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Non-Price Policies for Addressing Climate Change

The Global Experience

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Designed by Mukesh Rawat

Non-Price Policies for Addressing Climate Change:

The Global Experience

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Abstract

This paper analyses the non-price policy measures that aim to lower carbon emissions across the G20 countries. A comprehensive range of non-price policies is mapped across sectors, objectives, and targets, uncovering substantial heterogeneities and complexities. The paper underlines the difficulties in assessing effectiveness and comparability of non-pricing mechanisms vis-à-vis explicit ones such as carbon taxes. A cross-country assessment of sequencing and stringency patterns, along with the impact of and experiences with non-pricing policies, is also undertaken. The findings point to critical gaps and a lack of rich data and hard evidence on non-pricing policies. This impedes evaluations of their effectiveness in reducing emissions. We conclude that a balance of price and non-price measures might be the most suitable for global coordination of climate action.

Abbreviations

AFOLU	Agriculture, forestry, and other land use
AEs	Advanced economies
BECCS	Bioenergy with carbon capture and storage
CAPMF	Climate actions and policies measurement framework
CCS	Carbon capture and storage
DACCS	Direct air capture with carbon storage
ECPE	Economy-wide carbon price equivalent
ECR	Effective Carbon Rates
EMDE	Emerging market and developing economy
ETS	Emissions trading scheme
EV	Electric vehicle
ESG	Environment, social, and governance
EU	European Union
GHG	Greenhouse gas
IMF	International Monetary Fund
MRV	Measuring, reporting, and verifying
NDCs	Nationally determined contributions
OECD	Organisation for Economic Co-operation and Development

1. Introduction

Climate policies have acquired fresh urgency with the change in the nature of the global debate on climate change after the pandemic. A spate of net-zero emissions pledges by more than 130 countries, including the world's top emitters, indicates accelerating actions to achieve these targets. As result, the spotlight is on the right type and mix of policies that can reconcile the manifold complexities and trade-offs facing countries as they shift to a low-carbon future. The search is on for a suitable blend of policy instruments that can balance competing objectives, i.e., those that are economically efficient, effective, socio-politically acceptable, and inclusive. Whether market-based or otherwise, the adopted mechanisms to reduce emissions constitute the environment for potential investment opportunities and risk appraisals. Investors also seek certainty and assurance about committing capital to sustainable projects, which must also fetch decent returns. In this context, enabling policies that generate market signals and expectations for the future can facilitate investments in low-carbon alternatives if strong price incentives are created to reduce emissions from targeted activities.

Against this backdrop, the G20 members, who have almost all pledged net-zero emissions over varying timespans, are keenly examining the policy preferences, sequencing patterns, and models employed by countries. The objective here is to secure sustainable investments for the low-carbon transition, the bulk of which will have to come from the private sector. The pressure to scale up actions for implementing the net-zero emissions promises is high. Yet, elevated public debts and deficits after the pandemic have limited the resources available for public spending on green investments. Incentivising the participation of private capital in sustainable projects and supporting the low-carbon transition with a consideration of the circumstances in individual countries is an important matter for the G20's deliberation. The focus is on the facilitating role of public policy levers in achieving these objectives.

The main division between pricing and non-pricing mechanisms is in the fact that the former alludes to carbon pricing. Pricing measures encompass emissions trading system (ETS), carbon taxes, and carbon crediting mechanisms, which directly put a price in proportion to the carbon content. In an ETS, emissions from covered entities are restricted by the issuance of tradable emissions units, which entities can utilise to meet their compliance obligations. In contrast, a carbon tax is a fee on the emissions generated or embodied in a specific amount of fuel. Lastly, a carbon crediting mechanism generates tradable certificates that represent the emissions reductions achieved.

Non-pricing instruments, on the other hand, check the use and efficiency of products and services that cause emissions without assigning prices. These are wide-ranging and extend from sectoral policies and regulations, including subsidies for green projects, financial incentives, emissions disclosures, norms, standards, quotas, and more. However, the evidence on their cost-effectiveness in lowering emissions is formative and unsettled; at best, it is mixed.[1]

There is considerable support for complementarity[2] between pricing and non-pricing tools for lowering emissions (or, more broadly, greenhouse gases [GHGs]), and in assisting private enterprise and capital. The report of the *High-Level Commission on Carbon Prices* (Stiglitz et al., 2017) also acknowledges that to attain the Paris target (i.e., restrict the rise in global temperature to below 2°C) carbon pricing alone will lead to unacceptable costs and distributional impacts, thus requiring complementarity with non-pricing measures.

[1] Carbon pricing through taxation and ETS is argued to be economically efficient and a cost-effective instrument for reducing emissions, incentivising the shift to cleaner energies, and encouraging greater decarbonisation efforts (ADB 2021, 2022; Parry et al., 2021, 2022; Dominioni, 2022; Mideksa, 2021; de Mooij et al., 2012). Also see UNFCC (2020). A meta-analysis of studies on carbon policies in the EU finds a limited impact of carbon pricing on emissions (Green, 2021).

[2] Substantial literature indicates complementarity between pricing and non-pricing instruments (e.g., IPCC, 2022; Stiglitz, 2019; Stiglitz et al.,2017; Van den Bergh et al.,2021; Peñasco et al., 2021; Bertram et al., 2015).

This points to a need for better understanding of the relative impacts of pricing and non-pricing tools, and possibilities for blending the two in alignment with country-specific contexts and requirements. The lack of standard methodologies or frameworks for assessing the impact of non-pricing tools has posed a challenge—the combinations of price- and non-price-based tools for controlling GHG emissions are complex and mostly a function of different mix of economic activities and structures. In the past, the *Forum on International Policy Levers for Sustainable Investment* (June 13, 2022, Indonesia)[3] have focused on these issues, specifically underlining the need for enhanced insights. Members noted the essential role of non-pricing tools in reducing emissions, even as they concurred that carbon pricing mechanisms were important. Comparing the effectiveness of pricing and non-pricing instruments was regarded necessary to examine in this light, in addition to considering the evolving methodologies to identify relevant metrics that could serve as inputs for macro-economic models.

While the choice of tools and pathways adopted is eventually unique and country-specific, there is enormous scope to learn from cross-country experiences. Lessons may be learnt from the design and implementation of non-pricing measures, the challenges faced while crafting policy mixes, and the management of the combinations with pricing tools which can offer crucial insights to G20 members, both in individual capacities and in instances where joint action towards a coordinated investment drive is contemplated or may be desirable.

Against this backdrop, this paper discusses the international experience with countries adopting non-price policy measures to switch to a low-carbon economy. It is organised as follows. Section 2 sets out the exhaustive array of non-pricing methods, adopted by the G20 countries, broadly classified according to sectors and objectives. Section 3 details sequencing and stringency patterns, experiences with implementation, and the impacts, where available; it also specifies important information gaps. Section 4 argues for a balanced approach between pricing and non-pricing measures. Section 5 concludes the paper.

2. Climate policy in the G20 countries

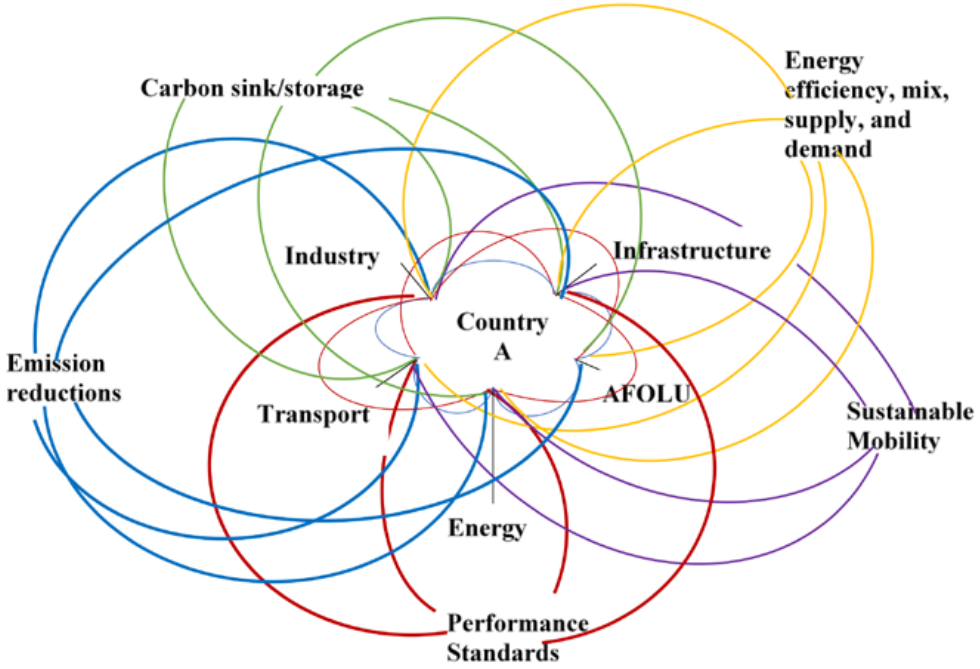
All G20 members have adopted a broad and diverse set of policy instruments to mitigate the impact of climate change and to strengthen resilience. There are pricing measures, such as carbon taxes and ETSs, combined with numerous non-pricing instruments. Because of the multiple objectives these seek to achieve, the overlap across sectors is extensive. Figure 1 points out how these policies may interact in complex ways.

Price-based instruments (implicit carbon pricing), such as grants and subsidies, are commonly employed in various sectors as incentives to reduce emissions, promote energy-switching and efficiency, and encourage sustainable mobility. Non-price-based tools include standards and norms relating to technology, performance, and disclosures, amongst others. In general, these constitute a complementary strategy for climate mitigation in all countries.

