Organisation for Economic Co-operation and Development

ENV/WKP(2022)15

Unclassified

English - Or. English

2 November 2022

ENVIRONMENT DIRECTORATE

THE CLIMATE ACTIONS AND POLICIES MEASUREMENT FRAMEWORK: A STRUCTURED AND HARMONISED CLIMATE POLICY DATABASE TO MONITOR COUNTRIES'MITIGATION ACTION

Environment Working Paper No. 203

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Authorised for publication by Jo Tyndall, Director, Environment Directorate.

Keywords: climate change, climate policy, climate action, market-based instruments, non-market-based instruments, composite index, policy instruments, carbon pricing

JEL codes: H23, Q48, Q54, Q58

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JT03506468

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Abstract

There are major gaps in the measurement of the adoption and stringency of countries' climate actions and policies, notably in a manner coherent across countries, time, sectors and instrument types. The climate actions and policies measurement framework (CAPMF) aims to fill this gap. It is a structured and harmonised climate mitigation policy database that informs about countries' climate action. The CAPMF was developed under the International Programme for Action on Climate (IPAC). It comprises 128 policy variables, grouped into 56 policy instruments and other climate actions, covering the 52 countries participating in IPAC and the period 2000-2020. The CAPMF is the most comprehensive internationally harmonised climate-related policy database currently available. Results indicate that IPAC countries strengthened their climate action between 2000 and 2020 in terms of both policy adoption and policy stringency, although individual countries progressed at different paces. Policy mixes in many countries changed from cross-sectoral to a more sectoral focus and from non-market to market-based approaches. Importantly, results suggest a positive relationship between stronger climate action and greater emissions reductions but further analysis is needed to fully assess policy effectiveness.

Keywords: climate change, climate policy, climate action, market-based instruments, non-market-based instruments, composite index, policy instruments, carbon pricing

JEL Classification: H23, Q48, Q54, Q58

Résumé

La manière dont sont mesurés le niveau d'adoption d'actions climatiques par les pays et le degré de rigueur de ces actions souffre de graves lacunes, notamment lorsqu'il s'agit de comparer sur une bases homogène les pays, les périodes, les secteurs et les types d'instrument. Le Cadre de mesure des actions et politiques climatiques (CMAPC) a été élaboré afin d'y pallier. Cette base de données structurée et uniformisée sur les politiques d'atténuation du changement climatique fournit des informations sur l'action climatique engagée par les pays. Mis au point dans le cadre du Programme international pour l'action sur le climat (IPAC), le CMAPC comprend 128 variables réparties dans 56 catégories d'instruments et actions climatiques ; il couvre les 52 pays IPAC au cours de la période 2000-20. Il s'agit de la base de données internationales harmonisées la plus complète qui soit à ce jour sur les politiques liées au climat. Il en ressort qu'entre 2000 et 2020, les pays de l'IPAC ont accentué leurs efforts pour le climat en adoptant davantage de mesures, dont la rigueur a été accru quoiqu'à des rythmes variables. Beaucoup ont revu leur arsenal de mesures, en passant à un périmètre non plus général mais sectoriel et en décidant de se fonder davantage sur des mesures de marché. Surtout, il semblerait exister une relation positive entre renforcement de l'action climatique et diminution accrue des émissions, mais il conviendrait d'étudier plus avant l'efficacité des mesures.

Mots-clés : changement climatique, politique climatique, action climatique, instruments fondés sur le marché, instruments non fondés sur le marché, indice composite, instruments d'action, tarification carbone

Classification JEL : H23, Q48, Q54, Q58

Acknowledgments

This paper is part of the 2021-22 Horizontal Project on "Building Climate and Economic Resilience in the Transition to a Low-Carbon Economy" and its International Programme for Action on Climate (IPAC). This work contributes to the development of the IPAC Climate Action Dashboard, as well as the broader set of IPAC indicators (the OECD set of indicators to monitor progress towards climate objectives).

The paper was reviewed by the OECD Environment Policy Committee (EPOC). It benefitted from helpful comments by members of the IPAC Technical Expert Group (TEG) as well as by Delegates to the Working Party on Environmental Information (WPEI), the Working Party on Climate, Investment and Development (WPCID) and the Working Party on Integrating Environmental and Economic Policies (WPIEEP). Comments by experts from Australia, Colombia, Costa Rica, Finland, France, Germany, Japan, Latvia, Lithuania, Poland, New Zealand, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States of America have been considered in preparation of the paper.

This paper has been drafted by Daniel Nachtigall, Luisa Lutz, Miguel Cárdenas Rodríguez, Ivan Haščič and Rodrigo Pizarro. It builds on contributions to data collection by Guendalina Bettinelli, Jonah Harris, Natália Palšová, Léo Robert and Rudy Saffar. Some of the data series come from the OECD EPS data collection which was made available for the purposes of this work which is much appreciated. The work has been carried out under the supervision of Nathalie Girouard, Head of the Environmental Performance and Information Division in the OECD Environment Directorate.

The authors would also like to thank OECD and IEA Secretariat colleagues for their helpful comments on previous versions of the paper, including Enrico Botta, Diane Cameron, Filippo D'Arcangelo, Jane Ellis, Justine Garrett, Guillaume Gruère, Ben Henderson, Tom Howes, Nick Johnstone, Tobias Kruse, Britta Labuhn, Roger Martini, Yannick Monschauer, Jerome Mounsey, Mauro Migotto, Jolien Noels, Dirk Röttgers, Jonas Teusch, Kurt van Dender, Antonio Vaya Soler, and Fabian Voswinkel. The authors thank workshop participants for comments provided at the 8th International Symposium on Environment and Energy Finance Issues (ISEFI) in May 2022 in Paris, France, the 9th Atlantic Workshop on Energy and Environmental Economics (AWEEE) in June 2022 in Toxa, Spain, and the UNECE Expert Forum for Producers and Users of Climate Change-related Statistics in September 2022 in Geneva, Switzerland.

Numerous experts have provided constructive advice and various inputs on the policy data used in this paper. They include Aimée Aguilar Jaber (OECD), Brilé Anderson (OECD), Arnaud Atoch (OECD), Heymi Bahar (IEA), William Becker (JRC), Daron Bedrosyan (World Bank), Veronica Bellonzi (Comune di Milano - Mobility System Development Unit), Thomas Bernauer (ETH Zürich), Alexandre Bizeul (IEA), Andrew Blazey (OECD), Tobias Boehmelt (ETH and University of Essex), Gerard Bonnis (OECD), Peter Börkey (OECD), Enrico Botta (OECD), Nils-Axel Braathen (OECD), Sara Budinis (IEA), Jan Burck (Germanwatch), Pedro Carvalho (IEA), Daniel Clarke (OECD), Valeria Constantini (Roma Tre University), Phillipe Crist (ITF), Lylah Davies (OECD), Pierre De Boisseson (OECD), Tomas de Oliveira Bredariol (IEA), Antoine Dechezleprêtre (OECD), Kathleen Dominique (OECD), Luisa Dressler (OECD), John Dulac (OECD), Jane Ellis (OECD), Sofie Errendal (OECD), Chiara Falduto (OECD), Ben Henderson (OECD), Andrés Fuentes-Hutfilter (OECD), Catherine Gamper (OECD), Justine Garrett (OECD), Grégoire Garsous (OECD), Gaelle Ferrant (OECD), Vitor Gois Ferreira (UNFCCC), Michael Gonter (OECD), Frederic Gonzales (OECD), Samuel Granath (Sweden- Transportstyrelsen), Carl Greenfield (IEA), Guillaume Gruère (OECD), Gyorgy Gyomai (OECD), Catherine Higham (London School of Economics), Ciara Hilliard (Climate Change Advisory Council Secretariat – Ireland), Raphaël Jachnik (OECD), Peter Jakob (Expertenrat für Klimafragen – Germany), Sirini Jeudy-Hugo (OECD), Nick Johnstone (IEA), Guðný Káradóttir Loftslagsráð (Icelandic Climate Council), Aidan Kennedy (IEA), Tomasz Koźluk (OECD), Hans Kringstad (Kommune

Trondheim), Tobias Kruse (OECD), Christoph Kull (Swiss Academy of Sciences SCNAT – Switzerland), Kevin Lane (IEA), Frithjof Laubinger (OECD), Margaux Lelong (OECD), Suzy Leprince (IEA), Karine Lepron (OECD), Myriam Linster (OECD), Luca Lo Re (IEA), Samantha MacCready (Climate Change Authority – Australia), Mikaël Maes (OECD), Florian Mante (OECD), Luis Martinez (ITF), Mark Mateo (OECD), Eugene Mazur (OECD), Olaf Merk (ITF), Kenneth Michaels (IEA), Sarah Miet (OECD), Mauro Migotto (OECD), Mariana Mirabile (OECD), Helena Mogensen (Klimarådets sekretariat – Denmark), Yannick Monschauer (IEA), Leonardo Nascimento (NewClimate Institute), Aloys Nghiem (IEA), Jolien Noels (OECD), Hyeshin Park (OECD), Lenia Pasalidou (National Scientific Climate Change Council – Greece), Francesco Pavan (IEA), Samuel Pinto Ribeiro (OECD), Mauro Pisu (OECD), Elisa Portale (World Bank), Andrew Prag (OECD), Roberta Quadrelli (IEA), Mikaela Rambali (OECD), Uwe Remme (IEA), Marcia Rocha (OECD), Sofia Grecia Rodriguez Jimenez (IEA), Dirk Röttgers (OECD), Felipe Saavedra (Permanent Mission of Chile to the OECD), Santaro Sakata (OECD), Tatiana Samsonova (ITF), Jehan Sauvage (OECD), Ingmar Schumacher (IPAG Business School), Penelope Seera (Climate Change Committee - United Kingdom), Joana Setzer (London School of Economics), Therése Sjöberg (Secretariat to the National Expert Council for Climate Adaptation), Andrzej Suchodolski (OECD), Jonas Teusch (OECD), Ioannis Tikoudis (OECD), Pedro Torres (UNFCCC), Kurt van Dender (OECD), Julia Wanjiru (OECD), Sally Weaver (Suomen ilmastopaneeli - The Finnish Climate Change Panel), Romain Weikmans (Free University of Brussels), Elisabeth Windisch (ITF), Shunta Yamaguchi (OECD), Sho Yamasaki (OECD), Robert Youngman (OECD), and Paul Yu (OECD).

The authors also gratefully acknowledge financial support for this paper and other IPAC outputs from Australia, Belgium, Bulgaria, Colombia, Estonia, Finland, France, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, New Zealand, Spain, Türkiye, Romania, Russian Federation, the United Kingdom and the United States of America.

Executive Summary

The Climate Actions and Policies Measurement Framework (CAPMF) is a structured and harmonised climate mitigation policy database. It aims at supporting countries' climate action, including efforts to implement their nationally determined contributions (NDCs) and advancing towards global net-zero greenhouse gas (GHG) emissions by mid-century. The CAPMF was developed under the International Programme for Action on Climate (IPAC). It provides 128 policy variables, grouped into 56 policy instruments and other climate actions (hereafter "policies"), covering the 52 IPAC countries from 2000-2020.

