HP 4 THEMATIC SERIES

HOW MINISTRIES OF FINANCE CAN SUPPORT COHERENT CLIMATE POLICY PACKAGES

Available analytical tools and emerging good practice

FEBRUARY 2026

A report of the Coalition of Finance Ministers for Climate Action Helsinki Principle 4 initiative: Economic Analysis for Green and Resilient Transitions

About this report

This publication is a product of the Helsinki Principle 4 (HP4) workstream under the Coalition of Finance Ministers for Climate Action. The overall aim of HP4 is to mainstream climate action into economic and fiscal policy. The report forms part of an effort to improve macroeconomic analysis and modeling tools for Ministries of Finance (MoFs) to drive climate action, including by developing coherent policy packages that combine fiscal and non-fiscal instruments.

This report focuses on identifying and illustrating how MoFs can best foster the design and implementation of coherent policy packages for climate action. It discusses how economists' traditional focus on stand-alone carbon pricing is gradually shifting to multifaceted climate packages. The various climate actions and policies that MoFs can deploy in coordination with line ministries are discussed and a structured approach to defining, assessing, implementing, and evaluating climate packages that combine multiple instruments is provided.

Several contributions to the online Compendium of Practice that also forms part of this work program have informed the report (see Table A). The Compendium of Practice is a global collaborative effort that consists of contributions from over 100 leading organizations and individuals gathered for this workstream. The author team would like to thank the numerous Coalition members, partners, and other individuals and organizations who directly contributed to the Compendium. The Compendium and complementary reports are available on a dedicated website, https://greenandresilienteconomics.org/. These include a survey of the world's MoFs, a report summarizing the Compendium, an overview of the analytical tools available to MoFs, and other thematic reports in areas related to Ministries' pressing climate policy needs. Further reports are under development.

This report was led by Patrick Lenain (Council on Economic Policies) with support from Magd Shamashan, Luke Hatton, and Priya Sahu. The overall effort was guided by Mads Libergren (Danish Ministry of Finance) and supported by Nick Godfrey, Hannah Maier-Peveling, and Hipólito Talbot-Wright (Grantham Research Institute on Climate Change and the Environment). The author team are grateful to the following peer reviewers for their input and guidance: Jan Nill, Janos Varga, and Margaux Salmon-Genel (European Commission), Diana Laura Jiménez Miranda (Mexico—Secretariat of Finance and Public Credit), Mike Fahy and Jean Brennan (Ireland—Department of Finance), Flavia Bottoni (Italy—Ministry of Economy and Finance), Leandro Rossi and Emma Nordkamp (Netherlands—Ministry of Finance), Alexander Barkawi (Council on Economic Policies), Andrew Burns and Stéphane Hallegatte (World Bank), Florence Jaumotte and Sneha Thube (International Monetary Fund), Filiz Unsal and Hélia Costa (Organisation for Economic Co-operation and Development), Fleance Cocker (University of Geneva), Renu Kohli (Centre for Social and Economic Progress), Murray Petrie, and Megan Mahajan (Energy Innovation). Sarah King at the Grantham Research Institute edited the report with editorial oversight by Georgina Kyriacou and typesetting by Joseph Adjei.

About this report

Disclaimer

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About this report

Table A. Contributions to the Compendium of Practice used in this report

Institution	Authors	Title
European Commission	Matthias Weitzel	Assessing the distributional consequences of the transition in the EU
European Commission	Francesco Ferioli, Derck Koolen, Janos Varga	Overview of the European Commission's energy and climate policy-related modeling suite
Italy—Ministry of Economy and Finance		The Italian Ministry of Economy and Finance climate-related modeling tools: how to build a flexible suite of models serving different purposes
Sierra Leone—Ministry of Finance		Climate policy priorities in Sierra Leone
Abdul Latif Jameel Poverty Action Lab (J-PAL)—Massachusetts Institute of Technology	Andre Zollinger, Claire Walsh	How Ministries of Finance and economic decision-makers can use ex-post pilot assessments to inform climate policy: designing, testing, and scaling emissions markets in India
Council on Economic Policies	Patrick Lenain	It takes two to tango: the role of Ministries of Finance in pricing and non-pricing policies for a low-carbon economy
French Economic Observatory (OFCE)—Sciences Po	Aurélien Saussay, Frédéric Reynès, Anissa Saumtally	The ThreeME model
International Monetary Fund (IMF) Research Department	Jean Chateau, Hugo Rojas-Romagosa, Sneha D. Thube, Dominique van der Mensbrugghe	IMF-ENV: integrating climate, energy, and trade policies in a general equilibrium framework
Organisation for Economic Co-operation and Development (OECD)	Filiz Unsal	The new macro-structural climate adaptation and mitigation framework by the Economics Department of the OECD
S-Curve Economics/University of Exeter/University of Manchester	Simon Sharpe, Jean-Francois Mercure, Anna Murphy, Frank Geels	Policy packages for cost-effective transitions: learning from the past, simulating the future with the Future Technology Transformations models, and case studies from the Economics of Energy Innovation and System Transition project
University of Wisconsin–Madison	Gregory Nemet	How government actions have accelerated clean energy innovation: lessons for economic analysis and modeling by Ministries of Finance
World Bank	Lulit Mitik-Beyene, Martin Christiansen, Ragchaasuren Galindev, Noe Reidt, Mei Mei Lam, Alhassane Camarra	MANAGE-WB: a recursive-dynamic CGE model
World Bank	Andrew Burns, Charl Jooste, Florent McIssac, Chung Gu Chee, Heather Ruberl, Thi Thanh Bui, Unnada Chewpreecha, Alex Haider, Baris Tercioglu	MFMod-CC: country-specific macrostructural models

Contents

List of abbreviations

CAPMF	Climate Actions and Policies Measurement Framework
CBAM	Carbon Border Adjustment Mechanism
CCDR	Country Climate and Development Report
CCfD	Carbon Contract for Difference
CFMCA	Coalition of Finance Ministers for Climate Action
CGE	Computable general equilibrium
CO_2	Carbon dioxide
EPS	Energy Policy Simulator
ETS	Emissions Trading System
EU	European Union
EV	Electric vehicle
GDP	Gross domestic product
GIS	Geographic Information System
GPP	Green public procurement
GPFM	Green public financial management
IAM	Integrated Assessment Model
ICE	Internal combustion engine
IEA	International Energy Agency
IMF	International Monetary Fund
IO	Input–Output
MFMod	Macroeconomic and fiscal model
MoF	Ministry of Finance
MVRS	Measuring, verification and reporting system
NECR	Net Effective Carbon Rate
NIER	National Institute of Economic Research
OECD	Organisation for Economic Co-operation and Development
PPP	Public–private partnership
RCT	Randomized controlled trial
RSB	Regulatory Scrutiny Board
SEC	Securities and Exchange Commission
SLB	Sustainability-linked bond
SOE	State-owned enterprise
VAT	Value Added Tax
WTO	World Trade Organization

Summary for policymakers

Governments are increasingly seeking to accelerate decarbonization and mobilize the required investment through mutually reinforcing policy tools. Ministries of Finance (MoFs) are critical to this agenda, given their responsibility for guiding economic strategy, allocating public resources, and mobilizing financing at scale. The fiscal levers held by MoFs underpin and strengthen climate policy packages, and their position at the center of government enables MoFs to support the design and implementation of coherent packages in collaboration with line ministries. To secure the most effective use of resources to drive the green transition, MoFs can benefit from setting clear objectives, rigorously assessing alternative policy options, ensuring effective implementation, and evaluating policy impacts.

Key messages

- **The climate packages deployed by governments contain a diverse range of actions.** Governments rarely rely on carbon pricing alone to drive green and resilient transitions. They deploy a wide range of fiscal, regulatory, financial, and investment measures to address market failures, financing gaps, and political economy constraints. Evidence from International Monetary Fund (IMF), Organisation for Economic Co-operation and Development (OECD), and World Bank research shows that such multi-instrument packages are being implemented across both high- and middle-income economies.
- **Coherent and well-coordinated climate policy packages can be highly effective.** Climate packages work best when effectively coordinated across and within institutions. However, climate measures often emerge incrementally, which risks a lack of coherence. MoFs cannot design all policy instruments, but they can play a critical role in ensuring coherence and fiscal sustainability and minimizing distortions. This is especially important where institutional capacity is limited.
- **Well-designed climate packages can contribute to long-term economic development.** Climate packages can advance growth, innovation, poverty reduction, and resilience while enabling net zero transitions as long as they take different objectives and their synergies into account. Analytical tools such as the World Bank's Country Climate and Development Reports (CCDRs) demonstrate how embedding climate goals into development strategies—whether in oil-exporting, water-scarce, or carbon-intensive economies—creates pathways that jointly deliver economic and climate benefits.
- **The short-term economic and fiscal benefits of climate packages are real.** Well-designed packages can generate a near-term surge in investment in clean energy and clean industries, with boosts to employment and growth. They can also deliver rapid co-benefits such as better air quality in cities, reduced vulnerability to extreme weather events, and improved wellbeing. Importantly for MoFs, climate packages generate government revenue from carbon pricing and reduced fiscal risks. Focusing on these short-term gains can help address the challenges of political acceptability.
- **MoFs have a powerful range of climate policy instruments they can use.** Taxes, subsidy reform, emissions markets, public investment, and green procurement all fall within the remit of MoFs. Evidence highlights that well-designed taxes and subsidies can create fiscal space, improve equity, and reduce pollution while supporting climate goals.
- **MoFs hold untapped potential in climate policy.** Despite their oversight of powerful fiscal instruments, many MoFs have not yet fully leveraged their capacity to support climate goals. In this context, MoFs are yet to completely embrace their role in aligning financial flows with low-carbon development, as mandated by the Paris Agreement. Broader involvement can ensure that climate packages remain fiscally sustainable, socially just, and aligned with national development priorities. A sequence of climate policies starting with well-targeted fiscal support ("carrots") before deploying taxes and regulations ("sticks") can raise political acceptability if designed in a fiscally sustainable way.

Summary for policymakers

- **To act, MoFs must answer some daunting policy questions.** MoFs face challenging questions regarding the direct and indirect implications of the green and resilient transition. Building effective policy packages requires robust and credible answers to these questions that are grounded in sound economic analysis that sets out the risks and opportunities of different policy pathways.
- **Context matters when designing climate packages.** Research findings confirm that instrument choice and sequencing depend on country context. Low-income economies can prioritize subsidy reform, social protection, and power-sector planning as "foundational reforms," while middle- and high-income countries can anchor packages on pricing, complemented by innovation and investment.
- **Better modeling approaches are emerging to support climate packages.** Hybrid and linked modeling approaches—as increasingly used in MoFs and international organizations—integrate macroeconomic, sectoral, and climate analysis to reflect real-world policy interactions. These tools help MoFs evaluate trade-offs, quantify impacts, and sequence measures. There is a need for further improvement, such as more advanced modeling of interactions of climate instruments with other policy priorities, as well as better access to such tools and models.
- **Evaluation and fine-tuning are crucial.** A structured policy cycle is essential—setting goals, assessing pathways, monitoring implementation, and evaluating impacts. MoFs must commit to regular data collection, modeling, and impact assessments to adapt and improve over time.
- **Stakeholder engagement enhances legitimacy.** Broad public consultation, cooperation with line ministries and subnational governments, and transparent communication of trade-offs (for example in subsidy reform) build acceptance and effectiveness. Such inclusive engagement increases the political feasibility of ambitious climate–development strategies.

1. Introduction

This report seeks to provide Ministries of Finance (MoFs) with insights for the design and implementation of climate policy packages that combine carbon pricing and a set of other fiscal and regulatory instruments. The report focuses on climate change mitigation policies while acknowledging that they can be usefully associated with adaptation measures. We discuss the various climate actions and policies that MoFs can deploy in coordination with line ministries and provide a structured approach to defining, assessing, implementing, and evaluating climate packages that combine multiple instruments.

Context

Since adopting the Paris Agreement in 2015, countries worldwide have implemented policies to steer their economies toward low-carbon development. The academic literature has traditionally focused on stand-alone carbon pricing to achieve progress on decarbonization. Many models and economic theory have indicated that uniform carbon prices set at sufficiently high levels could, in isolation, reduce carbon emissions at the lowest economic cost. However, in practice, most governments do not rely on stand-alone carbon pricing and the global community has been unable to agree on uniform, global carbon prices. Instead, many national ministries deploy multiple fiscal and regulatory policy instruments within their own areas of competence. This deployment often occurs incrementally and is not always coordinated.

Recent climate policy initiatives in Europe, North America, and Asia have been framed as packages, seeking to reduce carbon emissions while at the same time boosting investment, encouraging innovation, improving equity, and supporting growth. These packages mobilize carbon pricing, public investment, tax credits, and regulatory measures and experience has proven that they can be highly effective. However, ensuring the coherence of such climate packages, when line ministries intervene with their own priorities, is not an easy task. Without adequate intra-governmental cooperation, climate packages risk missing the opportunity to advance along low-carbon pathways or do so at a much higher (economic or social) cost. It is therefore essential that MoFs, with their broad oversight, develop the capacity to bring coherence to multifaceted climate actions. With robust analytical tools, MoFs can clarify trade-offs, limit incoherence, and minimize dead-weight economic losses.

Coherent packages can boost both short-term growth and long-term prosperity. Recently deployed, well-designed packages are delivering bursts of activity in clean energy and clean industry sectors, with associated employment gains. Over time, well-coordinated and well-sequenced climate packages generate persistent co-benefits such as improved health outcomes, productivity gains, and reduced climate vulnerability. In turn, this expands the fiscal and institutional capacity for large-scale investments in long-term growth. Such virtuous feedback loops help reinforce sustainable prosperity.

MoFs have faced knowledge gaps when attempting to understand the complexity of climate policy packages, especially outside high-income countries. The results of a recent survey conducted by the Coalition of Finance Ministers for Climate Action indicated that there is “insufficient information to answer a number of pressing climate-related policy and analytical questions on a broad range of issues” (CFMCA, 2025e). In particular, there is a general shortage of available modeling approaches within MoFs and research is still in its infancy regarding the socioeconomic and environmental impact of industrial and innovation policies and S-shaped adoption patterns. Where feasible, the effectiveness of different policy instruments and policy packages in reducing emissions and their economic impacts are being assessed. This can involve macroeconomic and energy models being linked together and hybrid models being developed, to enable a better understanding of the complex

effects of comprehensive policy packages. Microsimulation models are also being developed to understand the impact of climate policies across the income distribution. Despite these efforts and methods, many models do not yet capture these complex interactions, and so it remains a significant opportunity for improvement.

While knowledge gaps remain, this should not be an excuse for inaction. Despite progress, understanding of climate packages remains imperfect, especially in low-income economies. Yet, the prevailing state of recent climate and climate policy research clearly prescribes the need for bold and effective action with more and more countries progressing with the implementation of ambitious climate packages. The structured policy cycle set out in this report, summarized in Figure 1.1, provides a useful course of action for implementing climate policy packages with imperfect information. This approach acknowledges that policy implementation involves trial and error and strongly suggests the use of ex-ante assessments, ex-post evaluations, and careful monitoring.

Figure 1.1. The policy cycle for implementing climate policy packages set out in this report

Source: Authors

Information sources

The report draws on information from several sources:

- Contributions of Coalition of Finance Ministers for Climate Action (CFMCA) Members and Institutional Partners, in particular work in the context of Helsinki Principle 4 on mainstreaming climate change mitigation and adaptation in macro-fiscal and other relevant policies. Information was also obtained directly from MoFs.
- The rich datasets compiled by the IMF, OECD, and World Bank regarding carbon pricing, fossil fuel subsidies, and regulatory measures. While these datasets have been expanded to cover as many countries as possible, they do not include all low-income economies due to insufficient data availability, which implies that this report provides only limited perspectives on these countries.
- Evidence-based knowledge on the impact of climate packages was obtained by undertaking a survey of the literature and by running simulations with the Energy Policy Simulator, an economy-wide model created by Energy Innovation LLC that quantifies the economic, health, and environmental impacts of energy and climate policies.

Structure of the report

The report focuses on identifying and illustrating how MoFs can best foster the design and implementation of coherent policy packages for climate action. **Section 2** discusses how economists' traditional focus on stand-alone carbon pricing is gradually shifting to a focus on multifaceted climate packages. **Section 3** examines the various climate actions and policies that MoFs can deploy in coordination with line ministries. **Section 4** outlines steps for defining, assessing, implementing, and evaluating climate packages that combine multiple instruments. Useful definitions are provided in Box 1.1.

Box 1.1. Definitions

A policy package for climate action (also policy mix or portfolio of policy instruments) is a coordinated set of policy instruments—such as carbon pricing, subsidies, regulations, and information measures—designed to work together to achieve climate mitigation or adaptation goals more effectively than stand-alone policies. These packages aim to enhance policy coherence, overcome barriers, address multiple market failures, and reduce trade-offs between economic, social, and environmental objectives. The present report focuses on climate mitigation.

Climate-related instruments are policy instruments designed to guide the economy toward a low-carbon development pathway. In addition to financial approaches (see Appendix 3), the report focuses on the following categorization of fiscal and regulatory tools:

1. **Fiscal instruments** (under the responsibility or oversight of MoFs)
   a. Carbon pricing (carbon taxes, carbon markets, excises, fossil fuel subsidies)
   b. Fiscal support (tax incentives, subsidies, social transfers)
   c. Public investment and financial management, including spending on infrastructure, guarantees, public private partnerships (PPPs), equity shareholding participation, international funding
   d. Other budgetary action (green procurement, green budgeting).
2. **Regulations** (under the responsibility of line ministries)
   a. Emission performance standards
   b. Energy performance standards
   c. Limits on activities and consumption
   d. Bans and prohibition

Governments also, though rarely, use other approaches such as voluntary carbon markets (e.g., avoidance credits, removal credits, and verified emission reductions) and information-based instruments (e.g., labeling, monitoring, certification, and nudging). Although they are important actions, these approaches are not the focus of this report.

Policy interaction refers to the way in which different policies influence each other's effectiveness or efficiency when implemented together. Interactions can be complementary (reinforcing effects), neutral, or conflicting (undermining each other). For example, a carbon tax and a subsidy for renewable energy may jointly accelerate emissions reductions (complementarity), while overlapping regulations and pricing instruments may lead to redundancy or excessive costs (conflict). Apart from effectiveness and efficiency, policy interactions have other important dimensions, such as political acceptability and social effects. Understanding policy interactions is essential for designing coherent climate packages.

2. From carbon pricing to climate packages

2.1. A traditional focus on stand-alone carbon pricing

Traditionally, many economists have focused on carbon pricing as a powerful stand-alone policy to reduce greenhouse gas emissions (see Box 2.1). Under a carbon pricing approach, carbon emitters bear the cost of climate externalities (i.e., the costs imposed on society and future generations as a result of greenhouse gas emissions), following the "polluter pays" principle. This sends a price signal which encourages a shift to cleaner energy sources, greater energy savings, and lower demand for energy services. Applied uniformly across the economy at a sufficiently high level, carbon pricing leads to emissions reductions where the marginal abatement costs are the lowest, thus minimizing overall economic costs. Finally, carbon pricing generates tax receipts and fiscal space which help facilitate the energy transition, for instance by enabling means-tested subsidies that help low-income households to shift to low-carbon energy, or support for research into alternative energy sources. For these and other reasons, carbon pricing is being adopted by a rising number of countries, although not always at a high enough level and rarely across the whole economy.[1]

Box 2.1. Key arguments in favor of carbon pricing

Traditional arguments in favor of a stand-alone carbon pricing approach for reducing emissions have included the following:

- Carbon pricing corrects the core market failure by making emitters bear the full (or at least most of the) social cost of emissions
- Carbon pricing ensures emissions are reduced at the lowest overall cost by equalizing marginal abatement costs across actors
- Carbon pricing creates continuous incentives to reduce emissions and to innovate without requiring ongoing regulatory intervention
- Alternative instruments such as subsidies or mandates are inefficient, distort prices, and often duplicate the effects of carbon pricing inefficiently
- A single price instrument is more transparent, easier to adjust, and simpler to govern than complex policy packages.

Sources: Wall Street Journal (2019); Financial Times (2019)

These theoretical arguments favoring carbon pricing have prompted researchers to assess its ex-post impact on emissions using evidence-based methodologies. Numerous studies have shown that carbon pricing does have an effect on emissions, but it is significantly different across sectors. In addition, the effectiveness differs depending on the type of pricing instruments used. An early meta-review of ex-post quantitative evaluations of carbon pricing policies around the world since 1990 found effectiveness differed across sectors, carbon taxes performed better than emissions trading systems (ETSs) and, overall, there was a limited impact on emissions

[1] Note that the focus of this report is not to look at the detailed design of carbon pricing or subsidy reform measures but to look at how to combine carbon pricing with other measures to create mutually reinforcing climate policy packages. The Coalition's complementary Helsinki Principle 3 (HP3) work program provides guidance and support on the detailed design and implementation of carbon pricing and related policies (i.e., ETS, taxes, fossil fuel subsidy removal, and other market-based mechanisms) to drive cost-effective greenhouse gas emission reductions, align economic incentives with international and domestic climate goals, and support a just energy transition (see Coalition 2025/6 workplan Annex).

(Green, 2021). However, the findings of this meta-review appear to reflect the low level of carbon prices in the period studied, as well as the limited number of jurisdictions with carbon prices.

A more recent review of the ex-post evaluation literature by Köppl and Schratzenstaller (2022) concluded that carbon taxes can effectively reduce carbon emissions or at least dampen their growth without affecting economic growth and employment. Similarly, a systematic review covering 80 causal ex-post evaluations across 21 carbon pricing schemes found that introducing a carbon price yielded immediate and substantial emissions reductions for at least 17 of these policies, despite the low level of carbon prices in most instances (Döbbeling-Hildebrandt et al., 2024). Likewise, using a dataset of carbon prices across five sectors in 39 countries, Rafaty et al. (2025) found that carbon pricing instruments reduced the annual growth rate of carbon dioxide emissions by 0.6–1.5 percentage points on average relative to counterfactual emissions, with most abatement occurring in the electricity and heat sector.