An attempt is made here to compile the many types of non-pricing measures used to check carbon or, more broadly, GHG emissions, across countries. The list is not definitive but is sufficiently comprehensive to underscore the wide prevalence of non-pricing measures across different sectors, the typical attributes, and different reasons for which they are deployed worldwide. This compilation exercise also demonstrates the difficulties associated with measuring or quantifying the impact of non-pricing measures on containing emissions, and how these compare with explicit and implicit carbon pricing tools.

[3] Excerpts from the G20 Indonesia 2022 Presidency Summary (G20 Indonesia, 2022).

Figure 1. Non-pricing policy levers form a complex network across sectors and purposes



Source: Authors' analysis.

Note: AFOLU- agriculture, forest, and other land use.

The following sub-sections classify and describe such tools across sectors, the policy mix of pricing and non-pricing mechanisms, and a brief country-wise profiling.

2.1 Non-Pricing Levers Across Sectors

Panel 1 displays the distribution of the diverse range of climate-related non-price-based policies across different sectors in the G20 countries. It reveals the dominance of overarching non-pricing levers, such as setting GHG reduction targets, and support for research and development (R&D) for low-carbon activities in the hierarchy of preferences across the board (Panel 1, Chart 1.1). Most countries (80%) employ these tools across various sectors. Indeed, these tools feature as part of a primary climate strategy in 15 countries. Above three-fourths of the member countries support R&D for low-emission or emissions reduction technologies through funding, action plans, and other non-price measures. All countries have prioritised emissions reductions and energy efficiency improvements across power, industry, buildings, transport, and agriculture & forestry sectors. However, these are not the only non-price instruments employed - supplementary, price-based, and other mechanisms are commonly observed as well.

A brief elaboration of the sector-specific non-pricing levers in existence is given below.

Electricity and heat. This segment is characterised by renewable energy targets playing a leading role, often supplemented by fuel taxes. The sector has the most diverse set of non-price tools in use, with matching expansion in coverage. This is understandable as energy serves as the key input for all users, producers, or consumers in any economy. Four-fifths of the countries have support mechanisms for non-renewable or low-carbon alternatives (such as nuclear and hydrogen-based technologies), which may combine pricing and non-pricing tools; incentive schemes to increase the share of renewables, facilitate grid integration, and direct public investments; and policies for energy-efficient power plant stock ahead of the phase-out of inefficient power plants. A smaller number (14 countries) use renewable energy targets for electricity, or have undertaken grid infrastructure development, instituted electricity storage policies for developing grids and storage, and allow for

the installation of renewable electricity such as solar PV and wind in the system. Finally, only three countries (Canada, the European Union [EU], and Russia) have introduced phase-out plans for coal and oil in this sector (Panel 1, Chart 1.2).

Industry. The key mechanisms employed for industrial decarbonisation are again a mix of pricing and non-pricing instruments. Other than emissions reduction targets, one set of measures relates to incentives for lowering specific gases (Panel 1, Chart 1.3), coupled with technology support to develop alternate options for carbon dioxide removal (for example, bioenergy with carbon capture and storage [BECCS], direct air capture with carbon storage [DACCS], amongst others). To improve the energy efficiency of industrial output, non-pricing tools such as energy reporting, audits, and other support systems for carbon capture and storage (CCS), fuel switches, reduction of CH_4, N_2O, and other fluorinated gases have been adopted by 80% of the countries. Three-fourths have instituted performance and equipment standards, combined with schemes for renewables that encourage or impose the usage of renewables.

Buildings. The major non-pricing instruments to reduce carbon emissions in the building sector are standards, codes, materials, and energy-efficiency requirements. These are usually combined with price-based measures such as energy taxes. Sixteen countries have also set performance and equipment standards to improve the energy efficiency of appliances, with building codes and mandatory certification requirements to lower emissions from construction activities (Panel 1, Chart 1.4).

Transport. Countries have mostly employed taxes to contain transport-related emissions, with four-fifths taxing fuels. Non-price mechanisms relate to emissions and efficiency norms for vehicles, and performance standards for carbon emissions. Nearly three-fourths of the G20 countries have instituted emissions standards for vehicles, often combining them with supportive policies such as investments in public transport, incentives for the use of electric vehicles (EVs) for light-duty transportation, and the switch to low-emission mobility modes, including the use of biofuels (Panel 1, Chart 1.5).

Agriculture and forestry sector. This sector is observed facing typical climate policy tools, such as relevant laws, standards, incentives, and requisite support for sustainable farming and forestry practices. The Non-pricing instruments concentrate on reducing deforestation, enhancing reforestation efforts, and implementing afforestation activities. The measures are distinguished by their incentives in three-fourths of the countries, with a few more (80%) setting standards for sustainable products and production (Panel 1, Chart 1.6).

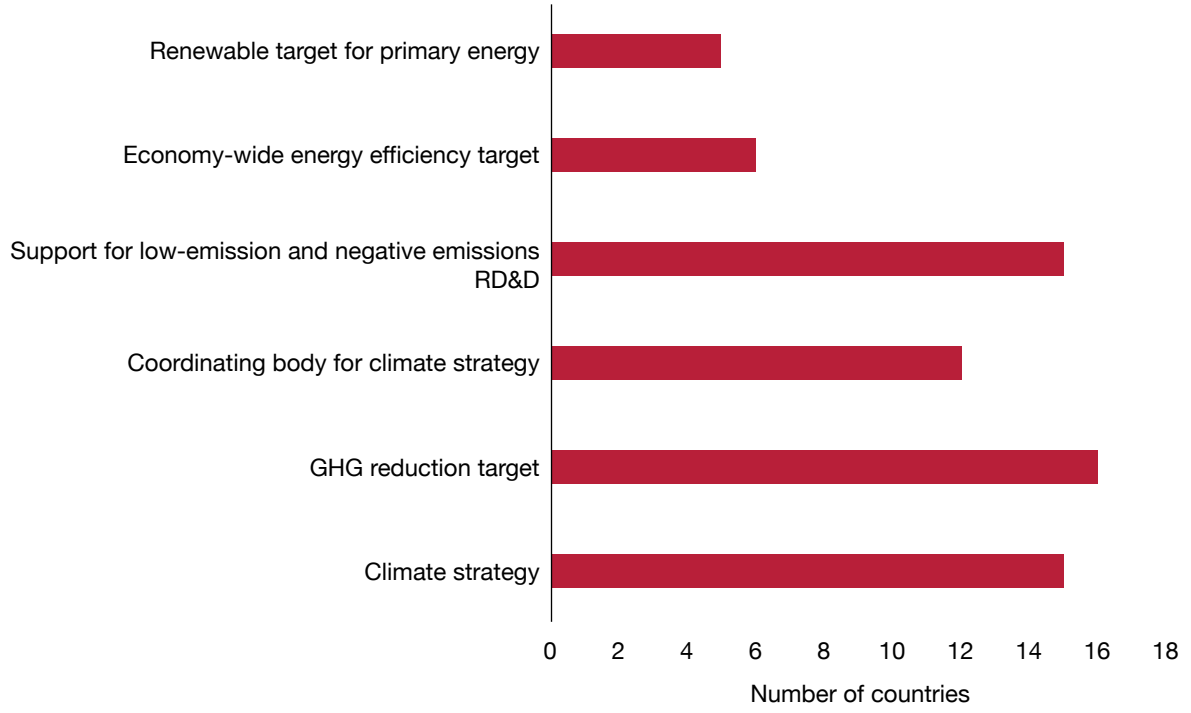
The need to incentivise larger funding flows into green and climate-friendly activities, and to limit environmental risks as part of climate mitigation strategies and financial disclosures through regulatory measures in the financial sector, has gained primacy in recent years. In 2017, the Financial Stability Board's Task Force on Climate-Related Financial Disclosures recommended a standardised framework to align multiple regulatory frameworks across countries. The International Sustainability Standards Board (2022) is currently deliberating upon these issues. All G20 members have introduced environment, social, and governance (ESG) reporting and disclosure norms.[4]

[4] For instance, the UK Financial Conduct Authority (2020) rules; the Companies Regulations (2022) under the Companies Act (2006); and the Limited Liability Partnerships Regulations (2022) require climate-related disclosures with compliance or explanations based on recommendations of the task force on such disclosures. The US also issued an executive order in 2021, on the coverage of climate-related financial risk by financial regulators, public procurement, public financial management, and budgeting processes. The EU Sustainable Finance Disclosures Regulations (2022) set technical standards for financial market participants regarding information disclosures. China also passed regulations in 2021 to standardise its processes for the legal disclosure of corporate environmental information. India introduced the National Voluntary Guidelines (NVG) (2011) on social, environmental and economic responsibilities of businesses, for adoption by the listed Indian companies, including banks. This was followed by several refinements of various elements of ESG-related disclosures by the Securities and Exchange Board of India (SEBI), to expand the coverage and scope of climate-related financial disclosures.