The CAPMF includes mitigation actions and policies coherent with UNFCCC and IPCC frameworks. The CAPMF initial stock-taking exercise covers 75% of instrument types listed in the policy framework of the 2022 IPCC Working Group III report.

The CAPMF covers both climate policies with an explicit intent of advancing mitigation as well as non-climate policies that have an expected positive effect on mitigation. These include sectoral, cross-sectoral and international policies with market-based instruments such as taxes or subsidies for zero-carbon technologies, non market-based instruments such as standards or energy labels, and other climate actions such as short-term and long-term emissions targets or climate governance.

Countries strengthened their climate action between 2000 and 2020. Countries increased both the number of policies adopted and the policy stringency. Policy stringency is defined as the degree to which climate actions and policies incentivise or enable GHG emissions mitigation at home or abroad.

Countries accelerated their policy adoption between 2000 and 2020 at different paces. All countries increased the number of policies adopted that are covered by the CAPMF. However, countries with already high policy coverage accelerated policy adoption at a relatively higher pace, leading to an increasing gap to countries with a relatively low policy coverage. In 2020, the number of policies adopted per country varied between 13 and 45 (out of 56 measured). In addition, 28 countries, accounting for 39% of GHG emissions of IPAC countries, had more policies adopted than the IPAC average (31 policies).

Countries improved the policy stringency between 2000 and 2020. Most countries strengthened their policies during 2000-2020. In particular, many countries with previously low policy stringency did well in terms of strengthening existing policies, leading to a convergence in terms of average policy stringency. However, an appropriate mix of additional policies and increased stringency will be required in many countries to achieve mitigation goals.

Countries with relatively larger policy adoption or higher policy stringency are associated with steeper GHG emissions reductions between 2015-2019. This result is not necessarily causal. Policy coverage and policy stringency are not necessarily indicative of policy effectiveness in reducing GHG emissions.

The CAPMF is a first step to carry out analysis of policy effectiveness. The CAPMF's granular policy data enables the continuation of OECD's work on assessing the environmental and economic effects of different types of climate policies as well as OECD's work on policy instrument choice and design. Some countries may find the results of such studies of interest in consideration of their NDCs.

Results from the CAPMF should be interpreted carefully. In fact, the CAPMF does not capture all relevant policies due to data availability constraints. Policies included in the CAPMF may, thus, not be fully representative of mitigation approaches of some countries. Rather, these policies represent a range of mitigation actions that countries could employ. The CAPMF is providing information for policymakers on

policy areas that are not yet covered and could be explored when considering future policies, or where stringency could be improved to more effectively achieve domestic and global emissions reductions. The CAPMF, however, does not suggest that every policy at maximum stringency is required to achieve the emissions reductions goals.

The CAPMF is the starting point for a more extended data collection, which would be carried out in the next biennium. Future work would extend the CAPMF's policy coverage across sectors and policy instruments such as tax credits and other subsidies for cleaner technologies or an expansion of voluntary approaches. Future work would also include adaptation policies, which are currently not covered.

IPAC's work on the CAPMF will have large synergies with the Inclusive Forum on Carbon Mitigation Approaches (IFCMA). The IFCMA consists of two modules: (1) stocktaking and mapping of mitigation policies, and (2) estimating policy effectiveness in terms of emissions reductions. As such, the CAPMF will provide key inputs to the IFCMA module 1 stocktaking exercise, given its broad set of policies already available.

The CAPMF will also inform other OECD work and beyond. These include other components of IPAC (e.g. Climate Action Monitor, Country Notes) as well as OECD Environmental Performance Reviews and Economic Surveys. The CAPMF will also inform international climate processes such as the UNFCCC global stocktake.

Synthèse

Le Cadre de mesure des actions et politiques climatiques (CMAPC) est une base de données structurée et homogène sur les politiques d'atténuation du changement climatique. Il a pour objet d'aider les pays à lutter contre le changement climatique, notamment à honorer leurs contributions déterminées au niveau national (CDN) et à se diriger vers la neutralité en gaz à effet de serre (GES) à l'échelle planétaire d'ici à la moitié du siècle. Mis au point dans le cadre du Programme international pour l'action sur le climat (IPAC), il contient 128 variables réparties dans 56 catégories d'instruments et de mesures climatique (appelées plus loin les « politiques ») ; il couvre les52 pays IPAC au cours de la période 2000-20.

Le CMAPC porte sur les actions et politiques d'atténuation conformes aux cadres définis par la CCNUCC et le GIEC. Son premier bilan couvre 75 % des instruments énumérés dans le rapport 2022 du Groupe de travail III du GIEC.

Le champ d'étude du CMAPC inclut à la fois les mesures climatiques explicitement dédiées à l'atténuation, mais aussi des mesures censées contribuer à la diminution d'émissions de GES sans toutefois relever de la lutte contre le changement climatique. Il s'agit notamment de mesures touchant l'ensemble de l'économie, des mesures et des mesures internationales qui font intervenir des instruments de marché (par exemple, taxes ou subventions en faveur des technologies zéro carbone), des instruments ne reposant pas sur un système de marché (normes ou labels énergétiques) ou d'autres types de dispositifs (cibles d'émission à court et long termes ou gouvernance climatique).

Les pays ont intensifié la lutte contre le changement climatique entre 2000 et 2020. Ils ont multiplié les mesures et accru la rigueur leur action. La rigueur d'une action désigne le degré auquel les mesures et politiques de lutte contre le changement climatique incitent ou aident à atténuer les émissions de GES sur le territoire national ou à l'étranger.

La vitesse à laquelle l'action s'est accélérée entre 2000 et 2020 varie selon les pays. Tous les pays considérés ont adopté davantage de mesures entrant dans le champ d'étude du CMAPC. Cela dit, les pays qui avaient déjà mis en œuvre le plus grand nombre de politiques ont nettement plus accéléré le rythme d'adoption que les autres, creusant ainsi l'écart entre les pays. En 2020, le nombre de mesures adoptées par pays allait de 13 à 46 (sur 56 étudiées) et 30 pays - représentant 39 % des émissions de GES imputables aux pays de l'IPAC - s'étaient dotés d'un arsenal plus vaste que la moyenne des pays IPAC (32).

Les pays ont accru la rigueur de leur action entre 2000 et 2020. La plupart des pays ont durci leurs politiques entre 2000 et 2020. Notamment, les pays qui présentaient auparavant un faible niveau de rigueur, ont durci leurs politiques existantes, contribuant à la convergence du niveau moyen de rigueur des politiques. La réalisation des objectifs d'atténuation exige néanmoins des mesures supplémentaires et une rigueur accrue de la part de nombreux pays.

Les pays ayant adopté le plus grand nombre de politiques ou les plus rigoureux ont vu leurs émissions de GES décroître plus fortement entre 2015 et 2019. Il n'existe pas nécessairement de lien de causalité. L'ampleur de l'action et sa sévérité ne permettent pas toujours d'indiquer l'efficacité des mesures prises pour réduire les émissions de GES.

Le CMAPC est une première étape dans l'analyse de l'efficacité de l'action publique. Son niveau de détail aide l'OCDE à poursuivre l'évaluation des conséquences environnementales et économiques de

différents types de mesures climatiques et d'étudier la manière dont les instruments politiques sont choisis et conçus. Les résultats de ces travaux pourraient intéresser certains pays eu égard à leurs CDN.

Les résultats issus du CMAPC doivent être interprétés avec prudence. En effet, toutes les mesures dignes d'intérêt ne figurent pas dans le CMAPC en raison des contraintes de disponibilité des données. Les politiques couvertes peuvent donc ne pas être pleinement représentatives de la stratégie d'atténuation de certains pays. Elles constituent plutôt des exemples des mesures d'atténuation susceptibles d'être employées. Le CMAPC informe les décideurs sur les domaines d'action qui n'ont pas encore été abordés et pourraient être explorés dans l'avenir ou dans lesquels un durcissement permettrait de mieux réduire les émissions nationales et mondiales. Il ne faut pas en déduire que la réalisation des objectifs de réduction suppose une sévérité maximale de chaque mesure.

Le CMAPC est le point de départ d'une collecte de données plus vaste au cours du prochain exercice biennal. La tâche à venir consiste à accroître le nombre des secteurs et instruments considérés dans le CMAPC, en y ajoutant par exemple les crédits d'impôt et autres subventions en faveur de technologies plus propres ou encore les approches volontaires. On s'intéressera également aux politiques d'adaptation, pour l'instant exclues du champ d'étude.

Les travaux de l'IPAC sur le CMAPC créeront d'importantes synergies avec le Forum inclusif sur les approches d'atténuation des émissions de carbone. La mission du Forum inclusif est double : (1) établir l'inventaire et la cartographie des mesures d'atténuation et (2) estimer leur efficacité en termes de réduction des émissions. Le CMAPC lui fournira des informations indispensables pour l'exercice d'inventaire (1), compte tenu de l'éventail des mesures pour lesquelles il dispose déjà de données.

Le CMAPC apportera également des informations utiles à d'autres travaux, relevant ou non de l'OCDE. Il s'agit notamment des autres composantes de l'IPAC (par exemple, l'Observateur de l'action climatique, les Notes Pays) ou encore des Examens environnementaux et Études économiques de l'OCDE. Le CMAPC éclairera aussi des processus de la lutte internationale contre le changement climatique tels que l'exercice d'établissement du bilan mondial de la CCNUCC.

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1 Introduction

To achieve countries' Nationally Determined Contributions (NDCs) and net-zero targets, as well as the collective goal of the Paris Agreement, countries need information about which policy approaches work most effectively and efficiently. Providing evidence-based guidance to countries requires the existence of harmonised climate policy data. However, to date there is a lack of structured and harmonised climate policy database that would cover a large number of countries and years. This paper attempts to fill the gap by compiling a climate policy database that provides selected information on countries' mitigation policy landscapes at a granular level.

The Climate Actions and Policies Measurement Framework (CAPMF) is a structured and harmonised climate mitigation policy database with 128 policy variables, grouped into 56 policy instruments and other climate actions (hereafter "policies"), covering 52 IPAC countries from 2000-2020. The CAPMF was developed under the International Programme for Action on Climate (IPAC), which supports country progress towards net-zero greenhouse gas (GHG) emissions through regular monitoring and policy evaluation (IPAC, 2022[1]). IPAC monitoring tools, including the Climate Action Dashboard, are being developed by the OECD in collaboration with the International Energy Agency (IEA), the International Transport Forum (ITF) and the Nuclear Energy Agency (NEA).

IPAC's work on the CAPMF includes climate mitigation actions and policies presented in a way that is consistent with the organisation of information on policies and measures under the UNFCCC (UNFCCC, 2022[2]) and the IPCC frameworks (IPCC, 2022[3]). The CAPMF covers both climate policies with an explicit intent of advancing mitigation domestically and abroad as well as non-climate policies that have an expected positive effect on mitigation. These include sectoral, cross-sectoral and international policies of which market-based instruments (e.g. carbon taxes, subsidies for zero-carbon technologies), non market-based instruments (e.g. standards, bans) and other climate actions (e.g. short-term and long-term emissions targets, climate governance) are further categorised.