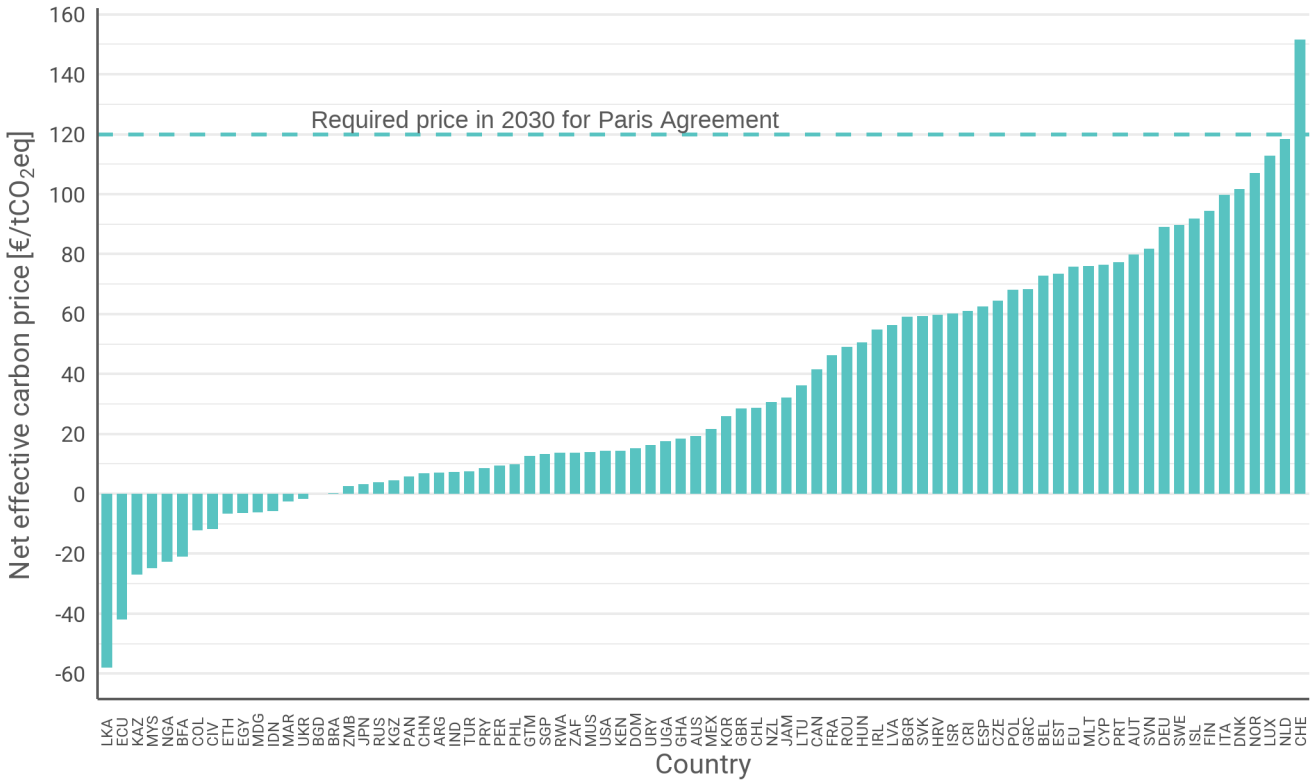
Finally, a systematic review covering 187 articles published in scientific journals or as working papers concluded that carbon pricing policies have a powerful effect in the buildings sector, are very effective in the power sector, and are effective but less impactful in the industry and transport sectors (OECD, 2025a). Overall, these studies suggest that carbon pricing is effective, but with variations across sectors and instruments. These findings about the causal effects of carbon prices on lower emissions have shaped the climate action frameworks used routinely by many organizations and have led to the emergence of a class of simulation models used to project possible pathways toward net zero emissions.

2.2. A growing focus on climate packages

Despite these academic findings suggesting causal effects of stand-alone carbon pricing, in practice, very few countries implement carbon pricing alone and at levels high enough to comply with the Paris Agreement (see Figure 2.1). In reality, most countries implement combinations of pricing and non-pricing policies—referred to in this report as "climate policy packages" or "climate packages" but also labeled elsewhere as "climate policy mixes" or a "portfolio of climate policies." With the help of newly available datasets covering both pricing and non-pricing policies, climate policy packages have been found to have a powerful causal effect on emissions. For instance, Nachtigall et al. (2024) found, based on regression analysis, a significant relationship between stronger packages of climate actions and greater emissions reductions, with most of the effect attributable to a reduction in the energy intensity of the economy. Additionally, recent strands of the literature have shown that well-designed policy mixes with the necessary policy efforts can be effective at reducing emissions (D'Arcangelo et al., 2024; Stechemesser et al., 2024).

As discussed in the remainder of this report, a government's preference for climate policy packages over stand-alone carbon pricing appears to result from the market failures and unintended consequences of carbon pricing (Fay and Hallegatte, 2015). These unwelcome effects include carbon leakage in heavy industries (Teusch et al., 2024), horizontal and vertical negative effects on income distribution (Ohlendorf, 2021; Morris et al., 2015), green innovation aspects requiring support for innovation (Aghion et al., 2025), and other aspects. As argued in this report, the critical challenge faced by Ministries of Finance is identifying how to cultivate coherent climate packages which contribute to lowering carbon emissions while supporting economic growth, equity, and innovation and within existing fiscal frameworks.

Figure 2.1. Carbon pricing makes a modest contribution to climate packages in most countries: implicit carbon price (€/tCO_2eq) in 80 areas, ordered from lowest to highest, 2023



Notes: This indicator combines the price effects from carbon taxes, emissions trading systems, energy excise duties, minus fossil fuel subsidies. A negative price indicates that fossil fuels are subsidized. The bars in the figure are for the 80 areas (country names shown using three-letter ISO country codes) that are OECD members, accession countries, non-OECD G20 countries, and other OECD partners. The highest carbon rate shown in the figure is implemented in Switzerland. The list of areas and details on the methodology can be found on the OECD Data Explorer. €/tCO_2eq = euros per metric ton of carbon dioxide equivalent.

Source: Authors, based on data from OECD (2024c)

As evidenced by inventories such as the OECD Climate Action and Policy Measurement Framework (CAPMF), no country relies only on carbon pricing as its sole measure for reducing greenhouse gas emissions. In the real world, governments deploy diverse sets of policy measures to promote low-carbon economic development. Some countries rely heavily on carbon pricing, while others make significant use of fiscal support instruments such as tax credits and regulations. A third group employs a wide range of climate-related regulations. Irrespective of the exact mix of the different categories of instruments, all countries deploy multiple instruments. For instance, the OECD estimates that countries deploy, on average, 36 instruments out of a total of 56 that have been inventoried across the world (D'Arcangelo et al., 2024). Recent literature has found that such packages are more effective than stand-alone carbon pricing (e.g., Stechemesser et al., 2024).

Several theories have been proposed to account for the comparatively greater effectiveness of climate policy packages:

- **Multiple market failures.** Carbon pricing alone may address emissions externalities, but other market failures—such as R&D spillovers, capital market imperfections, imperfect information, and behavioral biases—require complementary instruments.

- **Political acceptability.** Carbon pricing faces resistance due to concentrated losses and visible costs which may have disproportional impacts on vulnerable households or small, financially constrained firms. Packages that recycle revenues, invest in clean infrastructure, and protect vulnerable groups increase social and political acceptability—thus facilitating their implementation and increasing their effectiveness.
- **Sectoral reallocation.** Moving to net zero requires large-scale sectoral reallocation and replacement of carbon-intensive assets. Hybrid policy packages allow for managing investment surges, labor transitions, and trade shocks.
- **Path dependence.** Infrastructure and the physical characteristics of urban areas exhibit strong path dependence, locking societies into high-carbon trajectories if left uncorrected. A carbon price is insufficient if alternative pathways (e.g., widespread public transportation as an alternative to private vehicles) are not in place.
- **Co-benefits.** Climate packages can generate multiple co-benefits, such as emissions standards reducing local pollution and generating health benefits while carbon pricing helps to mitigate climate change.

In addition to these theoretical explanations, empirical evidence suggests that climate packages deploying several instruments can be an effective approach to climate action. Nearly 20 years ago researchers suggested that "no single instrument is clearly superior along all the dimensions relevant to policy choice; even the ranking along a single dimension often depends on the circumstances involved" (Goulder and Parry, 2008). As an illustration, mitigation strategies adopted by European Union Member States in the context of the "Fit for 55" and the "European Green Deal" include a carbon market (the EU Emissions Trading System [EU ETS]), technology support subsidies, and energy use regulations spanning buildings, electricity, transportation, and industry. Together with climate action by individual Member States, this strategy has been associated with a decline in greenhouse gas emissions in the EU27 by 37% between 1990 and 2024 (European Environment Agency, 2025), placing the bloc well on its way toward its 2030 climate target of a 55% net reduction relative to 1990.

More generally, beyond their greater effectiveness, governments adopt climate policy packages because they are well-suited to pursuing multiple development goals. By blending various instruments, governments can progress on several fronts, including investment (e.g., battery mega-factories, solar farms, and electric vehicle [EV] assembly plants), skills (e.g., training in renewable electricity installation and maintenance, and home retrofits), innovation (e.g., research in new battery materials or clean industrial processes), and foreign trade (e.g., reduced dependence on imported fossil fuels; exports of clean hydrogen). Furthermore, with the right climate actions, countries can deepen their integration into global value chains, such as clean manufacturing, batteries, or EVs, and strengthen their internal value chains. Diversified packages are also well-suited to addressing social equity concerns, leading to greater acceptability. The diversification of fiscal and regulatory instruments contained in climate packages allows countries to progress on decarbonization pathways, sustain economic growth, and improve social inclusiveness. Reflecting the vital need for integrating climate change and development, the World Bank has framed its Climate Change and Development Reports (CCDRs) as a key tool to help design coherent climate–development packages (see Box 2.2).

Box 2.2. The climate–development nexus: insights from Climate Change and Development Reports (CCDRs) in 72 countries

The World Bank's CCDRs, covering 72 countries and representing about 60% of the population and 73% of gross domestic product (GDP) in low- and middle-income countries, provide a comprehensive evidence base on how to align development and climate goals. They show that climate action is not a drag on growth: in many cases, low-emission investment pathways deliver long-term economic growth, while also generating productivity and health co-benefits.

From a fiscal perspective, CCDRs highlight the central importance of revenue and expenditure reforms. Eliminating or better targeting fossil fuel subsidies can release significant fiscal space for priority investments in clean energy, health, and social protection. Carbon pricing—whether through taxes or trading schemes—offers a dual dividend of emissions reductions and new revenues. Public investment in clean infrastructure for the power, transportation, and urban sectors can catalyze private capital, underpinned by stable fiscal frameworks and credible regulatory regimes. At the same time, long-term development can be made more resilient when MoFs manage climate-related fiscal risks, including contingent liabilities from extreme weather, stranded assets, and volatility in fossil fuel revenues.

To achieve a long-term climate–development nexus, CCDRs underline that policy sequencing must match institutional and fiscal capacity. In lower-income settings, foundational reforms include subsidy reform and social protection. Power sector planning can create the basis for more ambitious pricing and investment packages. In middle- and high-income contexts, pricing-anchored portfolios can be deployed earlier, complemented by regulatory and industrial policy tools. Taken together, these CCDR findings show that MoFs can play a pivotal role in combining economic development and climate action: they hold the instruments to mobilize revenues, allocate expenditures, and manage risks in ways that can make climate action fiscally sustainable, economically efficient, and socially inclusive.

Source: World Bank (2024a)

Climate packages require effective intra-governmental cooperation. To deploy a portfolio of policies, MoFs need to cooperate closely with sectoral ministries such as environment, energy, industry, agriculture, labor, and social affairs, which all have specific expertise and their own policy priorities. Coordination is also needed *within* MoFs to ensure that various departments responsible for fiscal policy functions work together. This is because core fiscal functions may be shared between two or even three separate departments or agencies. Even within a fully unified MoF, coordination of multifaceted climate packages is required across departments responsible for fiscal policy, tax policy, expenditure policy (often split between current and capital spending, perhaps also a PPP unit), budget management, debt management, oversight of subnational governments, oversight of public corporations, oversight of the financial sector, international relations, and macroeconomic analysis and forecasting. Coordination within MoFs, even for vital instruments such as tax collection, has always been a challenge, and there is no reason that coordinating climate packages would be any easier. This coordination necessitates sufficient institutional capacity, which can be challenging in federal systems with high levels of subnational government autonomy and is ideally supported by a shared vision of the same policy priorities, a willingness to cooperate, and a similar theory of change. By improving their internal coordination, MoFs can lead by example and encourage intra-governmental cooperation.

To promote the coherence of climate packages, MoFs must be able to analyze, quantify, and evaluate the impact of the various instruments as well as their interplay. To foster the coherence of complex climate packages, MoFs need to understand if the various policies included in their country's climate package complement or undermine each other; they need to understand if the sequencing of implementation is appropriate; and they need to analyze whether the choice of policy actions is the most effective course, given the political and social context. In other words, they need analytical tools that embrace the entirety of climate packages and not just the deployment of stand-alone carbon pricing.

Economists and modelers are gradually shifting their approaches to help MoFs analyze climate policy packages—although a lot of work still needs to be done to upgrade theoretical frameworks and empirical models and to implement the tools and use the results on the ground (see Box 2.3). Economists and modelers are embracing the variety of climate actions deployed in the real world. This shift is partly driven by the realization that various barriers, including social, political, and technological, stand in the way of levying high carbon prices. Prominent economists, including Nobel Prize winners, are now acknowledging the role of diversified climate packages that combine pricing tools, other fiscal instruments, and regulations. They also

recognize that other actions need to come first to prepare the ground for carbon pricing, such as making clean energy alternatives available that enable households and companies to make their move away from high-carbon energy sources without undue disruption. Modelers now have access to comprehensive inventories of climate-related fiscal and regulatory tools that they can use to enrich their models and simulate the impact of multifaceted packages.

Box 2.3. Key arguments in favor of climate packages

Over the past decade, a growing strand of the literature has focused on multifaceted climate packages:

- In their review of Integrated Assessment Models (IAMs), **Stern et al. (2022)** argued that "when there are multiple market failures, it is in general desirable to employ a multiplicity of interventions, not just a carbon tax."
- In their extensive review of the literature and practical policy experience, **Blanchard et al. (2022)** identified obstacles that constrain the effectiveness of carbon pricing and suggested that "these arguments call for complements to carbon pricing, such as bans and standards."
- In their guest post for *The Economist*, **Fay and Hallegatte (2015)** noted that "what each country needs is a policy package that includes carbon pricing tailored to its specific needs and political constraints, and complementary policies to make carbon prices effective and acceptable."
- In his book on transforming energy systems, **Fries (2021)** argued that "complementary policies to support innovations and market creation for low-carbon technologies and cost-effective emissions pricing strengthen its credible implementation and overall resilience, especially if effectively sequenced."
- In his systematic review of the literature on policy mixes, **Cocker (2025)** found that "carefully designed combinations of measures may perform better than stand-alone instruments in many instances, although trade-offs between policy objectives are inevitable."
- Applying a machine learning–based extension of the common difference-in-differences approach to the above-mentioned OECD CAPMF dataset, **Stechemesser et al. (2024)** concluded that "the effect sizes of policy mixes that combine these non-price-based instruments with taxation or reduced fossil fuel subsidies suggest that in most cases pricing is the complement that enables effective emission reductions."
- In a similar vein, using a clustering analysis together with panel data regressions, **D'Arcangelo et al. (2024)** concluded that their finding "provides suggestive evidence that countries' emission reduction efforts that rely on rich and comprehensive policy mixes can benefit from synergies arising from the use of a diverse set of individual policies. A diverse set of policies can harness synergies and amplify the effectiveness of the overall mitigation strategy in terms of emission reduction."
- In their comprehensive review of the literature on mitigation policies, **Hoppe et al. (2023)** concluded that "Policy mixes are, theoretically and empirically, superior to standalone policy instruments," notably in reducing emissions and stimulating innovation.
- Based on a review of climate policies in China, India, Brazil, the EU, and the United Kingdom, **Anadon et al. (2022)** concluded that "a combination of policies will be needed to drive each low-carbon transition. Since the effect of each policy depends on its interactions with others, assessing policies individually can be misleading. Assessing policies as a package can identify those that are mutually reinforcing, generating outcomes 'greater than the sum of the parts'."
- In their review of the Netherlands' policy for climate-neutral industry, **Anderson et al. (2023)**, argued that "A consensus has emerged in academic and policy circles that accelerating this transition will be impossible with any single policy instrument, but instead requires a package of instruments comprising carbon pricing, standards and regulation, and complementary policies that facilitate the reallocation of capital, labour and innovation towards low-carbon activities and offset the adverse distributional effects of reducing emissions."
- In his review of "five things to know about carbon pricing," **Parry (2021)** argued that "Carbon pricing should be part of a comprehensive mitigation strategy" with reinforcing policies such as regulations on emission rates or feebates (i.e., where taxes on emissions are used to subsidize access to low-emission technologies). "[T]hese reinforcing instruments have a narrower impact than carbon pricing—for example, they do not encourage people to drive less—but they may be an easier sell politically because they avoid a significant increase in energy prices."
- The **World Bank (2021)** also argued that "carbon pricing is not a silver bullet" because "it is only effective as part of a broader arsenal of tools to achieve domestic climate targets."
- A joint report by the OECD, International Monetary Fund (IMF), UN Trade and Development (UNCTAD), World Bank, and World Trade Organization (WTO) stated that "Decarbonization calls for a package of coordinated and strategically sequenced climate change policies in which carbon pricing can play a central role" **(OECD et al., 2024)**.

Recent analysis shows that countries deploying diversified packages of policies can indeed be successful in lowering carbon emissions. The literature suggests that well-coordinated packages combining a diversified set of instruments such as pricing, public investment, subsidies, and regulations appear to have been effective in reducing greenhouse gas emissions (Stechemesser et al., 2024; D'Arcangelo et al., 2024; Cocker, 2025). There are several reasons to favor diversified packages in the *long term*, as noted in Box 2.2. In addition, the experiences of numerous countries demonstrate that well-designed climate packages also come with various benefits in the *short term* (see Box 2.4).

Box 2.4. Climate packages bring socioeconomic benefits—even in the short term

Climate action is sometimes perceived as having a negative impact in the short term and only long-term benefits—the so-called "Tragedy of the Horizon" (Carney, 2015; 2021). However, recent experience demonstrates that benefits can also materialize in the short term.

Short-term boost to growth. Well-designed climate action can deliver a powerful near-term economic boost. In the **United States**, nearly US$1.5 trillion dollars flowed into the clean energy sector during 2018–2025, with particularly strong growth in manufacturing and clean energy production (Rhodium Group, 2025). Clean investment now accounts for around 5% of all relevant private investment—up from under 3%—marking a significant structural shift. In **Europe**, the EU's "Fit for 55" package is spurring significant investments in renewables, heat pumps, and electric vehicles (EVs)—estimated to reach 3–5% of GDP annually depending on the taxonomy—with measurable gains in energy security and job creation in green industries (I4CE, 2025). In the **UK**, the net zero economy grew by 10% between 2023 and 2024, now generating £83 billion in gross value added, and employing nearly a million people in green sectors—far outpacing growth in other parts of the economy (Energy & Climate Intelligence Unit and CBI Economics, 2025). **India** has accelerated its renewable energy capacity, having passed 100 gigawatts of solar power, attracting substantial private capital and stimulating domestic clean-technology manufacturing (Ministry of New & Renewable Energy [MNRE], 2025). In **China**, record investment and production in clean energy reached RMB 13.6 trillion (US$1.9 trillion) in 2024—equivalent to around 10% of national GDP—and the clean energy sector is expanding three times faster than the broader economy (CREA, 2025). These examples demonstrate that investment in clean energy, clean industries, and housing retrofits can drive rapid growth, create jobs, and mobilize innovation even in the near term. In addition, the switch to renewables has proved useful to protect countries from fossil fuel price shocks, as occurred in 2022–23.

Mitigation—adaptation nexus. Policymakers in many low- and middle-income countries face the dual challenge of reducing emissions while adapting to worsening weather trends. Well-designed climate packages show that mitigation and adaptation can be pursued together. Investments in building insulation, for example, lower emissions while at the same time reducing vulnerability to heat waves and cold spells. Expanding electric mobility with simultaneous renewable electricity development improves air quality and shields households from volatile fossil fuel prices. The same applies to space cooling—an urgent need in many heat-stressed developing countries—which must expand in parallel with low-carbon electricity. Nature-based solutions such as reforestation or mangrove restoration both store carbon and protect communities against floods and storms. In agriculture-dependent economies, better water management and climate-resilient crops reduce emissions from land-use change while increasing food security. In oil-exporting countries, diversification into clean energy strengthens fiscal stability while supporting the transition to net zero. Framing mitigation and adaptation together enables governments to prioritize investments with the highest combined benefits, ensuring that scarce fiscal resources are used more efficiently.

With their diverse fiscal instruments, MoFs could and should play a more active role in designing and implementing climate packages. Empirical evidence suggests that the fiscal measures currently deployed—carbon pricing, low-carbon investment, fiscal support for the transition—do not exploit the full potential of fiscal and pricing instruments. This suggests that many MoFs are possibly less active than they should be in pursuing effective climate strategies and that many are not yet embracing their role in aligning financial flows with a pathway toward low-carbon development. As noted by the CFMCA (2023), "Ministries of Finance are not yet fully utilizing their powers to drive sustainable, inclusive and resilient growth," and "only around a quarter of the members of the Coalition of Finance Ministers are actively involved in all stages of the [Nationally Determined Contribution] development and implementation process" and only some have dedicated climate strategies.

This underlines the need for MoFs to be more proactively involved in the design and implementation of climate packages. MoFs serve as the custodians of their countries' public finances, including the development of medium-term frameworks, budget execution, and coordination of debt management (Shah and Cole, 2015).

Having responsibility for advising on the deployment of powerful tools, they can do more, while considering the social and political realities of their countries. As the primary agencies responsible for raising government receipts, allocating public resources, mobilizing financing, and steering the economy in the right direction, they are critical for ensuring that climate packages employ coherent mixes of regulations and fiscal measures. Advancing in this direction would contribute significantly to reducing global emissions and increase the likelihood of climate action being undertaken.