Panel 1. Non-pricing tools across sectors in G20 countries

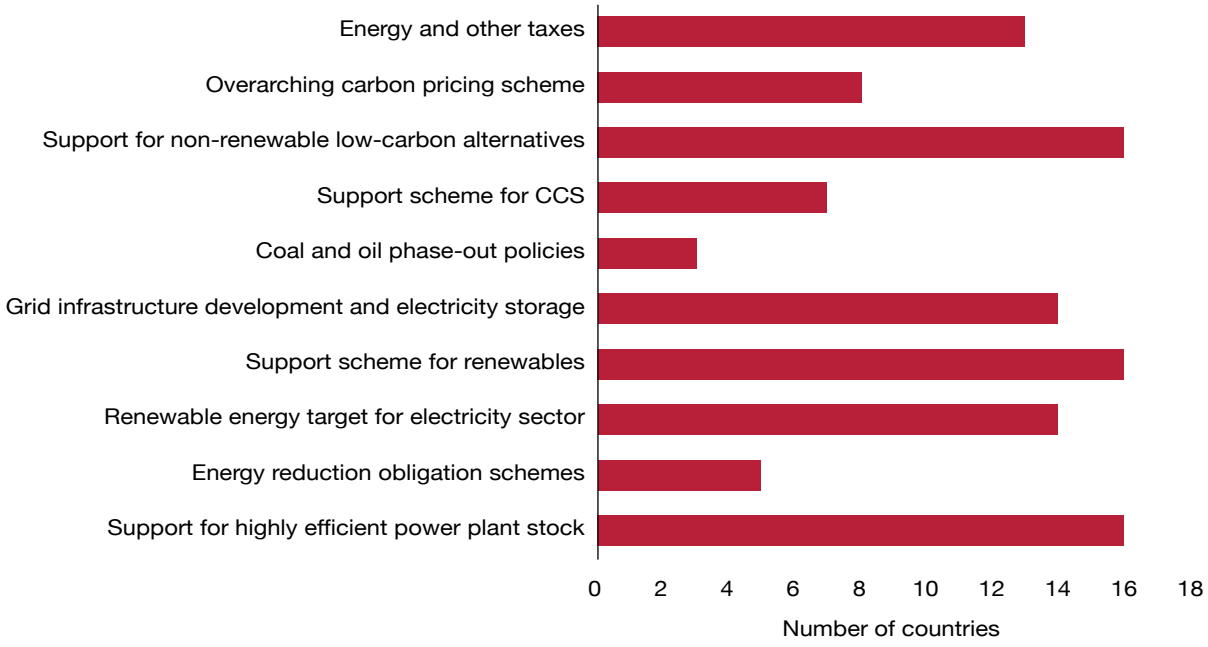
GHG reduction targets, R&D support dominates overall[5]

Chart 1.1. General policies with multisector coverage



Targets, taxes, other support for green energies lead electricity sector

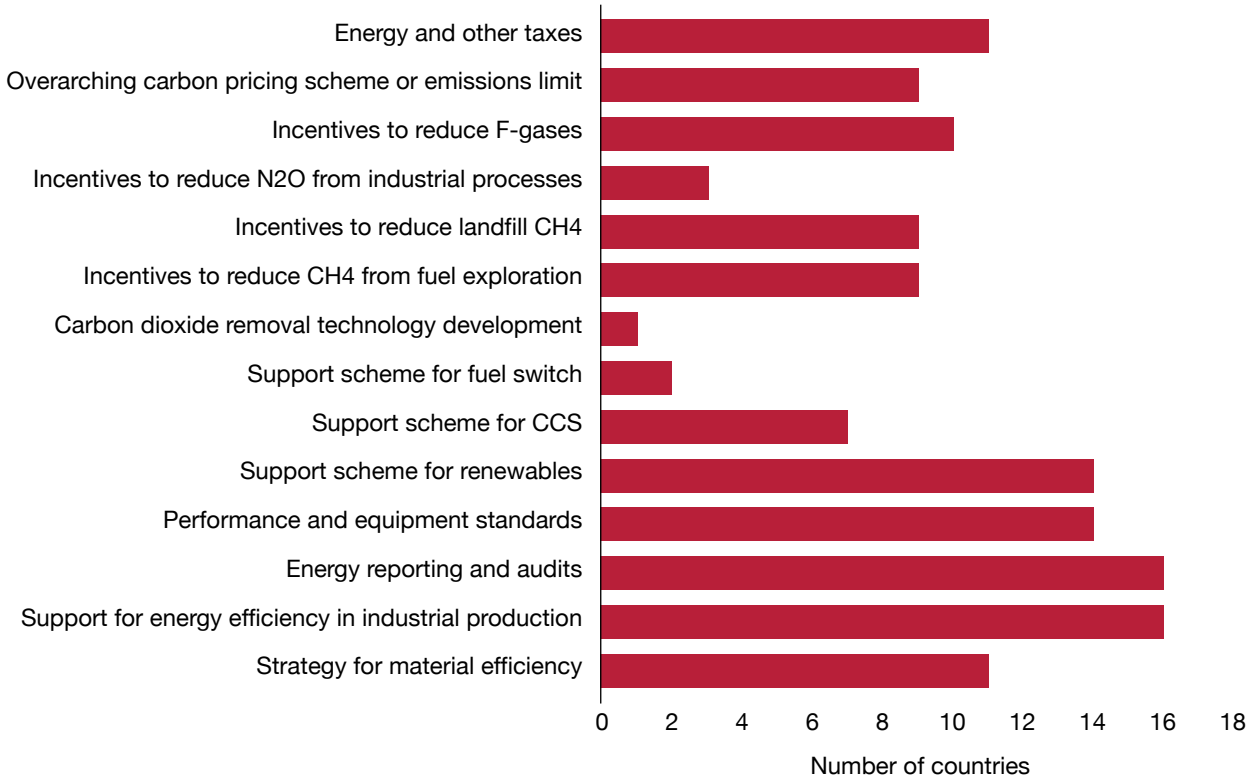
Chart 1.2. Policies for electricity and heat sector



[5] See the Appendix for a description of the database.

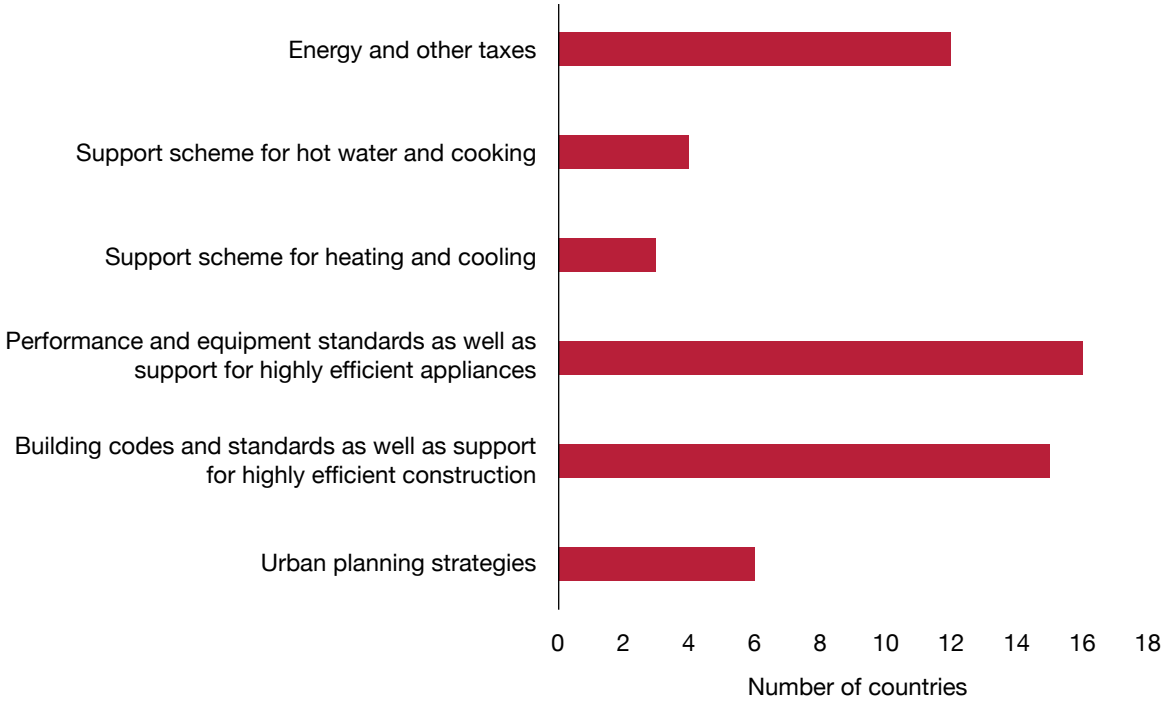
Pricing, taxes, financial incentives, and technology support: key mechanisms for industrial decarbonisation