The major objectives of the CAPMF are the following:

- Provide structured and harmonised climate mitigation policy data based on common definitions, across a long time period, and for a large number of countries.
- Enable the analysis of the effectiveness of climate policies in reducing GHG emissions, which may support the design of comparable policy recommendations across countries.

IPAC's work on the CAPMF is complementary to UNFCCC stocktaking efforts. While it draws on the UNFCCC stocktaking, in which countries declare their climate policies (UNFCCC, 2022[2]), this paper goes a step further by tracking at a more granular level, which policies have actually been adopted and at what level of stringency. For example, the latest UNFCCC synthesis report on NDCs revealed that 91% of countries were committed to mitigation actions in energy supply, 82% in the transport sector and 77% in buildings, among others (UNFCCC, 2022[2]). The work developed in this paper provides essential information at a granular scale on the coverage (i.e. whether a policy is adopted) and the stringency (i.e. the degree to which climate actions and policies incentivise or enable GHG emissions mitigation at home or abroad) of countries climate action.

While policy coverage and policy stringency do not measure effectiveness, they are the first key steps for assessing effectiveness. The results of the CAPMF, however, should be interpreted carefully. Through

inter-country comparison, the CAPMF may provide information on policy areas that are not yet covered and could be explored when considering future policies, or where stringency could be improved to more effectively achieve domestic and global emissions reductions.

The CAPMF is a starting point for a harmonised climate policy data collection. There are several limitations to its coverage and applicability, some of which may be addressed in future work. Drawing on ongoing OECD data collection efforts such as the Policy Instruments for the Environment (PINE), future work could expand the CAPMF's policy coverage towards new sectors (e.g. agriculture, waste) and new policy instruments, including subsidies for clean technologies (e.g. rebates, tax credits) or internal carbon pricing based on the social cost of GHG emissions. Information on climate adaptation, currently not included, could also be added when the data become available.

IPAC's policy stocktaking effort through the CAPMF will have large synergies with the Inclusive Forum on Carbon Mitigation Approaches (IFCMA) (OECD, 2022[4]). The CAPMF will provide inputs to the module 1 of the IFCMA, which is expected to carry out a stocktake of climate mitigation policies. The primary focus of IPAC's CAPMF is measurement, aiming at collecting comprehensive and harmonised data that are internationally comparable and suitable for quantitative and qualitative analyses. Compared to the stocktake exercise for module 1 of the IFCMA, the scope of the IPAC's CAPMF is broader, also including climate actions such as GHG emissions targets, climate governance, climate information and international climate policies. The CAPMF also covers a longer time series from 2000-2020, enabling ex-post empirical analysis on policy effectiveness, namely module 2 of the IFCMA. Close coordination will take place to efficiently exploit the synergies between the IPAC and the IFCMA.

The CAPMF will inform a number of IPAC deliverables as well as other OECD products and may support international climate processes. IPAC deliverables include IPAC Country Notes that will assist countries to operationalise climate policy commitments, and the annual IPAC Climate Action Monitor that provides a global evaluation of progress towards climate objectives and alignment with the goals of the Paris Agreement. The CAPMF will also feed into OECD Environmental Performance Reviews and OECD Economic Surveys. Importantly, the CAPMF's granular policy data enables the continuation of OECD's work on assessing the environmental and economic effects of different types of climate policies (e.g. market-based and non market-based) and under different country conditions (OECD, 2021[5]). Results of such studies would support countries in tailoring their climate actions to implement their NDCs and move towards net-zero.

The remainder of this paper is structured as follows: Section 0 presents the CAPMF including its objectives, scope and structure, and discusses the methodology for measuring the various policy variables. Section 3 showcases some selected applications and use cases of the CAPMF, both for policy stocktaking and for country-specific analysis. Section 4 discusses some limitations of the CAPMF and provides guidance for interpretation. Finally, Section 5 summarises the main findings and outlines possible future work areas. Annex A provides definitions of key terms used in this paper.

2 Scope, structure and methodology

Scope

The CAPMF is a structured and harmonised database on climate *mitigation* actions and policies. The CAPMF considers *governments'* policies at face value. It does not take into account direct or indirect outcomes or information on how climate policies are perceived.[1] The 2022 edition of the CAPMF provides 128 policy variables grouped into 56 policies for the 52 IPAC countries (OECD members and accession candidates, G20 countries and the European Union) from 2000-2020.[2] Collectively, IPAC countries contribute to more than 85% of global GHG emissions. In addition, the CAPMF covers all countries that contribute to global GHG emissions by more than 1%, except for Iran.

The CAPMF stocktaking exercise includes 75% of policy instrument types listed in the policy framework of the IPCC (2022[3]) Working Group III report (Annex Table C.1). Policies not covered by the CAPMF include bans on SF_6 emissions (which represent less than 2% of global GHG emissions in 2020 (EPA, 2022[6])), or biofuel mandates, which are deliberately excluded from the CAPMF because of issues related to potential increased emissions from direct and indirect land use change (Section 4). The CAPMF does, however, include some policies on GHG other than carbon dioxide (CO_2), such as methane and nitrous oxide. A non-exhaustive list of policies not included in the current edition of the CAPMF (e.g. tax credits, rebates, internal carbon pricing) can be found in Annex Table C.4. This list is expected to shrink in the future as new data become available, for example through the 2023 update of the PINE database, which will focus on replenishing the data on subsidies.

Policies included in the CAPMF directly contribute to all broader mitigation strategies that are mentioned in the UNFCCC synthesis report on the first Global Stocktake (UNFCCC, 2022[2]). These strategies include renewable energy generation, energy efficiency improvements, electrification and fuel-switching to low- or zero-carbon fuels.

The CAPMF covers both climate policies with an explicit intent of advancing mitigation (e.g. carbon taxes, GHG emissions standards, subsidies for zero-carbon technologies) as well as non-climate policies that have an expected positive effect on mitigation (e.g. fuel excise taxes, energy efficiency standards, congestion charges). All policies of the CAPMF have demonstrated to contribute to reducing GHG emissions (see below). The CAPMF provides a toolbox of possible actions that countries may wish to

[1] For example, the CAPMF includes countries' public R&D expenditure on low-carbon technology, but not the number of patents filed by countries' inventors, which are an outcome of public policies. The CAPMF also does not capture environmental outcomes such as GHG emissions or emissions intensities. Moreover, climate actions and policies of non-government actors (e.g. the private sector) are not within the scope of the CAPMF as long as there is no direct government involvement. Finally, the CAPMF does not account for the enforcement of climate policies.

[2] The IPAC countries include: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Türkiye, the United Kingdom, the United States and the European Union.

consider, but is not intended to be prescriptive to countries' policy approaches. At this stage, the CAPMF focusses primarily on national policies, covering only a few sub-national approaches, which are key in some countries.[3]

The CAPMF sources data from data collection efforts within and outside the OECD. Data sources include information from policy databases such as the OECD Policy Instruments for the Environment (PINE) database (OECD, 2021[7]), the IEA Policies and Measures database (IEA, 2021[8]) and the ITF Transport Climate Action Directory (ITF, 2021[9]). The CAPMF draws on other official data, including from the United Nations Statistical Division (UNSD), the United Nations Framework Convention on Climate Change (UNFCCC) and the World Bank (see Annex Table B.1 for more details). Expanding the coverage of policies in the future could include climate adaptation policies.

The CAPMF categorises policy data in two ways. First, the policy variables are categorised into sectoral, cross-sectoral and international climate actions and policies (Section 'Structure'). Second, they are categorised by policy type, including market-based instruments (e.g. feed-in-tariffs, emissions trading schemes), non market-based instruments (e.g. emissions limit values, bans or phase outs of fossil fuel equipment and infrastructure) and 'NDCs and other actions' (e.g. NDCs, net-zero targets, climate governance) (Annex Table C.2).

The CAPMF is complementary to and does not duplicate the synthesis report prepared by the UNFCCC and the broader reporting framework, the enhanced transparency framework (ETF). The CAPMF is based on an objective, systematic and internationally harmonised data collection and validation process. Its value added compared to the UNFCCC reporting framework is the following:

1. The CAPMF provides information on policies adopted at a much more granular level. For example, the UNFCCC synthesis report on countries' NDCs indicates the number of Parties with policies in the transport sector. The CAPMF, in contrast, provides more granular information on policy adoption of the most common policy instruments.
2. The CAPMF provides information on the stringency of policies.
3. The CAPMF is more flexible as new policy data can be integrated and historical values updated on an ongoing basis. The CAPMF will be available two years before the ETF (start date is 2024) and will be updated on an annual basis rather than on a biannual one.

The CAPMF can be used to develop evidence about policy effectiveness by enabling empirical analyses based on harmonised policy data across time, countries and policy type, and in combination with outcome variables (e.g. GHG emissions, GHG emissions intensity). The wealth of the CAPMF data offers opportunities to investigate which policy approaches work most effectively under which country specific conditions. The results from these analyses can support tailored policy recommendations, which are crucial for achieving NDCs and net-zero targets (Section 5).

Structure

The structure of the CAPMF follows the organisation of policies and measures used in UNFCCC synthesis reports on biennial reports (UNFCCC, 2020[10])4 and is aligned with relevant OECD work classifying policy instruments such as the OECD PINE database (OECD, 2021[7]) and the OECD Environmental Policy

[3] Sub-national policies included in the CAPMF are emissions trading schemes, carbon taxes, renewable energy auctions, renewable energy portfolio standards and motorway speed limits.

[4] The UNFCCC categorises countries policies and measures into sectoral policies (for each of the IPCC source sectors), cross-sectoral policies, and others. The CAPMF follows this approach and adds a building block 'international policies'.

Stringency (EPS) Index (Botta and Koźluk, 2014[11]) (Kruse et al., 2022[12]). The CAPMF is organised across three building blocks, which reflect the spectrum of countries' climate actions and policies: sectoral policies, cross-sectoral policies, and international policies (Figure 2.1).

Sectoral policies are defined as policies that can be constrained to or are designed to apply to a specific source or economic sector (e.g. emission limit values for passenger cars, phase out of power plants). The CAPMF covers all IPCC source sectors, including power generation, industry, transport, buildings, agriculture, land use, land-use change, and forestry (LULUCF) and waste. In most countries, sectoral policies are proposed by the respective Ministry.

For each sector, the CAPMF explicitly distinguishes between market-based instruments and non market-based instruments. Market-based instruments are policy instruments that use markets, prices and/or other monetary means to provide incentives for producers and consumers to reduce or eliminate environmental and other externalities (OECD, 2007[13]). Non market-based instruments are instruments that work through the imposition of certain obligations or by installing non-monetary incentives to change behaviour (Prahl and Hofmann, 2016[14]).

A sector-by-sector approach allows for a granular empirical assessment of policies' environmental and economic effects when combined with data on emissions and economic variable. Around 70% of emissions reduction from climate strategies and policies in countries' 4th Biennial Reports (submitted in 2020) can be attributed to sectoral measures (UNFCCC, 2020[10]).