The engagement of MoFs in coherent climate packages is a necessity, though it comes with various challenges. There are technical challenges; for instance, because the models available to simulate pathways depend critically on assumptions about elasticities of demand, technology adoption, and fiscal incidence, which may diverge from real-world behavior. In addition, few countries have access to comprehensive models, which often necessitate a dedicated team of experts and can be costly to maintain (CFMCA, 2025a). There are also political challenges: because they alter multiple relative prices at once, packages can face resistance from many groups. MoFs can address these challenges by strengthening their approach to policy design, monitoring, and evaluation, as suggested below. A gradual approach involving engagement with stakeholders, open consultations, information campaigns, and a gradual sequencing of implementation can help with political acceptability. Paying particular attention to the social consequences of action is essential, for instance with conditional transfers and earmarked grants to subnational governments, as illustrated by India's afforestation-linked tax sharing formula. Highlighting such mechanisms helps anchor packages in fiscal realities while acknowledging the socio-political complexities of their adoption. The next section discusses how these challenges can be confronted.

3. Combining fiscal instruments and regulation for climate action

Governments have large toolboxes for climate action at their disposal. For example, the OECD's Climate Actions and Policies Measurement Framework (CAPMF) inventory identifies 56 policy instruments in use across 50 countries (Nachtigall et al. 2024).[2] The average country uses 36 instruments, with the number varying from 13 (in Peru) to 46 (in France) (D'Arcangelo et al., 2024).[3] Notable examples include the following countries (for which further statistics are provided in Table 3.1):

- **Chile** has reduced fossil fuel subsidies in the electricity and industrial sectors, has banned new coal-fired power plants, supports energy-efficient investment, and regulates energy performance.
- **Costa Rica** has eliminated most explicit fossil fuel subsidies, uses feed-in tariffs, has banned new coal-fired plants, and enforces energy performance regulations.
- **Indonesia** has introduced a carbon trading scheme covering power plants, has reformed fossil fuel subsidies in the industrial sector, supports energy-efficient buildings, and regulates energy performance.
- **Denmark** has deployed a comprehensive carbon tax, participates in the EU ETS, has eliminated fossil fuel subsidies, uses a renewable energy planning system, supports electric mobility, and regulates energy efficiency performance.
- **France** participates in the EU ETS, collects a carbon tax and fuel excise taxes, has banned new coal-fired plants, auctions new renewable energy capacity, promotes the sales of EVs, and regulates energy efficiency.
- **The UK** currently deploys an emission trading system combined with renewable energy auctions and certificates, has reformed its fossil fuel subsidies, regulates the sales of internal combustion engine (ICE) vehicles, collects excise taxes on fuels, and regulates energy efficiency.

Table 3.1. Countries deploy a broad variety of climate policies

Country	Market-based sectoral policies	Non-market-based sectoral policies	Cross-sectoral policies	Total adopted policies (out of 56 policies)
Costa Rica	5	10	5	24
Indonesia	8	10	3	26
Chile	10	11	8	37
Denmark	14	13	10	45
United Kingdom	13	13	11	45
France	16	13	11	46

Note: Sectors are buildings, electricity, industry, and transportation. The column "Cross-sectoral policies" includes policies such as greenhouse gas emission targets; data collection and reporting; public energy-related R&D spending; fossil fuel production policies; climate governance; and participation in international climate cooperation.

Source: Authors, based on OECD CAPMF, 2023 data, with some estimated observations

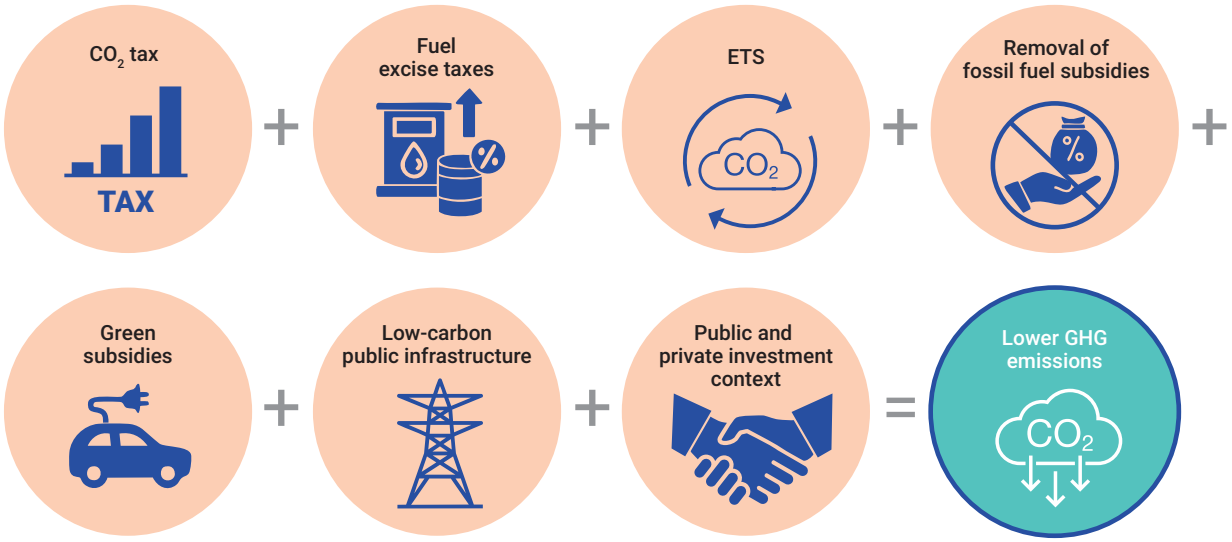
[2] The OECD dataset does not cover policies to reduce greenhouse gas emissions in agriculture and land use. In addition, it does not cover green finance, public investment, or voluntary initiatives such as carbon credit markets.

[3] The various datasets available to track climate actions are discussed in Appendix 1.

Ministries of Finance, for their part, possess a wide array of fiscal instruments that can be deployed within climate packages (see Figure 3.1). By combining fiscal instruments on the revenue side of the budget (e.g., carbon taxes and fuel excise taxes), the spending side (e.g., subsidies, green procurement, and public investment), and the financial side (green bonds, climate funding, equity participation, and financial market regulation) they can exert a powerful downward impact on greenhouse gas emissions. MoFs have a more direct role when designing comprehensive price instruments (e.g., taxes, subsidies) and ensuring their effectiveness along environmental dimensions while quantity instruments (e.g., ETS, renewable energy standards, etc.) provide certainty on the quantity of emissions regardless of complementary measures—although complementary measures can certainly reduce adverse social or competitiveness effects in any case.

Although MoFs wield powerful tools, they do not always contribute effectively to climate policy. Real-world experience contains numerous examples of inefficient, ineffective, or unjust climate packages arising from poor design and weak coordination. This encompasses the deployment of feed-in tariffs with excessive fiscal costs, conflicting interventions in building retrofits, carbon taxes implemented without accompanying social transfers, regressive EV subsidies, and biofuel support that ultimately increased greenhouse gas emissions. Although policymakers inevitably "learn by doing," poorly designed policies often have persistent consequences and thus should be avoided whenever possible—especially given the by now relatively broad experience gained from climate policies having been implemented in many different jurisdictions.

Figure 3.1. Governments have access to a broad range of climate-related fiscal instruments



Note: The figure shows a subset of the possible fiscal measures available for climate action. Table 3.2 contains a more comprehensive list of available measures. ETS = emissions trading system; GHG = greenhouse gas.

Source: Authors

The fiscal toolbox available to MoFs can be grouped into four main categories: carbon pricing instruments, fiscal support, public investment and financial management, and other budgetary action (see Table 3.2). These instruments fall within the scope of conventional budgetary operations and can be targeted at other objectives than reducing emissions. For example, urban congestion charges come with several co-benefits, such as less congestion, less urban noise, fewer accidents, better local air quality, and local government revenues, in addition to lower emissions.

Table 3.2. A large toolbox of climate-related fiscal instruments

Instrument	Description	Location examples
1. Carbon pricing		
Carbon tax	Levy on CO_2 emissions	Austria, Canada, Germany, Ireland, South Africa, Sweden
Fossil fuel excise duty	Tax on consumption of diesel, petrol/gasoline, coal, etc.	EU, France, Germany, Ireland, Japan
Emissions trading scheme	Cap-and-trade system for CO_2 allowances	California (USA), EU, South Korea
Withdrawal of fossil fuel subsidies	Subsidies to fuels eliminated, indirect taxes harmonized	Denmark, Nigeria, the Philippines
Removal of excise duty exemptions	Removing special rates for certain fossil fuels	India, Indonesia
Convergence of gasoline and diesel taxes	Eliminating price distortion between fuels	Chile, Morocco
Feebate	Tax on internal combustion engine (ICE) vehicles, used to finance a subsidy for EVs	Denmark, France, New Zealand, UK
2. Fiscal support		
Reduced corporate income tax (CIT) rate	Lower corporate tax rate for low-carbon technologies and service	Italy, Ireland, Netherlands
Accelerated depreciation	Faster cost recovery of capital expenditure to attract investment in clean investment and innovation technologies and promote economic development	Canada, Mexico, USA
R&D tax credit	Tax incentives for low-carbon technology innovation	France, Ireland, Japan
Investment tax credit	Tax incentive for investment in low-carbon equipment	Canada, Ireland, USA
Production tax credit	Tax incentive supporting the production of renewable energy and processes using carbon capture, utilization, and storage (CCUS)	Canada, USA
Lower VAT on home retrofits	Reduced VAT on insulation, windows, etc.	Belgium, France, Ireland, UK
Lower fees and taxes on EVs	Reduced registration fees or road taxes	Ireland, Germany, Netherlands, Norway
Tax credits on solar panels and heat pumps	Income tax credits for households	France, USA
ICE vehicle scrappage subsidy	Incentive to scrap high-emission cars and vans	France, Germany, India
Subsidized electricity tariffs	Targeted lifeline tariffs for basic consumption	France, Philippines, Thailand
Free public transportation for people on low incomes	Means-tested transportation support	Luxembourg, Vienna (Austria)
Means-tested EV subsidy	Income-based EV purchase subsidies	California (USA), Germany
Urban congestion charge	Fees for driving in congested areas	London (UK), Singapore, Stockholm (Sweden)
Capacity generation market	Payments for electricity supply capacity	China, Ireland, New York (USA), UK
Contract for Difference	Contracts for emissions-reducing projects that provide a guaranteed electricity or carbon price	Austria, Denmark, France, Netherlands, UK
3. Public investment and financial management		
Green public investments	Low-carbon investment spending such as public transport infrastructure and zero-emission government buildings	Abu Dhabi, Canada, Ireland, Singapore
Public–private partnership (PPP)	Projects that blend public and private funding such as renewables and selected rail developments	Denmark, India, Mexico
State participation as shareholder in climate-focused firms	Acquisition of equity stakes in private sector companies engaged in climate mitigation or adaptation	Australia, Canada, China, France, India

Instrument	Description	Location examples
Derisking of low-carbon private investments	Guarantees, insurance, blended finance, securitization, credit enhancements	Australia, Brazil, India, Japan, Malaysia, USA
Retrofit of government buildings	Energy efficiency upgrades in public buildings	Ireland, Germany, South Korea
Government low-carbon car fleet	Public fleets switched to EVs	China, Sweden, USA
Power grid extension	Investment in transmission for renewables	Brazil, France, India, Ireland, UK
Public R&D spending	R&D on new low-carbon technologies	All countries
International funding	Access to external grants, concessional finance, market-based funding, and blended finance	All countries
4. Other budgetary action		
Green public investment management	Purchase of low-carbon goods and services, such as EV fleet and electric buses	Chile, France, Japan
Green budgeting	Budget document informing about environmental and climate considerations	Austria, Ireland, France, Sweden
Cost–benefit analysis with climate focus	Use of social cost of carbon in cost–benefit analysis for public and state-owned enterprise (SOE) investment appraisals	Canada, France, Norway, UK

Source: Authors

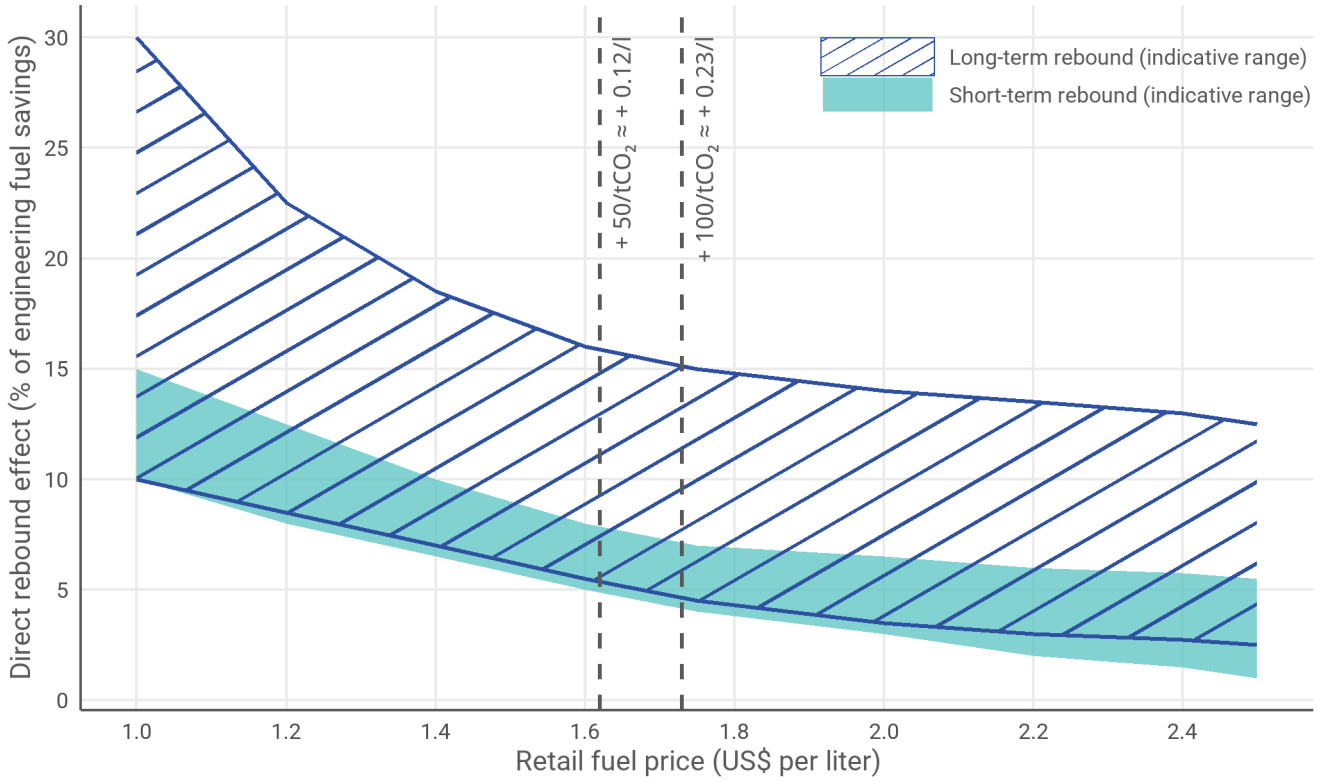
Available evidence suggests that governments frequently include stringent regulations in their climate packages, while fiscal instruments are utilized less frequently—or at lower levels of stringency. As discussed below, the OECD CAPMF observes that regulatory policies (defined as "non-market-based") are on average more stringent than fiscal instruments (defined as "market-based"), and that the recent trend has been toward even more stringent regulations. For example, minimum energy performance standards are used in almost all countries covered by the OECD inventory.

MoFs' reluctance to act more decisively appears to reflect several concerns regarding fiscal costs (CFMCA, 2025b). MoFs seem to perceive the cost of measures such as public investment, subsidies, and transition spending to be large and open-ended. In addition, they face substantial uncertainty about the magnitude, timing, and budgetary risks of these measures. Finally, only about one-third of MoFs see climate action as a core part of their mandate, as opposed to their traditional fiscal and macroeconomic priorities. The CFMCA's June 2025 Global Survey on fiscal challenges noted that "[f]iscal sustainability is the top priority for policymakers when designing climate-related policies" but also highlighted capacity and data gaps that inhibit full integration (CFMCA, 2025e: 45). Meanwhile, the survey found that for 89% of MoFs climate change is a core economic issue, but only 32% indicated it is central to their mandate, and only 3% and 11% had fully integrated decarbonization and mitigation considerations into core budget projections and tax and fiscal policy, respectively.

However, this perception underestimates the short-term economic and fiscal benefits generated by well-designed climate packages. As noted in Box 2.4, recent climate packages deployed in China, the EU, India, and North America have led to a strong acceleration in investments to reduce greenhouse gas emissions and significant employment gains in these sectors. MoFs may also underestimate the short-term co-benefits for the health and wellbeing of citizens, such as better air quality in metropolitan areas and decarbonized electricity that can fuel air conditioning units and reduce mortality during heat waves. Furthermore, in the EU, failure to meet EU climate and energy targets creates fiscal risks, notably under the Energy Sharing Regulation. Some Member States, notably Luxembourg, have already recorded budgetary expenditures for renewable energy statistical transfers, demonstrating that compliance costs can directly affect public finances. For countries projected to miss their reduction trajectories, these obligations represent quantifiable contingent liabilities, with potential costs running into several billion euros if corrective measures prove insufficient. Non-compliance may also lead to infringement penalties and stricter access conditions for EU funds. In fiscal-risk terms, the cost of climate under-performance remains latent but is significant, especially as compliance flexibilities narrow toward 2030.

While there is no consensus on the optimal weighting of fiscal instruments and regulations, adopting ambitious policy stances in both domains is likely to be beneficial. Research and practical experience only provide limited guidance on how to balance the respective contributions of fiscal and regulatory instruments. The interactions between, for example, fuel efficiency standards and fuel excise taxes, are likely to be non-linear. Thus, ambitious policy stances are necessary in each domain to get positive interactions between instruments. As an illustration, empirical evidence drawn from the road transportation sector shows that fuel prices need to be at a sufficiently high level to dampen the rebound effect[4] following the introduction of stringent fuel efficiency standards (Benjamin et al., 2019; Dimitropoulos et al., 2016; Zhang et al., 2018). Figure 3.2 illustrates this interaction: carbon pricing of at least US$50/tCO$_2$ is required to limit the rebound effect below 20% of the energy saving resulting from adapting fuel efficiency to standards in the long term.

Figure 3.2. Carbon pricing limits the rebound effect (example from the road transportation sector)



Source: Authors, based on a range of literature

However, high carbon taxes face weak political acceptability in most countries, and governments are therefore often reluctant to raise them. This is particularly the case for gasoline (petrol) taxes because of the low price–volume elasticity in the short term (a car's life expectancy is typically 15 years) especially when households have no alternative than to drive to work. Public investment in public transportation is another complementary measure that reduces the rebound effect and increases the price elasticity of gasoline. Using simulations of a dynamic model calibrated for the urban area of Paris, Rentschler et al. (2014) showed that the price elasticity of carbon dioxide emissions is twice as high in the short term if public transportation options exist. In other words, investment in public transportation is a complementary policy that increases the price elasticity and, therefore, leads to effective packages that combine fuel efficiency standards, carbon pricing, and public investment—and allows many workers to commute to their workplaces despite higher gasoline prices. This example demonstrates how MoFs can lead by designing tax policies and allocating funding for public investment.

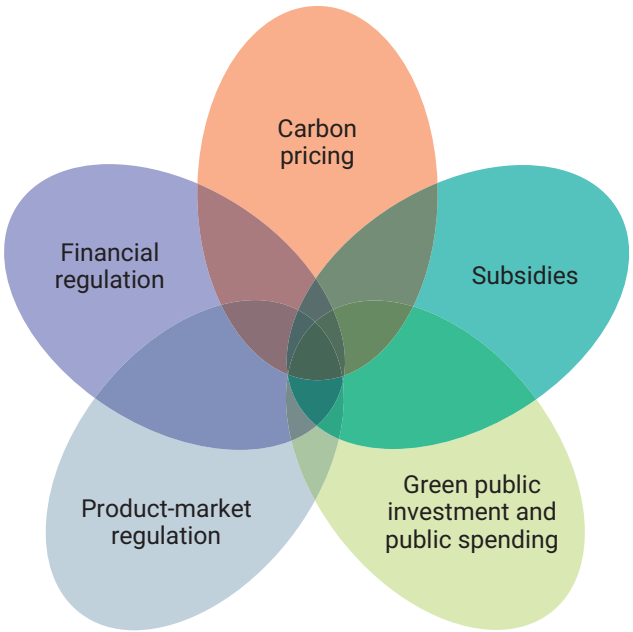
[4] The rebound effect is the phenomenon whereby improvements in the efficiency of resource use (such as energy efficiency) lower the effective cost of consumption, which often leads to increased usage of the improved service or related services. Consequently, the actual environmental or economic gains from the efficiency improvement are less than initially anticipated.

In the real world, the exact balance of fiscal instruments and regulations can be adapted to each country's context, including its policy goals, instrument capabilities, stage of development, and socioeconomic context. Fuel excise taxes are comparatively straightforward to implement, as they are collected at easily monitored points of fuel distribution and therefore can work where institutional capacity is constrained or in multi-country contexts such as the EU. Some instruments act as "carrots," while others act as "sticks," with the balance between the two depending on political acceptability and budgetary feasibility. Institutional capacity, administrative feasibility, and prevailing political preferences all shape the feasibility, effectiveness, and acceptability of policy options.

Overall, ambitious involvement by MoFs in climate packages can do a lot to steer the economy onto a low-carbon development pathway. Fiscal measures can bring positive interactions by sending clear price signals, providing financial incentives, and easing liquidity constraints—thus helping lift barriers and avoiding some of the problems that can occur with regulations, such as rebound effects and other market distortions. Some fiscal instruments such as carbon taxes, energy excise duties, and ETSs also generate revenue. Similarly, removing fossil fuel subsidies (or even narrowing their scope with better targeting) frees up fiscal resources. These revenue-enhancing measures can be used for financing green investments, clean innovative technologies, and social transfers (IMF, 2019). They can finance cuts in distortionary taxes, such as some labor taxes—thus generating "double dividends." Such policy action where higher carbon pricing and withdrawal of fossil fuel subsides are combined with investments and tax reforms can have a positive effect on growth—contrary to the common critique of carbon taxes that they reduce GDP. Examples of model simulations illustrating these positive policy combinations are available for Indonesia (Box 2 of 2023 Article IV Indonesia country report) and Saudi Arabia (Box 2 of 2023 Article IV Saudi Arabia country report). For these reasons, they should play an active role in comprehensive climate action strategies.

A core challenge for MoFs is selecting fiscal instruments that make the most effective and sustainable contributions to climate packages. A key aspect of this is choosing fiscal tools that generate positive synergies among themselves and when combined with regulatory instruments. As illustrated in Figure 3.3, the various categories of climate-related measures often overlap, which results in either positive, negative, or neutral interactions. Identifying the most positive interactions leads to more effective climate packages, which are also likely to be more cost-effective, sustainable, and resilient.

