambition while facilitating a level playing field. This may be done through the alignment of regulations (e.g. minimum market share or content standards, low- and near-zero emissions thresholds and definitions, sunset clauses, etc.), or through similar levels of subsidies to different activities (including, for instance, co-ordinating the level of subsidies to near-zero emissions production, and the removal of subsidies for high-emitting steel and cement production).

How could this policy instrument target deep emissions reductions?

A precondition for deep emissions reductions is that the price of carbon is sufficiently high, regulatory requirement is sufficiently stringent, or the subsidy for clean technologies is sufficiently high to incentivise technological changes. Co-ordinating measures among multiple countries can help facilitate such

ambitious policies, especially if done among key major trading partners, which would help to reduce concerns about competitiveness and risks of carbon leakage.

When is this policy instrument suitable?

- For governments that want to use market measures or other stringent policies to tackle carbon emissions and seek to minimise the risk of carbon leakage.
- Particularly suitable for countries that are already part of the same trading bloc or have established common markets for other goods and services. In addition, this policy instrument can also be suitable for countries that, in spite of not integrating a common market, have a strong trade relationship.

What needs to be considered before implementation?

- **Policy design:** Technical decisions around policy design should ideally be co-ordinated in advance of launching co-ordinated or joint measures. For example, with regards to carbon pricing, if pricing systems are tax-based, agreement on tax rates and rate increase factor/schedule would need to be co-ordinated; if the carbon pricing comes from an ETS, the actual cap to be implemented, the reduction factor/schedule, any rules around use of offsets (if allowed), and the penalties for non-compliance would need to be co-ordinated. Additionally for joint measures, governments might have to jointly create or designate institutions to be responsible for market oversight.
- **Monitoring:** Monitoring and enforcement of the mechanism(s), including how to report and verify alignment between different systems if they are not directly linked. Ensuring adequate measurement rules and mechanisms.
- **Exemptions:** Ensuring that the assignment of free allocations and exemptions in different countries is harmonised or compensated via other mechanisms (e.g. a carbon tax).
- **Distributional impacts:** Carbon pricing measures and regulations are means for industrial emitters to internalise the externality cost of their emissions. Therefore, the burden of the cost increases associated with the establishment of joint measures falls entirely on the private sector (which might pass it through to the consumer). Policy makers should evaluate if there is a need for this measure to be complemented with some sort of financial assistance (see Mobilising finance and investment for options) or recycling of the revenues collected back to the regulated sectors.
- **Inclusivity and fairness:** Discussing co-ordinated or joint measures in an open and inclusive international setting can help ensure that all interested countries can participate, while respecting their differing circumstances. See Multilateral alliances and collaborative fora.

Best practices

Effectiveness

- Ensure mechanisms are in place to avoid the price or stringency of regulation remaining too low to achieve desired objectives. Joint carbon pricing measures, in particular, should establish clear rules for intervention by governments in case the market drives the carbon price to low levels. This might require the establishment of a market stability mechanism.
- Co-ordinated measures should address carbon leakage issues that could result between countries within the agreement and those countries that are not covered by the agreement.

Simplicity

- Clearly outline the emissions measurement methodology, if relevant, and ideally draw on existing internationally agreed methodologies.
- Monitoring and reporting mechanisms should be kept as lean as possible, while not compromising the effectiveness of the instrument.

Stakeholder acceptability

- Engage representatives of each impacted sector, from all participating countries, in the design of the co-ordinated measures. Stakeholders should also be consulted during the operation phase.
- Be transparent in the use of proceeds from collected revenues, if relevant.

Economic efficiency

- Aim for optimal carbon price or regulatory stringency that will generate adequate incentives for deep emissions reductions without hindering economic activity. Effective monitoring of policy might require a certain flexibility on the stringency, especially at the beginning.

Examples of governments that have implemented this type of policy instrument

- The European Union's Emissions Trading System (2005).
- Agreement to link the Swiss and EU Emissions Trading Systems (2020).

3.1.2 Carbon border adjustments

Description

Carbon border adjustments are a policy option that aims to help reduce risks of carbon leakage across markets that have differences in the stringency of their policies for industrial decarbonisation – whether carbon pricing or otherwise.

One such method could be a carbon levy established to compensate for the carbon price differential inside and outside the country (or the group of countries with joint carbon pricing). This is called a carbon border adjustment (CBA). Its objective is to prevent internal products from facing a competitive disadvantage compared with products from jurisdictions with less ambitious climate policies because of differences in the carbon pricing or climate regulation applying to production. In other words, CBAs aim at applying an equivalent price on the carbon emitted during the production of carbon-intensive goods, regardless of where they are produced, and strengthening the abatement effect of a domestic carbon price by accounting for cross-border carbon emissions (in imports).

Carbon leakage could also be a problem for countries that do not have explicit carbon pricing, in situations where there is a difference in the decarbonisation ambition level of other policies, such as regulations that impose an implicit carbon price. Such countries could also implement carbon border measures to address leakage, such as through requiring imported goods to abide by similar standards for domestically produced goods.

This levelling of the carbon price, whether explicit or implicit, for products produced inside and outside of the jurisdiction(s) with a CBA can have the positive effect of increasing industrial decarbonisation actions in jurisdictions outside the CBA, and encouraging emissions reductions in industrial production overall. However, it might have the negative effect that these producers try to instead sell their high-emissions products in other countries outside the CBA area, which is known as resource reshuffling. The more countries that adhere to ambitious decarbonisation policies, potentially complemented with CBA measures, the more difficult it would be for high-emissions producers to sell their products on international markets.

Carbon border measures are a policy option that, if under consideration by a government, require very careful evaluation and design given the potential impacts internationally. Governments may wish to consider how such measures can be implemented within the framework of international co-operation and equity, including compliance with principles of key international frameworks such as the United Nations Framework Convention on Climate Change (UNFCCC) and World Trade Organization (WTO) trade rules. Actions that may help in this direction include consultations with potentially affected stakeholders outside the jurisdiction;

consideration of pairing measures with just transition policies and international climate finance; and action to help producers in other countries comply with the measures, given the administrative burdens potentially involved in emissions reporting. Such considerations would have heightened importance for EMDEs that export to the jurisdiction considering border measures, who may face greater challenges in developing compliant data collection, monitoring and reporting systems. Fostering and prioritising international collaboration wherever possible

can help ensure that such measures, if adopted, can aid rather than hinder international action on industrial decarbonisation and foster healthy and open global markets.