Chart 1.3. Policies for industry sector



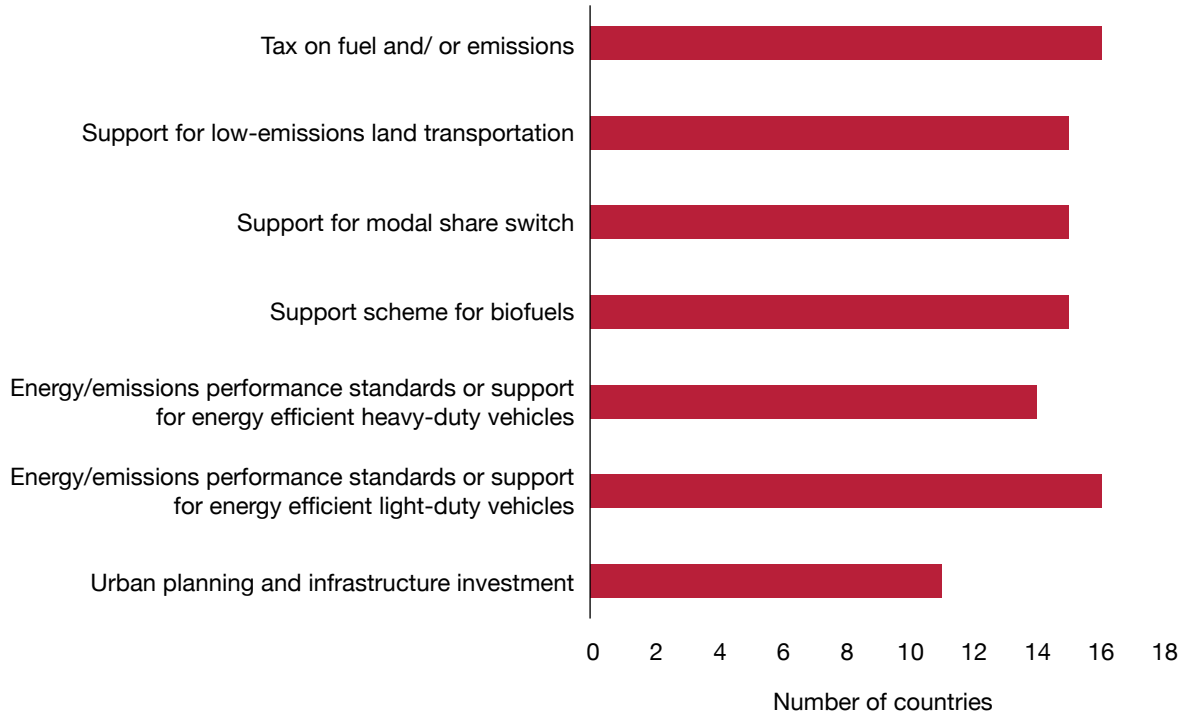
Standards, codes, materials, and energy efficiency to lower building sector emissions

Chart 1.4. Policies for buildings sector



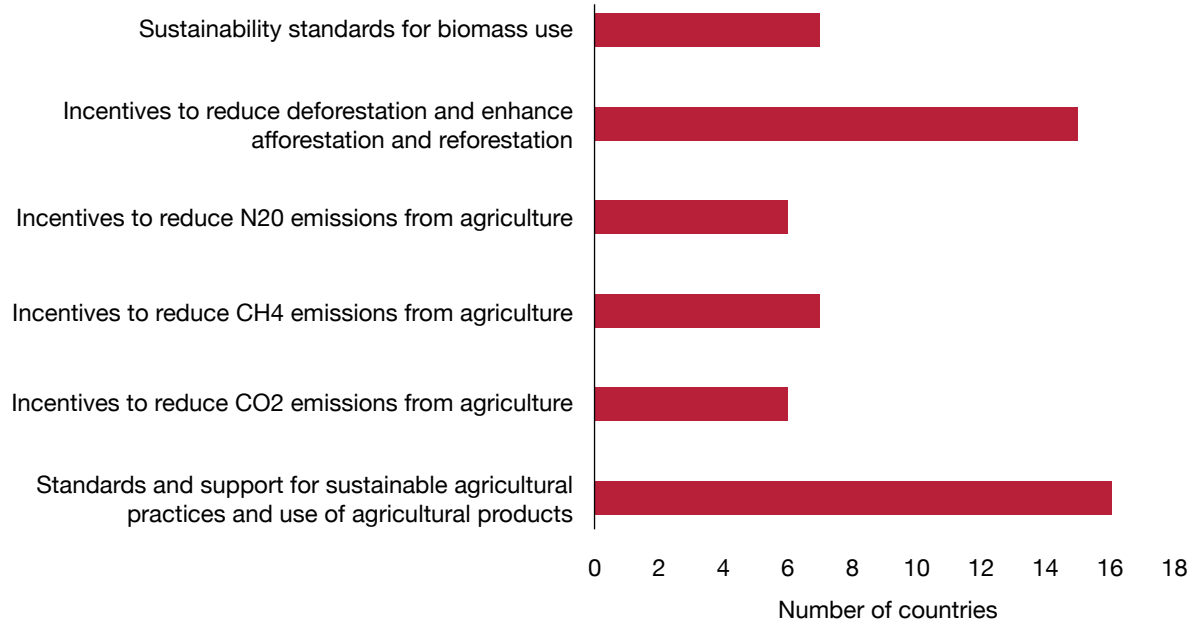
Taxes, emissions and efficiency norms, performance standards mostly cover transport emissions

Chart 1.5. Policies for land transport sector



Laws, standards, and incentives with sustainable farming support in agriculture and forestry

Chart 1.6. Policies for agriculture and forestry sector



Source: Authors' compilation using the Climate Policy Database (n.d.).

2.2 How Pricing and Non-Pricing Measures Complement Each Other

Panel 2 presents a picture of the mix of pricing and non-pricing policy instruments to demonstrate the complementarity that exists across countries for checking GHG emissions. Evidently, fiscal and other financial incentives (implicit carbon pricing measures) are commonly deployed, in conjunction with a wide range of non-pricing methods, as part of the overall climate policy framework in all countries. Non-pricing interventions are diverse in nature; e.g., public information and education, regulations, research and development (R&D), procurement rules, and voluntary methods. Regulatory instruments, grants, subsidies, and other fiscal incentives for reducing carbon emissions are more evenly distributed across different segments in comparison to voluntary approaches and research and development (R&D) (Panel 2, Chart 2.1).

Fiscal and financial incentives which are implicit carbon pricing measures. These incentives abound, with as many as 406 grants and subsidies across 20 countries, as on Feb 2023; they are combined with 212 tax relief measures. At the opposite end of the spectrum are user charges, GHG emissions allowances, GHG emissions reduction credits and offset mechanisms, and the removal of fossil fuel subsidies; in this regard, only Mexico and Saudi Arabia have introduced explicit policies.[6]

Public awareness measures are mostly non-price in nature. The most popular in this genre are information and education tools—numbered 285 across all countries, along with 183 measures relating to enabling advice or aid in implementation. Some examples of the latter measures include Home Performance with ENERGY STARs in the United States (US; 2002), the Smart Metering Implementation Programme in the United Kingdom (UK; 2010), energy checks for private households in Germany (2012), amongst others. In comparison, labelling, certification, professional training, and qualification provisions form less than a third of these measures. This possibly indicates lower stringency of non-price methods for raising public awareness.

Policy support measures. These measures (645 in total) cover numerous climate targets as part of strategic planning in most countries. Measures such as the procurement of energy-efficient appliances for government enterprises in India (2013), a national energy policy in India (2017), energy conservation and CO_2 reduction actions by the Japanese government (2007), and Forest AR 2030 in Argentina (2018) serve as some examples. To create new and relevant institutions to address sector-specific requirements, 146 non-pricing measures such as The Clean Energy Regulator Act 2011 in Australia, the EU Offshore Oil and Gas Authorities Group (2012), establishment of the Non-Food Biomass Feedstock Standardization Technical Committee in China (2012), the Amazon Fund of Brazil (2008), the Managing Agency for the Reduction of Emissions from Deforestation and Degradation of Forest and Peat Lands in Indonesia (2013), and the National Green Tribunal Act 2010 in India are observed to be important. In contrast, there are few formal and legally binding targets concerned with policies of strategic planning, rule setting, and so on.

Public procurement. Across countries there are several mechanisms which include infrastructure investments (139), procurement rules (48), and funds to sub-national governments for climate-resilient projects at the provincial, territorial, and local authorities' levels across sectors (54). Non-pricing policies include procurement rules that cover government purchase standards in the UK (2011), a legislation to promote the purchase of environmentally friendly products in the Republic of Korea (2010), Energy Efficiency in Government Operations in Australia (2006), amongst others.

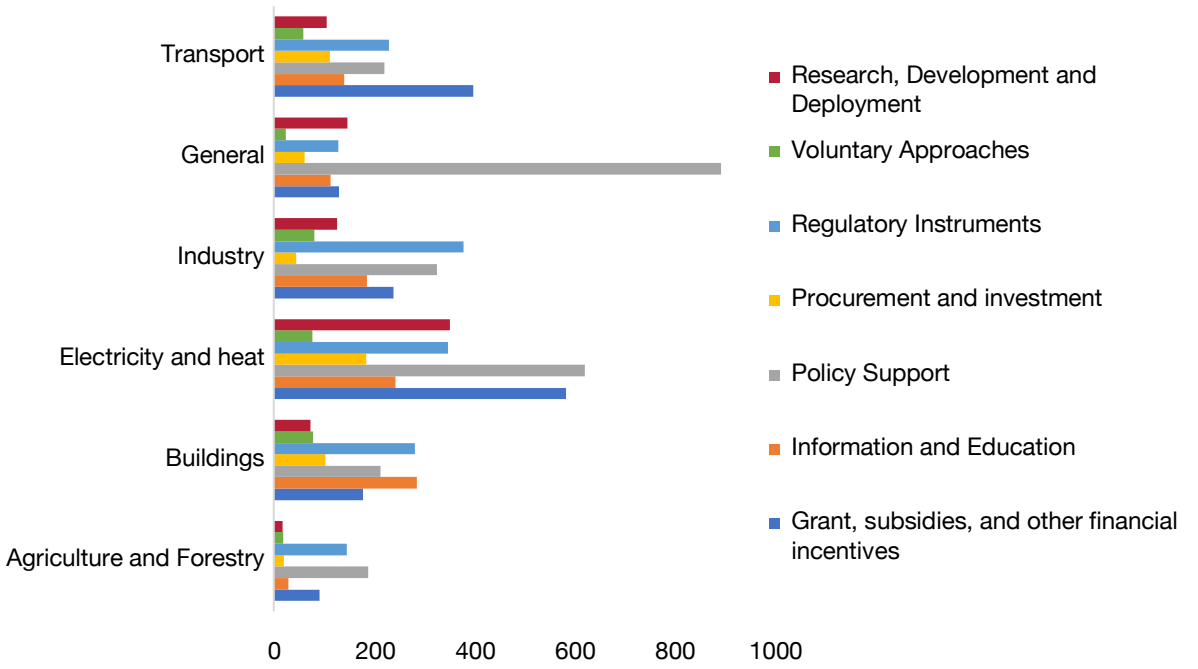
In terms of the frequency of their usage or application for emissions reduction, regulatory instruments constitute the broadest range worldwide. Such levers include monitoring (139), product standards (127), sectoral standards (135), building codes and standards (103), vehicle fuel economy and emissions standards (112), and so on. To encourage low-carbon and low-emission alternatives,