Figure 3.3. Climate-related measures overlap



Source: Authors

3.1. Tax policy as part of climate packages

Several fiscal instruments that MoFs integrate into climate packages relate to tax policy. As the actors responsible for designing tax policy and administering tax collection, MoFs are uniquely positioned to ensure that the tax system works harmoniously with other climate policies. For instance, taxes on greenhouse gas emissions and fossil fuel use send price signals that encourage a shift toward low-carbon energy sources, promote energy efficiency, and lower the demand for energy services. In addition, collecting carbon taxes and fuel excise taxes helps to reduce fiscal deficits. Phasing out fossil fuel subsidies helps improve the fiscal accounts, though this may imply significant cost increases and adverse effects in some sectors of activity.

Carbon taxes are deployed at ambitious levels in some countries. Two of the early movers in this direction were Finland and Sweden, which introduced carbon taxes in 1990 and 1991, respectively. Starting from low levels of taxation (e.g., in Sweden, SEK 250/€22 per tCO_2), the two countries have gradually increased them (SEK 1,510/€134 per tCO_2 in 2025). However, fewer than 40 countries have a carbon tax, with often modest tax rates and limited sectoral coverage. As a result, carbon tax revenue amounted to only about US$29 billion globally in 2023 (World Bank, 2024b).

There are several ways to collect carbon taxes:

- Carbon taxes can be collected *upstream* in the value chain at the point of fossil fuel extraction or import. This method is applied in countries including Austria, Finland, France, Germany, Sweden, and Switzerland, which use their excise tax frameworks for administrative efficiency.
- Carbon taxes can be collected *downstream* in the value chain at the direct source of the greenhouse gas emissions, such as motor vehicles, farms, power plants, and industrial facilities, as done in Chile, Singapore, by the EU ETS for industrial installations and power plants, and in South Africa. This method demands robust measuring, verification, and reporting systems (MVRS).
- Carbon taxes can also be collected *midstream*, often at the point of fuel distribution or sale to retailers, for instance the collection of excise taxes. An example is the UK Climate Change Levy.

Upstream carbon taxes offer multiple advantages. This reflects their administrative simplicity (fewer collection points), comprehensive coverage (most fossil fuels are covered), and thus an efficient price signal throughout the economy. Downstream taxes are more visible and therefore have a stronger behavioral impact, but they can be distorted politically to exempt some categories of emitters.

Fuel excise duties are excise taxes on fuels that are not explicitly linked to the carbon content of the fuel. For example, India does not levy a carbon tax but imposes excise duties on petrol and diesel. The same holds in Vietnam and the Philippines. These taxes are typically levied by the central government but can be jointly administered by the central and subnational governments. In India, fuel excise taxes are among the few excise duties not subsumed within the Goods and Services Tax (GST) regime introduced in 2017. In many countries, they are levied on top of other indirect taxes such as VAT and sales taxes, though the order may also be the reverse, with excise duties applied first and VAT and GST applied on top of this. EU countries typically levy high excise taxes on gasoline (petrol), with the Netherlands charging €0.84/liter from 1 January 2026 (Netherlands Enterprise Agency, 2026), and the UK charges approximately €0.62/liter (£0.5295/liter) (UK Government, 2026).[5] Singapore charges approximately €0.45/liter (SGD 0.66/liter) and €0.54/liter (SGD 0.79/liter) for intermediate-grade and premium-grade gasoline respectively (Singapore Customs, 2026),[6] while some emerging-market economies, such as Costa Rica, charge the equivalent of €0.46/liter (CRC 260.50/liter) (Costa Rica Ministerio de Hacienda, 2025).[7] In contrast, some countries, including oil-producing nations such as Kuwait, Nigeria, Qatar, and Saudi Arabia, do not levy excise taxes on car fuels.

[5] The euro value in the UK case is calculated using the 2025 average exchange rate reported by the European Central Bank (2026a) of £1 = €1.1671.
[6] The euro value is calculated using the 2025 average exchange rate reported by the European Central Bank (2026b) of SGD 1 = €0.6777.
[7] The euro value is calculated using the 2025 average exchange rate, constructed from monthly averages recorded in the IMF Exchange Rate database (IMF, 2026), of CRC 1 = €0.001762.

Mandatory Emissions Trading Systems (ETSs) set a cap on the emissions of regulated entities. To emit greenhouse gases, these entities must obtain emission allowances, which are either distributed, sold, or auctioned, with the number of emission allowances gradually being reduced over time in line with national emissions targets. Because the allowances are tradable, entities with lower-cost abatement options can sell their excess permits to those with higher mitigation costs. This market-based exchange leads to the emergence of an equilibrium carbon price. The largest mandatory ETS covers the sectors of power and manufacturing in all EU countries, Iceland, Liechtenstein, and Norway and is linked to the Swiss ETS. ETSs also operate in California, Korea, the UK, and other jurisdictions, while China has introduced an emission intensity market initially in the power sector that is now being extended to industry. Total global ETS revenues in 2023 reached US$74 billion, according to the World Bank (2024b), representing a significant increase over previous years.

The governance of ETSs is vital to their effectiveness. Institutional arrangements across existing ETSs vary at present, but identifying best practices will be essential if these carbon markets are to continue expanding effectively. ETS governance arrangements that are transparent, participatory, accountable, efficient, equitable, and grounded in the rule of law are more likely to be effective. The responsibilities for designing the rules and for administering the system should be separated to avoid conflicts of interest and ensure accountability. Given the complexity of ETSs, the ETS Administrator in charge of governing the market should have a sufficiently high level of human, technical, and financial capacity. An ETS Administrator with experience in collecting revenue can be the MoF (Partnership for Market Readiness and International Carbon Action Partnership, 2022; IEA, 2020). To ensure transparency, ETSs tend to be rules-based, thus avoiding discretionary negotiations with regulated entities. Nevertheless, flexibility is also needed to enable arrangements to be adapted in line with energy technologies and climate imperatives.

Some ETSs are complemented by a carbon border adjustment mechanism (CBAM). The EU CBAM, for example, requires importers to report the greenhouse gas emissions embedded in their imported goods, and as of 2026, will gradually start to levy a carbon price on these emissions based on the EU ETS carbon price. The EU CBAM applies to imports of carbon-intensive goods such as cement, fertilizers, iron and steel, electricity, and hydrogen. It aims to gradually replace benchmark-based free allocation under the EU ETS to address the issue of "carbon leakage," a potential spillover effect from carbon pricing that could lead to key products being manufactured in locations with lower carbon prices and imported into the EU, impairing the contributions of the EU ETS to global mitigation. To address the resulting risk of carbon leakage for the production of CBAM goods for export markets, the European Commission has announced that it intends to propose compensating affected producers proportionally to the phasing out of free allowances subject to deliverables on long-term decarbonization. Projected CBAM revenue ranges from €5 billion to €14 billion per year by the early 2030s, depending on implementation details and carbon market dynamics.

In addition to encouraging a smaller carbon footprint inside the EU, the CBAM appears to also encourage lower emissions outside the EU. For example, discussions are underway between the EU and the UK to link their ETSs. If implemented with the required equivalence, this could allow UK exporters to avoid EU CBAM charges on relevant goods entering the EU market—but the details depend on final agreement and alignment of the systems. India has begun responding to the EU CBAM by investing in cleaner steel production. In September 2025, the Indian Government announced a program (of about US$570 million) to help domestic steelmakers adopt low-carbon technologies, including green hydrogen and carbon-capture processes—a move aimed at aligning with emerging global green-steel standards and promoting EU–India trade (Del Bello and Soni, 2025).

Fossil fuel subsidies include direct budgetary transfers, regulations that favor fossil fuel activities, as well as tax benefits that reduce the price of fossil fuels. As such, they can be seen as "negative" carbon prices. Reforming or removing these subsidies can thus have similar effects as the introduction of a carbon price, i.e., increase the relative price of fossil fuels. The OECD estimates that fossil fuel subsidies reached around US$1.1 trillion in 2023 (OECD, 2024a), while IMF staff estimate that explicit subsidies declined to US$725 billion in 2024 (0.6% of world GDP) (Black et al., 2025). As an illustration, the Government of Sierra Leone removed petroleum

subsidies in August 2023, reducing pressure on the government budget. In the first half of 2023 the Government incurred a revenue loss of US$32.8 million by subsidizing fuel prices and a loss of US$3.3 million from paying direct subsidies to oil marketing companies.[8] While many governments have pledged to reduce the value of fossil fuel subsidies, momentum toward this goal has declined in recent years. However, eliminating such subsidies is not easy (see Box 3.1). In general, standardizing definitions, comparing progress, and coordinating international action on fossil fuel subsides remain key challenges, which are being discussed in international forums such as the Coalition on Phasing Out Fossil Fuel Incentives Including Subsidies (COFFIS).

Box 3.1. Reforming fossil fuel subsidies: a crucial climate action

Despite past reforms, fossil fuel subsidies remain macro-significant in many high-, middle-, and low-income countries. The IMF's most recent global update estimated subsidies at US$6.7 trillion (5.8% of world GDP) when underpricing of supply and environmental costs (implicit subsidies) is included (Black et al., 2025). In addition, fossil fuel subsidies are generally regressive. In high-income countries, energy support measures such as tax expenditures are typically untargeted, meaning that they tend to disproportionately support better-off households who are car owners and frequent travelers (Castle et al., 2023). In low- and middle-income countries, the regressive impact stems from below-cost pricing of fuels and electricity, with richer households using more energy and capturing a disproportionate share of the subsidy (IMF, 2023). However, some targeted schemes—such as subsidized kerosene or low-consumption electricity tiers—can be mildly progressive when well-designed, though these are exceptions rather than the rule (Olivier et al., 2023).

Scaling back subsidies would reduce spending, improve efficiency, cut air pollution, and lower carbon dioxide levels. The World Bank's Energy Subsidy Reform Assessment Framework (ESRAF) provides operational guidance on mapping support, assessing impacts, and sequencing reforms with targeted transfers, lifeline tariffs, or social registries, alongside clear communication and gradual reform to build acceptability. Experimental evidence shows that information on the environmental and fiscal costs of subsidies measurably raises public support for reform. Reforms should include tailored transition policies that protect the vulnerable and safeguard energy security while phasing out inefficient support.

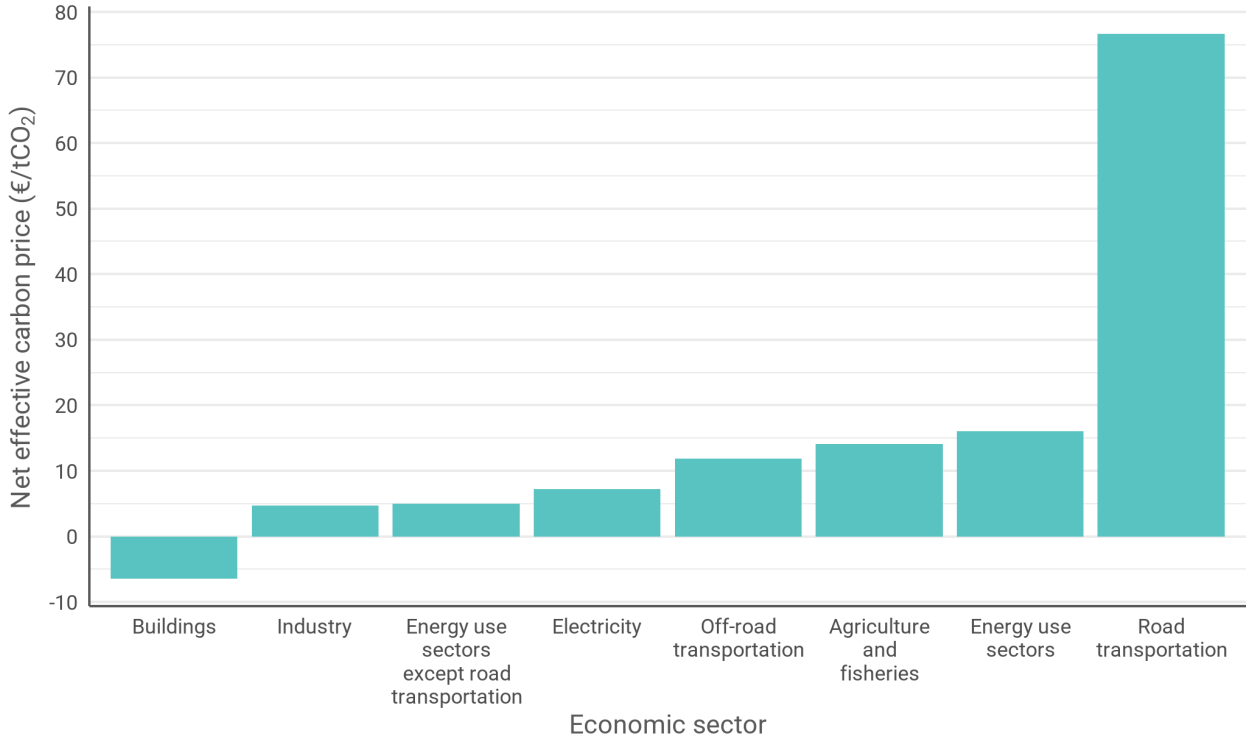
The macroeconomic and fiscal payoffs can be substantial when reforms are paired with smart recycling of the withdrawn subsidies. Recent IMF Article IV consultations discuss practical combinations of subsidy rationalization, compensation, and tax reform in emerging and oil-exporting economies; while contexts differ, the common message is that well-sequenced packages to withdraw fossil fuel subsidies have environmental benefits and can strengthen growth.

Additional sources: Agnolucci et al. (2024a); OECD (2024a)

MoFs can assess their country's overall pricing of carbon using indicators such as the OECD's Net Effective Carbon Rate (NECR) (see Figure 3.4) and the World Bank's Total Carbon Price (TCP). NECRs combine the price effects from carbon taxes, ETSs, energy excise duties, minus fossil fuel subsidies and are available for more than 70 countries, while the TCP combines direct forms of pricing such as carbon taxes and ETSs and indirect forms of carbon pricing such as fuel excise taxes and fuel subsidies and is available for 142 countries from 1991 to 2021 (Agnolucci et al., 2024b). The TCP and NECR are generally well aligned, though with significant differences for some countries. These indicators offer a comprehensive view of how carbon taxes, mandatory carbon markets, excise duties, and fossil fuel subsidies are combined to price carbon dioxide emissions from energy use (see Appendix 2 for more details). In OECD countries, governments typically adopt high NECRs in the road transportation sector—often between €50 and €100/tCO_2—while NECRs in other sectors are kept at very low levels, especially in agriculture and industry (see Figure 3.4). Despite this high taxation of transportation fuels, the sector's carbon dioxide emissions have not declined globally (Crippa et al., 2025), reflecting the expansion of the worldwide fleet of vehicles and the lack of clean and affordable alternatives.

[8] See 'Climate policy priorities in Sierra Leone', contribution from the Sierra Leone Ministry of Finance to the HP4 Compendium of Practice.

Figure 3.4. Net Effective Carbon Rates (NECRs) by sector



Source: Authors, based on data from OECD (2024c)

Altogether, this leaves carbon pricing in most countries at a level insufficient, in isolation, to reach the objectives of the Paris Agreement (see Figure 2.1). As an illustration, using the NECR approach, Ahumada et al. (2023) estimated the net price of carbon for a selected group of Latin American and Caribbean countries to be at an average of €17/tCO_2eq, whereas IAM results show that a price of €120/tCO_2 could be necessary to achieve the goals of the Paris Agreement (OECD, 2021). However, combined with other climate action, such as fiscal instruments and regulations, the level of NECR implemented in some countries makes a key contribution to a low-carbon pathway. While a high NECR exceeding €100/tCO_2eq may not be achievable in certain countries, especially in developing countries, MoFs should seek to implement a level sufficient, in association with other action, to foster climate packages.

Associating the different carbon pricing instruments mentioned above can create positive synergies. For example, carbon taxes and ETSs can complement each other if they target different emission bases, as done in several European countries (Parry et al., 2022). An ETS and a CBAM complement each other also by leveling the playing field across origins of products (domestic and foreign) and thus reducing the risk of leakages. There are many other examples of positive synergies between fiscal interventions such as combining a carbon tax and an investment or production tax credit to support clean energies; similar positive synergies arise from associating a coal tax or a fuel tax with subsidies for solar, wind, hydro, biomass, and nuclear energies; in the EU, the various fossil fuel taxes (ETS + excise taxes + carbon tax) and the withdrawal of fossil fuel subsidies have reduced the region's need to rely on imports of oil and gas, thus increasing energy security and long-term resilience. Such positive policy synergies can curtail the significant cost of energy transitions as illustrated by model simulations for Canada (Fournier et al., 2024), the EU (Dolphin et al., 2024), and India (Chateau et al., 2023). A framework is also proposed by Black et al. (2022) for implementing carbon taxes or ETSs and using revenues for productive public investment (while compensating vulnerable households for elevated fuel prices), which could cut transition costs for middle-income and low-income economies by two-thirds or more.

At the same time, when they lack coherence, the associations of instruments can reduce effectiveness. When a carbon tax is added on top of an ETS covering the same emissions with a fixed cap, any emissions reductions

caused by the tax simply free up allowances, which are then either banked or sold elsewhere—meaning total emissions remain unchanged. This full offset, known as the 100% waterbed effect, means the tax has no additional environmental impact unless allowances are retired, or the cap is lowered. The EU ETS addresses this issue partially through the Market Stability Reserve (MSR), which absorbs surplus allowances when they exceed a certain threshold. A portion of the allowances held in the MSR above a set limit is permanently invalidated. This mechanism weakens the waterbed effect by ensuring that emissions reductions from overlapping policies, e.g., domestic carbon taxes or green subsidies, lead to a tighter effective cap and real environmental benefits, rather than simply displacing emissions elsewhere in the system. Additionally, the EU ETS emissions cap is lowered annually based on the reduction factor. Together, this means the effect in the EU ETS is a so-called punctuated waterbed effect. The waterbed effect can, however, be a desired outcome, if governments target a specific sector for faster emissions reductions. The carbon price floor implemented on top of the EU ETS in 2013 is being credited with supercharging the coal phase-out in the UK electricity mix.

It has been argued that associating a fixed cap ETS with a carbon tax, feed-in-tariffs, or green subsidies would sharply reduce the ETS market price and mute the price signal sent to consumers (Fankhauser et al., 2010). This would also reduce the fiscal revenue that could be used to finance the green transition. The question is relevant in the EU because the ETS market mechanism in the power and industry sectors interacts with regulation introduced at the national level by Member States. In the US, where a national carbon market was once envisaged, its interaction with state-level regulation was also discussed. Similarly, it is argued that combining a low carbon tax with generous green investment subsidies would create a significant financial burden for the public budget and a large welfare loss (Schubert et al., 2023). MoFs need to be aware of these interactions and design instruments that make it more likely to generate positive interactions. As noted above, interactions between pricing instruments are stronger than between quantity instruments, which should encourage MoFs to make the best of their potential to leverage pricing tools.

In addition to providing incentives, the role of carbon taxes (and receipts from ETSs) is also to provide additional resources to the government in an efficient way. The use of these resources can be a critical component of effective and socially acceptable climate policy packages. How governments choose to recycle the revenues generated from carbon pricing can significantly influence the economic, environmental, and political outcomes of the policy (Cardenas et al., 2024). For instance, these resources can make it possible to increase public investments in infrastructure, notably infrastructure that is hard to finance by the private sector, such as the power grid or sanitation systems. Well-designed recycling strategies can also address distributional concerns by compensating vulnerable households, support the competitiveness of exposed industries, and finance investments in low-carbon innovation. Recycling revenues can also help to reduce other distortionary taxes—such as labor or corporate income taxes—and therefore enhance economic efficiency, while targeted transfers and social protection schemes can bolster fairness and political acceptability. Importantly, the visibility and use of revenues matters for political acceptability and public support, and support for a policy can be predicted by the policy being believed to be effective in reducing emissions, not raising inequality concerns, and not making a household worse off (Dechezleprêtre et al., 2025). Feebates are an example of a visible policy where taxes on emissions (e.g., a low fuel efficiency car) are used to subsidize access to low-emission technologies (e.g., electric vehicles or hybrid cars). Thus, revenue use is not merely an ancillary consideration but a fundamental lever for aligning climate ambition with broader economic and social goals.

3.2. Public spending as part of climate packages

MoFs can contribute to climate packages by deploying targeted spending programs with the objective of raising the supply of and demand for low-carbon goods and services. They can also contribute with indirect action, such as by derisking low-carbon private investment or via PPPs.

Subsidies

MoFs provide public subsidies to encourage the supply of low-carbon goods and services. For example, R&D grants, low-interest loans, and tax credits can support green innovation, pilot projects, and the scaling up of emerging technologies such as clean hydrogen and green cement (Aghion et al., 2025). The emergence of low-carbon technologies, such as full EVs, batteries for energy storage, and smart grids, is a result of innovations initially supported by fiscal support for businesses. Consumer subsidies encourage demand for these goods and services, for instance by encouraging the adoption of EVs, heat pumps, and home energy retrofits. There is widespread evidence that these subsidies have played a significant role in the deployment of renewable electricity and other low-carbon technologies (IEA, 2025a; IMF, 2023).

Notwithstanding their apparent success, these subsidies need to be deployed carefully and should ideally be phased out in combination with more effectively targeted instruments. For example, support measures to reduce the cost of clean energy do not incentivize energy conservation and can even stimulate higher overall energy consumption through a rebound effect—commonly referred to as the "Jevons Paradox." In addition, they can have a significant fiscal cost and therefore increase budget deficits and, in a supply-constrained context, lead to inflationary pressures on the subsidized goods. Notwithstanding these concerns, the evidence collected by the International Energy Agency (IEA) for various sectors (such as renewables, electric cars, and buildings) suggests that, when well-designed, government subsidies have impactful effects on the deployment of clean technologies and their adoption by customers.

The distribution of subsides requires diligence in targeting and attention to their distributional implications. Non-refundable tax credits for EVs or subsidies for private solar panels or thermal insulation, for example, which are not subject to income caps, primarily benefit high-income households, who can use them to reduce their tax liabilities and who may have switched to an EV or have carried out these investments without these incentives. In addition, the financing of these fiscal incentives can have a regressive impact if they are funded, for example, by higher indirect taxes (Benoit and Lenain, 2023). Reflecting these concerns, governments have improved the targeting of these subsidies, for instance by making them subject to an income cap as well as a cap on the vehicle purchase price (e.g., in France and the US). Supporting investment in public charging infrastructure in rural areas and low-income neighborhoods is also a more equitable approach.