How could this policy instrument target deep emissions reductions?

If the domestic policies in the country or countries implementing the CBA target deep emissions reductions, then the CBA would consequently also target deep emissions reductions – both by aiding domestic producers to comply with ambitious domestic requirements, and by encouraging those exporting to the jurisdiction to also reduce emissions. CBA policies may be viewed by some governments as important to help increase the stringency of domestic policies to enable deep decarbonisation, as without them, increased stringency could result in carbon leakage and harm competitiveness, rather than resulting in actual emissions reductions.

When is this policy instrument suitable?

- For governments that want to use market measures or other stringent policies to tackle emissions and seek to minimise the risk of carbon leakage.
- Particularly relevant for countries whose industrial sectors represent a large portion of GDP and employment, since competitiveness risks of carbon reduction policies may be of particularly high concern for them.
- For countries who have implemented ETSs and provide free allowances to emissions-intensive and trade-exposed (EITE) industrial producers to help protect against international competitiveness risks, and are now looking to phase out free allowances in order to increase policy stringency as a way to meet their decarbonisation targets.

What needs to be considered before implementation?

- **Domestic carbon pricing or regulation:** The first required element for a CBA is for there to be domestic carbon pricing (either via a carbon tax or an ETS), or a regulatory policy covering industry.

- **Scope and value chain:** Governments could consider at what stage of the value chain the CBA would be applied and how this can impact upstream and downstream production. Leaving parts of the supply chain outside the scope of the CBA increases the risk of having carbon leakage moving to different stages of the value chain; meanwhile expanding the scope increase the reporting burden. Finding the right balance between effectiveness of the measures and reporting burden is important when determining the scope.
- **Monitoring:** Ensuring adequate measurement rules and mechanisms for monitoring, validating and reporting, as well as mechanisms and institutions to collect the levy or enforce the regulation.
- **International law:** The implications of international law, including WTO rules, as there is potential for international litigation.
- **Equity and just transition:** It is crucial that international stakeholders, particularly trade partners, are consulted throughout the development and implementation of such mechanisms, and potential negative effects on other economies are minimised. Efforts should be made to ensure that the implementation of a carbon border adjustment is in line with the equity provisions and principles of the UNFCCC and the Paris Agreement.

Best practices

Effectiveness

- Ensure the CBA level increases at a rate that is fair respective to the trajectory of the carbon price or regulation inside the CBA bloc.
- Ensure the scope of the CBA is clearly defined and that it covers key stages of the value chain, while balancing with impacts on reporting burden.
- Ensure the correct mechanisms are in place to avoid CBA evasion.
- If there are exemptions for any sectors, countries or companies, the CBA policy should outline a clear schedule for the phase-out of exemptions for all impacted parties.

Simplicity

- Clearly outline the emissions measurement methodology, ideally drawing on existing internationally recognised methodologies.
- Ensure the CBA is aligned with the rest of the tariff and tax framework.
- Monitoring and reporting mechanisms should be kept as lean as possible while not compromising the effectiveness of the instrument.

Stakeholder acceptability

- Engage representatives of each impacted sector in the design of the market and CBA.

- Engage with governments and stakeholders outside the CBA area (particularly trade partners) and seek to understand how the policy might impact them, and any actions they are planning in response. Efforts to aid EMDEs with compliance (e.g. capacity-building on emissions reporting, flexible provisions to adapt to existing emissions measurement systems in different countries) may also be useful.
- Be transparent in the use of proceeds from the revenues collected from CBA levies charged on imported goods.

Economic efficiency

- Given that the objective of the CBA is not government revenues (tariff collection is only a consequence of it), governments should not establish the CBA rate based on maximising revenue collection, but rather on the optimal emissions reduction level (based on the carbon price or regulation inside the CBA area), and taking into account its potential effects and equity provisions under the UNFCCC.
- Effective carbon prices charged outside the CBA area should be recognised in order to avoid double counting.

Examples of governments that have implemented this type of policy instrument

- The European Union's CBAM (2023).
- The United Kingdom's plans to adopt a CBAM (from 2027).

3.1.3 International technology co-development and strategic partnerships

Description

Partnerships between countries for the development of technologies can advance progress and help to bring down costs, particularly when countries have complementary experience, resource endowments and technical capacities.

Co-development for R&D and piloting of new technologies could facilitate and speed up commercialisation of new production routes. Strategic partnerships, on the other hand, usually focus on technologies that are already commercial, and can facilitate access to a broader range of financing options for large-scale projects in particular. Strategic partnerships may also include collaboration on cross-border purchases of low-emissions energy inputs such as electricity or hydrogen.

How could this policy instrument target deep emissions reductions?

This policy instrument can target deep emissions reductions if the technologies under development are targeting near-zero emissions goals.

When is this policy instrument suitable?

- Particularly pertinent to countries that have complementary capacities and/or resources.
- To facilitate international financing mechanisms.
- Easier to implement between countries that have long-standing trade relationships.

What needs to be considered before implementation?

- Ensure priorities of all participating countries are aligned.
- Set a sufficiently robust legal and diplomatic framework that can be sustained over the long term, irrespective of changes in governments. This not only supports the finalisation of the joint projects but also would lay the groundwork for future collaboration.
- Harmonise any pre-existing trade agreements with the policy.

Best practices

Effectiveness

- Develop a plan of action for the project with checkpoints at predefined dates.
- Establish monitoring mechanisms to evaluate the progress of the project.

Simplicity

- Establish the appropriate stakeholder responsibilities (within ministries and governing bodies of participating countries) to ensure ownership and responsibility for the objectives.
- Ensure that goals are easy to measure and that the process of monitoring them can draw on the strengths and structure of existing government departments/institutions for implementation wherever possible.
- Clearly outline the timeline for the different steps of the project.

Stakeholder acceptability

- Engage representatives of impacted sectors from all involved countries in the design and evaluation of the project.

Economic efficiency

- Economic efficiency will depend on the project itself. Employ mechanisms to verify that there is no big deviation from the initial budget.
- Particularly for technology co-development, note that having unsuccessful projects is part of the risk that R&D investments entail, so this should not necessarily be regarded as a loss, but as part of the technological development process.