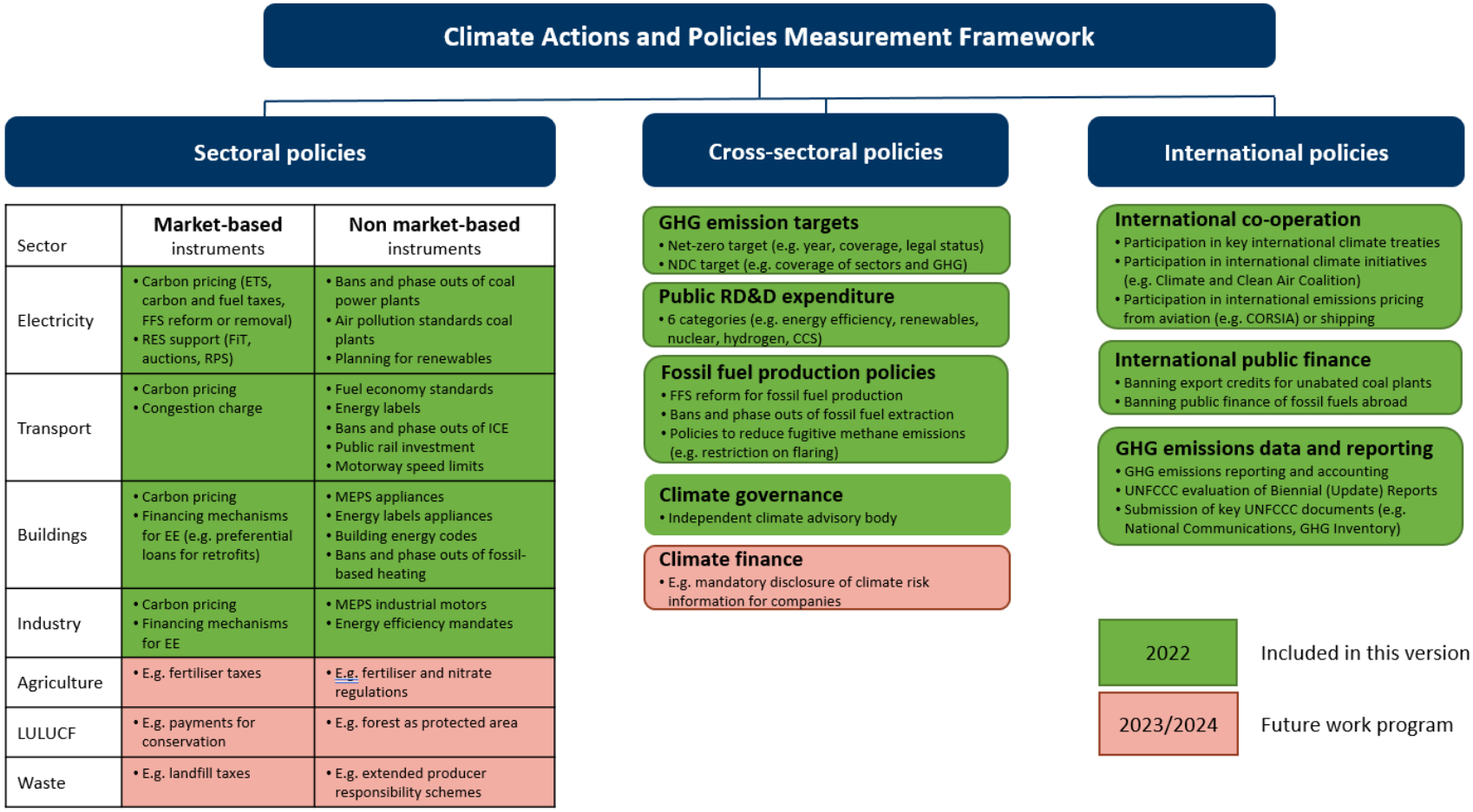
Cross-sectoral actions and policies refer to policies that cut across more than one emission source or sector. These are overarching policy areas to mitigate or remove domestic GHG emissions that cannot be easily attributed to a specific sector (e.g. GHG emissions targets, climate governance).

International policies refer to policy commitments associated with international covenants or agreements where more than one country participates (e.g. participation in international climate agreements, international public climate-related finance). While international policies do not necessarily reflect domestic mitigation commitments or efforts, these policies and international co-ordination are vital to reach the goals of the Paris Agreement given the global nature of the climate change challenge. Some countries explicitly highlight the importance of international policies to reduce emissions abroad (Finnish Government, 2019[15]). In addition, some international policies legalise and legitimise national commitments which is important especially for developing and middle-income countries. International co-ordination can address several challenges, including unevenly distributed emissions sources, heterogeneous mitigation costs and heterogeneous climate impacts (IPCC, 2014[16]).

The modular structure of the CAPMF facilitates the analysis of the building blocks separately. This may be relevant for countries that have different policy approaches emphasising specific types of policy instruments. For example, practitioners may not want to take international policies into account when the major focus of their work is on domestic mitigation efforts.

Each building block consists of a number of modules (e.g. targets in national cross-sectional policies and actions). Each module encompasses a number of climate actions and policies (e.g. net-zero targets and NDC in targets) and each policy can consist of a number of policy variables (e.g. target year of net-zero targets). Modules with green colour code in Figure 2.1 are included in this version of the CAPMF. Policies and actions in light red modules of Figure 2.1 are *indicative* and expected candidates to be developed in 2023-2024.

Figure 2.1. The structure of the CAPMF



Note: Modules for future work program are only indicative. Abbreviations: LULUCF: Land use, land-use change and forestry; ETS: Emissions trading system; FFS: Fossil fuel support; RES: Renewable energy sources; FiT: Feed-in-tariff; RPS: Renewable Portfolio Standard; EE: Energy efficiency; ICE: Internal combustion engine; MEPS: Minimum energy performance standard; CCS: carbon capture and storage.
Source: Authors.

The three building blocks of the CAPMF

This section provides details on the modules and policies of the CAPMF. It presents the policies, the measurement or policy variables included, the rationale, and the data source for each building block. Annex B provides additional information on the policies, including a detailed description of the underlying raw data, as well as information on country and time coverage.

Building block I: Sectoral climate actions and policies

This building block consists of a broad set of sectoral climate actions and policies grouped into market-based instruments and non market-based instruments, following the classification adopted in previous OECD work, including the OECD EPS (Botta and Koźluk, 2014[11]). This section provides more details on sectors included in the 2022 edition of the CAPMF, notably electricity, transport, industry and buildings, which jointly account for 79% of global GHG emissions in 2019 (IPCC, 2022[3]). Sector-specific policies on public RD&D expenditures are included in building block II.[5]

Market-based instruments

Market-based instruments covered by the CAPMF include explicit (carbon taxes, emissions trading schemes) and implicit carbon pricing instruments (fuel excise taxes), other charges related to reducing GHG emissions (e.g. congestion charges in urban areas), as well as support policies for renewable electricity (e.g. feed in tariffs, auctions) and financing instruments for low-carbon technologies or energy efficiency (Table 2.1).

GHG emissions pricing and other market-based instruments are effective in promoting low-cost mitigation measures (IPCC, 2022[3]). The CAPMF includes all relevant carbon pricing instruments such as carbon taxes, ETS (both national and sub-national) and fuel excise taxes, which is coherent with OECD work on carbon pricing (OECD, 2021[17]). The CAPMF uses the permit price level and the coverage of GHGs (e.g. carbon dioxide, methane, nitrous oxide) weighted by their contribution to global GHG emissions for ETS as well as the nominal rates of carbon taxes and the most relevant fuel excise taxes in each sector (e.g. diesel, gasoline, coal, natural gas, and kerosene). Using nominal rates is complementary to the IPAC dashboard indicator on the net effective carbon rate (NECR).[6]

[5] Including the category 'technology support policies' (following the updated version of the EPS (Kruse et al., 2022[12])) was, however, not feasible. This is because attributing the RD&D technology categories in the IEA database to specific economic sectors is not possible. For example, RD&D on hydrogen technologies could be attributed to most energy sectors, including electricity, industry, or transport. Hence, public expenditure on RD&D is included under cross-sectoral policies.

[6] Once the NECR is developed, a future update of the CAPMF may use that indicator provided that it falls within the scope of the CAPMF. It is also planned to include data on internal carbon pricing (e.g. based on the social cost of carbon) in future update of the CAPMF (Section **Error! Reference source not found.**). Disaggregating the ECR (which is the sum of carbon tax, ETS and fuel excise taxes) into its components provides a more granular picture of countries' carbon pricing policies (OECD, 2021[75]). In addition, evaluating nominal rates instead of average sector-specific ECRs that are weighted by country-specific consumption shares of energy products, ensures that a change in the policy variables is solely driven by a change in policy and not by a change in the underlying energy consumption basket. In fact, the Covid-19 crisis has shown that average ECR rates are influenced by exogenous shocks although governments' action has hardly changed. While data on effective carbon rates (ECRs) is only available for 2012, 2015, 2018 and 2021, nominal rates for fuel excise taxes, carbon taxes and ETSs are available from 1990, which significantly enhances the sample size and is key for prospective empirical applications.

The CAPMF evaluates the carbon pricing instruments sector-by-sector to account for differentiated tax rates by sector.[7] To account for tax exemptions, the CAPMF includes the sector-specific support estimate on fossil fuels from the OECD Inventory, which documents tax exemption data (OECD, 2015[18]) (OECD, 2021[19]). The OECD support estimate is normalised by the total government expenditure.[8]

The CAPMF includes subsidies for renewable electricity generation and financing mechanisms to improve energy efficiency. As countries use different instruments to support renewables, the CAPMF captures the most common approaches, including Feed-in-Tariffs (FiTs), auctions and renewable portfolio standards with tradeable renewable energy certificates.[9] For FiTs and auctions, the level of the support price is scaled by the levelised cost of electricity (LCOE) to reflect falling technology costs, following the approach of the OECD EPS (Kruse et al., 2022[12]). Subsidies for low-carbon technologies in other sectors are currently not included due to data availability (Section 4). The CAPMF includes the existence of financing mechanisms to finance building retrofits or energy efficient industrial equipment (e.g. preferential loans, risk guarantees).