Notwithstanding these caveats, subsidies for climate action can play a valuable role when strategically combined with carbon pricing. They help reduce the cost of emissions abatement, thereby increasing the effectiveness of carbon taxes in driving the adoption of low-carbon technologies. Innovation-focused subsidies can also accelerate cost reductions for emerging clean technologies, making the green transition more affordable and politically feasible, particularly when carbon prices rise. In addition, carbon pricing generates government revenue that can be used for climate action—although such dedicated use tends to reduce budgetary flexibility and impairs reallocation across priorities when needed. At the same time, integrating subsidies with pricing instruments requires close attention to ensuring additionality, thus avoiding using public funds in support of actions that would have occurred anyway. As noted, an approach taken in several countries has been to place an income cap that targets the subsidies toward those that cannot access low-carbon equipment, thus creating the enabling conditions for introducing a carbon price without unfavorable social consequences. The removal of fossil fuel subsidies also needs to be coordinated with these actions, otherwise they weaken or even counteract the desired policy impact. Overall, well-designed policy frameworks that ensure complementarity and overall coherence of climate packages can make critical contributions to this goal.

Public investment

Public investment undertaken by ministries, municipalities, states, and regional authorities, has emerged as a critical component in the design and execution of climate action worldwide. Governments at different levels actively fund infrastructure projects that foster emissions reductions and enhance climate resilience, such as

efficient public transportation systems and climate-adapted urban infrastructure. For example, municipalities across Europe have directly financed urban bicycle networks and electric public transportation, while state-level agencies in the US have led investments in EV charging infrastructure and energy-efficient public buildings. In Canada, the federal government has invested in biomass and renewable heating systems at military bases, while Danish municipalities directly invest in low-carbon district heating networks powered by solar and biomass. At the same time, MoFs should roll back investments in infrastructure that lock in high carbon emissions and are likely to become stranded assets. Cost–benefit analysis with an appropriate social cost of carbon is a useful tool in this respect.

By directing financial resources into strategic infrastructure, governments can act as catalysts and significantly influence the pace and direction of overall investment. Public investment in infrastructure can mobilize private sector investment, such as in the power grid that connects isolated regions with high renewable potential to metropolitan centers or by providing the necessary infrastructure and energy at affordable costs for industry to decarbonize. This enables private investment in low-carbon electricity generation. Similarly, investment in EV charging stations can trigger investments in EV fleets. In addition to public investment, public finance models such as guarantees, insurance, structured funds, securitization, and green, social, sustainability, and sustainability-linked (GSSS) bonds have been found to effectively mobilize private finance (OECD, 2025b).

Subnational governments play a particularly pivotal role in such public investment (OECD, 2022a). In 2019, they accounted for approximately 63% of total "climate-significant" public expenditure and 69% of "climate-significant" public investment across 33 OECD and EU countries. These figures underscore the substantial financial responsibilities shouldered by subnational entities in advancing climate objectives. They also underscore the need for MoFs to coordinate with subnational governments in the development and implementation of climate action packages.

Moreover, and crucially, spending by state-owned enterprises (SOEs) significantly shapes the low-carbon transition, given their dominant role in sectors such as energy, transportation, and heavy industry. SOEs account for roughly one-fifth of global direct (scope 1) carbon dioxide emissions, highlighting their climate relevance—even more so in developing countries (OECD, 2022b). Their market position enables them to lead major investments in renewables, efficiency, and green technologies. In 2024, nearly a third of investment in energy-related sectors—power, fuel supply, and end-use consumers—was made by SOEs, an estimated US$1 trillion (IEA, 2025a). While avoiding undue political interference is essential, SOEs must be held to the same sustainability standards as private firms through strong governance, transparency, and accountability mechanisms. Indeed, depending on the specific context, SOEs can be effective engines for climate action by, for example, providing necessary public infrastructure at comparatively low cost (Benoit et al., 2022). MoFs often have an oversight role for SOEs, including seats on their Executive Boards, which should be filled by professional experts rather than political appointees. SOEs' liabilities are often officially guaranteed (explicitly or implicitly), thus making MoFs the guardians of their financial health, including through avoidance of future stranded assets. The IMF's Climate module of the Public Investment Management Assessment (C-PIMA) provides guidance in this respect.

Green procurement and public investment management

Green public procurement (GPP) is a tool through which public authorities procure goods and services with a reduced environmental impact. By integrating environmental considerations into procurement processes, GPP aims to promote resource efficiency, reduce greenhouse gas emissions, and stimulate the market for environmentally friendly goods and services. Although green goods and services procured by governments may be initially more expensive than conventional alternatives, the total cost of ownership over the lifetime of green products is typically lower than for the alternatives (e.g., low-energy bulbs and EVs) (OECD, 2024b).

Green public investment management (Green PIM) refers to the systematic integration of climate considerations—such as mitigation, adaptation, and resilience—throughout the public investment cycle (Petrie, 2025). It involves embedding climate-responsive planning, appraisal, budgeting, risk screening, and monitoring into existing PIM systems to ensure infrastructure spending yields both development and environmental benefits. As the IMF emphasizes, "better PIM—and especially better 'green PIM'—makes government spending go further" by reducing efficiency losses exacerbated by climate risks (Schwartz, 2023).

As an illustration, a group of nine countries has committed to the Zero-Emission Government Fleet Declaration (Clean Energy Ministerial, 2022). These countries aim at 100% zero-emission light vehicle acquisitions and aspire toward 100% zero-emission acquisitions of their medium- and heavy-duty vehicles by no later than 2035. Australia aims to reach 75% (government fleet) and 100% (buses) electric vehicle acquisition by 2025. In the EU, half of new city buses were zero-emission in 2024 (Transport & Environment, 2025).

Overall, green public expenditure can complement both carbon pricing and regulatory measures by fostering the development and expansion of low-carbon markets. Strategic government spending can stimulate innovation, drive economies of scale, and enhance learning-by-doing, thereby accelerating patent activity and reducing technology costs. These effects can lower the carbon price needed to incentivize the energy transition and reduce reliance on subsidies for technology deployment. As noted by a contribution to the Compendium of Practice, the implication for MoFs, and governments more generally, is that putting diverse and non-correlated policy instruments in place can help create an expectation for large and growing markets that are robust to political changes, business cycles, and changing social priorities.[9] This helps foster an environment for long-term investment in the energy transition. Policy instruments can include funding innovation directly, for instance through R&D; derisking novel technologies by co-funding technology demonstrations; creating early markets via advanced market commitments; stimulating broader adoption through subsidies; pricing pollution to improve the competitiveness of clean technologies; and coordinating international cooperation. All of these are only possible with the investment of public funds raised by MoFs. At the same time, the fiscal cost of such expenditures can be substantial. To ensure cost-effectiveness and avoid prolonged support for mature technologies, sunset clauses and ex-post evaluations are essential.

3.3. Combining fiscal instruments and regulation for climate action[10]

All countries combine multiple fiscal instruments with regulation for climate action. As noted earlier, a key argument for blending these diverse instruments is the presence of multiple externalities and market failures, such as the social cost of emissions, innovation, and technology spillovers; intergenerational myopia; information asymmetries; network effects; collective action problems; as well as behavioral biases. For instance, Metcalf (2019) argues that while carbon pricing is efficient, it may not fully address all externalities, necessitating supplementary regulations to achieve desired environmental outcomes. Regulation included in climate packages comprises a broad range of interventions that, together with carbon pricing, help to address these market failures. For instance, regulatory measures help to shape energy markets, set industrial standards, and provide incentives for technology shifts. These regulations encourage both producers and consumers toward cleaner technologies. Regulations are often implemented within sector-specific packages (see Table 3.3). While these regulations are usually implemented by sectoral ministries, MoFs can play a crucial role in ensuring their integration into a cohesive policy package for climate action. MoFs should play a second opinion role on significant regulatory policies, one at a time, as well as on how each interacts with other policy instruments.

[9] See 'How government actions have accelerated clean energy innovation: lessons for economic analysis and modeling by Ministries of Finance', contribution from the University of Wisconsin-Madison to the HP4 Compendium of Practice.

[10] This section does not cover the integration of financial regulation and monetary policy practices in climate packages. Most inventories of policy measures for climate action do not yet include these instruments and, therefore, little research is available on the interaction between them and other policy tools. A brief review of the topic is provided in Appendix 3.

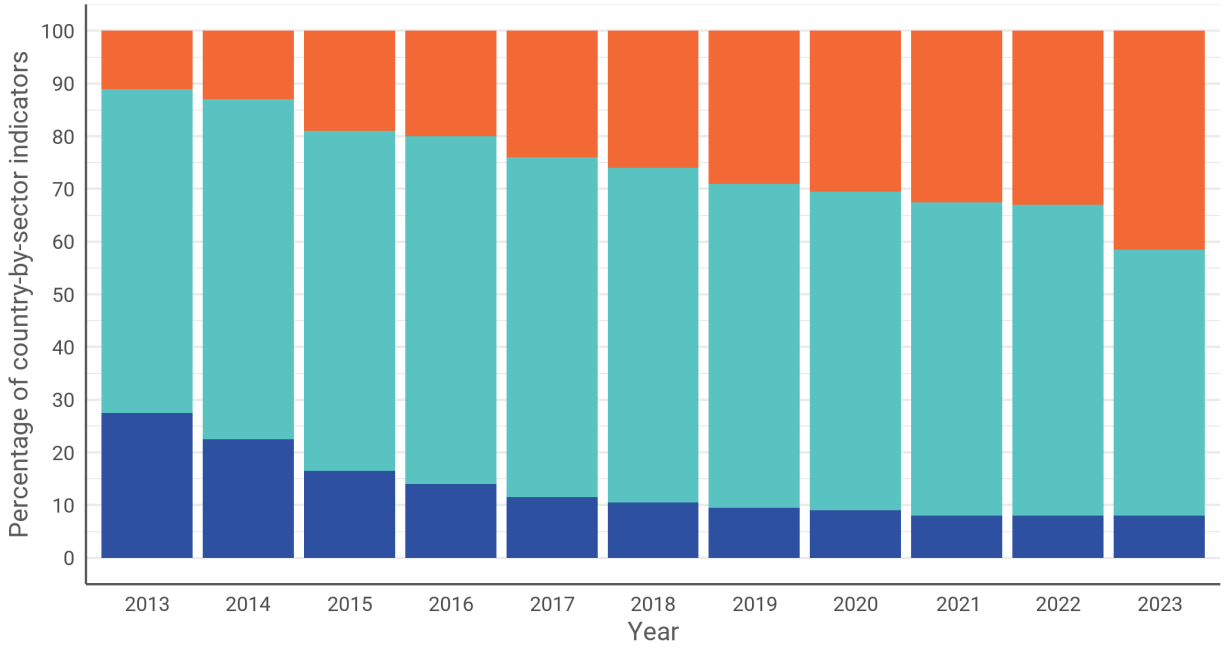
Table 3.3. Examples of climate-related regulations in three sectors

	Electricity	Transportation	Buildings
Standards	CO_2/greenhouse gas emission limits on power plants	Fuel efficiency and emission standards for road vehicles	Minimum energy performance standards for lighting, cooling, and cooking appliances
Market regulation	Power purchase agreements between clean power producers and consumers	Low-emission zones in urban areas with access restricted to clean vehicles	Obligation for landlords to retrofit and meet minimum standards before leasing to a new tenant
Regulatory incentives	Guarantee of origin certification for renewable energy certificates	EVs are tolerated in bus and high-occupancy vehicle (HOV) lanes when the number of passengers on board is above a given threshold	Less stringent land use or permitting for buildings that meet green standards, e.g., higher height of buildings
Mandates	Renewable Portfolio Standard (RPS)	Minimum percentage of zero-emission vehicles produced by manufacturers	Mandate that leased homes and offices observe minimum energy efficiency standards
Bans	Mandatory phase out of unabated coal-fired plants	Bans of new ICE vehicles by deadline	Bans on new fossil fuel boilers (coal, oil, gas) by a deadline

Source: Authors

Statistical evidence suggests that countries have adopted more stringent climate-related regulations over the past decade. In 2023, approximately 40% of sectoral policies implemented by the 50 countries monitored by the OECD were highly stringent,[11] representing a significant increase compared to previous years (see Figure 3.5). The recent surge in stringency was predominantly observed for manufacturing industries, especially in Europe.

Figure 3.5. Climate-related regulations have become more stringent



Note: The figure shows the breakdown of regulatory stringency in four sectors (buildings, electricity, industry, and transportation) and 50 countries. The value of the stringency indicator varies from 0 (no stringency) to 10 (maximum stringency).

Source: Authors, based on the OECD CAPMF indicator (accessed February 2025). U.S. data is missing from the OECD dataset.

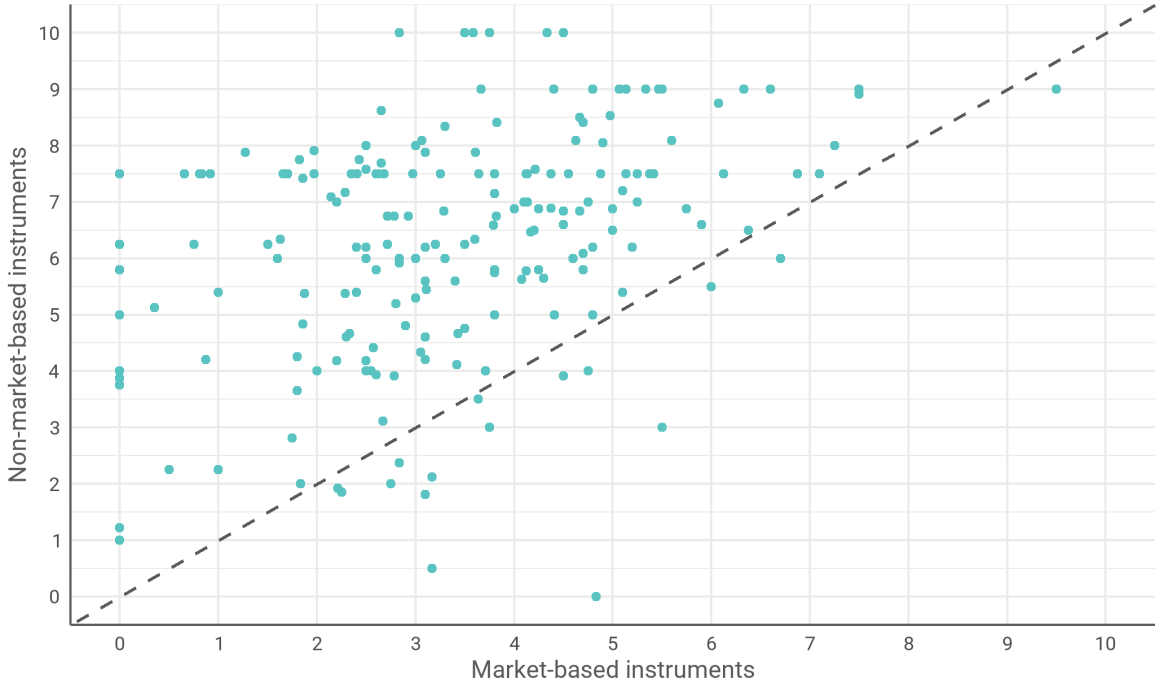
While countries have adopted stricter climate-related regulations, progress in carbon pricing and other fiscal interventions has been slower. For instance, regulations such as efficiency standards and mandates are stringent in the buildings and industry sectors of the 50 countries tracked by the OECD, while net carbon

[11] In the OECD climate-policy context, "stringency" refers to the strength of policy signals—measured by the explicit or implicit cost imposed on environmentally harmful behavior. As shown in Figure 3.5, a policy is "highly stringent" when the corresponding CAPMF indicator is between 7 and 10.

effective rates in these sectors are low. All 50 countries implement medium- or high-stringency measures in the buildings sector. Forty-seven countries do so in the industry sector. In contrast, carbon pricing instruments are significantly less common, particularly in the electricity sector, where only 23 countries have adopted them, while 44 countries have adopted medium- to high-stringency non-market measures. This disparity highlights the continued dominance of regulatory approaches in climate policy design, rather than pricing, possibly due to their traditional use in broader environmental policy and concerns about political acceptability.

Figure 3.6 confirms that most countries use climate-related regulations that are more stringent than market-based interventions such as carbon pricing. This is evidenced by the concentration of observations above the 45-degree line, indicating more stringent non-market approaches relative to their market-based counterparts. Notable outliers include Ireland, which appears to maintain a high degree of stringency in both policy domains, while Peru and Russia exhibit relatively weak interventions across both axes. These findings suggest that while market-based tools are widely discussed in economic policy circles, in practice, governments tend to rely more heavily on regulatory instruments to drive decarbonization efforts.

Figure 3.6. Regulations are more stringent than market-based instruments in most climate packages



Note: Axes show the degree of stringency from inactive (0) to highly stringent (10). The dataset covers 51 countries and four sectors (buildings, electricity, industry, and transportation). Data is missing for some countries and preliminary estimates in several instances. CAPMF stringency indicators are relative (rather than absolute), i.e., a country's high stringency lowers the ranking of other countries.

Source: Authors, based on OECD CAPMF (accessed 20 April 2025)

Considering the potential impact of stringent climate-related regulations on economic performance and income distribution, MoFs must closely monitor their implementation. These policies do not have an explicit price tag, but the required reduction in emissions comes at a cost. Such costs may additionally have disproportional impacts on vulnerable households or small, financially constrained firms with implications for welfare or market structure and competitiveness, respectively. For instance, automakers often pass upfront costs of fuel efficiency standards onto consumers, potentially making the purchase of cars more challenging for low-income households. For example, when the U.S. Corporate Average Fuel Economy (CAFE) standards were tightened in the 2010s, automakers responded by increasing the prices of new vehicles to cover compliance costs—adding an estimated US$1,000–2,000 per vehicle (Jacobsen, 2013). This disproportionately affected low-income households, who are more likely to purchase lower-cost vehicles and are often pushed toward older, less efficient used cars as a result.

When the cost of abatement imposed by regulations becomes excessive, it can negatively impact productivity, output, and employment. Numerous studies have examined the effects of varying environmental standards across U.S. states and counties following the implementation of the 1997 Clean Air Act and Amendments (CAAA) to investigate their impact on manufacturing plant locations. Dechezleprêtre and Sato (2017) found that the effect of stricter climate regulation is spatially heterogeneous and systematically varies with location-specific attributes, such as unemployment levels. Millimet and List (2004) also found that the impact of stricter climate regulation is spatially variable and varies systematically with location-specific characteristics. Because of this heterogeneity of agents and types of equipment, regulation requires considerable fine tuning, thus increasing the compliance costs of regulated entities and increasing the cost of policy oversight.

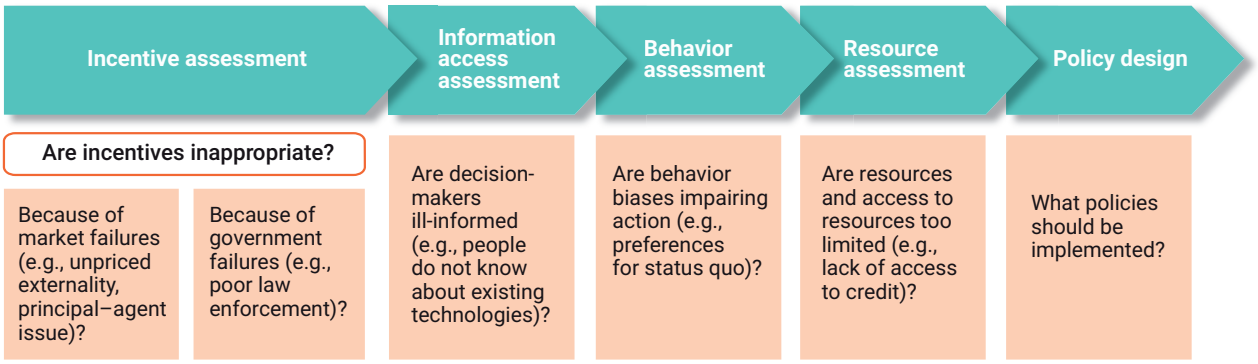
As noted above, fiscal instruments and regulations interact in complex ways. A carbon price may make a regulation redundant, or the two policies may be mutually reinforcing; a third outcome is that the interaction will increase the cost of abatement and therefore yield a negative outcome. As a result, the concurrent implementation of carbon pricing and direct regulations can lead to policy redundancy or counterproductive interactions. Levinson (2010) highlighted that if regulatory standards mandate emissions reductions beyond what is economically justified by the carbon price, they can distort the market, leading to inefficiencies without additional environmental benefits. Similarly, Tello (2025) found that in the electricity generation sector, overlapping policies can result in diminished effectiveness, where the combined impact on carbon dioxide emissions is less than the sum of their individual effects. Tight regulations also reduce the demand for fossil fuels, leading to lower energy-related tax revenue, such as excise taxes and carbon pricing. This impact can affect government plans for which these revenues are earmarked. The analysis is complex because it is highly context-dependent, influenced by factors such as granular policy features, sectoral characteristics, and prevailing market conditions.

A growing body of research provides new insights into the interplay of various types of climate action. For example, Cocker (2025) synthesized findings from the literature across four major emitting sectors: power, transportation, buildings, and heavy industry. The review evaluated interactions based on four key criteria—environmental effectiveness, economic efficiency, social equity, and political feasibility—and found that carbon pricing interacts positively with most other instruments. Specifically, Cocker (2025) noted that:

- Stand-alone carbon taxes face challenges such as feasibility and equity concerns, thus making complementary policies essential for decarbonization. He also observed that the introduction of carbon taxes within climate packages, at a lower rate than in a stand-alone setting, allows for positive synergies with complementary measures. Carbon taxes encourage energy conservation at the intensive margin (less intensive energy consumption), whereas most regulatory instruments primarily incentivize changes at the extensive margin (energy conservation resulting from investment). Subsidies, R&D support, standards, and information campaigns also strengthen carbon tax policies.
- ETSs, when combined with non-pricing instruments, may also exhibit positive synergies for the same reasons as discussed for carbon taxes. However, interactions are more likely to be neutral or even negative, especially if the ETS cap is binding. These tensions can be mitigated through MSRs (see above) or careful cap adjustments.
- Subsidies, particularly those supporting renewable energy innovation and deployment, exhibit strong complementarities with carbon and energy taxes. However, their interaction with ETSs may distort allowance prices thus reducing the efficiency of the system, unless the cap is tightened accordingly.
- Standards also tend to interact positively with pricing policies, though they risk rendering ETSs redundant when mandates, such as Renewable Portfolio Standards (RPS), implicitly determine emissions caps.
- Information campaigns generally complement other measures, enhancing public acceptance and encouraging behavioral change without significantly distorting price signals.
- Instruments such as Carbon Border Adjustment Mechanisms (CBAMs) and Carbon Contracts for Difference (CfD) are largely complementary, especially when paired with carbon pricing, as they provide leakage protection and price stability for low-carbon investments.