Examples of governments that have implemented this type of policy instrument

- Japan-Australia Partnership on Decarbonisation through Technology (2021).

3.1.4 Multilateral alliances and collaborative fora

Description

Collaborative international fora and initiatives can provide a valuable action-oriented space for governments to come together to share experiences and potentially establish common goals and measures to advance the industry transition. Such fora could focus on industry decarbonisation in the broad sense, or may address specific issues relevant to industrial decarbonisation, such as innovation or finance.

Reaching agreement within global fora on industrial decarbonisation goals and how to achieve them can be challenging. Sometimes no action is taken due to lack of consensus. Agreements by a smaller group of countries that share the same industrial decarbonisation goals may be a useful interim step to drive forward action. In turn, the achievements of a small group can inspire other countries to follow similar paths or even to join the group.

How could this policy instrument target deep emissions reductions?

Targeting deep emissions reductions may be considered as an explicit goal of the alliance or forum. Since the greatest challenge arises when working towards deep decarbonisation, this is the area where international collaboration is most needed. Activity by the forum or alliance could be focused on collectively working towards the goal of deep decarbonisation, or specific targeted enablers of deep decarbonisation.

When is this policy instrument suitable?

- For countries that share common goals and priorities regarding industrial decarbonisation.
- For countries that want to tackle barriers for industrial decarbonisation via international collaboration.
- For countries that want to create strong market signals towards decarbonisation goals.
- For countries that want to upscale the effort made by first movers in industrial decarbonisation.

What needs to be considered before implementation?

- **Different starting points:** The different starting points and different structural characteristics of each country have to be considered. Sometimes, in order to advance concrete actions and reach consensus (for instance, via joint declarations), governments might need to accept less stringent conditions than they would have liked to implement, while accepting more restrictive ones in other aspects; differentiated conditions for different countries could be another option to enable flexibility. Allowing for frequent spaces for dialogue between countries (both at an official and a more informal level) can set the groundwork for countries to reach creative solutions to bridging their differences.
- **Ensure alignment of priorities:** Success of a multilateral forum or alliance will hinge on the degree of shared goals and priorities among its members and their willingness to create joint approaches via open and inclusive dialogue.

Best practices

Effectiveness

- Set Terms of Reference for the forum/alliance and abide by them.
- Hold periodic meetings between members with clearly defined objectives, and steps to work towards shared outcomes in the interim.

Simplicity

- Clearly state the eligibility requirements for membership. Standardise the process for application to the forum/alliance.
- Transparently communicate with members the progress, achievements and next steps of the forum/alliance.

Acceptability by stakeholders

- Ensure members are up-to-date on the latest activity of the forum/alliance, and brief members that are absent from meetings.

- Allow members easy access to information produced by the forum/alliance.
- Provide spaces for members to raise questions or concerns.
- Make processes collaborative.
- Engage external experts and stakeholders (i.e. industry, academia, civil society) to discuss technical matters with members.

Economic efficiency

- The economic efficiency of the forum/alliance will depend on its set objectives. In general, the cost of running a forum/alliance could be relatively low compared to the potential impact on domestic policy improvements and effective international collaboration that a forum/alliance could have.

Examples of governments that have implemented this type of policy instrument

- Climate Club (2023).
- Global Forum on Steel Excess Capacity (GFSEC) (2016).
- Industrial Deep Decarbonisation Initiative of the Clean Energy Ministerial (2021).
- International Carbon Action Partnership (ICAP) (2007).
- International Climate Initiative (IKI) (2015).
- Net-Zero Industries Mission of Mission Innovation (2022).
- Partnership for Market Readiness (PMI) (2021).

3.1.5 Capacity-building and international best practice sharing

Description

Programmes that contribute to capacity-building and help disseminate knowledge are very important not only for innovation, but also for the implementation of already existing technologies. This can be done through technical assistance/exchanges, training programmes, or advice in policy design. Moreover, sharing best practice on countries' governance relating to industrial decarbonisation pathways can create substantial value by helping to accelerate the advancement of industrial decarbonisation strategies in different countries. Such exchanges can be effective on a bilateral basis, particularly if the aim is to cover particular topics in depth, e.g. particular aspects of policies or details of technology roll-out. Multilateral exchanges can also be useful in sharing best practices on broader policy considerations, see Multilateral alliances and collaborative fora.

How could this policy instrument target deep emissions reductions?

If the aim is to target deep emissions reductions, international capacity-building and sharing of best practice should focus on the early deployment and long-term scale-up of near-zero emission technologies. Nevertheless, it will also be important to share best practices related to short-term emissions reductions that can help pave the way to deeper emissions reductions and industrial decarbonisation in the longer term.

When is this policy instrument suitable?

- For countries that have institutions that are looking to fully support industrial decarbonisation pathways, but that do not yet have the necessary structures or processes in place.
- Programmes relating to guidance on policy design may be most relevant to countries that have somewhat similar industries.
- Particularly pertinent for countries acquiring technologies not developed locally, and where the workforce has not had prior experience with this technology.
- Could be of particular interest to countries that aim to be trade partners in low- and near-zero emissions industrial value chains.

What needs to be considered before implementation?

- Local specificities in each country, particularly those in which capacity-building programmes are to be established. This could include the cultural, technological and infrastructural context, and even language barriers, among other specificities.

Best practices

Effectiveness

- Ensure there are clearly defined roles and responsibilities within the governmental entities of all countries involved.
- Earmark the necessary budget for the accomplishment of the capacity-building and best practice sharing programme.

Simplicity

- Ensure stakeholders involved in the process have ownership of their tasks.
- Clearly outline the timeline and checkpoints for the programme.

Stakeholder acceptability

- Enable discussion spaces where workers, unions, industrial producers and civil society affected by the programme can present their views. Capacity-building and knowledge-sharing programmes should allow for exchanges that are bidirectional. The idea is not that only one country trains the other, but rather that the country that is "receiving" capacity-building or training in best practices can also raise ideas and share challenges that are specific to their location and conditions, and which might allow for technological or process improvements and for mutual learning at a broader level.

Economic efficiency

- Economic efficiency will depend on the specific objectives of each international capacity-building and best practice sharing programme and on who will bear the cost burden of the policy (e.g. the government of one or both countries, a multilateral organisation, or the private sector).