[6] Fuel price adjustments (subsidies removal) in Saudi Arabia (2017) will increase gasoline prices (cut subsidies for full-price parity with international ones between 2018 and 2025, and raise diesel prices (cut subsidies) to 90% of international prices in the same period. Mexico's new energy reform law on hydrocarbons intends to eliminate gasoline subsidies and promote the substitution of oil energy sources by natural gas.

technology deployment and diffusion measures are in wide use (111 measures); these are matched by technology development and demonstration projects. Funding support and related measures for research and development (R&D) are fairly evenly distributed, with 80 such initiatives. Meanwhile research grants are far behind, with just six available.

Panel 2. Pricing and *non*-pricing policies across sectors

Chart 2.1. Instruments across sectors



Source: Authors' compilation using the Climate Policy Database (n.d.).

Finally, voluntary approaches are an established non-pricing method to reduce emissions. The most common are the negotiated private–public agreements, of which there are 126 in all countries. Some examples include the Motor Challenge Programme in the EU (2003), Quebec Voluntary Agreement with Aluminium Industry Canada (2002), Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation (2012), the Green & Smart Transportation Partnership in the Republic of Korea (2012), and the 50001 Ready Program in the US (2017).

2.3 Country-Wise Coverage of Non-Pricing Instruments

A brief country-specific profile of non-pricing instruments across the major sectors is given in Table 1. Overall, such mechanisms either reflect and/or correspond to the respective economic structures and country-specific vulnerabilities to climate change. However, there are several common features in the use of non-pricing levers across countries. One, the energy transition from fossil fuels to clean, renewable alternatives is mostly structured around target-setting, carbon-emissions, and energy-efficiency norms, codes, and performance standards cutting across users (industry, transport, buildings, etc.). Two, the non-pricing measures that the industry sector uses to control emissions are comparably fewer, not universal, and clustered. Three, there appears to be exclusive deployment of non- pricing methods for containment of GHG emissions, preservation of green cover, and adoption of sustainable farming in the agriculture, land use, and forestry sectors[7]. Four, there is comprehensive implementation of codes, standards, materials efficiency, and other such non-pricing tools to check emissions in buildings.

[7] This is explained by the fact that animal and agricultural GHGs are hard to quantify, making it difficult to implement price-based measures ("Non-price and supplementary price measures", Ministry for the Environment, (New Zealand, 2021)

Table 1. Sector-wise coverage of non-pricing instruments across G20 countries

Country	Electricity and Heat	Industry	Buildings	Transport	AFOLU
Argentina	15	7	7	12	11
Australia	12	19	11	5	5
Brazil	22	17	7	18	19
Canada	19	4	21	8	12
China	38	36	9	18	18
EU	15	25	10	21	14
Germany	39	14	11	19	3
France	49	21	12	30	6
India	44	8	16	20	13
Indonesia	30	12	9	21	32
Italy	28	3	6	11	1
Japan	23	16	14	26	9
Mexico	18	5	22	8	11
Republic of Korea	21	14	9	14	13
Russia	9	7	9	8	4
Saudi Arabia	12	6	4	3	5
South Africa	11	9	11	11	5
Turkey	15	11	13	10	13
UK	25	24	6	35	6
US	74	51	19	40	12

Source: Authors' compilation using the Climate Policy Database (n.d.).

*Notes: *AFOLU- agriculture, forestry, and land use.*

The above mapping reveals wide variations between sectors and targets in the deployment of non-price mitigation instruments across the 20 countries. In light of the observed heterogeneities in climate mitigation policies, this is not surprising that the effects vary substantially across sectors and policies (OECD-IMF, 2022). Assessments of their effectiveness are complicated by the lack of rich data on which estimations of emissions reductions could be based. In this regard, ongoing work by the Organisation for Economic Co-operation and Development (OECD) is devoted to developing the Climate Actions and Policies Measurement Framework (CAPMF). This is intended to be a starting point for comprehensive information on climate policies. It will be accompanied by a mapping of these measures to the respective emissions base, reflecting the sectors covered by the various instruments and the extent of their coverage of emissions in each sector.

Indeed, the OECD has already carried out a similar exercise, covering the key price-based carbon policies (the Effective Carbon Rates [ECR] dataset). Hard evidence on policies and their effects is a critical gap that needs addressing to advance climate policy dialogues and coordination. This is also crucial to alleviate concerns about competitiveness losses, increase and/or establish overall trust, and lower the risks associated with implementation and breaches.

3. Sequencing, Experiences, and Stringency[8]

In this section we evaluate the experience of G20 countries with non-pricing policies. The multitude of measures that exist to check carbon emissions—either standalone ones or those in conjunction with pricing mechanisms—and the complex interlinkages across sectors and measures make it difficult to quantify the relative impacts or compare them with those of carbon pricing interventions. As the preceding section shows, there is no country that does not have this issue. These are also key reasons for why few comprehensive assessments exist at present in this sphere. Acknowledging these constraints, we nevertheless make an attempt here to enhance our understanding to the extent possible.

3.1 Sequencing

In the last three decades, countries have introduced climate-related non-pricing tools in a pattern that can be described as more unique than universal. The most visible common trend is of a steady increase in the number of non-price-based measures in the last two decades over that in the 1990s, although the peaks vary across countries. Likely, this corresponds to the steady increase in climate-related events, related evidence, increasing awareness, and heightening concerns that have translated into climate mitigation pacts and/or agreements for urgent climate actions to restrict the rise in global temperatures in recent years.

A snapshot profile of the evolution of these tools across countries and the different spheres of mitigation is given in Panel 3 (table and charts). The advanced economies (AEs) significantly scaled up non-price-based measures in 1991–2010, after which there were further additions in 2011–2022. Despite that, the increase in the number of non-price tools during 2011–2022 was more than twice that in the two decades to 2010. Emerging markets and developing economies (EMDEs), on the other hand, display a more evenly distributed rise in such policies in the same time even as the aggregate numerical evolution matches that of the AEs. As a group, however, AEs have more such measures in practice than EMDEs, amongst G20 members (Panel 3). This may possibly reflect lags and/or less urgency or stringency in emissions-checking measures.

Still, there are some within-group variations. For instance, the US, France, Germany, and the EU introduced the most measures in 2001–2010, a three-fold increase over the previous decade; however, the UK and Japan displayed similar increases in the post-2000 period, over two decades. Likewise, India, Indonesia, China, Argentina, Mexico, and Russia from the EMDEs had very few measures (in single-digits, or 2-7) in the 1990s but ramped these up substantially in the following decade, peaking in the most recent one. Other EMDEs, e.g., South Africa and Korea, displayed a discrete increase in this millennium that they have sustained, while Saudi Arabia appears to have continued adopting non-pricing levers to date.

There has been a visible shift in policies towards energy efficiency and a push for renewables cutting across the advanced, and emerging and developing economies (AEs and EMDEs) alike (Panel 3, Chart 3.1). Implicit carbon price interventions such as fuel taxes and coal cesses (as opposed to explicit ones like carbon taxes and emissions trading) are employed in India; according to the OECD, fuel excise taxes, an implicit form of carbon pricing, covered 54.7% of emissions in 2021 (unchanged since 2018), whereas fossil fuel subsidies covered 2.5% of emissions in the same year.[9]

[8] Stringency is defined as the degree to which environmental policies put an explicit or implicit price on polluting or environmentally harmful behaviour.

[9] Fuel excise taxes, an implicit form of carbon pricing, covered 54.7% of emissions in 2021, unchanged since 2018. Fossil fuel subsidies covered 2.5% of emissions in 2021, unchanged since 2018 (OECD, 2022).

Panel 3, Chart 3.1: Policy sequencing in G20 countries

Number of Policies			
Countries	**1991–2000**	**2001–2010**	**2011–2022**
AEs (excluding EU)	315	1047	711
Argentina	7	25	60
Australia	40	121	111
Brazil	19	51	46
Canada	37	156	113
China	6	83	116
EU	32	102	73
France	36	107	66
Germany	34	105	71
India	6	72	126
Indonesia	4	61	74
Italy	21	70	31
Japan	36	80	80
Mexico	4	33	77
Korea	13	74	60
Russia	2	24	34
Saudi Arabia	0	10	19
South Africa	1	44	41
Turkey	9	35	53
UK	16	94	88
US	82	240	91
EMDEs	58	438	646
EU	32	102	73

Source: Authors' compilation using the Climate Policy Database (n.d.).

3.2 Experiences With Non-Pricing Mechanisms for Greenhouse Gas Emissions

There is diversity in the understanding of non-price-based climate mitigation policies. Fekete et al. (2021) have compiled good practice policy indicators for sectors like electricity generation, industry, buildings, and others to serve as representative measures for assessing progress in implementation in the respective sector. One caveat is that it is quite superficial to interpret these correlations as causal, given the complex combination of price- and non-price-based mechanisms for controlling GHG emissions, which often relate to different mixes of economic activities and structures. However, we borrow selective sector-wide indicators to analyse the historical evolution and shed some light on the outcomes observed.