Overall, this analysis suggests that the adoption of low-carbon solutions is not always a question of incentives. In the real world, some mitigation solutions are not adopted even though they are cheaper in net present value terms. MoFs need to understand the reasons, using empirical evidence, and deploy complementary policies to foster adoption, while recognizing that interactions between instruments can either enhance or undermine climate policy objectives depending on the context. The World Bank suggests a series of steps to assess such situations and design appropriate policies (see Figure 3.7).

Figure 3.7. Assessing the obstacles to low-carbon solutions



Source: Fay et al. (2015) adapted from Loayza and Okter-Robe (2014). License: Creative Commons Attribution CC BY 3.0 IGO

The findings underscore that in many situations MoFs need to go beyond financial incentives for low-carbon solutions and investigate complementary policies. Climate packages combining carbon pricing and complementary policies—fiscal instruments or regulations—can overcome sector-specific barriers. However, the findings also highlight the importance of well-designed policies to avoid unintended inefficiencies or conflicts.

3.4. Modeling the interactions between fiscal instruments and regulation

The usefulness of models for exploring policy interactions within climate packages

In addition to theoretical analyses, empirical macro–energy–climate models can provide useful insights on the joint impacts of carbon pricing, further fiscal interventions, and regulatory measures. A range of economic tools, models, and frameworks can be used to assess and explore the implications and effectiveness of climate mitigation policies. Models cover a diversity of sectors, geographies, and time periods, ranging from simple sectoral-level models to whole economy-energy-climate-linked models at a regional or global scale. Economic models used for climate policy analysis can broadly be categorized into three types (Pfenninger et al., 2014):

- **Bottom-up models:** include a detailed depiction of technical processes at a sectoral scale with a high granularity and are typically limited in scope to the energy system. Examples include the MARKAL/TIMES and MESSAGE energy model families, the IEA's Global Energy and Climate Model, and PRIMES, the comprehensive energy model used by the European Commission.[12]
- **Top-down models:** based on general equilibrium economic relationships, these models characterize the economy by depicting the interactions between consumption, prices, incomes, and input costs and their influence on demand and supply interactions, typically at an aggregate, economy-wide level. Examples include the OECD-ENV, IMF-ENV, and EU JRC-GEM-E3 models.[13]

[12] See 'Overview of the European Commission's energy and climate policy-related modeling suite', contribution from the European Commission to the HP4 Compendium of Practice.

[13] See 'IMF-ENV: integrating climate, energy, and trade policies in a general equilibrium framework', contribution from the IMF Research Department to the HP4 Compendium of Practice, and 'Overview of the European Commission's energy and climate policy-related modeling suite', contribution from the European Commission to the HP4 Compendium of Practice.

- **Hybrid models:** these models extend the functionalities of top-down (bottom-up) models by including a bottom-up (top-down) module to extend their technological (sectoral) resolution. Adopting a hybrid approach allows models to deliver insights that a single top-down or bottom-up model would struggle to provide. For example, this class of model can explore the interactions between sectoral-level dynamics and their broader macroeconomic impacts. Examples include the MESSAGE-MACRO and TIMES-MACRO models (which link the MESSAGE or TIMES models with the MACRO macroeconomic model).

The simulations produced in the context of the World Bank's CCDRs using a set of sectoral analyses and macroeconomic models are a useful illustration of the hybrid modeling approach. This approach using several tools helps to capture the various dimensions of the green transition such as the multiplicity of market failures, the interactions between instruments, the need to replace certain assets and infrastructures, and the macroeconomic feasibility of the transitions. For instance, the CCDR exploring Turkey's climate transition (World Bank, 2022) uses a hybrid modeling framework that links sectoral techno-economic pathways with the World Bank's global MANAGE model and the MoFs' macro-fiscal model.[14] The simulations build a net zero pathway by mid-century, which assumes a set of climate action and additional investments of over US$300 billion. The decline in greenhouse gas emissions is mainly driven by rapid renewable energy deployment and coal phase-out in the power sector, complemented by energy-efficiency upgrades in buildings and industry, transportation electrification, and reforestation and land-use reforms. Key policies supporting this shift include the introduction of a carbon tax with recycling of revenues into green investment, regulatory support for renewable energy, and grid modernization, and labor market and financing policies that ease structural frictions. Model results suggest that if these measures are implemented effectively, Turkey could achieve substantial emissions reductions while sustaining, and potentially accelerating, GDP growth and generating net employment gains (Hallegatte et al., 2024).

Existing economic models are typically used to explore the impacts of climate action. Pricing-based policies such as carbon taxation are relatively simple to integrate into existing models, but models are increasingly integrating non-pricing policies (including regulations, standards, and technology mandates), which are frequently associated with price-based policy measures. The integration of non-pricing policies is typically carried out through exogenous constraints or calibration approaches to ensure that model outputs are in line with non-pricing policies. For example, a technology ban could be integrated by including a constraint of a given year that the technology can no longer be purchased from (depending on the ban formulation), or energy efficiency regulations could be included as fixed requirements that must be complied with.

Bottom-up, sectoral models are well-suited to analyzing the direct, technical impacts of non-pricing policies at a sectoral level with a high granularity, particularly for policy interventions such as standards, mandates, or technology bans. However, they struggle to capture broader economic impacts, cross-sectoral interactions, or feedback caused by non-pricing policies (Prina et al., 2020). For example, macroeconomic parameters such as economic growth and inflation are typically defined exogenously, rather than modeled internally. Top-down macro-climate models may struggle to capture the full effectiveness of non-pricing policies due to limited granularity at a technology or sector level (Delzeit et al., 2020) but are well-equipped to capture feedback or macroeconomic effects caused by non-pricing policies (e.g., changes in prices and subsequent consumption).

There are substantial challenges involved with evaluating the impacts of non-pricing policies and their interactions with other policies, in all types of models. The limited amount of empirical evidence on policy implementation and their stringency and effectiveness (OECD, 2025b) means that models are often used to evaluate the potential implications of climate action. However, the treatment of interaction effects between policies in both top-down and bottom-up models can be limited, with non-pricing policies in particular being challenging to evaluate. Approaches used include evaluating the emissions impact of non-pricing policies by converting their effects into a "carbon price equivalence"—for direct comparison with price-based instruments and other policies—but there are substantial uncertainties in performing these evaluations. Principally, these uncertainties result from the need to define a policy baseline to use in scenario modeling to estimate the

[14] Also see 'MANAGE-WB: a recursive-dynamic CGE model', contribution from the World Bank to the HP4 Compendium of Practice.

impact of non-pricing measures on emissions and challenges extracting the impact of a single policy from the interaction with contributions from other policies (OECD/IMF, 2022).

Given the shortcomings of simulations using standard bottom-up or top-down models, there is an emerging focus on linking models together to produce hybrid models. Linking top-down and bottom-up models could improve technical insights by capturing the macroeconomic impacts of policies while still including a detailed representation of technologies and emission sources (Pfenninger et al., 2014). This can be done with "soft links" controlled by the user or "hard links" made directly through the code. Linking of top-down and bottom-up models has been shown to substantially change the economics of climate mitigation policies. For example, the linking of a top-down computable general equilibrium (CGE) model with an energy sector bottom-up model for China by the World Bank suggests that the carbon tax required to meet Nationally Determined Contribution commitments is one-third of the level needed in the absence of the linkage (Timilsina et al., 2019). Similarly, The JRC-GEM-E3 CGE model is linked to the PRIMES energy model to incorporate information on the transition in key sectors. However, there are numerous challenges associated with the linking of models that makes this time and resource intensive. Models may have inconsistencies in data formats and definitions, making integration complex (Krook-Riekkola et al., 2017).

Microsimulation models can also play a crucial role in assessing the social impact of climate policy. They provide detailed insights into how different household types will be affected by measures such as carbon or environmental tax reforms. For instance, in Finland, this type of model was used to simulate distributional consequences alongside general equilibrium modeling (Tamminen et al., 2019). The results showed that when environmental taxes are paired with tax cuts or compensations (e.g., lowering income taxes), not only can emissions be reduced, but employment can also rise, and inequality need not worsen. By mapping the effects on households across different income deciles, regions, and consumption baskets, microsimulation enables policymakers to design more socially just instruments. This approach ensures that climate policies are effective, efficient, and equitable by targeting support to vulnerable groups.

MoFs need to play a key role in integrating climate objectives into medium-term fiscal plans and, more broadly, into their country's development strategy. Climate objectives need to be embedded into perspectives for economic, industrial, and social development and made consistent with plans for the energy sector, taking into account the available fiscal space. Achieving a high level of within-government coherence is, however, difficult. There are many challenges to coordinating climate policies across institutional frameworks and government ministries, requiring innovative approaches to coordinating climate policy (UNDP, 2025). In the absence of coordination, the economic and political costs of government failure are likely to be severe. For instance, the lengthy process of coordinating the UK's climate package has delayed investment in low-carbon energy. This has led to escalating fiscal costs of mitigation and higher public debt, as delayed action implies a shorter and more chaotic transition (OBR, 2021).

Model simulations of climate packages are a good place to start the process of within-government coordination and to allocate institutional responsibilities for climate action (OECD, 2023). While MoFs typically use top-down models that explore macroeconomic and budgetary implications of climate policies, they may not "own" the bottom-up models under the responsibility of Ministries of Climate or Energy. Some sectoral ministries use a suite of modeling tools, with specialized tools defined for specific purposes, e.g., a tool for power system planning and an additional one for modeling the buildings sector, though the scope of most of these modeling tools may not be within the mandate of MoFs. To avoid the costs from lacking coordination, MoFs should catalyze modeling simulations across ministries (see Box 3.2).

Box 3.2. Using models to foster inter-ministerial cooperation in climate packages

Designing credible and coherent climate packages requires effective coordination between ministries responsible for finance, energy, environment, transport, and other sectors. Governments are increasingly relying on integrated modeling frameworks to provide a common evidence base for decision-making. These models, ranging from computable general equilibrium (CGE) models to detailed energy system models, enable ministries to work together on scenarios, aligning sectoral perspectives and fostering consensus.

In **Italy**, the Ministry of Economy and Finance has worked closely with the national energy agency ENEA to link a dynamic CGE model of the Italian economy with the TIMES bottom-up energy system model.[15] This iterative two-way "soft linking" allows the MoF's macroeconomic simulations to incorporate the technological detail of the energy system model, while ensuring that the energy pathways generated by ENEA reflect consistent macroeconomic assumptions. The approach has yielded more realistic projections of carbon prices and electricity mixes, thereby strengthening the credibility of Italy's National Energy and Climate Plan scenarios. More broadly, inter-ministerial coordination has been formalized through the creation of the Inter-ministerial Committee for Ecological Transition (CITE), supported by a technical committee that runs joint scenario analyses covering economic, social, and environmental variables. These exercises serve as a neutral platform for different ministries to agree on targets and resources, embedding modeling in Italy's climate governance.

France has similarly institutionalized shared modeling through the preparation of the Stratégie Nationale Bas-Carbone (SNBC) and the Programmation Pluriannuelle de l'Énergie (PPE). The Directorate General for Energy and Climate in the Ministry for Ecological Transition coordinates these plans in close collaboration with the Ministries of Economy, Agriculture, Transport, and Housing, alongside agencies such as ADEME and CITEPA. A range of sectoral and macroeconomic models is mobilized, including ADEME's building and agriculture models, the MODEV transport model, and macroeconometric tools such as ThreeME and NEMESIS.[16] External research institutes such as CIRED also contribute through the IMACLIM model. By harmonizing inputs and assumptions across these tools, the government produces consistent "additional measures" scenarios that form the legal basis for France's carbon budgets. This collective modeling process provides transparency, ensures that sectoral ministries operate under shared projections, and builds consensus around the economic impacts of climate mitigation measures.

In the **UK**, inter-ministerial cooperation has been strongly supported by the UK TIMES model, a comprehensive energy system optimization framework developed with academic input and used across government. Initially developed for the Department for Business, Energy and Industrial Strategy, UK TIMES has become the principal tool underpinning the design of decarbonization pathways across all sectors of the economy. Its shared use by the Treasury, Department for Transport, and the Department for Environment, Food and Rural Affairs has enabled different ministries to analyze the same scenarios, improving communication and reducing policy fragmentation. The model has been instrumental in shaping the Clean Growth Strategy, the Sixth Carbon Budget, and the Net Zero Strategy, ensuring that decisions on fiscal measures, energy investments, and sectoral regulations are made with a consistent analytical foundation.

Taken together, these cases show that modeling has become more than a technical instrument; it is a governance tool that facilitates cooperation and negotiation between ministries. By embedding joint scenario analysis into national planning processes, Italy, France, and the UK have used models to create shared narratives and align diverse ministerial priorities. The result is greater policy coherence, stronger credibility of national climate commitments, and a clearer understanding of the economic and technological pathways to decarbonization.

Sources: CFMCA (2025d); Direction générale du trésor (2022); France Stratégie (2022); HM Government (2021); Italian Ministry of Economy and Finance, Department of Finance (2025); Ministère de la transition écologique (2022); UCL Energy Institute (2022)

Models are also predominantly developed by and for high-income countries, lacking region- and country-specific economic and development contexts. Models used to formulate climate policy typically do not account for the unique characteristics of low- and middle-income countries—e.g., high costs of capital, political instability, and limited regulatory structures (Mulugetta et al., 2022)—and low- and middle-income countries typically lack the institutional capability to develop and use existing models or even to access them directly due to hardware or software requirements. Many large top-down and bottom-up models also require substantial computing power, extensive training, and software licenses to set up and run at an economy level, which may not be viable in low- and middle-income countries. These factors explain why modelers from high-income countries often lead or support modeling efforts in low- and middle-income countries (Musonye et al., 2020).

[15] See also 'The Italian Ministry of Economy and Finance climate-related modeling tools: how to build a flexible suite of models serving different purposes', contribution from the Italian Ministry of Economy and Finance to the HP4 Compendium of Practice.

[16] See also 'The ThreeME model', contribution from the French Economic Observatory (OFCE)—Sciences Po, to the HP4 Compendium of Practice.

The Energy Policy Simulator

The Energy Policy Simulator (EPS) allows the modeling of climate packages which integrate carbon emission taxes, fuel taxes, and a wide array of energy and environmental policies. The EPS model reports outputs for emissions of 12 different pollutants, fuel consumption, changes in governments' financial position, and the structure of the electricity generation fleet, among other variables. It accounts for five key sectors: transportation; buildings, appliances, and heat; electricity supply; industry; and agriculture, land use, and forestry. In addition, it incorporates macroeconomic effects (GDP, jobs), public health, and additional sectors such as carbon capture and storage (CCS), hydrogen production, and geoengineering. It operates within a System Dynamics framework, which treats the economy and energy systems as constantly evolving. This approach differs from others, such as CGE models—which assume equilibrium states are disrupted by exogenous shocks—or technology-based models focused narrowly on the potential gains from upgrading specific equipment.

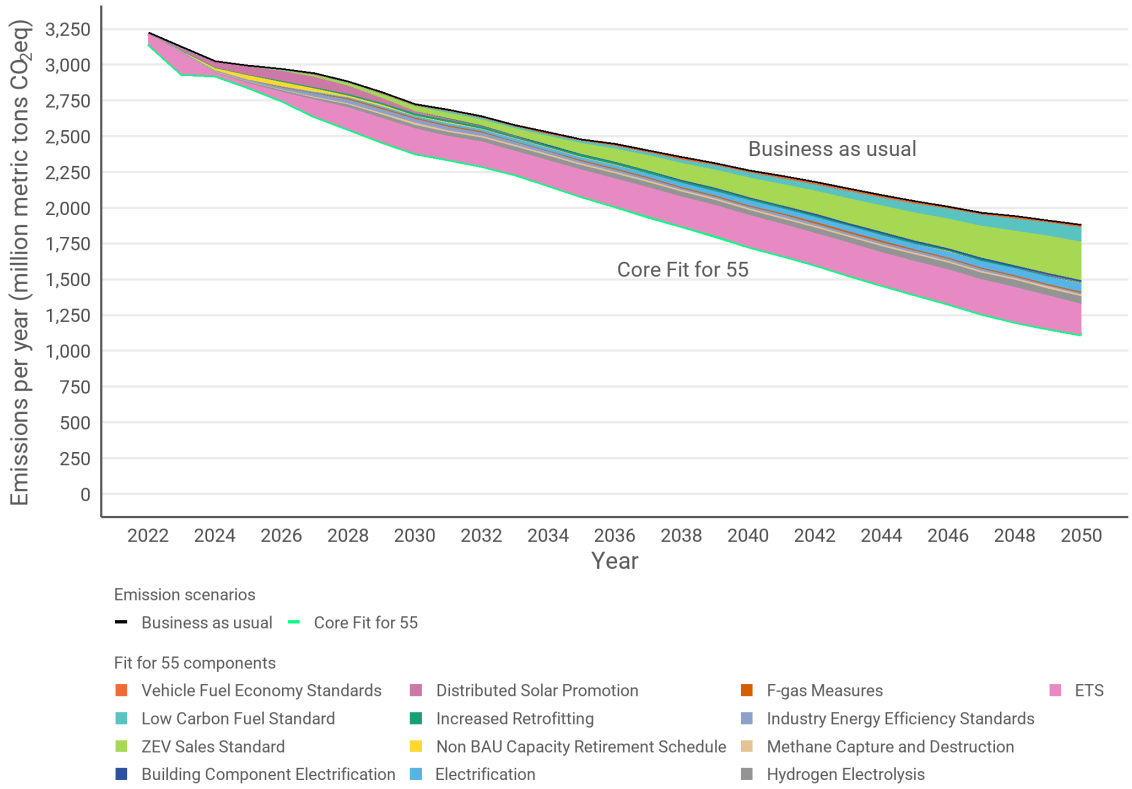
The model was used, in partnership with Agora Energiewende (2024), to simulate the impact of the EU Fit for 55 package, with results analyzed against a "business as usual" baseline representing the EU's climate and energy policies before the EU Green Deal.[17] The model indicates that the EU-level policy could by itself cut emissions by 49% below 1990 levels by 2030 (see Figure 3.8). The simulation also suggests that carbon pricing plays a key role in the EU climate strategy: nearly half of the 2030 greenhouse gas emissions reduction comes from the 2023 overhaul of the EU ETS, which now consists of (i) a tighter "ETS 1" for power, energy-intensive industry, maritime shipping, and domestic aviation, and (ii) the new "ETS 2" that will set a cap on carbon dioxide emissions from buildings, road transport, and remaining industry from 2027 onward (the two pillars are incorporated under the instrument ETS in Figure 3.8). The other half of greenhouse gas emissions reduction is delivered by instruments such as the Energy Performance of Buildings Directive, Zero Emissions Vehicles (ZEV) standards, and the Renewable Energy Directive. The contributions of new policies shift during the 2030s and, by 2050, strengthened ZEV standards for cars become the single largest driver of additional abatement of the Fit for 55 package, followed by the two ETS pillars. Yet even with the full Fit for 55 package, emissions still reach 1,113 million metric tons of carbon dioxide equivalent in 2050—well above the climate neutrality level—indicating that deeper national measures or more ambitious EU initiatives will be required after 2030 to achieve the EU's legally binding target of net zero emissions by 2050 under the European Climate Law.

For this report, the EPS was used to investigate the interactions between carbon pricing and a diversity of regulatory policies. Policy interactions can be positive when the impact of combining the policies is greater than the sum of each policies' impacts (in other words, 1+1>2); or the interaction can be negative when the policies undermine each other (1+1<2). In certain cases—such as the combination of a carbon tax with feed-in tariffs, public transit support, or tradeable white certificates—the EPS shows positive interactions between policies, as reported in the literature, often because carbon prices sharply deter the rebound effect that can result from more efficient energy use (see Table 3.4).

In other combinations the interactions are negative (1+1<2). While the combined impact of two climate actions may be less than the sum of their separate impacts, this does not necessarily mean they are undermining each other or causing negative environmental or financial consequences. For instance, an efficiency standard and a sales mandate for cleaner technologies overlap, but with no negative consequences. There may be good reasons for such overlap, such as for a subsidy for low-income consumers in addition to a sector-wide mandate to promote equity. While governments should in principle aim for positive interactions between climate actions, it is in practice impossible to achieve a net zero policy package without some degree of policy overlap.

[17] The EU Green Deal aims at net zero emissions in 2050 and at least a 55% reduction of emissions in 2030 with respect to 1990. The EU Fit for 55 package is a set of laws and law revisions to achieve the 2030 target.

Figure 3.8. Projected emissions under the EU's Fit for 55 package



Note: The figure shows a breakdown of the contributions of the Fit for 55 package's constituent policies projected from 2022 to 2050.

Source: Authors, based on EPS simulations of the EU Fit for 55 package

Table 3.4. Estimates of interactions between carbon pricing and other instruments based on the Energy Policy Simulator (EPS) model

Sector	Instrument mix	Interaction based on EPS	Explanations
Power	Package combining: • Carbon tax or ETS • Renewable energy subsidy (feed-in tariff [FIT], feed-in premium [FIP])	Positive ↑	Tax => less investment in coal plants Renewable energy subsidy => more investment in clean power Interaction from lower rebound effect
Buildings	Package combining: • Carbon tax or excise tax • Tradeable Energy Efficiency Certificates (EEC)	Positive ↑	Tax => lower use of carbon-intensive appliances and heating systems EEC => energy saving irrespective of carbon content
Transportation	Package combining: • Carbon/fuel tax • Earmarking of revenue to public transport	Positive ↑	Tax => lower use of ICE vehicles Earmarking revenue => commuters shift from road to rail/buses
Buildings	Package combining: • Carbon tax • Means-test social transfer to offset the energy cost increase	Negative ↓	Tax => lowers energy consumption Offsetting subsidy => more energy consumption
Transportation	Package combining: • Carbon tax/fuel tax • Fuel efficiency standard	Negative ↓/Neutral	Carbon tax => less mileage Fuel efficiency => more mileage (rebound) Interaction: average mileage increases/stays neutral depending on the model calibration

Note: Positive ↑ indicates that the combined impact of two instruments is greater than the sum of their individual impacts when simulated separately. Conversely, Negative ↓ indicates that the combined impact is smaller. The signs of the interactions have been verified with different calibrations, though this does not exclude a different sign of interaction with other calibrations of policies.