Examples of governments that have implemented this type of policy instrument

- Egypt's Industrial Energy Efficiency (IEE) Project (2013) – United Nations Industrial Development Organization (UNIDO) programme.
- Mexico's General Law on Climate Change (LGCC) (2022) – Support from the United States.
- United States-China Memorandum of Understanding to Increase Cooperation and Energy Efficiency in China's Industrial Sector (2007).
- International Carbon Action Partnership (ICAP) (2007).
- International Climate Initiative (IKI) (2015).
- Partnership for Market Readiness (PMI) (2021).

3.1.6 International finance to support the global transition

See 1.2.9 International finance to support the global transition in the section on "Mobilising finance and investment".

3.2 Infrastructure planning and development

What is the purpose of this category?

The transformation of steel and cement production to near-zero and low-emissions will require not only the refurbishment and construction of new plants,

but also the construction of the external infrastructure that will enable the plants to access clean energy and other physical inputs, to transport materials, and to get rid of waste products. New infrastructure such as additional clean electricity and hydrogen production facilities, distribution systems and storage; CO_2 transport pipelines and storage sites; bioenergy and renewable waste processing and handling facilities; railway and transportation networks, and shipping facilities, among other infrastructure, will need to be built in cases where existing infrastructure is not sufficient. Whether production sites use hydrogen; carbon capture, utilisation and storage (CCUS); electrification; or bioenergy, a connection to adequate transportation networks will be a condition for the investment decision to build or refurbish a plant.

In the new landscape of low- or near-zero emissions industries, production might be located in different places to the existing sites, due to natural resource endowment. Some of these new production sites might be able to use and repurpose existing infrastructure, but in other cases, completely new infrastructure may be needed. The planning and buildout of efficient infrastructure are therefore crucial.

Governments can play an important role in co-ordinating this process, for example by incentivising planning of new plants in industrial clusters that may be able to make use of shared infrastructure and thus reduce overall costs. Government involvement is also valuable to provide additional foresight on lead times, which are typically lengthy for infrastructure projects, sometimes in the order of up to a decade, and potentially to help reduce them. Meanwhile, given that infrastructure development typically implies a high investment cost, with the benefits being shared among a large number of actors, government intervention can be important to ensure that sufficient infrastructure development is undertaken.

Policy instruments in this category are related to the governments' role in directly co-ordinating, leading and/or providing financial support for the development of these infrastructure projects (co-ordinated planning and public financing for required enabling infrastructure) and in improving the conditions for developers to initiate and complete these projects, thus speeding up the transition (streamlined and accessible permitting).

What critical role does this category serve in an overall industrial decarbonisation strategy?

This category will be instrumental in enabling low- and near-zero emissions production. Without proper infrastructure planning and development, many existing plants may be unable to transform to low- or near-zero emissions production, and many new sites may not be constructed. Ideally, policy measures

in this category should be aligned with those in the Establishing plans and policy for long-term GHG emissions reductions category and integrated into countries' long-term visions. These policies should also be considered alongside those designed to scale up and create demand for near-zero and low-emissions materials, as infrastructure is a key enabler of such materials. Moreover, given the high cost of most of these infrastructure projects, the link with the Mobilising financing and investment category will be key.

In general, it is preferable that infrastructure is shared among multiple users to create economies of scale. This does not necessarily mean that it has to be publicly owned or constructed, but there will always be a public planning element involved. For this reason, governments (both at a local and national level) have the opportunity to boost low- and near-zero emissions industrial sites through their infrastructure policies. Any lack of co-ordination in adjoining infrastructure planning, or lack of visibility on the pace at which infrastructure plans will be realised, can act as a strong barrier to the decarbonisation of the industry.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key questions for a government deciding which instrument (or set of instruments) in the area of infrastructure planning and development would be better suited to their industrial decarbonisation strategies include the following:

What are the infrastructure needs for achieving the country's industrial decarbonisation objectives?

As a starting point, governments may wish to conduct an assessment of infrastructure needs and resource potential, including evaluating the most likely and most cost-efficient pathways for decarbonisation. This may provide an overview of the various types of infrastructure projects that could be needed, in which locations, and with what timelines. A high-level assessment of this sort can help determine the government's role in infrastructure development and, in turn, what set of policy instruments may be most suitable.

What are the government's budgetary and resource considerations?

Given the high cost of infrastructure projects, budgetary constraints will be a key element to consider, particularly with regards to co-ordinated planning and public financing for any required policy instruments. Governments will need to assess and prioritise different possible infrastructure projects in the overall industrial

decarbonisation process, and the available budget. Based on this, governments will then choose whether they want to directly fund these projects or bring in third parties to finance and/or develop them.

Budgetary requirements related to streamlined and accessible permitting might be lower, though key considerations for governments will include whether they have the human resources needed to design, implement and monitor these policies, as well as the necessary technology (if any) to speed up permitting processes.

What are the timing considerations?

All policy instruments in this category help increase the pace at which the industrial sector can become less emissions-intensive. Facilitating the development of low- and near-zero emissions production sites and the enabling external/shared infrastructure will be instrumental to achieving internationally aligned government objectives for net zero emissions by mid-century. The earlier investment decisions are taken and projects start construction, the faster these objectives will be achieved. Given the long lead times of infrastructure development, planning as early as possible can help ensure nearer-term decarbonisation targets can be reached.

How may these policies be perceived by different stakeholder groups?

Policies to build or improve infrastructure for use by low- and near-zero emissions industrial producers, or to streamline their permitting processes, are likely to be positively perceived by producers.

However, the implementation of policies within this category could impact third parties not directly involved in the industrial subsectors for which the infrastructure is intended for. Stakeholder groups that may raise concern about these policy instruments include taxpayers and other sectors (including subsectors within industry) that are not being supported by the policies, who may consider that the budget could be spent differently. In addition, communities that live close to the sites where new infrastructure is planned might also raise concerns related to the use of land and to environmental matters.

It will therefore be important for policy makers to take a holistic approach, both when co-ordinating planning and public financing for necessary enabling infrastructure, as well as for streamlining permitting processes. Ideally, planning of new infrastructure should closely address the needs and concerns of communities and other sectors. When possible, it may be more efficient to allow infrastructure to be used to also meet other purposes (e.g. hydrogen pipelines that could support other non-industrial uses). Effective political communication with

taxpayers, and a fluid dialogue and consultation with communities and stakeholders from other sectors, can be key to addressing potential concerns.