Table 2.1. Sectoral climate policies: Market-based instruments

Policy	Policy variables/ Measurement	Rationale	Source
		For each sector	
Emissions trading schemes	• Average annual price level of emissions trading scheme • Number of GHG covered by ETS weighted by contribution to global GHG emissions	Carbon pricing is the most cost-effective mitigation policy to reduce CO_2 emissions. Pricing of GHG emissions provides incentives to reduce GHG emissions, including short-lived climate pollutants and other non-CO_2 GHG emissions	OECD, ICAP
Carbon tax	Nominal tax rate of carbon tax in USD/tCO_2	Carbon pricing is the most cost-effective mitigation policy to reduce CO_2 emissions	OECD
Fossil fuel excise taxes	• Level of nominal diesel tax in USD/tCO_2e • Level of gasoline tax • Level of coal tax • Level of natural gas tax • Level of kerosene tax	Fossil fuel excise taxes indirectly put a price on energy-related carbon emissions which helps reduce fossil fuel consumption and, thus, CO_2 emissions in a cost-effective way. The CAPMF only takes into account a fuel in a sector if the fuel accounts for more than 5% of energy consumption.	IEA/OECD
Governments' reform of fossil fuel support	Fossil fuel support for oil, natural gas and coal in % of total tax revenue	Fossil fuel support (e.g. tax exemptions) encourages consumption of fossil fuels, leading to an increase of CO_2 emissions. Removing those incentives would reduce consumption of fossil fuels.	OECD
		Electricity	
Feed-in-tariffs for solar PV and wind	• Ratio between the level of feed-in-tariff (FiT) and its levelised cost of electricity (LCOE) for solar PV and wind • Duration of support in years for solar PV and wind	Financial support for renewables is necessary to accelerate renewables deployment. FiT provide certainty for investors, channelling private funds into renewables. Scaling by LCOE ensures that the level of policy support takes falling technology costs into account	OECD
Auctions for solar PV and wind	• Ratio between the level of bid price and its LCOE for solar PV and wind • Duration of support in years	Financial support for renewables is necessary to accelerate renewables deployment. Auctions provide certainty for investors, channelling private funds into renewables.	IEA
RPS with tradeable renewable energy certificates	Share of renewable electricity obligation on total electricity generation	Renewable energy portfolio standards and tradeable certificates provide an extra revenue source for renewable energy developers, which can accelerate the deployment of renewables.	OECD
		Transport	
Congestion charges	Price of a city's congestion charge	Congestion charges for passenger cars in urban areas reduce	OECD

[7] Note that this is in contrast to the UNFCCC synthesis reports that evaluate carbon pricing as cross-sectoral policy (UNFCCC, 2020[10]).

[8] See the detailed description in 5Annex B for the caveats related to using the OECD fossil fuel support Inventory.

[9] RPS are strictly speaking non market-based instruments. However, the vast majority of existing RPS are coupled with tradeable renewable energy certificates to reduce compliance costs. Hence, the CAPMF considers RPS as market-based instrument. This is also in line with the methodology of the EPS (Botta and Koźluk, 2014[11]) (Kruse et al., 2022[12]).

Policy	Policy variables/ Measurement	Rationale	Source
		incentives for car use and, thus, car dependency while promoting the shift towards more sustainable modes of transport such as public transport or cycling.	
		Industry	
Financing mechanisms for energy efficiency	Number of financing mechanisms for energy efficiency investments of large consumers (e.g. preferential loans, risk guarantees).	Financing mechanisms reduce the upfront investments costs, one of the key barriers for technology adoption, for companies, driving investments into more energy efficient technologies. Improving energy efficiency is one of the key channels to reduce industrial GHG emissions.	World Bank (RISE)
		Buildings	
Financing mechanisms for energy efficiency	Number of financing mechanisms for building retrofits (e.g. preferential loans, risk guarantees)	Financing mechanisms for building retrofits drive investments into renovation by reducing the upfront investments costs, which are one of the key barriers for carrying out major building renovations. Improving energy efficiency is one of the key channels to reduce buildings' GHG emissions.	World Bank (RISE)

Source: Authors.

Non market-based instruments

The CAPMF includes non market-based instruments such as standards (e.g. voluntary and mandatory building energy codes, emission limit values, minimum energy performance standards), information instruments (e.g. energy efficiency labels), other regulatory instruments (e.g. bans and phase outs of carbon-intensive technologies, energy efficiency mandates, planning frameworks for renewables) as well as non-climate instruments that would reduce GHG emissions (e.g. motorway speed limits, public investment in rail infrastructure, air pollution standards) (Table 2.2).

Standards such as emissions limit values, building codes and mandatory minimum energy performance standards (MEPS) help increase the adoption of low-carbon technologies (e.g. renewables in electricity generation), energy efficient assets (e.g. buildings, electric motors) and equipment (e.g. passenger cars, appliances) (Schleich, Durand and Brugger, 2021[20]). For example, appliance efficiency policies have helped more than halve the energy consumption of major appliances in countries with the longest-running programmes (IEA, 2021[21]).

The CAPMF includes the level of the emission limit value and the performance requirements of the MEPS, where data on the performance requirements is available (e.g. MEPS industrial electric motors, emission limit values of power plants). Where this data is not available, the CAPMF includes the existence of these policies (e.g. building energy codes, MEPS for electric appliances, ELV for light- and heavy duty vehicles).

Bans and phase-outs of carbon-intensive technologies (e.g. coal in power production, conventional passenger cars, oil or gas heating) send a clear policy signal and provide certainty for investors, firms and households to switch to low-carbon alternatives (Meckling and Nahm, 2019[22]). Bans refer to the prohibition of the purchase of or investment in *new* assets whereas phase-outs refer to the prohibition of using already existing assets. According to IEA's net-zero scenario, all unabated coal power plants need to be phased out by 2040 globally and much earlier in developed economies (IEA, 2021[23]). Banning or phasing out fossil fuel infrastructure by governments can be part of a policy mix to ensure that there is no appetite for new investments in infrastructure and equipment.

The CAPMF includes both the year in which the ban or phase out of carbon-intensive technologies becomes effective and the legal status (e.g. announcement, in law, achieved). This is because a more binding legal status (e.g. enshrining bans and phase-outs in law) increases the credibility and the accountability of these actions.

Table 2.2. Sectoral climate policies: Non market-based instruments

Policy	Policy variables/ Measurement	Rationale	Source
Electricity			
Ban on the construction of new and phase out of existing unabated coal power plants	• Target year and legal status of phase out • Target year and legal status of ban	Coal power plants are the single most important contributor to global GHG emissions. According to IEA's net-zero 2050 scenario, all unabated coal power plants need to be phased out by 2040 globally and much earlier in developed economies. In addition, the last unabated coal power plant would be completed in 2025 and no unabated coal power plant will go online in developed economies from 2020	IPAC CAPMF data collection
Planning for renewables expansion	Existence of integrated transmission and generation planning and renewable siting	Integrated transmission and (renewable) generation planning in combination with resource data and siting is the foundation to expand generation from renewable energy sources such as wind and solar PV.	World Bank (RISE)
Air pollution standards for coal power plants	Emission limit value for • nitrous oxide • sulphur oxide • particulate matter and • sulphur emissions	Emissions limit values on air pollutants increase the operating costs of coal power plants, reducing the operating hours and accelerating market exit of inefficient plants. Although the effect of emission limit values on GHG emissions is highly non-linear (e.g. because standards typically incentivise the installation of pollution abatement equipment, which could increase energy consumption and, thus, GHG emissions), the market exit effect is found to clearly dominate.	OECD EPS
Transport			
Fuel economy standards	Emission limit value in place (yes/no) for • light duty vehicles • heavy duty vehicles	Emission limit values or minimum energy performance standards for light and heavy-duty vehicles can improve the fuel efficiency of cars, leading to lower GHG emissions.	IEA and World Bank (RISE)
Mandatory fuel economy labels for light duty vehicles	Existence of mandatory fuel economy label for light duty vehicles	Information about prospective fuel consumption supports consumers to make better informed purchasing decisions, increasing demand for more fuel-efficient cars.	IEA
Ban on the sales of new and phase out of conventional passenger cars	• Target year and legal status of phase out • Target year and legal status of ban	Fossil-based passenger cars are the major source of transport-related GHG emissions. According to IEA's net-zero 2050 scenario sales of new conventional passenger cars is required to halt in 2035 globally	IPAC CAPMF data collection
Share of rail on total surface transport public expenditure	Share of central government's expenditure on new investments in rail infrastructure on total surface transport expenditure	Public investments in rail infrastructure provides alternatives to private car journeys. Rail transport has substantially lower GHG emissions per passenger kilometre compared to cars, notably in non-urban areas (IEA, 2020[24]).	ITF
Speed limits on motorways	National speed limit on motorways	Speed limits on motorway are one of the most effective ways to reduce road transport emissions immediately. According to the European Environmental Agency, reducing the speed limit from 120 km/h to 110 km/h would reduce fuel consumption and GHG emissions of passenger cars by 12-18% (EEA, 2020[25]).	ITF
Industry			
Minimum energy performance standards for electric motors	Level of the minimum energy performance standards of industrial motors	Minimum energy performance standards for electric motors are key to limit industry's energy demand. According to IEA's net-zero 2050 scenario, all new electric motors need to be best in class from 2035.	IEA
Energy efficiency mandates	Existence of mandates for large energy consumers	Mandates such as mandatory energy audits, certified energy management systems or energy managers can play a vital part in reducing energy consumption, and thus, CO_2 emissions in industrial facilities.	World Bank (RISE)
Buildings			
Building energy codes	Mandatory or voluntary building energy code for new buildings in place (yes/no)	Mandatory or voluntary building energy codes are key to curb energy demand by mainstreaming energy efficient buildings. According to IEA's net-zero 2050 scenario, all new buildings need to be zero-carbon ready from 2030.	IEA
Minimum energy performance standards of appliances	MEPS in place for new domestic appliances: lighting, refrigerator, freezer, air conditioner	Minimum energy performance standards in the buildings sectors are key to curb energy demand by mainstreaming energy efficient electrical equipment. According to IEA's net-zero 2050 scenario most new appliances and cooling systems need to be best in class from 2035.	IEA
Mandatory energy labels for appliances	Mandatory energy label in place for new domestic appliances	Energy labels provide information on appliances' energy performance, enabling consumers to make better-informed decisions. This helps mainstream more energy efficient products.	IEA

Policy	Policy variables/ Measurement	Rationale	Source
Ban and phase out of fossil fuel heating systems	• Target year and legal status of phase out • Target year and legal status of ban	Using fossil fuels for heating substantially contributes to building-related GHG emissions. Banning fossil fuel use (oil and natural gas) for heating in new buildings and phasing out fossil fuel use in existing ones would accelerate the uptake of alternative heating technologies (e.g. heat pumps, district heating with non-fossil fuel where available).	IPAC CAPMF data collection

Source: Authors.

Building block II: Cross-sectoral climate actions and policies

This building block consists of four modules spanning cross-sectoral climate policies, including GHG emissions targets (NDCs and net-zero), public research development and demonstration, fossil fuel production policies, and climate governance (Table 2.3).

NDCs and net-zero targets are key short-term and long-term targets that shape consumers' and producers' expectations, affecting their decisions already today.[10] Long-term targets and pathways about how to achieve them (e.g. through long-term low emissions development strategies) are key anchors against which short-term climate action can be evaluated and potentially legally challenged (Grantham Research Institute, 2021[26]).

The CAPMF includes, i.a, the scope (e.g. coverage of sectors and GHGs) or the type of target (e.g. absolute reduction target or emission intensity target) for NDCs; and the scope, institutional arrangement (e.g. in law or in policy document) and the target year for net-zero targets. It is, thus, complementary to the IPAC dashboard indicator 'Trends and trajectories', which measures the trajectory towards NDCs and net-zero targets. Assessing whether a country's NDC is in line with the goals of the Paris Agreement is beyond the scope of this paper.

Public expenditure on research development and demonstration (RD&D) supports continuously improving key zero-carbon energy technologies through innovation. Innovation is important for the transition towards net-zero energy systems. Early-stage technology development requires more targeted policies than deployment of more mature technological solutions (Johnstone, Haščič and Popp, 2009[27]) (Haščič and Johnstone, 2011[28]).