Electricity and heating. Using the percentage change in electricity from renewable energy between 2000 to 2021 as a gauge, Table 2 identifies an increasing push towards renewable energy through non-price measures outlined in the preceding sections (i.e., a focus on the electricity and heating sector).

Table 2. Good practice policy indicators across different sectors in G20 countries

Country	Increase in Electricity from Renewable Energy (RE) in 2000–2021 (%)	Change in Primary Energy Consumption per GDP (kWh/US$) in 2000–2018 (%)	Relative Change in Annual Deforestation Rate in 2000–2015 (%)
Argentina	28.7	-8.95	-58.83
Australia*	320.69	-30.61	-34.08
Brazil	64.74	-12.85	-66.94
Canada	17.32	-23.63	-25.63
China	987.32	7.21	-57.41
EU (27)	161.21	-	-
France	73.03	-29.3	-
Germany	560.90	-32.91	20.07
India	313.88	-22.05	6.18
Indonesia	186.84	-27.59	-32.92
Italy	129.64	-20.78	-
Japan	108.07	-26.96	-
Mexico	81.20	-17.06	-60.97
Russia	34.96	-50.35	-
Saudi Arabia	-	-33.66	-
South Africa	843.02	-39.29	-50.13
South Korea	1024.08	-13.04	12.36
Turkey	274.87	-0.31	-15.22
UK*	1117.74	-37.53	150
US	144.87	-27.9	-

Source: Data has been compiled using Our World in Data.

*Note: *The relative change for annual deforestation is calculated for 2010–2015.*

There was a notable surge in renewable energy electricity generation between 2000 and 2021, no doubt a result of mandated targets, research and development (R&D) and other supporting incentives during the period to encourage the use of non-fossil energy sources. The magnitudes of the increase in UK, China, South Korea, and South Africa are particularly impressive. It is equally important to acknowledge the significant role of commercialisation and innovation in driving the advancement in renewable energies. These factors serve as critical enablers for overcoming technological and market barriers, further facilitating the adoption and deployment of renewable energy solutions.

Moreover, our analysis in Section 2 underscores the comprehensive policy coverage witnessed in the electricity and heating sector which has likely enhanced the effectiveness of non-price policy instruments.

Industry. In the third column of Table 2, energy intensity is used as a performance indicator for industry, where non-price-based policies, including efficiency standards for industrial production and equipment are employed. All G20 countries except China managed to reduce their energy intensity between 2000 and 2018, indicating a positive impact of policies.

Transport. In the transport sector, a significant number of G20 countries have prioritised the implementation of emissions standards for both light- and heavy-duty vehicles, alongside policies aimed at promoting low-emissions transport, with a particular emphasis on EVs. Due to limited data availability regarding emissions reductions resulting from vehicle standards—and the fact that electric mobility is still in its formative phase, it is yet to be scaled up for mass adoption, and is not at present affordable—it is hard to establish any association between non-price measures and the containment of carbon emissions.

AFOLU (agriculture, forestry, and land use). In agriculture, there is a discernible trend towards decreased deforestation although it is difficult to directly associate this with the large differences in the AFOLU policies across countries (Table 1).

There are also several research attempts in related directions. Nascimento et al. (2022) recently analysed the G20 climate policies from between 2000 and 2019 and found significant gaps in policy adoption. The study argues for widening the sectoral coverage of climate policies, as a portion of global emissions remain uncovered by the policies. However, the performance of different policy instruments was not examined. This leaves the cost-effectiveness and leakages due to low stringency, lax enforcement, etc. ambiguous. On the other hand, non-price policies aimed specifically at renewable energy, fuel efficiency, electrification of passenger vehicles, and forestry have been successfully implemented in China, the EU, India, Japan, and the US, in the spheres of electricity generation, passenger vehicles, freight transport, forestry, industry, buildings, agriculture, and oil and gas production (Fekete et al., 2021).

Two studies, by Davis and Knittel (2019) and Levinson (2019), examined the distributive impact of fuel economy standards in the US and found no evidence to support fuel economy standards over carbon tax. Indeed, the latter study concluded that energy-efficiency standards are more regressive than energy taxes. Zhao and Mattauch (2022), examined the US's vehicle markets and China's transport sector, found efficiency standards more equitable than carbon pricing when consumers prefer high-carbon technology attributes and richer households have higher consumption of high-emissions goods.

Sarker et al. (2020) analysed energy efficiency policy strategies of China, India, Indonesia, and Japan based on non-price instruments such as subsidies, tax reductions, and voluntary agreements, and market-based instruments such as white certificates and tendering. The researchers observe mixed responses, wherein voluntary agreements are significant to energy efficiency in China but not the other countries. Market-based instruments also play an important role in reducing energy intensity. Direct subsidies showed burdening government budget with limited results. Indeed, Hahn and Stavins (1992) argued that ease of implementation, equity, information requirements, monitoring and enforcing capabilities, political feasibility and clarity to public are some of the important determinants other than efficiency and cost-effectiveness of a climate policy.

Many studies have also examined the impact of climate policies upon public perception and the associated challenges in public acceptance of carbon taxes. A recent survey of 40,000 respondents in the G20 countries by Dechezlepretre et al. (2022) found that public perception of the effectiveness of climate policies in reducing emissions, the distributional impacts on others (for instance, a disproportionately high burden on lower-income households), and self-interest determine public acceptance of policies to a significant extent. Following the Yellow Vests movement in France, a survey by Douenne and Fabre (2022) using a representative sample revealed possibilities of rejection of a carbon tax and dividend policy in France as people tend to overestimate their net monetary losses assuming the policy to be regressive, and do not perceive it as environmentally effective.

The response of private capital is another yardstick used to evaluate the impact of non-pricing measures. For example, the impact of financial disclosures and ESG norms on sustainable investment flows can be considered significant. These have picked up significantly, especially in response to the start of the pandemic.[10] By early 2020, sustainable investments were estimated at US$ 35.3 trillion in five major markets (Europe, the US, Canada, Australia, New Zealand, and Japan), according to the Global Sustainable Investment Review 2020 (GSIA, 2021). Cumulative green bond issuance across the globe is assessed at around US$ 2.25 trillion, of which US$ 65.9 billion has been issued this year, according to the Climate Bonds Initiative.[11] Bloomberg predicts that sustainable investments will

[10] See Financial Times (n.d.).
[11] Data accessed on March 1, 2023 (Climate Bonds Initiative, 2023).

reach US$ 53 trillion by 2025,[12] with Europe accounting half of the total assets, followed by the US, Japan, and other Asian economies.

More recently, ESG investments have come under scrutiny, with mounting concerns about the 'greenwashing' of such investments (see International Monetary Fund, 2021, Chapter 3, Global Financial Stability Report, October 2021). In this light, the G20 Climate Sustainability Working Group (CSWG, 2022) as emphasised the need to develop measures to reduce greenwashing through standards for measuring, reporting, and verifying (MRV) mechanisms; climate risk evaluation and management and disclosure standards; and legal standards for environmental thresholds and performance indicators. Measuring the relative impact of price- and non-price-based methods is a well-acknowledged challenge at all levels, including for multilateral agencies. The most recent examination by the OECD and International Monetary Fund (IMF) from late 2022 identifies the various challenges associated with making such assessments and comparisons of policies across countries. The outstanding one being the complex interactions amongst the two sets of policies (price and non-price-based). The analysis suggests that price- and non-price-based instruments emit different signals to market participants through changes in the prices of activities or assets and/or by constraining activities or investments in assets to comply with regulatory requirements. Thus, the report establishes the need to develop an operational methodology with potential metrics to facilitate comparison and to estimate the impact of non-pricing policies on overall emissions.

The OECD's recent work[13] in this regard finds that pricing mechanisms, which do affect emissions reduction, are nonetheless insufficient to meet net-zero emissions targets with the present technologies and abatement costs. At the global level, a minimum international carbon price of EUR 60 per tonne of CO_2 (2.4 times the 2018 average effective carbon rate) would lower global CO_2 emissions from fossil fuels by about 17%; more than half of this reduction would result from starting to price emissions that are currently unpriced. This points to the importance of non-price-based, complementary policies to enable the acceleration of the development and use of clean technologies and to facilitate the substitution of low-carbon energy sources for fossil fuels. Yet, to compare the relative efficacy and efficiency of the two mechanisms, the OECD-IMF report (2022) underlines that the required stocktaking and mapping of the respective emissions bases of countries is needed to provide additional orientation for policymakers. This will require supplementary work, which the two agencies are presently undertaking.

The initial comparison of policies based on their emissions reduction and economy-wide carbon price equivalent (ECPE) is only illustrative, as there is no unique methodology to date. There is substantial variation across the G20 countries in the combined effects of the chosen policies and targets.[14] Relative to a no–carbon pricing scenario or other new mitigation measures in 2030, CO_2 reductions are around 10% or less in four countries, and range higher than 50% in four others. Further, countries differ vastly in their instrument choices and the relative contributions of sectoral targets. Indeed, renewable targets contribute significantly to emissions reduction in the policy mix in 12 countries, and explicit carbon pricing contributes substantively in eight countries. For most, a significant contribution to realising mitigation commitments in NDCs (nationally determined contributions) could originate from policies not modelled therein, or not numerically specified. Finally, ECPEs for combined policies exceed US$ 100 per tonne of CO_2 in seven cases, and amount to around US$ 30 per tonne or less in another nine. The exercise, which lacks a sensitivity analysis, is dependent on model assumptions, the policy detail level, metrics used for comparison besides the

[12] ESG assets may hit US$ 53 trillion by 2025, a third of global AUM (Bloomberg Intelligence, 2021).