What is the complexity associated with implementing each policy instrument?

Complexity in the implementation of policies in this category will be largely related to existing industrial sites and resource endowments in the country or region concerned. In some regions, conditions may easily facilitate planning for shared infrastructure and industrial clusters. In others, the existing landscape of industrial sites and limitations in availability or geographic dispersion of required resources (e.g. renewables potential or CO_2 storage potential) may add to the complexity and costs of infrastructure planning and development. The perceptions of different stakeholder groups and any resulting challenges may also create complexity (see prior question).

Depending on the jurisdiction, another element that could potentially add complexity to the policy instruments in this category is any necessary co-ordination between different government levels (national, state or provincial, and local). If the policies cover cross-border infrastructure, this also applies to co-ordination with other national or supranational governments. Fluid communication between the different governments involved will be key to addressing any issues arising as a result of their different views, priorities, budgets and regulatory frameworks.

3.2.1 Co-ordinated planning and public financing for required enabling infrastructure

Description

The government can act as a co-ordinating body for the construction of infrastructure that is required to underpin the industrial transition, such as transport and storage of CO_2; low-emissions electricity and hydrogen production and distribution; and collection, sorting and distribution of materials. This co-ordinating role can imply full construction of the infrastructure, or it can be related to creating the necessary legal and regulatory framework to enable its development, including procuring land for transport or storage facilities. The government's role can also be related to developing long-term infrastructure plans, setting permitting rules, establishing concessions for the projects, or enabling public private partnerships (PPPs).

How could this policy instrument target deep emissions reductions?

To target deep emissions reductions, there should be a vision to develop an infrastructure system that will accommodate for the long-term scale-up of near-

zero emissions technologies. This will include making investments for infrastructure that might not immediately be used, but that can be built or refurbished for such production in the near future.

When is this policy instrument suitable?

- Given that public/shared infrastructure can enable the development of low- and near-zero emissions plants, the role of the government in providing foresight regarding its buildout is key to industrial decarbonisation investment decisions.
- The benefits of the constructed infrastructure might also serve other purposes apart from industrial decarbonisation (e.g. hydrogen pipelines to be used for hydrogen in other applications). Mapping the infrastructure needs of other sectors will help build a better case for such large investments, as well as creating more social acceptability for the constructed infrastructure. In addition, there could be synergies (e.g. new infrastructure could promote the development of other economic activities in the area).
- Particularly pertinent for countries that will see their industrial sites relocating to areas that are better suited for low- and near-zero emissions production (mainly due to renewable resource endowment or access to ports).

What needs to be considered before implementation?

- **Budget:** Infrastructure planning and especially direct construction by the government can create an unaffordable burden on public budget. Efficient use of resources has to be evaluated, with a thorough cost-benefit analysis that considers all users of the infrastructure and takes into consideration other budgetary priorities.
- **Avoid duplication:** The diversity of low- and near-zero production technologies might imply the parallel development of new infrastructure. To build a stronger investment case, it will be important for the same infrastructure to serve as many production sites as possible and to avoid duplicating infrastructure due to inefficient siting of plants. Promoting industrial clusters could aid in this respect.
- **Public acceptance:** The development of new infrastructure could imply the modification of land that has other uses, or even of public access to certain areas or resources. Moreover, if infrastructure investments are financed with public funds, competing projects have to be considered, since society might have other infrastructure priorities. Public concerns around safety should be addressed clearly and transparently, particularly with regards to CO_2 storage sites (whether underground on land or at sea).

Best practices

Effectiveness

- Ensure that funded projects have clearly defined objectives and mechanisms to measure their progress.
- Establish checkpoints to monitor project development.

Simplicity

- Clearly establish conditions for projects to be eligible for public funding.
- Clearly outline the processes for the disbursement of project funds.
- Make sure that stakeholders involved in the process have ownership of their tasks and that there is a clear mechanism to monitor this.

Acceptability by stakeholders

- Engage representatives of each impacted stakeholder group in the planning process. Perform market consultations to understand the state of play and the needs and interests of the different stakeholders involved.

Economic efficiency

- In this case, economic efficiency will be very much related to the type of project being co-ordinated and financed by the government. For more detail on the financing part, please refer to the Direct public funding instrument.

How can international collaboration improve the efficiency of this instrument?

Access to international financing

- With the purpose of advancing industrial decarbonisation goals, many countries and international organisations could be open to providing financing for the development of international best practice sharing programmes.

International co-operation agreements

- International co-operation agreements can allow public funding to leverage capacities of other countries (such as technological or human resources) for the effective use of public funds.

Commercial agreements

- International commercial agreements between producers and buyers can help guarantee the offtake of low-emissions hydrogen, electricity or materials that result from these projects. This would contribute to building a better investment case.

Examples of governments that have implemented this type of policy instrument

- Brazil's Guidelines for National H2 Program (PNH2) (2021).
- China's Hydrogen Medium- to Long-Term Plan (2022).
- The European Union's Hydrogen Strategy (2020).
- India's Green Hydrogen Mission (2022).
- Japan's Sixth Strategic Energy Plan - 2050 Carbon Neutral (2021).
- Japan's Basic Hydrogen Strategy (2023).
- Korea's Strategy for Technology Innovation for Carbon Neutrality (2021).

3.2.2 Streamlined and accessible permitting

Description

Permitting for both industrial decarbonisation projects and the adjoining infrastructure required for these projects can take many years, thus postponing the decarbonisation actions and increasing the costs of the projects. Long wait times for permit approvals could act as barriers to the development of industrial decarbonisation initiatives, not only because of timing, but also because these delays are translated into total project costs.

The difficulty in estimating the length of the wait time can be an additional barrier. A more streamlined and transparent permitting process could allow for better planning and contribute to lowering investment risk.

While stringency of requirements and safety should not be compromised, there are measures that governments can take to lower the administrative burden for projects and accelerate permitting procedures. This can be done by simplifying the administrative process (e.g. through one-stop shops) and devoting more resources to permitting verifications.

How could this policy instrument target deep emissions reductions?