The CAPMF distinguishes between six different energy categories for public research, development and demonstration (RD&D) budget, including energy efficiency, renewable energy, nuclear, CCS, hydrogen and fuel cells, and power and storage technologies, all of which are critical in the technology mix towards net-zero (IEA, 2021[29]). This distinction provides a more granular picture of countries' energy innovation landscape. Data on public RD&D budgets for low-carbon technologies in end-use sectors such as buildings (e.g. building envelope technologies) or transport (e.g. electric vehicles) are subsumed under energy efficiency. Data on RD&D for urban design or carbon removal technologies such as direct air capture is not yet available, but can be integrated once it becomes available (Section 4).

Fossil fuel production policies shape investments in exploration and extraction of fossil fuels, including coal, oil, and natural gas that are used in the electricity and end-use sectors. Fossil fuel producer support (e.g. reductions in royalties or government spending on fossil fuel infrastructure such as gas pipelines) remain substantial in some countries (OECD & IEA, 2021[30]).

The CAPMF includes the amount of support for fossil fuel production, following the OECD Inventory of Support Measures for Fossil Fuels (OECD, 2015[18]). The Inventory aims to cast a wide net to support governments with identifying potential budgetary and tax expenditure measures for reform, consistent with the notion that "information precedes analysis" (OECD, 2021[19]). The CAPMF includes bans and phase

[10] There are still significant gaps between long-term targets and short-term targets as well as between targets and action (Falduto and Rocha, 2020[72]).

outs of fossil fuel extraction, following the announcements of the Beyond Oil and Gas Alliance (BOGA) in Glasgow 2021 (BOGA, 2021[31]). These policies are effective in avoiding GHG emissions, but are not in place in most countries (Green and Denniss, 2018[32]). IEA's net-zero 2050 scenario states that in order to reach net-zero by 2050, there is no need for the development of new oil or gas fields as well as coal mines and mine extensions from 2021 (IEA, 2021[23]). Hence, banning or phasing out of fossil fuel production by governments can be part of a policy mix to ensure that there is no appetite for new developments. Finally, the CAPMF includes a number of policies to reduce fugitive methane emissions in the energy sector such as technology standards and regulations related to leak detection and repair as well as flaring and venting (IEA, 2022[33]).

Climate governance is key for effective climate mitigation and enhancing the legitimacy of policy making. Independent climate advisory bodies were found to enhance the legitimacy of the policymaking process while helping strengthen public trust and political support for climate action (Averchenkova and Lazaro, 2020[34]). For example, emissions in the United Kingdom have decreased sharply after the implementation of the UK Climate Change Panel in 2008 (OECD, 2021[35]) whereas Finland determined its net-zero target based on the recommendation of the Finnish Climate Change Panel (OECD, 2021[36]). The CAPMF includes a number of key parameters of independent advisory bodies (e.g. whether they are in law, number of staff). Other policy variables on climate governance (e.g. domestic or international climate envoy, stakeholder engagement) could be added in a future version of the CAPMF.

Table 2.3. Cross-sectoral climate actions and policies

Policy	Policy variables/ measurement	Rationale	Source
GHG emissions targets			
NDCs	• Coverage of NDCs (sectors, GHGs) of NDCs • Type (e.g. absolute reduction target)	NDCs are key short-term targets to support the goals of the Paris agreement. Yet, NDCs differ in terms of coverage and type. The NDC is more demanding and more transparent the broader the coverage of NDCs and the more stringent the type.	UNFCCC
Net-zero target	• Year in which country plans to achieve net-zero • Institutional arrangement of the net-zero target (categorical). • Coverage of net-zero target (e.g. all GHG, all domestic sectors)	To limit global warming to 1.5°C, global GHG emissions must reach net-zero by 2050. The earlier countries are planning to reach net-zero, the higher the chance to limit global warming in line with the 1.5°C target. The institutional arrangement of net-zero targets has implications on the credibility and on potential litigation actions from civil society if countries are not on track in meeting their targets. The scope of net-zero targets is key for its effectiveness.	IPAC CAPMF data collection
Public RD&D expenditure			
Public Research, Development and Demonstration expenditure	• Spending on public RD&D related to energy efficiency in % of national GDP • RD&D for renewables • RD&D for nuclear • RD&D for hydrogen • RD&D for power and storage • RD&D for CCS	Public RD&D expenditure in low-carbon technologies (e.g. renewables, nuclear, CCS) is crucial for innovation and adoption of new technologies to limit global warming to 1.5°C. Other non-fossil energy technologies (e.g. energy efficiency, hydrogen, fuel cells, smart grids) are key technologies to decarbonise hard-to-abate sectors (e.g. steel, cement) or key enablers for the shift towards zero-carbon energy systems.	IEA
Fossil fuel production policies			
Reform of governments' support for fossil fuel production	Governments' support for fossil fuel production in % of total government expenditure.	Governments' fossil fuel support encourages the use of fossil fuels, contributing to the lock-in of carbon-intensive production and consumption styles. The volume of government support for fossil fuels remains substantial. Reforming or removing fossil fuel support would increase fossil fuel prices, providing incentives to shift away from fossil fuels.	OECD
Bans and phase outs of fossil fuel extraction	• Target year and legal status of phase out Target year and legal status of ban	Fossil fuels are the major contributor to GHG emissions. According to IEA's net zero 2050 scenario, from 2021 there is no need for new oil and gas fields for development as well as for new coal mines or mine extensions. To limit global warming to 1.5°C, it is estimated that 90% of proven coal reserves and around 60% of proven gas and oil reserves must not be extracted (Welsby et al.,	IPAC CAPMF data collection

Policy	Policy variables/ measurement	Rationale	Source
		2021[37]).	
Policies to reduce fugitive methane emissions	Score of IEA's methane reduction policy indicator	Methane is a very potent, though short-lived greenhouse gas. Methane policies, including robust measurement and reporting requirements, technology standards and economic incentives for abatement have successfully reduced energy-related methane emissions (IEA, 2022[33])	IEA
Climate governance			
Independent climate advisory body	• Climate advisory body in law • Annual budget • Size of the Secretariat • Number of staff	The existence of an independent advisory body on climate change has proved effective to monitor governments' progress towards climate targets, to propose policy instruments to reach targets or to propose short-term, mid-term and long-term targets (Averchenkova and Lazaro, 2020[34])	IPAC CAPMF data collection

Source: Authors.

Building block III: International actions and policies

This block consists of international climate policies grouped into three modules: GHG emissions data and reporting, international climate co-operation, and international public climate finance (Table 2.4).

Transparency and completeness of GHG emissions data and reporting are a prerequisite to tailor effective mitigation strategies (Yamin and Depledge, 2004[38]). Providing climate data and international reporting under the UNFCCC, including the UNFCCC evaluation of the BRs, BURs and BTRs under the Paris Agreement as well as submissions of other UNFCCC documents (e.g. National Communications, National GHG Inventories) ensure that data is available to measure progress and to identify drivers of emissions.[11]

Following internationally agreed reporting guidelines, the CAPMF uses information provided in the reports of the respective UNFCCC Technical Expert Groups to assess the transparency of countries' Biennial Reports (BRs), Biennial Update Reports (BURs), and GHG inventories.[12] The CAPMF accounts for the fact that currently (mandatory) reporting requirements and review or technical assessment processes differ across Annex I, Annex II, non-Annex I parties to the UNFCCC by normalising the UNFCCC evaluation depending on the country group, following the approach of (Weikmans, Asselt and Roberts, 2019[39]). Under the Enhanced Transparency Framework entering into effect in 2024, this distinction will disappear. The CAPMF includes the timeliness of mandatory UNFCCC submissions, which often serve as a basis for assessing countries transparency in climate reporting (Baettig, Brander and Imboden, 2008[40]) (Bernauer and Böhmelt, 2013[41]). In addition to UNFCCC reporting, the CAPMF includes information of whether or not countries compile GHG emissions accounts, following the System of Environmental-Economic Accounting (SEEA) – an internationally agreed accounting standard.[13] Emissions accounts complement IPCC emissions inventories because they disaggregate GHG emissions by economic activity (e.g. manufacturing, other industries and households), supporting policy makers to better tailor and evaluate policies.

[11] Most of the UNFCCC documents are not required to be submitted on an annual basis. The CAPMF carries forward the evaluation of the latest submission of the document for the subsequent years.

[12] From 2024, the CAPMF will use the information on the Biennial Transparency Reports (BTR) instead of the BRs and BURs.

[13] The SEEA (United Nations et al., 2021[74]) is a direct extension of the System of National Accounts (UN, 2009[76]) as it is based on the same accounting principles.

International climate co-operation is crucial to achieve net-zero GHG emissions by 2050. International co-ordination and participation in international climate agreements are key for establishing a common understanding of the global climate problem (Bernauer and Böhmelt, 2013[41]).

The CAPMF measures whether countries are being Party to major international climate agreements (e.g. Montreal Protocol, Paris Agreement). The CAPMF uses participation in a selected set of international co-operative initiatives (e.g. Climate and Clean Air Coalition) as a proxy for countries' efforts to multilateral climate cooperation. This indicator is based on the initiatives listed on the UNFCCC global climate action portal (NAZCA) that was launched in 2014 (UNFCCC, 2021[42]).[14] Basing the initiatives on the NAZCA portal helps anchor and orient initiatives included in the CAPMF. This module includes emissions pricing from international aviation and maritime transport along with participation in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which is voluntary in the first phase from 2021-2023.[15] These sectors account for almost 5% of global GHG emissions (Lee and Fahey, 2020[43]). Measures to reduce GHG emissions from these sectors are addressed by the International Maritime Organisation (IMO) and the International Civil Aviation Organization (ICAO) (IMO, 2020[44]).

International public climate finance allows governments to directly support other countries' efforts to mitigate climate change. Some countries (e.g. Finland, New Zealand) explicitly mention that international climate finance has substantial leverage by reducing emissions abroad (MFAT, 2021[45]) (Finnish Government, 2019[15]).

Banning governments' export credit support for new unabated coal power plants – i.e. power plants that are not equipped with carbon capture utilisation and storage (CCUS) technologies or non-CCUS emission abatement technologies, which may be developed in the future (OECD, 2021[46]) – is expected to discourage investment in new unabated coal plants by removing incentives which run counter to the goals of the Paris Agreement. Similarly, banning public finance for unabated fossil fuel infrastructure abroad - in accordance with the 2022 G7 Leaders' Communique (G7, 2022[47]) – is expected to decrease the number of fossil fuel projects.