Source: Authors, based on simulations using the Energy Policy Simulator (EPS)

These insights from the EPS should be considered with caution. The EPS—like all other economic models—is built on numerous assumptions and simplifications, and its input data is derived from studies conducted under specific contexts. These do not necessarily reflect the granularity and complexity of overlapping policies across diverse socioeconomic environments. Furthermore, many policy effects in the EPS are modeled using elasticities or coefficients based on context-specific research that would likely change depending on the social and economic environment in which policies are enacted. In addition, the impact of policies may not be linear. When policies are implemented in combination or at high intensities, the technical procedure to solve the EPS may not result in a perfect convergence. Lastly, the EPS lacks numerical representations of uncertainty, limiting its ability to predict bounds of possible outcomes in complex policy settings. These caveats notwithstanding, the EPS and other macro-energy models provide helpful tools to assess the interactions of policy packages and to better understand different potential impacts of different designs.

Further theoretical research, ex-ante model-based simulations, and ex-post econometric investigations will be important pillars for continuously advancing the use of climate packages. In that context, collaboration between empirical research and modeling efforts will be a key building block to inform policymakers' decisions in real-world conditions.

3.5. Carrots and sticks: sequencing climate actions

The sequencing of climate actions over time has received significant interest in policy forums and the literature. While earlier, largely static, conceptual frameworks and quantitative models overlooked this aspect, there is now a growing consensus that sequencing matters. Real-world observations suggest that governments tend to stagger the implementation of their climate actions over many years rather than taking a one-time approach. Comprehensive climate packages, which include various instruments, offer governments the flexibility to introduce their policy measures gradually over time, rather than all at once. The evidence indicates that well-planned sequences of actions can play a crucial role in the success of transition to low-carbon economic development (OECD, 2025c). The right sequencing should put policies that can overcome short-term political economy obstacles first, and also improve capacities and change the political economy to facilitate further climate action (Hallegatte et al., 2023).

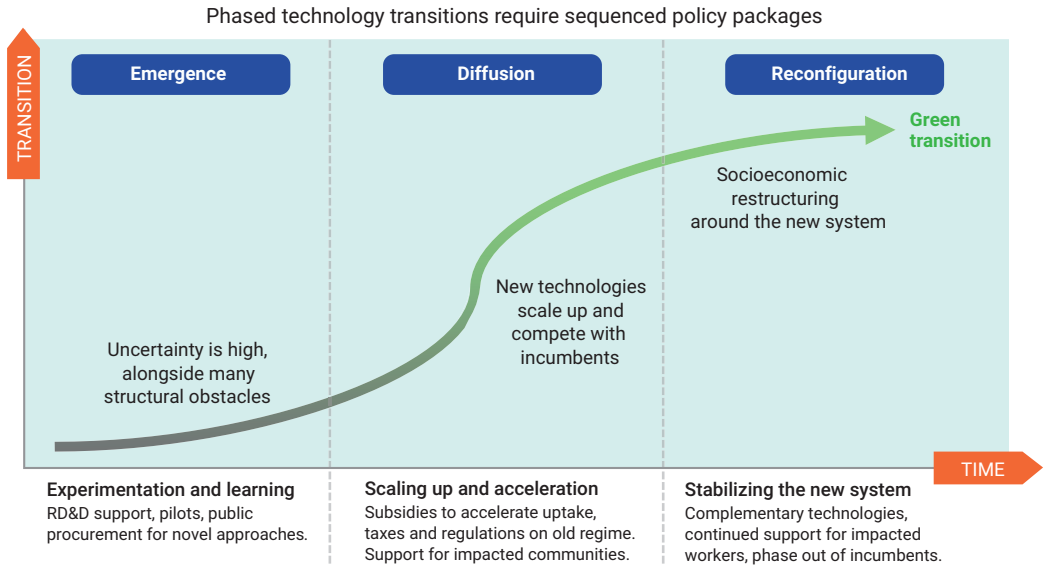
Recent research found that governments deploying climate packages typically implement stringent levels of carbon pricing as the final step (Linsenmeier et al., 2022). The typical approach is to offer "carrots" first, such as subsidies, tax expenditures, and concessional financing. Then, the stringency of "sticks" is increased, particularly carbon pricing (Tchorzewska et al., 2025). This approach aims to eliminate economic, technological, and political barriers that hinder stringent carbon pricing. Once these barriers are overcome, governments appear more able to transition to their final sequence in a sustainable, resilient, and accepted context. Importantly, preparing the ground carefully allows for the introduction of carbon pricing at a higher level than otherwise, as evidenced in G20 countries (Linsenmeier et al., 2022).

- **The first step in a sequence often involves public funding for R&D.** This aims to promote innovation in low-carbon alternatives such as solar panels, EVs, and heat pumps. By doing so, households can shift to these alternatives when carbon pricing is introduced, making the transition more effective and acceptable.
- **Information campaigns can also be included in this first step to reduce information asymmetry.** Energy labels, information about fuel efficiency, detailed utility invoices, and home energy efficiency audits—when systematically required—all educate consumers about the higher carbon prices that they will eventually face.
- **Pre-announcing the future rise in carbon prices gives households more time to prepare for the transition.** This approach allows economic agents to prepare, reducing adjustment costs and increasing policy credibility (Carattini et al., 2018).

- **In the business sector, where investments are planned over long time periods and assets have life expectancies that can span several decades, providing credible information about future carbon prices is crucial.** This information helps avoid the emergence of loss-making stranded assets and encourages a well-planned transition to low-carbon facilities. However, such information may be subject to the "time inconsistency problem," if government plans are changed due to evolving circumstances. Certain fiscal instruments (especially subsidies) are likely to lack long-term predictability due to the political cycle. Embedding official commitments into national law, which is difficult though not impossible to change, is an approach that has been followed in some countries (e.g., Ireland and Switzerland) to strengthen credibility.

Sequencing implementation over time also allows policies to remain adaptive as innovation makes new low-carbon technologies available throughout the transition, though often in non-linear and unpredictable patterns (OECD, 2025c).[18] Technological development typically unfolds in three interrelated phases (see Figure 3.9). The **emergence phase** is marked by high uncertainty and experimentation, where diverse technologies are developed in niche small markets. Public support is essential at this stage through investments in research, development, and demonstration (RD&D), targeted procurement, and early-stage subsidies. During the **diffusion phase**, promising technologies begin to scale up and compete with incumbent systems. Policy support should shift accordingly, focusing on infrastructure deployment, regulatory pressure on old technologies, and social support for affected communities, including worker reskilling. Finally, the **reconfiguration phase** involves broader institutional adaptation once new technologies dominate. At this point, governments must facilitate market reform, fully institutionalize new regulatory frameworks, and maintain social policies to manage distributional impacts.

Figure 3.9. Sequencing climate actions along the innovation cycle



Note: The curve depicts how the policy focus shifts for a given technology along the innovation cycle. In practice, governments deploy these packages in parallel across different technologies, alongside economy-wide policies (e.g., carbon pricing, performance standards) that apply at all stages.
Source: Authors

Sequencing is particularly critical because policy effectiveness depends not only on the tools selected within a package but also on when and in what order they are introduced. Using firm-level data from Ireland, Lenihan et al. (2024) demonstrate that firms respond more positively to receiving R&D grants followed by R&D tax credits, compared to the reverse order or either instrument in isolation. Evidence from Löfgren et al. (2021) on the Swedish basic materials industries suggests that introducing performance standards before a carbon price can

[18] See also 'How government actions have accelerated clean energy innovation: lessons for economic analysis and modeling by Ministries of Finance', contribution from the University of Wisconsin-Madison to the HP4 Compendium of Practice, and 'Policy packages for cost-effective transitions: learning from the past, simulating the future with the Future Technology Transformations models, and case studies from the Economics of Energy Innovation and System Transition project', contribution from S-Curve Economics to the HP4 Compendium of Practice.

reduce regulatory uncertainty surrounding carbon price levels and may allow higher carbon prices. Consistent with this logic, EPS simulations for the US indicate that such sequencing could yield substantial additional abatement—up to 300 million metric tons of carbon dioxide by 2035. An illustration of successful policy sequencing is the introduction of the Renewables Obligation and Feed-in Tariffs in 2002 and 2010, respectively, in the UK to support renewable electricity generation. These measures created a pipeline of projects, and once costs fell, the 2013 Carbon Price Floor locked in a firmer price signal—delivering one of Europe's fastest coal phase-outs.

Overall, the right sequencing of policy implementation is crucial to the success of climate packages. Traditionally neglected in theoretical frameworks and empirical models, the question of sequencing is now gaining rapid interest in policy forums and the literature. More analytical work is essential to understand how to best sequence climate action, particularly research on introducing policy sequencing into macro-energy-climate models.

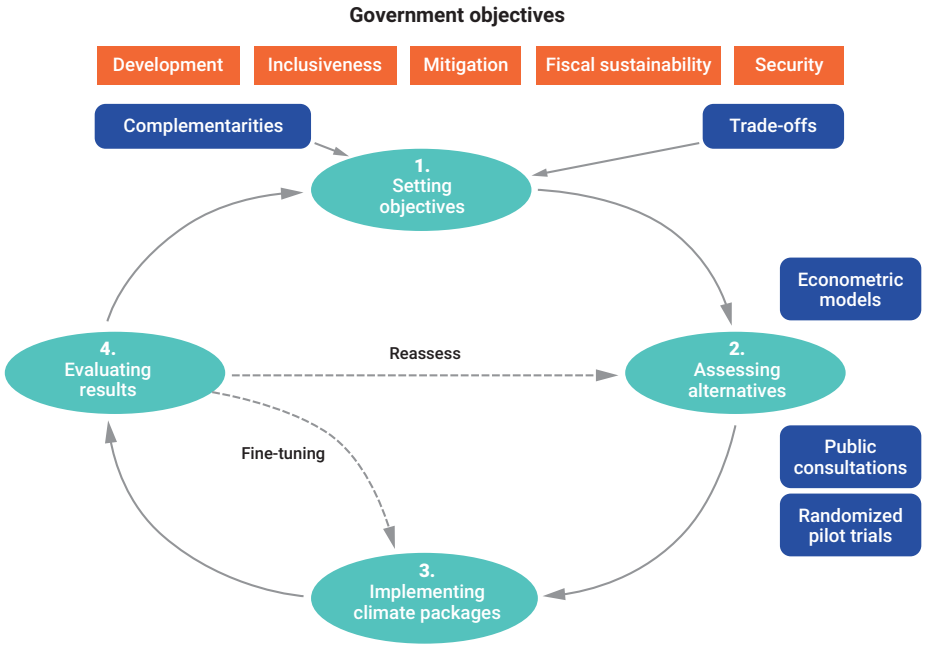
However, waiting for research findings should not be an excuse for inaction. As argued in the next section, governments should not hesitate to embrace ambitious climate action, even in the absence of perfect information, and suboptimal policies—or policy failures—can always be identified following ex-post evaluations, corrected, and implemented once again with better settings.

4. How to successfully design and implement climate packages

This section outlines how Ministries of Finance can actively foster the design and implementation of coherent climate packages through fiscal interventions. The previous section highlighted that countries employ a diversity of fiscal instruments and regulation to confront climate change, but there is uncertainty about how these policies interact. In this context of uncertainty, MoFs must closely monitor and frequently evaluate the impact of their interventions on energy use and carbon emissions. While running model simulations is promising, especially with linked models, it may not be feasible for all countries.

These knowledge gaps should not deter action. As already noted, inaction comes with high costs—especially for public finances, but also for the financial system—which are projected to be much higher than those induced by imperfect climate action. This section demonstrates a structured approach for progressing, even in the absence of models. Governments should not only consider alternative packages but also frequently evaluate their achievements, return to the drawing board, and redesign appropriately. This is the essence of the policy cycle of effective climate action we set out, which is also summarized in Figure 4.1. MoFs are at the core of this process.

Figure 4.1. The policy cycle of effective climate action



Source: Authors

Step 1: How to set objectives for climate packages

While acting to address climate challenges, including reducing the long-term costs of climate change, is increasingly considered a crucial policy objective, governments also strive to achieve many other important goals. They aim to make progress simultaneously with multiple objectives, such as adaptation to global warming, economic development, inclusiveness, and energy security. In addition, in many countries, governments

face high levels of public debt and limited fiscal space, making cost-efficiency also a crucial dimension. While there can be complementarities between these objectives, there can also be trade-offs.

Multiple objectives can be more effectively achieved with multiple policies. As recommended by the canonical Tinbergen rule (1952), there should be at least one policy instrument per policy objective. When designing climate packages, governments should consider the mix of instruments that will best reduce emissions, taking into account other objectives such as economic development, inclusiveness, and fiscal sustainability. By assessing how a combination of policies can help achieve multiple objectives simultaneously, governments can identify complementarities between tools and avoid conflicts. This approach can lead to progress on emission reduction, economic development, equity, fiscal sustainability, and energy security simultaneously. Clearly, achieving all these goals simultaneously is challenging. Seizing the complementarities and addressing the trade-offs is critical for that.

As a core actor in guiding the economy toward sustainable prosperity, MoFs in low- and middle-income economies seek to integrate development and climate objectives, rather than treating them as separate agendas. For example, action to promote renewable electricity can be accompanied by measures to enhance skills in the installation and maintenance of solar panels and wind turbines, as well as home retrofits. In low- and middle-income countries, governments can design policy packages that simultaneously advance growth, poverty reduction, and net zero pathways, thereby embedding climate objectives into a positive development strategy (Hallegatte et al., 2023). These packages include cross-sectoral policies that impact various aspects of economic performance—such as competitiveness, productivity, innovation, and inflation—together with social goals such as poverty reduction, income distribution, and inclusiveness—thus boosting the political acceptability of packages and making them more resilient. For instance, India has layered its climate action onto other vital priorities such as energy security, pollution control, and economic opportunities. Therefore, aligning climate objectives with broader macroeconomic and social co-benefits is crucial.

In middle- and high-income countries, climate packages are increasingly designed to catalyze net zero goals with innovation objectives. Together with carbon pricing, complementary policies such as targeted R&D support, tax incentives, and public investment can overcome initial barriers to the deployment of clean technologies, thus aligning innovation and decarbonization strategies (Aghion et al., 2025). By encouraging early adoption and facilitating "learning by doing," such packages accelerate the scaling up of new technologies and drive down their costs. This dynamic can lead to lower market prices for low-carbon solutions, making them more accessible to consumers and businesses alike.

Step 2: How to assess alternative climate policy packages using analytical tools

MoFs can benefit from strong analytical capacity to assess the fiscal impact of their climate actions. Various models can assist MoFs with this assessment. Global models, such as IAMs, help MoFs prepare for international debates and understand economic consequences; however, they are less useful for guidance on the domestic policy agenda. Microsimulation models assist in assessing distributional impacts, while input–output (IO) models and CGE models consider the relations of production between sectors. While all these models are informative for answering their specific questions, substantial modeling challenges remain, especially in the context of full decarbonization and the influence of innovation and modern technologies on that pathway. With global CGE models, policymakers can also investigate international policy spillovers and a wide range of economic outcomes of policy packages. Geographic Information System (GIS)-based models help identify geographic differences and the distributional impacts of climate change (CFMCA, 2025c; 2025d). Furthermore, ex-post (econometric) analysis has led to an improved understanding of the actual effect of policies and can be informative for future forecasting of energy and climate variables.

MoFs also need strong analytical capacity to assess the cost of inaction—including the cost of doing nothing. As an illustration, the IEA's World Energy Outlook annually examines the implications of (1) policies currently implemented (current policy scenario), (2) policies under development (stated policies scenario), (3) a net zero emissions by 2050 scenario consistent with the Paris Agreement, and (4) a scenario assuming accelerating clean cooking and electricity services. By examining the differential impacts of scenarios, analysts can get a sense of the cost of inaction. Although the IEA's models are largely focused on energy and climate impacts, inaction entails significant fiscal risks: without ambitious and sufficient mitigation, worsening climate trends would result in rising heat stress, higher mortality, lower productivity, and lost potential output, as well as extreme weather events such as typhoons that cause large-scale destruction of infrastructure and buildings (Costa et al., 2024; Costa and Hooley, 2025). MoFs need to estimate the cost of such disasters, revenue losses, increased public debt, and the impact on sovereign credit-ratings and the cost of borrowing. For example, the UK Office for Budget Responsibility (OBR) regularly examines the fiscal risks resulting from global inaction, taking into account a range of temperature rise assumptions and their physical effects. The latest OBR assessment concludes that public debt would increase by 74% of GDP compared to the OBR's baseline measure by the early 2070s in a scenario of 3°C global warming (OBR, 2025). This includes the direct costs of climate damages, indirect costs of damages on the economy, additional interest costs, and a limited amount of mitigation spending.

Ex-ante assessments can help with minimizing failures and mitigating unintended consequences. As an illustration, EU climate targets and policies were preceded by in-depth impact assessments comprising a broad range of industries, stakeholders, and jurisdictions. Significantly, the review by the EU's Regulatory Scrutiny Board (RSB) provided an independent analysis of impact assessments and policy evaluations. In Germany, the Climate Action Plan commissioned comprehensive ex-ante evaluations of the targets to assess their consistency and feasibility ahead of implementation. In South Africa, the government developed its own framework to calculate its "fair share" of emissions reductions for its Nationally Determined Contribution, representing an ex-ante quantitative exercise to support its negotiating position. In France, the government regularly employs ex-ante evaluations to guide strategic climate planning, notably through the National Low-Carbon Strategy (Stratégie nationale bas-carbone, SNBC) and the Multiannual Energy Programme (PPE), which serve to model carbon budgets and energy trajectories toward 2030 and 2050 before policies are enacted. In Australia, authoritative bodies such as the Climate Change Authority and the eminent Garnaut Review have conducted forward-looking assessments of mitigation scenarios, policy instruments, and economic implications—modeling feasible emissions pathways and cost impacts under different climate ambition settings well before political adoption. Ex-ante assessments should focus on a limited number of objectives—relevant for each country's specific context and development—in order to keep them tractable.

Large integrated macro-fiscal-energy-climate models can help assess the energy transformation strategies supported by comprehensive policy packages. A well-established practice is to use CGE models to simulate alternative policy scenarios and assess their impact on a set of sector variables (notably energy prices and carbon emissions) and macroeconomic indicators (such as GDP, inflation, employment, and fiscal positions). The most advanced models examine the impact of both pricing and non-pricing policies, though this is often limited to the power sector, such as in the phasing out of coal-fired plants. Sector-specific models with a granular description of the industry are better adapted to the analysis of specific non-pricing measures (such as tax credits for clean hydrogen), though they lack the capabilities to depict sectoral linkages and the macroeconomic impacts of industrial transformations. Some models cover tradeable sectors and investigate possible carbon leakage effects, but the transportation and buildings sectors are rarely covered. The fiscal aspects are often focused on carbon pricing receipts and subsidies, with limited treatment of overall budgetary impacts of policy packages. The most recent models also investigate the social dimension of the energy transition, including distributional impacts from policy interventions. For instance, the European Commission combines the output of its CGE model with detailed household microdata from the European Household Budget Survey (HBS), which helps to shed light on the distributional effects.[19] The OECD has also been engaged in a major push to use

[19] See 'Assessing the distributional consequences of the transition in the EU', contribution from the European Commission to the HP4 Compendium of Practice.

conceptual and quantitative models to guide policymaking in the climate space and is developing its macro-structural climate adaptation and mitigation framework, which will add to its existing analytical tools. This framework is a general equilibrium model designed for short- to medium-term macro-fiscal decision-making that supports modeling joint mitigation and adaptation choices, endogenous green innovation and investment choices, interactions among carbon pricing, subsidies, and regulatory measures, and growth, investment, and debt paths, providing information that can support MoFs in assembling coherent climate policy packages.[20] Apart from rare attempts, the treatment of social factors has typically been limited, impairing the accuracy of models when applied backwards and compared to the actual evolution of energy and economic systems (Fisch-Romito et al., 2025). Financial constraints and bankability challenges are also rarely addressed.

As an illustration, the macro-fiscal model MFMod built by the World Bank has been extended to create PakMoD, which includes parameters to study the impact of climate change in Pakistan (Burns et al., 2021).[21] This reaps "double dividends" in terms of not only providing projections for economic growth, inflation, fiscal sustainability, and other macro indicators, but also generates climate outcomes such as air pollution levels, carbon emissions produced, and their impact on labor productivity, health, and agricultural production. A significant aspect of this simulation exercise is the incorporation of the widespread informality prevalent in the financial sector of Pakistan.

However, such models also have their limitations and drawbacks. As noted in the previous section, particular policy interactions are likely to play out differently depending on the sector, country, or region in which they are implemented. As a result, climate packages that work well in one context may not in another. In addition, existing macroeconomic models are mostly designed to simulate the impact of carbon pricing, but they are less competent at simulating non-pricing measures and their interaction with pricing-based policies. Furthermore, the results of simulations are typically presented as deviations from a baseline or "business as usual" projection, rather than medium-term forecasts that project the actual levels of emissions and GDP. However, the baseline projection itself is important for policymakers who need to make decisions in terms of economic, fiscal, social, and environmental outcomes. The baseline scenarios produced by models are sometimes made available but, unfortunately, some of these models have a weak forecasting track record, which undermines their usefulness to guide policymaking. For example, the Global Energy and Climate Model of the IEA (2024a) has been repeatedly criticized for underestimating the sudden surge in renewable investments, notably because it has not foreseen the rapid rate at which renewable costs have declined (Schreiber, 2021). A good practice for all institutions would be to regularly review and evaluate their forecasts retrospectively, a common practice among macroeconomic forecasters. Also important to consider is that MoFs may struggle to use some of the very useful analytical tools that exist: a tool may not be open access, or it may require costly licensing or specialist software that a MoF may not have available, or MoF staff may not yet have the necessary skillset to use it effectively. Efforts in information sharing and making work open access can help overcome some of these barriers.[22]

Large models are useful for ex-ante simulations but less so for ex-post evaluations. Ex-post evaluations of climate policies increasingly draw on micro-level data and rigorous causal methods—such as randomized control trials (RCTs) and econometric assessments using administrative datasets—to go beyond scenario modeling and capture real-world impacts.[23] These methods enable policymakers to assess who is affected, by how much, and through which channels. For example, empirical research on the diffusion of low-carbon technologies and on energy-efficiency obligations (e.g., using micro-data on consumer appliances or patents) provides evidence that ex-post measurement can uncover misallocations, behavioral responses, and distributional consequences (e.g., Cohen, 2025). By linking detailed household-, firm-, or patent-level data with policy implementation timelines, policy analysts can determine not only the effectiveness of pricing (taxes, ETS) or non-pricing (regulations,

[20] See 'The new macro-structural climate adaptation and mitigation framework by the Economics Department of the OECD', contribution from the OECD to the HP4 Compendium of Practice.