To target deep emissions reductions, the government should prioritise projects that involve near-zero emission technologies. Expedited and exceptional treatment can be especially valuable in the early stages of development, when near-zero emission technologies are expected to be more limited in number.

When is this policy instrument suitable?

- Streamlining permitting and making it more accessible is particularly important for large strategic projects, which many other projects may depend on.

- This measure is particularly pertinent to countries that tend to have a long-standing list of projects under review.

What needs to be considered before implementation?

- **Safety:** In the quest for more streamlined and accessible permitting, safety must not be put at risk. The aim should be to make the permitting process more efficient and not less stringent.
- **Internal resources:** Evaluate internal capabilities (including human and technological resources) to carry out these changes in the permitting processes and assess whether the government requires more resources and the associated costs.

Best practices

Effectiveness

- Define objectives and establish checkpoints for the revision of the permitting process.
- Identify bottlenecks in the process and target those first.
- Engage people involved in permitting to share experience on how to make the process more efficient.

Simplicity

- Clearly outline the process of revision of the permitting processes and the costs it will entail.
- Introduce one-stop shops for permitting as a streamlining tool to make the process easier and more efficient for applicants.

Acceptability by stakeholders

- Ensure that people affected by projects clearly understand that the streamlining of the permitting process does not mean that the evaluation is becoming less stringent. If necessary, provide space for the discussion of these issues with all impacted stakeholders.

Economic efficiency

- If the government is able to substantially decrease the permitting time, this could have an important impact on the amount of near-zero technology projects that reach final investment decision and get completed.
- Moreover, properly streamlining the permitting process can reduce project costs significantly.

How can international collaboration improve the efficiency of this instrument?

Knowledge-sharing

- Understanding how other countries (especially those that have faster permitting processes) operate can help governments build a better permitting strategy.

International co-operation agreements

- International agreements to share information and to agree on evaluation criteria for permitting can help improve the permitting process.

Examples of governments that have implemented this type of policy instrument

- The European Union's Net-zero Industry Act (2024).

3.3 Tracking progress and improving data

What is the purpose of this category?

Accurate, detailed and timely data is a key precondition for most policies that aim to directly or indirectly reduce GHG emissions and that are aligned towards a net zero energy system. Having effective mechanisms for reporting emissions and other related data will enable governments to get a clear picture of the situation and in turn to make informed decisions about policy choices and implementation.

Tracking progress and improving data mostly concerns emissions data, but it can also include other data necessary for policy implementation, such as on industrial output, production costs, consumption, energy use, planned investment projects, and so on.

Policy instruments in this category include those that improve the availability and quality of information (increased data collection and reporting); set thresholds and establish clear and common understanding of emissions performance (standards, definitions, certifications and labelling for low- and near-zero emissions materials production, and work towards common international methodologies); and use information as a means to give credit to market players who make efforts to reduce their emissions (sustainability certifications and product stewardship initiatives).

What critical role does this category serve in an overall industrial decarbonisation strategy?

Many policies relating to targeted actions for specific technologies and strategies require robust definitions and criteria in order to be put into practice. For instance, for policies in the Managing existing assets and near-term investments category, policy makers may need to decide upon a certain threshold of emissions per unit of production above which they would not allow a plant to operate. Policies within the Creating a market for near-zero emissions materials production category, for example, would be facilitated if definitions for near-zero emissions materials, underpinned by verifiable emissions accounting and reporting methodologies, were accepted by market participants. Meanwhile, robust emissions data also underpins broader policies like carbon pricing, and policies that seek to facilitate a level playing field for industrial producers internationally.

The critical role of policy instruments that track and improve data lies in: 1) allowing governments to understand the state of play; 2) facilitating comparability between emitters, thus providing information to policy makers on where to focus; 3) giving credit to actors that are making decarbonisation efforts; and, ultimately, 4) easing the implementation of other policies that aim to reduce emissions.

What factors should be considered when selecting a certain policy instrument or set of instruments within this category?

Key questions for governments deciding on which instrument (or set of instruments) in the area of tracking progress and improving data would be better suited to their industrial decarbonisation strategies include the following:

How will these policies be perceived by different stakeholder groups?

Tracking progress and improving data is generally seen as providing transparency and facilitating decision-making. However, some stakeholder groups might see oversight and regulation regarding emissions as something that increases their costs and reporting efforts. For both the “increased data collection and reporting” and the “standards, definitions, certifications and labelling for low- and near-zero emissions materials production” policy instruments, the direct impact on many producers is an increase in costs arising from measurement, reporting, auditing, compliance and interactions with regulators. Additionally, some industrial players may have concerns regarding confidentiality and may prefer to not make public detailed emissions data (e.g. plant-level emissions). Others may have concerns that certain definitions or certifications may impact their competitiveness.

Nevertheless, governments could increase the acceptability by closely consulting with potentially affected industries and aiming for policies that maximise fairness for all. It will be important to properly convey to companies the benefits of these instruments for the creation of low- and near-zero emissions markets, including easing implementation of other policies that could benefit producers, and for increasing alignment and coherence between different reporting requirements to help reduce reporting burden.

Similarly, governments could convey the benefits that work towards common international methodologies could bring to facilitating trade and expansion of markets for low- and near-zero emissions materials at an international level, as well as to reducing the burden for producers and buyers operating across multiple jurisdictions.

Sustainability certifications and product stewardship initiatives are mostly an incentive for best performers, so are generally well-perceived by producers, particularly if they are voluntary. However, if some producers perceive that particular certifications put them at a competitive disadvantage, there may be a need for consultation and working towards solutions that are fair to all while still facilitating robust emissions reduction outcomes.

What is the complexity associated with implementing each policy instrument?

A key challenge with most of these policy instruments – and in particular those related to definitions and certifications – is related to gathering experts and stakeholders to advance certain discussions, and foregrounding these topics in local (and in some cases international) debate in order to reach agreements and common understandings.

The main complexity of some of these policy instruments (standards, definitions, certifications and labelling for low- and near-zero emission materials production, and work towards common international methodologies) is likely to lie in the initial discussions, design and approval/formalisation of the definitions/standards. Once agreed and in place, they could be simple to maintain. For the other policy instruments (increased data collection and reporting, and sustainability certifications and product stewardship initiatives), complexity may lie in setting up the relevant systems, as well as continual oversight, measurement and revision of the activities by producers.