Table 2.4. International climate policy: Detailed description of components

Policy	Policy variables/measurement	Rationale	Source
GHG emissions data and reporting			
UNFCCC evaluation of Biennial Reports and Biennial Update Reports	Evaluation of the UNFCCC technical expert review's assessment on the transparency and completeness of BRs and BURs (replaced by BTRs post-2024)	Transparency and completeness of Biennial (Update) Reports is a prerequisite for climate action because it ensures that relevant data is available to measure progress and to identify the drivers of emissions.	UNFCCC
Submission of key UNFCCC documents	Timely submission of key mandatory and voluntary documents to the UNFCCC (e.g. BR, BUR, BTR post 2024, NIR, NC, LT-LEDS)	Submission of documents to the UNFCCC is a prerequisite for climate action because it fills information gaps and helps identify drivers of emissions as well as strategies to climate mitigation.	UNFCCC
GHG emissions reporting and accounting	•UNFCCC evaluation of the submission of GHG Inventories based on UNFCCC Technical Expert reviews •Existence of Air emissions accounts under the System of Environmental Economic Accounting (SEEA)	Tracking GHG emissions is key for enhancing transparency and addressing climate change effectively. Environmental accounting enables countries to analyse and track total emissions, emissions sources, and emission removals, all of which are key to inform policy and track progress towards targets.	UNFCCC, OECD, Eurostat
International climate co-operation			
Participation in international climate agreements	Being Party to major international climate agreements (yes/no, year of adhesion or ratification), including the Montreal Protocol (+amendments), the UNFCCC convention,	Major international agreements are key to tackling climate change as they provide a common understanding of the problem, and its solutions while laying out common targets. Participation in those	UNFCCC, UNTC

[14] While the NAZCA portal predominantly lists initiatives from non-state actors, the CAPMF only takes initiatives into account for which at least one national government (along other sub-national governments or corporate actors) is a member.

[15] Other measures besides pricing to reduce emissions from international aviation and maritime transport are under consideration.

Policy	Policy variables/measurement	Rationale	Source
	the Kyoto Protocol, the Paris Agreement.	agreements shows commitment to the stated goals.	
Participation in international climate initiatives	Number of memberships in international climate initiatives listed in the Global climate action portal of the UNFCCC	Participation in international climate activities is a good proxy for international co-operation, which is needed to reach climate goals.	UNFCCC
Participation in international emissions pricing from aviation and shipping	•Carbon price on CO_2 emissions from international aviation (e.g. through ETS) •Carbon price on CO_2 emissions from international maritime transport •Participation in CORSIA	Emissions from international aviation and maritime transport cannot easily be attributed to specific countries and, thus, require international co-operation. Pricing those emissions is a cost-effective means to reduce emissions.	IPAC CAPMF data collection
International public finance			
Banning governments' export credits for new unabated coal power plants	Ban on export credits for new unabated coal power plants (yes/no).	Banning governments' export credit for new unabated coal power plants is expected to increase coal plants' financing costs, discouraging investments in new unabated coal plants.	IPAC CAPMF data collection
Banning public finance for unabated fossil fuel infrastructure abroad	Ban on public finance for unabated fossil fuel infrastructure abroad (yes/no).	Banning public finance for unabated fossil fuel infrastructure abroad is expected to reduce investments in this kind of infrastructure.	IPAC CAPMF data collection

Note: Abbreviations refer to NC: National Communication, BR: Biennial Report, LT-LEDS: Long-term low-emissions development strategy, ETS: emissions trading scheme.
Source: Authors.

Normalisation and missing data

The CAPMF *groups* its 128 policy variables into 56 policies (see Figure 2.1). This is to aggregate policy variables that describe the same policy instrument or are otherwise similar in nature. For example, the CAPMF comprises four variables on feed-in-tariffs (FiT) for renewable electricity (support level and contract duration for both solar PV and wind), but only one variable for renewable energy portfolio standards. Hence, the CAPMF groups the four variables into one to assess the extent to which a country has adopted a FiT.

The CAPMF normalises each policy variable based on the *in-sample distribution across all countries and years*. Normalisation is necessary in order to map different dimensions of policy variables into one common dimension. For example, the contract duration of FiT is measured in years whereas the FiTs' support level is measured in USD per MWh.

Normalisation also allows for determining policy stringency. Policy stringency is defined as the degree to which climate actions and policies incentivise or enable GHG emissions mitigation at home or abroad. This allows to track within-country evolution of countries' policy stringency and ensures that countries' policy stringency can change only if there is a change in a policy. More precisely, if a country has, for example, increased its carbon tax, this will be reflected in a higher policy stringency. Importantly, the policy stringency is determined based on all observed data until 2020, meaning that a country's policy stringency will not decrease if other countries strengthen their efforts in the future.[16]

For each policy variable, a stringency level between 0 and 10 is assigned as follows:

- A level of 0 is assigned if a policy or action is not in place.
- All other levels are assigned according to the in-sample distribution across all years and countries, so that the percentiles constitute the thresholds between the levels. More precisely, a level of 10 is assigned if the value of the policy variable is at or above the 90th percentile after excluding all

[16] Adding new countries and years to the sample may require a re-attribution of bin thresholds and therefore lead to a reattribution of stringency levels (Botta and Koźluk, 2014[11]). To address this concern, the bin thresholds will remain fixed for the coming years based on data until 2020. Bin thresholds will be updated less frequently, e.g. every five years. Once updated, the entire time series of all policy variables will also be updated.

observations where the policy variable is not in place.[17] A level of 9 is assigned if the value falls between the 80th and 90th percentile and so on. Finally, a level of 1 is assigned if the value of the policy variable is below the 10th percentile, but is in place.[18] This methodology is straightforward for most variables, but needs to be interpreted carefully for some.[19]

- For binary or categorical variables, a level of 10 is assigned to the highest value of the policy variable. All other values of categorical variables are linearly mapped into the space from 1 to 10.[20]

In a second step, the policy variables describing the same 'policy' are grouped into one by assigning equal weights to all underlying policy variables. For example, each of the four FiT policy variables receive a weight of 0.25. The equal weighting assumption is conservative as it does not make any judgement call on the relative importance of various policy variables.

All policy variables with *missing data* receive a policy stringency of zero to enable the grouping and will be labelled as 'not available' in the published database.[21] The CAPMF does not impute values for missing data even where this would be possible. This is a conventional way to deal with missing data because it does not require any assumption about the imputation procedure (Gachau et al., 2021[48]).

The only exception from the treatment of missing data refers to *missing data in t-1*. In each annual update, the CAPMF aims to provide data for the previous year to capture an up-to-date picture of countries' climate action. For some policy variables, however, data will not be available in such a timely manner. For those, the CAPMF imputes the missing data in *t-1* based on the observation of the previous year.

[17] First excluding the observations, where an instrument is not in place, and then performing the normalisation is advisable, as this avoids having extreme values that dominate the grouping (Talukder, Hipel and vanLoon, 2017[73]).

[18] All bin thresholds will be available upon request.

[19] For example, a low share of rail investment could be due to a preference for individual transport options or due to context-specific factors such as population density or geography.

[20] For example, the values from 1-5 of a categorical variable would get the stringency levels 2, 4, 6, 8, and 10 respectively.

[21] These data points are shown as 'missing' when the data of CAPMF is published and an explanation for the missing data is provided (e.g. data not collected or not reported).

3 Selected applications and use cases

One of the primary purposes of the CAPMF is to provide consistent data to track countries' policy adoption and development. This section presents some selected applications of the CAPMF. It illustrates a number of use cases for the CAPMF by showing some results regarding the stocktaking of policies. It also showcases how the CAPMF could be applied to country-specific analysis.

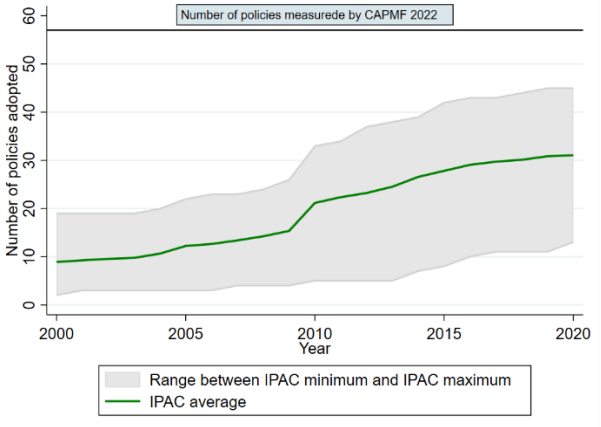
Stocktaking of policies: Overall trends and summary statistics

Policy adoption increased steadily between 2000-2020 (Figure 3.1, Panel A). All countries increased their number of policies covered by the CAPMF between 2000-2020. While the gap between the IPAC average and the IPAC minimum widened, the gap between the IPAC average and the IPAC maximum remained roughly constant. This finding is also confirmed when looking at the density plots of the number of adopted policies across time (Annex Figure C.2, Panel A). In 2020, the average IPAC country had 31 (out of 56 measured) policies in place, indicating that there are still additional policy options countries may consider. 28 countries had more policies adopted than the IPAC average. Collectively, these 28 countries accounted for 39% of IPAC GHG emissions. In 2020, the number of policies in place varies considerably across countries, ranging from 13 in Peru to 45 in France.

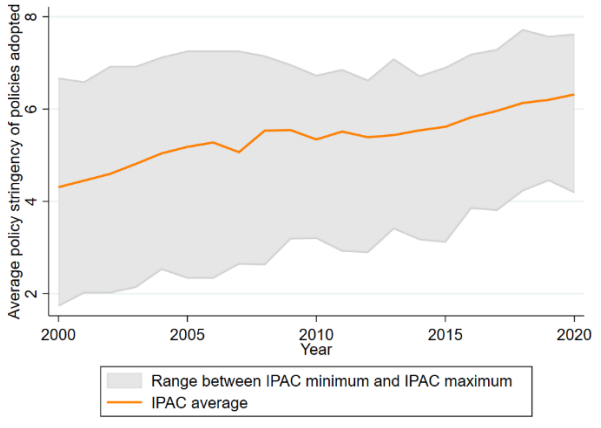
Policy stringency, as assessed by the CAPMF, increased between 2000-2020 (Figure 3.1, Panel B). The average policy stringency of IPAC countries collectively increased from 4.3 in 2000 to 5.3in 2010 and 6.3 in 2020. Interestingly, the gap between the average policy stringency between both the IPAC maximum and the IPAC average as well as the IPAC minimum and the IPAC average shrank, indicating some policy convergence of adopted policies. This is also confirmed when looking at the density plots of the average policy stringency across time (Annex Figure C.2, Panel B). In 2020, 26 countries, accounting for 37% of IPAC GHG emissions, had more stringent policies than the IPAC average.