[21] Also see 'MFMod-CC: country-specific macrostructural models', contribution from the World Bank to the HP4 Compendium of Practice.

[22] See the HP4 Capabilities Report for further discussion on how MoFs can build capabilities for economic analysis and modeling.

[23] See 'It takes two to tango: the role of Ministries of Finance in pricing and non-pricing policies for a low-carbon economy', contribution from the Council on Economic Policies to the HP4 Compendium of Practice, or Lenain (2024).

subsidies) instruments, but also their equity and cost-efficiency implications. As a result, MoFs and climate agencies obtain a richer, evidence-based foundation for fine-tuning instruments, ensuring that climate policy is not only ambitious but also socially just and economically robust. Research using microdata associated with RCTs and administrative data offers interesting perspectives for assessing the actual impact of climate policy packages, not just intentions.

While models bring useful insights, their limitations mean that further investigative methodologies also need to be adopted. Public consultation involving a broad range of stakeholders is a vital component in the formulation of climate packages, offering avenues for transparency, legitimacy, and the integration of diverse perspectives. For example, before implementing key provisions of the Inflation Reduction Act (IRA), U.S. federal agencies—primarily the Department of the Treasury, the Internal Revenue Service (IRS), and the Department of Energy (DOE)—conducted extensive public consultations to gather technical and stakeholder input. These included formal Requests for Comments (RFCs), roundtables, and public hearings aimed at refining guidance on tax credits such as 45Q (carbon capture), 45V (clean hydrogen), and 48C (advanced energy manufacturing). The IRS received over 560 public comments on clean hydrogen guidance alone (Notice 2022-58 and 2023-46), reflecting intense debate around the lifecycle emissions methodology and the "three pillars" (additionality, deliverability, temporal matching). For the clean vehicle tax credits under section 30D, the Treasury received more than 400 written submissions and conducted multiple stakeholder engagements. Similarly, for the 45X and 48C manufacturing incentives, the DOE's Office of Manufacturing and Energy Supply Chains (MESC) hosted workshops and received hundreds of industry comments during the implementation of Phase 1 of the 48C program. These consultations were critical to refining regulatory definitions, ensuring legal defensibility, and enhancing transparency in the rollout of the climate-related provisions authorized by the IRA.

This underscores the importance of an open dialogue with civil society. For an effective dialogue, it is essential to establish clear frameworks outlining how public input will be considered and integrated into policy decisions. Transparent communication about the scope and limitations of public consultation can manage expectations and maintain trust. Moreover, ensuring that citizen recommendations are feasible and aligned with broader policy objectives can facilitate their adoption and implementation. By addressing these considerations, public consultations can contribute meaningfully to the development of effective and publicly supported climate packages. The OECD, IMF, and World Bank, *inter alia*, recommend regular engagement with stakeholders as being fundamental for ensuring that diverse perspectives are considered and to enhance the legitimacy, predictability, and effectiveness of climate packages. Climate Change Councils are key stakeholders in climate policy because they are mandated to do original analysis, challenge government policy, and undertake ex-post reviews and evaluations. MoFs and other ministries are typically mandated to respond to their reports. These responsibilities make working with Climate Change Councils a key channel for collecting views from a diversity of stakeholders, obtaining independent and science-based analysis, and improving the design of policies.

Pilot experiments are a valuable tool for testing the effectiveness, feasibility, and acceptability of climate packages prior to broader implementation. MoFs are concerned about the value-for-money of public spending, including for subnational government spending. In the context of green urban environments, cities such as Barcelona and Milan have piloted "superblocks" and low-emission zones, respectively, to reclaim urban space from cars and reduce air pollution. These initiatives, implemented in select neighborhoods before wider roll-out, allowed city planners to assess impacts on emissions, mobility patterns, and public acceptance, leading to refined designs for future expansion. In another example, the city of Paris experimented with greening schoolyards to mitigate heat island effects and provide community green space, assessing ecological and social outcomes before city-wide adoption.

Step 3: How to ensure the effective implementation of packages

Effective implementation of climate policy packages necessitates predictability and credibility to guide investment decisions and foster public trust. Predictable policies provide clear signals to businesses and households, enabling them to make informed decisions regarding low-carbon investments and behavioral changes. Credibility, reinforced by consistent policy application and transparent communication, reduces uncertainty and enhances the effectiveness of climate initiatives. Regardless of the number and type of instruments within a package, the utmost importance should be given to ensuring long-term policy transparency and certainty. For this reason, policymakers should avoid instruments which postpone policy costs given the risk of diminishing support and should instead find the right balance in terms of current and future acceptability.

Monitoring the full implementation of climate packages is crucial for assessing progress and making necessary adjustments. This involves developing robust systems to track policy outcomes, financial flows, and emissions reductions. Such monitoring ensures accountability and facilitates the identification of areas requiring policy refinement or additional support.

MoFs play a pivotal role in this process of implementation by integrating climate objectives into national budgeting and fiscal planning. They are responsible for raising tax revenue, borrowing from bond markets, allocating resources effectively, coordinating with other ministries, and ensuring that climate packages are financially sustainable. Given their key responsibility is to ensure that the nation's budget is executed appropriately, MoFs play a crucial role in enabling other ministries—such as Ministries of Environment, Transport, and Energy—to deploy their own climate action. The Philippines and many other countries have adopted green tagging methodologies that increase transparency on the exact amounts of budgetary resources allocated for climate action. A step further is "green budgeting," as done in France, where Parliament is informed about the environmental and climate impact of the draft budget submitted for their approval, and subsequently informed about the execution of these actions. Furthermore, MoFs are instrumental in mobilizing international climate finance and ensuring its alignment with national priorities. They have a responsibility also to establish a stable macroeconomic framework that will attract climate-friendly private investment, such as foreign direct investment in the generation of renewable energy. Through all these actions, MoFs contribute to building resilient economies capable of making progress on a pathway toward low-carbon development.

Building consensus following an open dialogue with civil society and accepting amendments as a result of this dialogue appears to increase the likelihood of effective implementation. Denmark exemplifies how sustained political consensus, stakeholder engagement, and institutional accountability can facilitate the effective implementation of ambitious climate packages. The Danish Climate Act of 2020, which mandates a 70% reduction in greenhouse gas emissions by 2030 relative to 1990 levels, was enacted with broad parliamentary support, reflecting a national commitment to climate action. This consensus was further reinforced through the establishment of the Danish Council on Climate Change, an independent advisory body that monitors progress and provides policy recommendations, ensuring transparency and accountability in climate governance. A notable example of Denmark's inclusive approach is the 2023 plant-based food strategy, which garnered support from both environmental groups and the agricultural sector. By framing the transition to plant-based diets as a business opportunity rather than a restriction, the strategy avoided polarizing language and emphasized collaboration. This approach led to initiatives such as the world's first vegan chef degree and substantial investments in plant-based food development, demonstrating how consensus-building can drive innovative climate solutions. Denmark's experience underscores the importance of integrating diverse stakeholder perspectives, maintaining political unity, and establishing robust institutional frameworks to achieve and sustain ambitious climate objectives.

It is important to design resilient and adaptable climate strategies to avoid disruptive policy reversal or adjustments. Well-designed, stable, and credible policy, with a strong institutional framework and transparent review mechanisms, will allow climate packages to perform better in the face of potential changes in public

support, unforeseen events, and shifting political landscapes. Beyond strong initial support, institutional arrangements such as parliamentary agreements can help embed long-term commitments, even if they can be challenging and time-consuming to secure.

Step 4: How to evaluate the impact of climate packages

Policymakers typically need to optimize mitigation policies through regular adjustments. Effective policy design is often a process of trial and error, where governments introduce measures, monitor their impact, and refine them based on evidence. While ex-ante evaluations, using both models and expert judgment, are necessary, they cannot anticipate all the reactions of market participants. Ex-post evaluations play a crucial role in this iterative process, allowing policymakers to assess whether policies have achieved their intended goals. They are also crucial for identifying unintended consequences and determining necessary adjustments. The use of quasi-experimental methods—such as difference-in-differences analysis and modern causal inference methods—has been instrumental in estimating the actual effects of past policies, particularly when randomized trials are not feasible.

RCTs have increasingly been used to rigorously evaluate climate mitigation strategies. In India, an RCT conducted in the state of Gujarat tested the impact of emissions monitoring and third-party audits in polluting industries, finding that more credible monitoring significantly reduced emissions of particulate matter and sulfur dioxide.[24] In the US, researchers have used RCTs to examine the effectiveness of energy-efficiency information programs on household energy consumption, revealing heterogeneous treatment effects that helped refine policy targeting (Fowlie et al., 2018). These examples demonstrate that pilot experiments and RCTs can provide high-quality evidence to inform climate policy design, reduce implementation risks, and enhance cost-effectiveness—all dimensions of interest to MoFs.

By learning from past experience, MoFs can fine-tune their climate-related fiscal instruments, improve cost-effectiveness, and enhance policy coherence. They can also evaluate the economic impact of regulations introduced by other ministries, while drawing on evaluations done by others, such as a Ministry of Economic Development or a Productivity Commission. For instance, the assessment of past environmental policies has revealed that some regulations led to excessive compliance costs without significantly reducing emissions, highlighting the need for better-targeted interventions. Another example relates to ex-post assessments that have helped to understand that policy interventions, such as tax credits or subsidies supporting the purchase of EVs, tend to benefit high-income households who would have bought the vehicle even in the absence of fiscal incentives. Additionally, stakeholder consultations and participatory evaluation methods allow policymakers to incorporate real-world feedback from businesses and consumers, ensuring that policies remain practical and socially acceptable. Ultimately, a structured and evidence-based evaluation process ensures that climate policies evolve over time to become more effective and equitable.

[24] See 'How Ministries of Finance and economic decision-makers can use ex-post pilot assessments to inform climate policy: designing, testing, and scaling emissions markets in India', contribution from the Abdul Latif Jameel Poverty Action Lab (J-PAL) at the Massachusetts Institute of Technology to the HP4 Compendium of Practice.

5. Conclusion

The success of the low-carbon transition will depend less on isolated climate measures than on the ability of governments to design and sustain coherent policy packages that align fiscal, energy, and industrial objectives. This report has shown that Ministries of Finance occupy a central position in that effort. They have a high degree of control of crucial policy tools such as budgeting, taxation, investment, and macroeconomic stability—and thus determine whether climate ambition is translated into durable implementation. The challenge is not to add one more policy to an already crowded landscape, but to sequence and integrate instruments so that pricing, public investment, and regulation reinforce each other rather than work at cross-purposes.

A well-designed, well-sequenced, and well-coordinated climate policy package can deliver multiple dividends: it accelerates decarbonization, strengthens energy security, and supports productivity and innovation. Yet it also involves trade-offs. Carbon pricing alone cannot deliver just outcomes without parallel investments in clean infrastructure, retraining, and targeted transfers. Non-pricing measures, for their part, risk inefficiency and fiscal drift unless anchored in sound budget processes and measurable performance frameworks. The MoFs' role is therefore not simply to fund climate policies but to govern their coherence—ensuring that public spending, tax incentives, and regulatory commitments operate within a sustainable fiscal envelope and are consistent with medium-term debt and growth objectives.

Embedding climate objectives into fiscal planning also strengthens policy credibility. Multi-year expenditure frameworks, green budgeting, and climate-related fiscal risk assessments can align national budgets with emission pathways and adaptation needs. This integration makes the energy transition more predictable for private investors, encouraging capital reallocation toward low-carbon assets and innovation. International experience—from Northern Europe's energy tax reforms to emerging-market green bond frameworks—confirms that strong design is the foundation of credible climate policy. As fiscal space tightens, the imperative is to prioritize instruments that deliver the highest emissions reductions per euro spent, minimize regressive impacts, and catalyze private finance.

The coming decade will be decisive: the window to combine fiscal consolidation with a low-carbon transformation is narrowing. MoFs must therefore evolve from passive funders of environmental programs into active stewards of climate–economic strategy—integrating mitigation, adaptation, and growth agendas into one coherent fiscal framework. Ultimately, the transition to a sustainable economy is both an environmental and a fiscal reform project. Success will depend on the ability of MoFs to design consistent, evidence-based packages that are socially acceptable, fiscally viable, and resilient to political and economic shocks.

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Appendices

Appendix 1: Inventories of climate action

Inventories can play a key role in the analysis of climate policy packages, specifically when assessing non-pricing instruments. And indeed, governments' growing interest in non-pricing forms of climate action has led several organizations to create inventories of such measures, with the objective of spreading information on good practice and monitoring policy development around the world. Governments would benefit from building and assessing their own inventories of existing and potential policies. They can also draw from international inventories that showcase potential policies, some examples of which are listed here.

The **IEA State of Energy Policy** provides a comprehensive up-to-date review of energy policies by country and sector (IEA, 2024b). It covers over 50 policy types across more than 60 countries, and, in total, catalogues over 5,000 energy-related policies in areas such as government spending, regulation, and trade policies. The IEA covers both pricing and non-pricing actions, but only around energy policy and thus does not include other sources of emissions such as industrial processes, agriculture, and land use. It is based on the IEA's Global Energy Policies Hub, compiled regularly with the help of government officials and international experts. The IEA intends to publish the report every year and expand the range of policies covered. The inventory includes (i) regulations such as minimum energy performance standards as well as phase-out mandates, (ii) government spending in the energy sector covering clean energy investment support and consumer energy affordability measures, (iii) international commitments and climate pledges such as net zero pledges and announcements of Nationally Determined Contributions, and (iv) trade policy decisions that impact clean energy technologies and commodities. For example, in the electricity sector, the IEA monitors non-pricing actions such as financial incentives (feed-in tariffs, renewable auctions, and tax credits) and other regulatory measures (energy certificates, power purchase agreements, and emission standards).

The **OECD Environmental Policy Stringency (EPS)** index is "an internationally comparable composite index of different environmental policy instruments, focussing primarily on climate change and air pollution policies" (Frohm et al., 2023; see also Kruse et al., 2022). It keeps track of 13 policy instruments grouped into market-based policies, non-market-based instruments, and technology support measures. The EPS index covers policies such as carbon taxes, carbon markets, renewable energy certificates, diesel fuel excise duties, emission limit standards, green R&D fiscal support, feed-in tariffs, and renewable energy auctions. The information is organized to identify the stringency of these policies, which is defined as their capacity to deter environmental damages. For this purpose, policies measured in different units—e.g., US$/tCO$_2$ for carbon taxes and US$/kWh for feed-in tariffs—are converted into scores ranging from zero to six and then aggregated into the composite EPS index. The results are made available and discussed in the framework of OECD committees, including the Economic Policy Committee (EPC) and its Working Party 1, where delegates from MoFs of member countries and key partner countries can exchange views and share information on good practices.

The **OECD Climate Actions and Policies Measurement Framework (CAPMF)** is an inventory of 130 policy variables, grouped into 56 key climate actions and policies for the period 1990–2023, covering 50 OECD and OECD partner countries as well as the EU (Nachtigall et al., 2024). It aims at supporting the efforts made by governments to implement their Nationally Determined Contributions and advancing on paths of deep decarbonization toward carbon neutrality by mid-century. The range of mitigation policies covered is coherent with the United Nations Framework Convention on Climate Change and Intergovernmental Panel on Climate Change, making it a useful instrument in intergovernmental discussions. To build its database of CAPMF policies, the OECD interacts closely with experts in national governments, in the framework of OECD committees and

its dedicated climate action program (the International Programme for Action on Climate, IPAC). In addition to policies putting a price on air emissions, it covers a wide range of regulatory tools (e.g., emission limits, bans, mandates), it takes account of green R&D public expenditure, and it keeps track of international actions such as participation in international climate treaties and climate data reporting.

The **Climate Policy Database** is compiled and made publicly available by the Inclusive Forum on Carbon Mitigation Approaches (IFCMA). It covers 38 countries and around 1,600 climate change mitigation policy instruments. The database offers granular insights across the full range of policies adopted by countries, including information on subsidies, taxes, emissions trading systems, technology and performance standards, as well as framework regulations and labeling schemes.

Appendix 2: How to measure the stringency of carbon pricing

The academic literature has traditionally put strong emphasis on carbon pricing as a cost-effective approach to reducing emissions and mitigating the effects of global warming. This emphasis has also been reflected in the recommendations formulated by international organizations. Notwithstanding the increasing shift highlighted in this report toward multifaceted policy packages, it remains essential for MoFs to measure the level of pricing put on emissions and benchmark themselves against other countries. Although carbon pricing is a simple concept—a fee to be paid by emitters on the volume of their emissions—measuring it is not straightforward.

Several international organizations have formulated carbon pricing methodologies. The **World Bank's Carbon Pricing Dashboard** covers only carbon taxes and ETS permit prices. So far it has been implemented across 89 jurisdictions, 50 of which are at the national level. The World Bank's **total carbon price (TCP)**, elaborated on in Agnolucci et al. (2024b), covers 142 countries for the 30-year period from 1991 to 2021. The methodology adopted by the OECD for its **Net Effective Carbon Rate (NECR)** is summarized below (OECD, 2024c). A taskforce led by the WTO (WTO et al., 2024) has proposed unifying data collection and focusing on the commonalities across existing metrics, while recognizing the need for flexibility and pragmatism.

OECD Net Effective Carbon Rate (NECR)

1. **Carbon taxes.** Defined as all taxes for which the rate is explicitly linked to the carbon content of the fuel or where the tax is levied directly on greenhouse gas emissions. The tax is commonly expressed in monetary units per ton of carbon dioxide equivalent. Data following this methodology are compiled by the OECD and the World Bank.
2. **Carbon market price.** Defined by the OECD (2024c) as "[t]he price of tradable emission permits in mandatory emissions trading and cap-and-trade systems, representing the opportunity cost of emitting an extra unit of CO_2e., regardless of the permit allocation method." This data is available both from the OECD and the World Bank, which counts 36 countries as having established an ETS.
3. **Fuel excise taxes.** These are not carbon taxes because their rate is not explicitly linked to the carbon content of the fuel. Most countries in the world and some subnational jurisdictions levy such excise taxes, notably on diesel and gasoline (petrol). Not all economists consider them as carbon pricing because of the non-climate externalities that they seek to address (traffic congestion, noise, health), but others argue that they should be because they send a price signal that ultimately reduces emissions. The OECD maintains several databases of these excise taxes. VAT on energy is not included because it applies to all goods and services and not just energy.
4. **Fossil fuel subsidies.** Budgetary transfers and tax expenditures that decrease pre-tax prices for domestic fossil fuel use, such as in countries that regulate the price of fossil fuels below supply costs and then compensate fuel suppliers for the resulting losses—e.g., LNG in Mexico.

Bringing these four concepts together (1. + 2. + 3. − 4.), the NECR measures the taxation of energy net of fossil fuel subsidies and expresses it in terms of carbon dioxide equivalent content. The indicator is available over time,

enabling MoFs to analyze whether their carbon pricing is becoming more stringent, while observations across countries help to compare their stance internationally. The OECD indicator is also available across sectors and by types of fuels, helping government officials to get a detailed view of what can be done to send stronger carbon price signals. In compiling this indicator, the OECD uses a "bottom-up approach" that involves collecting an inventory of statutory energy tax rates from official documents in each country and applying it to the volume of energy consumed and carbon dioxide emitted. The upside of this approach is that MoFs can directly identify the tax instrument that they deploy in the calculation of carbon rates.

Appendix 3: How green finance can contribute to climate packages

Comprehensive climate packages increasingly employ green finance, climate finance, and green monetary policy instruments, as a complement to other tools. While carbon pricing internalizes environmental costs, green finance mobilizes capital for sustainable investments and green monetary policy can steer financial flows toward low-carbon sectors. Examples of interventions include:

- **Green bonds:** Debt securities issued to fund environmentally beneficial projects, such as renewable energy and energy-efficiency initiatives.
- **Sustainability-linked bonds (SLBs):** Bonds with financial terms tied to the issuer's achievement of predefined sustainability performance targets. Unlike green bonds, the proceeds from SLBs can be used for general purposes. For example, the Philippines has established clear standards for the issue of SLBs with the Securities and Exchange Commission (SEC) providing frameworks for transparency and credibility.
- **Green venture capital:** Equity investments in startups developing environmentally friendly technologies or services.
- **Green grants:** Non-repayable funds provided to support projects contributing to environmental sustainability.
- **Green quantitative easing:** Central bank purchases of green bonds to inject liquidity into environmentally beneficial sectors.
- **Green lending facilities:** Provision of low-interest loans by central banks to financial institutions and from SOEs to other companies for onward lending to green projects.
- **Green collateral frameworks:** Adjusting collateral eligibility criteria to favor green assets in central bank operations.
- **Green reserve requirements:** Mandating banks to hold a certain proportion of reserves in green assets.
- **Bilateral and multilateral climate finance:** Financial support provided by developed countries to developing nations for climate action.
- **Green sukuk:** Islamic financial certificates issued to fund environmentally sustainable projects, exemplified by Indonesia's MoF.

These green finance interventions may interact with other tools and potentially reinforce them. For instance, France's MoF not only implements carbon taxes but also issues sovereign green bonds to fund energy-efficient infrastructure. Similarly, Chile's climate finance strategy integrates carbon taxation with green bond issuance to support mitigation projects, demonstrating a cohesive approach to climate policy. MoFs need to play a pivotal role in coordinating these instruments to ensure policy coherence and economic efficiency. In Indonesia, the MoF oversees a carbon pricing roadmap while issuing green sukuk to finance renewable energy and climate-resilient infrastructure, illustrating the integration of fiscal and financial strategies. By actively engaging with green finance and monetary policy tools, MoFs can effectively drive the transition to a low-carbon economy, ensuring that environmental objectives are met alongside economic development.

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