[13] The analysis uses the OECD ECR database and covers 44 OECD and G20 countries over 2014–2018 to estimate the long-run responsiveness of CO_2 emissions and government carbon pricing–related revenues to carbon pricing, within a unified empirical framework across countries, sectors, and fuels. The baseline estimates imply that an increase in ECRs by EUR 10 per tonne of CO_2 reduces CO_2 emissions from fossil fuel use by 3.7%, on average. This responsiveness varies by sector and fossil fuel; it is stronger for road transport, agriculture and fisheries, coal, diesel, and kerosene (OECD-IMF, 2022).

[14] See OECD-IMF (2022, pp. 14–16) for more details.

choice of benchmark setup, how national and global variables evolve, and the treatment of policies when applied internationally and at sub-national levels.

3.3 Stringency of non-pricing policies over time

There have been attempts to analyse experiences in price and non-price-based instruments. The OECD Environmental Policy Stringency Index compares environmental policy stringency measures across countries. The index has interesting insights on developments in G20 countries; however, the data is only available for only 15 of the G20 countries (Panel 4).

Panel 4. OECD Environmental Policy Stringency Index in G20 countries

Chart 4.1. Environmental policy stringency in G20 AEs

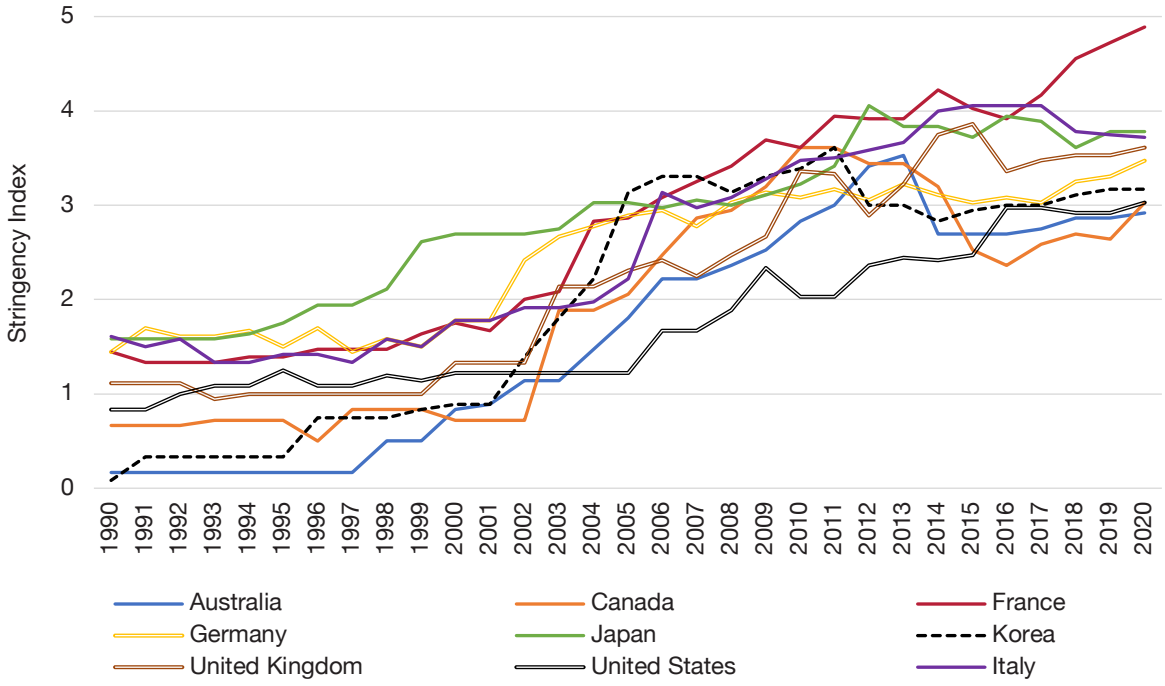
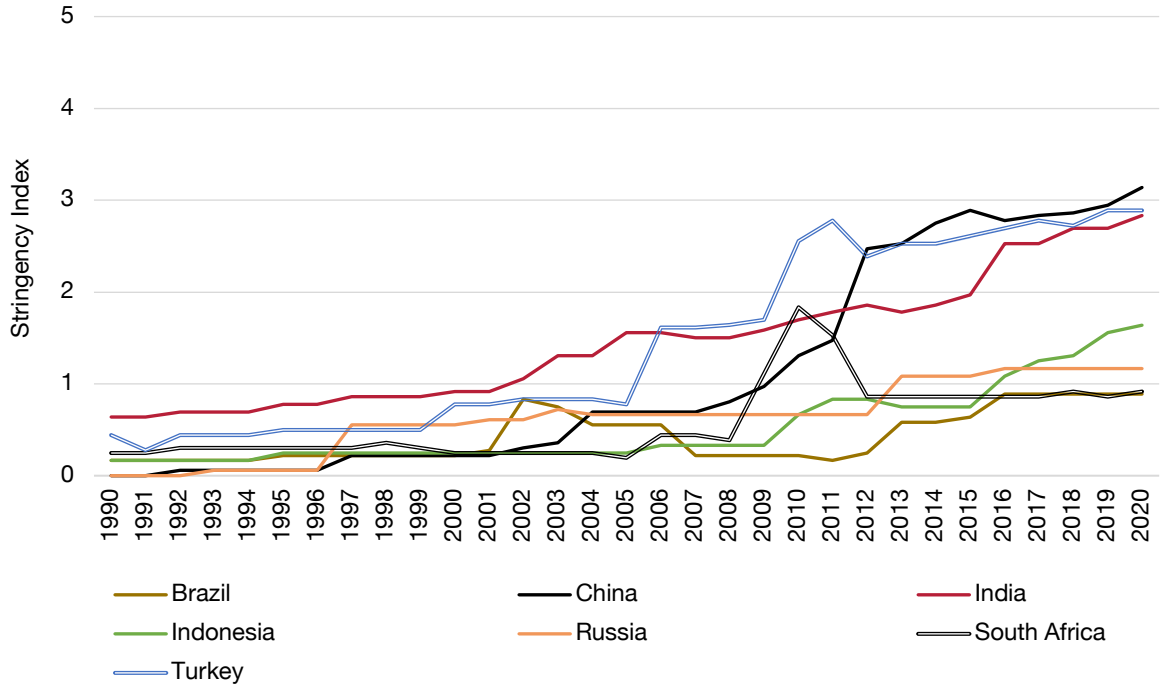


Chart 4.2. Environmental policy stringency in G20 EMDEs



Source: Authors' compilation with the OECD Environmental Policy Stringency Index (OECD,2020)

The policies have become more stringent in AEs over the years, especially in France, Japan, Italy, and the UK (Panel 4, Chart 4.1). However, the pace has reduced considerably in recent years as these have plateaued. While most continued to increase policy stringency in the mid-2000s, there was a considerable reduction in the extent of stringency in AEs post 2010. However, AEs have been attempting to improve their stringency measures since 2015. On the other hand, EMDEs were late to introduce stringent policy measures. But countries like India, China, and Turkey have progressed significantly in making their policies stricter over time (Panel 4, Chart 4.2). Nevertheless EMDEs (except Russia and South Africa) have not observed a significant decline in the pace of stringency; rather, the trajectory has been positive, especially after 2015. This is in line with the significant increase in their burden sharing of reducing emissions through increased policy measures.

The OECD climate actions and policies measurement framework (CAPMF) database provides comprehensive coverage of policy instruments, and instrument types. Argentina and Saudi Arabia have the least stringent policies for air emissions standards. Eleven countries have the least stringent policies for the ban and phase-out of coal power plants. Korea and Mexico are at the bottom for building energy codes and standards. France is the only country with high policy stringency on the carbon tax for buildings, whereas Canada, Japan, and South Africa have highly stringent policies for carbon tax in the electricity sector. Except for Brazil, Canada, Indonesia, and Mexico, all other countries have high policy stringency on labels for vehicles. Russia is the only one with low policy stringency on mandatory energy labels for appliances. Mexico is the only country with high policy stringency on methane reduction. Argentina, China, India, Indonesia, and Russia have low policy stringency for planning renewable capacity expansions.

Above all, the differences in the sequencing patterns of non-pricing mitigation measures across the AEs and EMDEs—in their introduction, acceleration, and broadening—point to the role they play in establishing pre-conditions for explicit carbon pricing mechanisms (see the next section). This is not insignificant to the sequencing of climate mitigation strategies, public buy-in, or support for carbon pricing, when eventually introduced, because of increased familiarity and awareness, which contribute to increased effectiveness of both types of measures.

The next section considers the aspects of carbon pricing to advocate the need for complementarity between the two types of polices for climate mitigations strategies.

4. Need for Balance: Complementarity Between Price and Non-Price Policies

Carbon pricing measures have become increasingly important as the required pace and scale of emission reduction increase and given their potential to directly impact the emissions. These measures are widely regarded as a central pillar of climate mitigation strategies. They are commonly cited as being cost-effective, as the price provides a compelling incentive to explore more economical, and low-emission or emissions reduction opportunities, and are often called "low-hanging fruit" (Boyce, 2018). As measured by the number of low-carbon patents, these serve as a catalyst of innovation in clean technology.