Complexity may be greater if a data collection or certification system aims to be interoperable with other systems internationally, rather than only used in one jurisdiction. Over the long term, having interoperable standards would simplify

operations for companies producing and trading across borders. Meanwhile, building on already existing data collection methods could ease the preparation steps required.

What are the government's budgetary and resource considerations?

Most of the policy instruments in this category do not necessarily imply large expenditures by governments, but rather efforts to mobilise different actors on the production side and the government side to reach common understandings. The main expenses would likely result from gathering the right human resources to design and implement these policies.

What are the timing considerations?

As the policies within this category often enable the design and implementation of other policies, not acting in a timely manner on aspects of an industrial decarbonisation strategy relating to tracking progress and improving data might ultimately delay progress. Some producers may be waiting for definitions or thresholds to be formalised by governments before making investment decisions. Lack of action in this category can result in non-action in the private sector.

With regards to the development of new standards, definitions and methodologies, allowing the private sector to advance with investments and decarbonisation projects without clear guidelines might result in additional costs, both for companies who will have to change their plans, as well as for the government, who may need to revise related policies and regulatory processes. Reaching agreements on definitions and setting up emissions data collection systems can take time, so starting early and planning in advance is important.

3.3.1 Improved data collection and reporting

Description

This instrument includes policies that aim to increase the amount and quality of information available to the government around emissions performance of the industry sector. It therefore includes both regulatory reporting requirements and simplified mechanisms for companies to disclose their information or implement better data collection methods.

How could this policy instrument target deep emissions reductions?

To target deep emissions reductions, this policy instrument would ideally cover data reporting by all major industrial producers, including detailed site- and product-level emissions data. This would build understanding of the full range of emissions performance, including that of first movers on technologies for deep decarbonisation.

When is this policy instrument suitable?

- For countries that want to implement other policy instruments that are dependent on information (e.g. on emissions) that is not yet available. Such instruments may include carbon pricing, for example.
- For countries that would like to track the progress of the industrial sector against emissions reductions targets or other transition milestones.

What needs to be considered before implementation?

- **Consistency with other reporting requirements:** Wherever possible, policy makers should seek to make new data collection consistent with other reporting requirements for companies and not duplicative. Ideally, a company should be able to report all information together, and in the simplest way possible. Drawing on existing emissions measurement methodologies (e.g. International Organization for Standardization [ISO] standards), may help with this.
- **Financial and technical support:** The ability of industrial players to implement such measurements, from both a cost and technical perspective. Complementary policies to support companies in establishing reporting teams and in adapting their accounting systems might need to be considered.

Best practices

Effectiveness

- Establish a certain periodicity (e.g. annually) for reporting.
- Where possible, avoid granting exceptions to companies. If exceptions are granted, make sure there is a clear mechanism to apply for exceptions and a strict timeline for the expiration of such exceptions.

Simplicity

- Ensure all companies report their data under the same measurement methodologies and reporting tools.
- If data is made public, make it available in clear, consistent and user-friendly data systems and tools.

Stakeholder acceptability

- Engage different companies and entities that would be subject to the reporting in the programme design.
- Build understanding of cost to stakeholders and existing data collection structures to evaluate how realistic the reporting requirements are, what the implementation challenges are, and what companies need in order to better comply with requirements.

Economic efficiency

- Once the reporting guidelines and requirements are defined and implemented, the costs to government will be related to monitoring and auditing the data. If the requirements are adequately enforced, the policy has the potential to have high economic efficiency.
- For companies, maximising compatibility and avoiding duplication with other reporting systems would reduce the costs of compliance.

How can international collaboration improve the efficiency of this instrument?

International definitions, standards and certifications

- Work to agree on and use internationally recognised, interoperable emissions measurement methodologies would simplify data reporting and understandability across jurisdictions.

Commercial agreements

- Commercial agreements between governments that require contract terms to reference certain emission levels could act as market incentives for companies to adhere to data-reporting practices.

Examples of governments that have implemented this type of policy instrument

- Brazil’s National Emissions Registry System (2016).
- The European Union's European Pollutant Release and Transfer Register (E-PRTR) (2022).
- Mexico’s Voluntary Agreement Programme (2017).
- Türkiye's Regulation on the Monitoring of Greenhouse Gas Emissions (2014).
- Türkiye’s Regulation on Ozone-Depleting Substances (2017).
- Türkiye’s Regulation on the Management of Industrial Emissions (2025).
- (United States) California's SB 905: Creation of a Carbon Capture Regulatory Framework (2022).

- Viet Nam's Decree No. 06/2022/ND-CP Providing Regulations on Reduction of Greenhouse Gas Emissions and Protection of the Ozone Layer (2022).

3.3.2 Standards, definitions, certifications and labelling for low- and near-zero emission materials production

Description

Standards, definitions, certifications and labelling for low- and near-zero emission materials production will allow for the differentiation of conventional higher-emitting production techniques from those that are on a net zero emission pathway, or already compatible with the net zero emissions endpoint.

Such a differentiation would enable governments to apply targeted policies, such as measures to restrict production above certain emissions levels or incentivise low-emissions products. In addition, this differentiation might enable producers to better market near-zero and low-emissions materials to potentially interested buyers.

How could this policy instrument target deep emissions reductions?

Standards, definitions, certifications and labelling schemes can clearly define their target(s) by ensuring there is a clear differentiation between deep emissions reductions and incremental emissions reductions. This could be done, for example, by clearly distinguishing between low-emissions and near-zero emissions performance, with the latter being most compatible with deep emissions reductions.

The design of standards, definitions, certifications and labels may consider ways to make transparent or otherwise account for performance that is inherently lower emissions due to the inputs used (e.g. use of scrap or conventional supplementary cementitious materials), so that certifications reward steps towards transformational technologies rather than only pre-existing production techniques.

When is this policy instrument suitable?

- For countries that want to implement targeted policy instruments that are dependent on information that could be reflected by standards, definitions, certifications or labels.
- For countries that want to aid private sector actors to choose lower-emissions products by providing transparent and reliable information.

What needs to be considered before implementation?

- **Flexibility:** The right balance needs to be found between establishing standards, definitions, certifications or labels that are simple, and those that are overly normative. The requirements should allow for a certain level of flexibility and consider all cases.
- **Use case:** The specific use of the standard, label or certification may affect the choice of measure or its design.
- **Coherence:** Before designing something new, policy makers could consider whether any existing standards would already serve the intended purposes. This would help improve coherence among different uses and reduce the proliferation of different standards.