However, political obstacles in the implementation of high enough carbon prices are significant, especially in developing countries. The resistance arises from the distributional consequences, particularly the regressive impact on consumer purchasing power and income. Although options like revenue recycling and targeted measures have been proposed to address these concerns, their adoption in the global south remains limited.

Most carbon taxes and ETSs are predominantly found in high-income countries in Europe and North America, From East Asia and the Pacific, China accounts for a significant proportion of emissions (Sara, 2023). As of April 2023, there are 73 operational carbon taxes and ETSs covering

23% of global emissions, with ongoing expansions to cover more sectors (Sara, 2023). Table 3 shows ETS and carbon tax implementation in the G20 countries. It is clear there is a high degree of heterogeneity in the volume of emissions covered amongst the countries, with only a handful of countries having implemented the two measures.

Empirical evidence suggests significant increases in patenting after carbon pricing in the case of the EU ETS (Calel & Dechezlepretre, 2016) and China's ETS (Cui et al., 2018). According to a meta-review of ex-post quantitative evaluations of carbon pricing policies worldwide since 1990, the overall reduction in emissions resulting from carbon pricing measures typically ranges from 0% to 2% per year. Moreover, there is significant variation in emissions reductions across different sectors (Green, 2021). A recent study on the impact of the UK Carbon Price Support, a carbon tax implemented in 2013 relative to a synthetic control unit from other European countries, finds that emissions reduced between 20% to 26% on average per year in the UK power sector over 2013–2017 (Leroutier, 2021). These findings point to the substantial impact of carbon taxes, and contribute to strengthening the case for coordinated carbon taxation to combat the climate crisis.

Table 3. Implemented Carbon Tax and ETS in the G20 countries

Country	Implemented Carbon Tax		ETS	
	GHG emissions covered [MtCO2e]	Year of Implementation	GHG emissions covered [MtCO2e]	Year of Implementation
Argentina	76.2	2018	-	-
Canada	214.2	2019	7.2	2019
China	-	-	4500	2021
EU	-	-	1354	2005
France	139.8	2014	-	-
Germany	-	-	305	2021
Indonesia	-	-	300.4	2023
Japan	866.5	2012	-	-
Korea	-	-	509	2015
Mexico	308.2	2014	280 (Pilot)	2020
South Africa	424.1	2019	-	-
UK	97.2	2013	113.4	2021

Source: Authors' compilation using the World Bank Carbon Pricing Dashboard (June, 2023).

Revenues fetched by carbon taxes and ETS are another positive. Globally, the combined revenues from these measures grew above 10% in 2022, reaching US$ 95 billion globally and indicating their potential (Sara, 2023). Carbon pricing, hence, provides a good tax base. Moreover, if well designed, it can be difficult to evade. Evidence suggests that carbon pricing does not harm competitiveness—over the medium term, the price effects are mostly offset by productivity gains (e.g., Bhattacharya et al., 2021, Venmans et al., 2020). Low carbon prices due to exemptions or high levels of free allowances to firms under ETSs are identified as factors limiting the effectiveness of carbon pricing (Venmans et al., 2020).

However, to drive investments and reduce emissions at the necessary pace and scale towards carbon neutrality, carbon prices need to substantially rise. For example, the IMF and World Bank's calculations show that the adoption of a carbon price of US$ 75 per tonne by all countries could cut emissions in line with what is needed to limit global warming to 2°C (IMF, 2022); these calculations are in line with past estimates (Stiglitz, et al., 2017). These can play an instrumental role in achieving collective climate ambitions, especially with the momentum behind expanding

coverage and increasing prices in the future. However, the political economy surrounding carbon pricing has become more complex with successive crises, including the war in Ukraine, fluctuating oil commodity prices, weakening growth prospects, rising interest rates, and currency depreciations which intensify debt burdens and associated risks.

Non-pricing policies can complement pricing policies in addressing concerns about distributional impacts and market failures. For instance, efficiency standards and investment incentives can be employed in cases where implementing carbon pricing is challenging or inefficient. Standards and regulations can address allocative inefficiencies and promote industry innovations that show promise in emission reduction. Indeed, in situations characterised by learning, economies of scale, and uncertainty, regulations tend to be more effective than pricing mechanisms. A notable example is the successful government intervention by Government of India to ban incandescent light bulbs and promote the development and adoption of affordable and highly efficient LED bulbs (Stiglitz et al., 2017).

The High-Level Commission on Carbon Prices underlines the importance of a range of carbon prices, aligned with the Paris Agreement, while acknowledging that these targets can only be met when complemented by non-pricing measures, thus making a strong case for complementarity. Modest levels of carbon pricing are unlikely to achieve fundamental transformation in a wide range of sectors, particularly hard-to-decarbonise ones like aviation, heavy industry, and building energy efficiency – The Intergovernmental Panel on Climate Change (IPCC) states that while carbon pricing is effective in promoting implementation of low-cost emissions reductions with high confidence, its effects on adoption of higher-cost mitigation options, and where decisions are often not sensitive to price incentives such as in energy efficiency, urban planning, and infrastructure, are limited (IPCC 2022).

In sum, a complementary mix in which both types of policies are employed is the optimal strategy for climate mitigation as there are multiple negative externalities, as well as market and non-market barriers. A combination of policy types will also enhance responsiveness to price-based measures.

5. Conclusion

This paper considers the cross-country experience with non-price policy levers for lowering carbon emissions. It takes stock of the variety of such measures employed by the G20 countries, and their coverage across sectors. It digs deeper by differentiating the non-price policies by the frequency of their use, purposes and broad targets. For a richer analysis, it examines the complementarity of their use along with price-based measures, including explicit ones like carbon taxes and ETSs, and others like feebates and subsidies in different sectors. In addition, the sequencing patterns and respective stringency levels across countries are analysed.

The review of experiences offers several insights that merit deliberation and further discussion by countries in the context of the search for the best way forward, which might involve the private sector in the low-carbon transition. One, most countries have instituted multiple non-price policy levers that cut across sectors in a complex interplay, which can be difficult or impossible to disentangle. This points towards challenges of causal interpretations, evaluation, and comparative assessments. Two, the main policy motivations are often diffused; this may be to reduce greenhouse gas (GHG) emissions or another primary goal that is climate relevant. These correspond to or align with an overall climate policy framework. Three, there is frequent complementarity with price-based policy measures, which provide noticeable support by incentivising behavioural changes or encouraging private investments.

Four, and notwithstanding some common patterns, the adoption of non-price measures is unique amongst countries. The trends usually reflect or correspond respective economic structures, climate-specific vulnerabilities, mitigation requirements, the availability of financial resources, or other factors. This points to both the need to appreciate and adapt price-based policies in accordance, as also the limits to harmonisation possibilities.

Five, although many non-price policy levers have long been in place and increased over time across countries, the evidence on their efficacy is inconclusive. The gaps in evidence are large: implementation and enforcement slippages, effectiveness in reducing GHG emissions, impact on firms' costs and competitiveness losses, and that upon households, along with a balance between the two.

Six, the challenges associated with evaluating the efficiency and impact are complex and several. Inter alia, causal inferences due to multiplicity, variations in responses across sectors, quantification difficulties, etc. impede empirical assessment. Seven, the comparative effectiveness with price-based measures at reducing emissions is likewise complicated. Specifically, the frequent overlap of price- and non-price-based mitigation instruments makes it extremely difficult to disentangle the contribution of separate measures to emissions; risks include double counting, amongst other major issues.

A recent analysis by OECD-IMF (2022) on the combined effect of the key measures (price and non-price ones) used by the majority of G20 countries to advance their mitigation commitments reveals substantial variation across countries. It underlines how differences in policy levers, and their coverage, can render estimating their sufficiency or otherwise to meet net-zero emissions targets extremely difficult. There is also the related concern about convincing private participants in this regard.

To conclude, the need for better understanding about the efficiency of non-price policy instruments, exclusive and in comparison, with price-based measures, must be emphasised. Besides illuminating possibilities for a policy mix and associated trade-offs, this is essential to support international negotiation and coordination on climate policies, competitiveness, and carbon leakages. The inability to decompose the relative emissions impacts of price- and non-price mitigation instruments has withheld progress on assessments of the likely reduction in emissions as a result of policies or sets thereof until now.

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Appendix: Data and Methodology

The major climate policy databases available and widely used include the following:

i. Climate Change Laws of the World database of the Grantham Research Institute at the London School of Economics (LSE) and the Sabin Centre at Columbia Law School (LSE, 2023);

ii. OECD Policy Instruments for the Environment database (OECD, n.d.); and

iii. Climate Policy Database, maintained by New Climate Institute, with support from the PBL Netherlands Environmental Assessment Agency and Wageningen University and Research (Climate Policy Database, n.d.).

We relied on the Climate Policy Database for its wider and more comprehensive coverage than other data sources, including those databases mentioned here. The database provides updated information, especially for G20 countries. For our purpose, we explicitly excluded price instruments–based policies in G20 countries. Many of the policies have multi-sector and multi-instrument coverage across G20 countries. We thus assimilated the information across five major mitigation areas, as grouped by the database: energy efficiency; energy service demand reduction and resource efficiency; low-carbon technology and fuel switch; renewables; and non-energy use.

We also followed the United Nations Framework Convention on Climate Change (UNFCCC, 2014) broader classification of non-market approaches, such as economic and fiscal instruments; regulations; voluntary agreements; framework targets; information; education and awareness programmes; and R&D. For a detailed policy instruments analysis, we further grouped the policies (similar to Linsenmeier et al., 2022).

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