Best practices

Effectiveness

- Consider making emissions performance and emissions reductions the central focus, rather than the technology used. By being technology-neutral, standards, definitions, certifications, and labels will provide more flexibility to producers, without deviating from the goal of deep emissions reductions.
- Establish a timeline for certifications or labels to expire, after which companies would have to apply for a renewal to show that they are still in compliance.

Simplicity

- Clearly state eligibility criteria and the process requirements.

Stakeholder acceptability

- Engage different companies and entities that may use standards, definitions, certifications and labels in the design of the policy.
- Build understanding of stakeholder cost structures to evaluate how realistic the standards, definitions, certifications and labels are in terms of measurement and implementation.

Economic efficiency

- This policy instrument could most effectively target investments towards emissions reductions by designing the standards to clearly distinguish between products and production sites that are net zero compatible and those which are not.

How can international collaboration improve the efficiency of this instrument?

International definitions, standards and certifications

- Low- and near-zero emissions definitions for materials such as steel and cement will provide a clearer end goal for governments to set their standards, definitions, certifications or labels. The existence of internationally recognised, interoperable definitions would simplify processes significantly and give more credibility to the policy, while helping foster strong international markets.

Commercial agreements

- International commercial agreements between producers and buyers that include terms that reference certain standards, definitions, certifications and/or labelling for low- and near-zero emission materials could act as market incentives for adoption by companies.

Examples of governments that have implemented this type of policy instrument

- China's Energy Efficiency Leader Scheme (2015).
- China's Announcement on matters related to standardizing the import management of recycled steel raw materials (2021).
- China's Chinese Environmental Products Declaration (EPD) platform for the steel sector (2024).
- Germany's Lead markets for climate-friendly basic materials (2024).
- India's Bureau of Energy Efficiency Plans to Introduce ISO 50001:2018 Standards (2018).
- Indonesia's Law 3 concerning Industry (2014).
- Indonesia's Green Industry Standards (Ministerial Regulation No.51/2015) (2015).
- Türkiye's Communique regarding Low Carbon Emission in Public Procurement Contracts to Promote the Use of Green Cement (2024).
- The United States' Low Carbon Cements and Concretes Consortium (2022).
- Viet Nam's Decision 01/2022/QD-TTg on the List of Greenhouse Gas Emitting Facilities that Must Conduct Greenhouse Gas Inspections (2022).

3.3.3 Work towards common international methodologies and definitions

Description

Standards, definitions, certifications and labelling for low- and near-zero emission materials production can make a greater impact when adopted at an international level. Definitions and the underlying emissions measurement methodologies used to implement and evaluate standards, certifications and labelling for low- and near-zero emission materials production can be agreed at an international level, or alternatively, means can be pursued to make different methodologies interoperable. As a larger number of countries adhere to international standards, common or interoperable methodologies can provide benefits related to:

- Increased creditability for the standard.
- Cost and process simplification for companies operating in multiple jurisdictions.
- Cost and process simplification for importers that want to make sure that the products they are buying align with local standards.
- Greater incentive for additional countries to adopt standards, definitions, certifications or labels.

How could this policy instrument target deep emissions reductions?

Definitions and methodologies will target deep emissions reductions when there is a clear differentiation between deep emissions reductions and incremental emissions reductions (see 3.3.2). This distinction can be maintained once definitions and methodologies are adopted internationally.

When is this policy instrument suitable?

- For countries that want to implement other policy instruments that are dependent on information that could be provided by international standards, definitions, certifications or labels.
- For countries with important trade relationships with countries that adhere to certain standards, definitions, certifications or labels.
- For countries that want to improve their trade exchanges with countries abiding by robust and commonly recognised standards, definitions, certifications, or labels.

What needs to be considered before implementation?

- **Alignment with local regulation:** Ensure the international standards, definitions, certifications or labels can be made interoperable with local regulation.

- **Diversity of views:** Ensure the standard/definition/certification/label properly reflects the interests of all the countries that initially adopt it.

Best practices

Effectiveness

- Consider making emissions performance and emissions reductions the central focus of the standard, rather than the technology used. Technology-neutral standards, definitions, certifications, and labels would provide more flexibility to producers, without deviating from the aim of deep emissions reductions.
- Establish a timeline for international certifications or labels to expire after which companies would have to apply for renewal to show they are still in compliance.

Simplicity

- Clearly state eligibility criteria and the process requirements.

Stakeholder acceptability

- Engage different companies in the process before agreeing on the standard/definition/certification/label in order to understand what information they would be able to provide and their views on what the standard/definition/certification/label should achieve.
- Understand stakeholder cost structures to evaluate how realistic the standards, definitions, certifications and labels are in terms of measurement and implementation.
- Engage international experts in the design and choice of such methodologies.

Economic efficiency

- By designing the standards with a clear distinction between products and production sites that are net zero compatible and those which are not, this policy instrument could most effectively target investments towards emissions reductions.
- Working towards an international solution would also improve efficiency for governments and industry, given the global nature of industrial markets.

How can international collaboration improve the efficiency of this instrument?

Commercial agreements

- Commercial agreements between producers and buyers in different countries that include contractual terms that reference certain international standards,

definitions, certifications and/or labelling for low- and near-zero emission materials could act as market incentives for countries to adhere to these practices.

Examples of governments that have implemented this type of policy instrument

- The European Union's European Pollutant Release and Transfer Register (E-PRTR) (2022).
- UNIDO - IDDI's Guidance for Product Category Rules (PCR) Harmonisation (2024).
- Climate Club work towards common and interoperable international definitions (2024).

Examples of initiatives by multilateral organisations and international industry associations to help countries advance on internationally comparable standards and definitions:

- Common standards and targets to support industry and procurers by UNIDO IDDI (2021).
- ResponsibleSteel International Production Standard V2.1 (2024).
- Global Cement and Concrete Association (GCCA) Definitions for Low Carbon and Near Zero Cement (2024).

3.3.4 Sustainability certifications and product stewardship initiatives

See 2.2.8 Sustainability certifications and product stewardship initiatives in the section on "Creating a market for near-zero emissions materials production".

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