Figure 3.1. Climate action increased between 2000-2020

Panel A: Number of policies adopted



Panel B: Average policy stringency

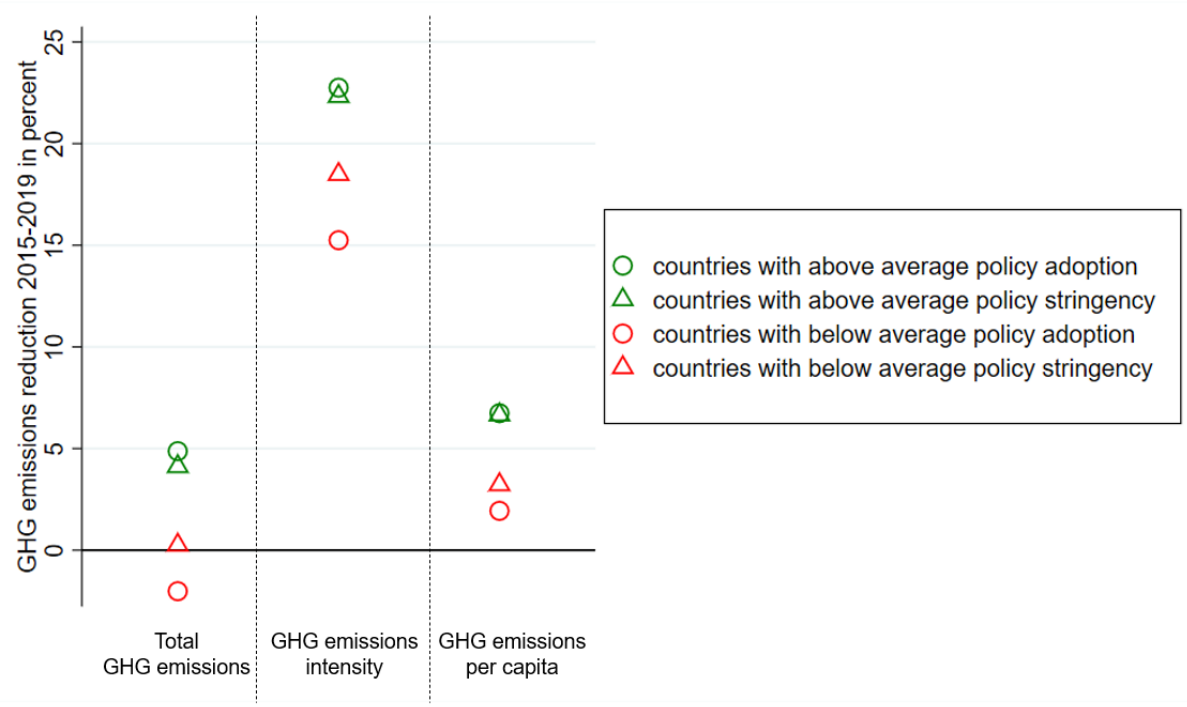


Note: The jump in 2010 is due to some data becoming available only from 2010 (e.g. data on fossil fuel subsidy reform, data from RISE).
Source: Authors.

Countries with relatively larger policy adoption or larger average policy stringency are associated with deeper GHG emissions reductions between 2015-2019. In fact, countries with an above-average number of adopted policies and above-average policy stringency were most successful in reducing their total GHG emissions as well as their GHG emissions intensity and GHG emissions per capita between 2015 and 2019 compared to countries below the respective average (Figure 3.2).[22] This analysis is purely descriptive and does not imply any causal relationship between policy adoption or policy stringency and GHG emissions reduction. Future work could shed more light on this (Section 5).

Figure 3.2. Countries with stronger climate action are associated with steeper emissions reductions

Emissions reduction 2015-2019: Total GHG emissions, GHG emissions intensity, GHG emissions per capita



Source: Authors.

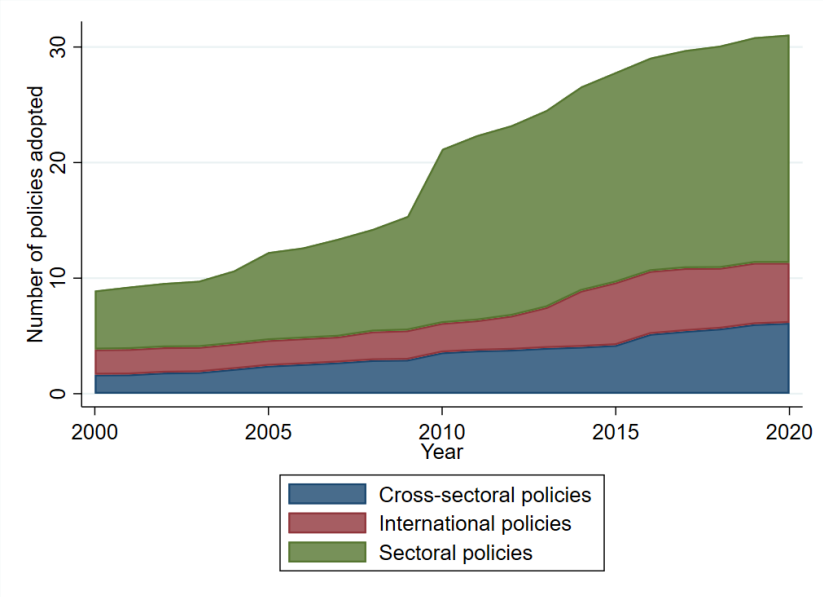
The policy mix has changed over the last 10 years with sectoral policies dominating the policy landscape across all IPAC countries (Figure 3.3). Note that the rise of sectoral policies in 2010 is primarily driven by data availability of some key sectoral policies (e.g. FFS reform). Apart from this technical issue, there was also increasing adoption of carbon pricing, labels to electronic appliances, and MEPS. The number of international policies increased notably after 2014 and 2015 due to new GHG emissions reporting requirements, adoption of the Paris Agreement (in 2015) and participation in international initiatives. The number of cross-sectoral policies has increased throughout 2000-2020, but more so after 2015, reflecting the submission of countries' first NDCs, increasing and updated announcements of net-zero targets and new announcements of bans or phase outs of fossil fuel extraction.

[22] This analysis uses data on GHG emissions up to 2019 to not confound the results with those of the effects of the COVID-19 pandemic on emissions.

In 2020, sectoral policies dominated countries policy mix. Part of the dominance of sectoral policies is related to the construction of the CAPMF, which includes 36 sectoral, 12 cross-sectoral, and 9 international policies. In 2020, the average IPAC country had 20 sectoral (56% of all sectoral policies), 6 cross-sectoral (50%) and 5 international policies (56%) in place.

Figure 3.3. Sectoral policies have been increasingly adopted in the past 10 years

Number of adopted policies by building block: IPAC average, 2000-2020



Source: Authors.

Policy adoption varies substantially across policies. Progress in policy adoption and increases in policy stringency across all IPAC countries in the transport sector was mixed between 2010-2020 (Figure 3.4). A slight increase in climate action is identified for carbon taxes, MEPS, and bans and phase outs, the latter of which was driven by announcements of banning passenger cars with ICE in some European countries. However, for other policies, there was no increase in climate action (e.g. congestion charges, ETS, FFS reform, and speed limits). The policy situation actually deteriorated for public investments in rail infrastructure, signalling that countries devoted an increasingly lower share of total surface transport investments to rail infrastructure between 2010-2020. Annex Figure C.1 shows the evolution for all policies of the CAPMF.

An example of a detailed stocktaking analysis is provided in Table 3.1 exemplified on the transport sector. In 2020, congestion charges were in place in at least one city in 4 out of 52 countries, which account for just 3% of IPAC GHG emissions. Fourteen countries had foreseen a ban or a phase out of passenger cars with internal combustion engines. Most countries had speed limits, emissions limit values and energy labels for vehicles in place. Most countries also have fuel excise taxes in place, yet these countries collectively account for less than 50% of IPAC GHG emissions. Only a few countries have (additional) carbon price instruments in form of ETS or carbon taxes in the transport sector.

Outside the transport sector, policy adoption by policy ranges from 0 (e.g. participation in CORSIA which starts in 2021) to 52 (ratification of at least one of the major international climate agreements). Annex Table C.3 provides descriptive statistics for all policy components.

The average policy stringency also differs substantially across instruments. Policy stringency across all IPAC countries ranges from 0.5 for congestion charges to 7.9 for energy labels for passenger cars, indicating a wide range of policy stringency. Yet, if focusses on countries that adopted a particular policy, that range shrinks to between 4.1 and 10.

Progress in policy adoption and increases in policy stringency across all IPAC countries in the transport sector was mixed between 2010-2020 (Figure 3.4). A slight increase in climate action is identified for carbon taxes, MEPS, and bans and phase outs, the latter of which was driven by announcements of banning passenger cars with ICE in some European countries. However, for other policies, there was no increase in climate action (e.g. congestion charges, ETS, FFS reform, and speed limits). The policy situation actually deteriorated for public investments in rail infrastructure, signalling that countries devoted an increasingly lower share of total surface transport investments to rail infrastructure between 2010-2020. Annex Figure C.1 shows the evolution for all policies of the CAPMF.

Table 3.1. Policy adoption and policy stringency vary greatly in the transport sector

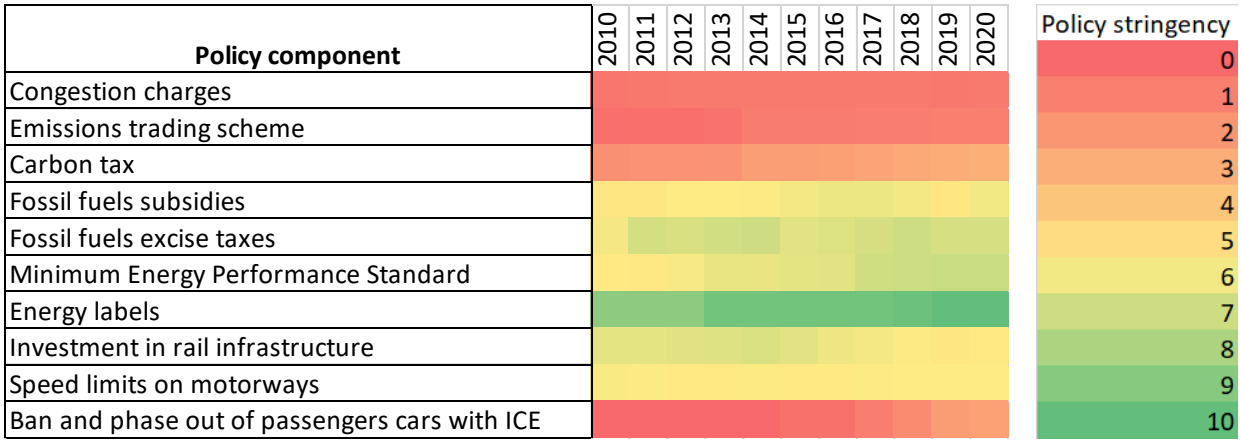
Summary statistics for year 2020, transport sector only; for the full list see Annex Table C.3

Policy	Number of countries where adopted	Share of IPAC countries	Share of IPAC GHG emissions	Policy stringency average (all IPAC countries)	Policy stringency average (if policy adopted)	Policy stringency median (if policy adopted)	Policy stringency mode (if policy adopted)
Transport							
Congestion charges	4	8%	3%	0.5	6.3	7.0	10.0
Emissions trading scheme	4	8%	56%	0.6	8.0	8.0	10.0
Carbon tax	18	35%	14%	1.9	5.6	6.0	7.0
Fossil fuels subsidies reform	34	65%	83%	3.9	5.9	6.0	6.0
Fossil fuels excise taxes	44	85%	48%	4.6	5.5	5.8	6.5
Minimum energy performance standards	40	77%	86%	5.0	6.5	5.0	5.0
Energy labels	40	77%	55%	7.7	10.0	10.0	10.0
Share of rail on total surface transport public expenditure	32	62%	79%	3.5	5.7	6.0	8.0
Speed limits on motorways	45	87%	96%	3.6	4.1	4.0	1.0
Ban and phase out of passengers cars with ICE	14	27%	9%	1.5	5.7	6.0	6.0

Source: Authors.

Figure 3.4. Progress in policy adoption and policy stringency in the transport sector was mixed over the last decade

Average policy stringency: IPAC average 2010-2020



Source: Authors.

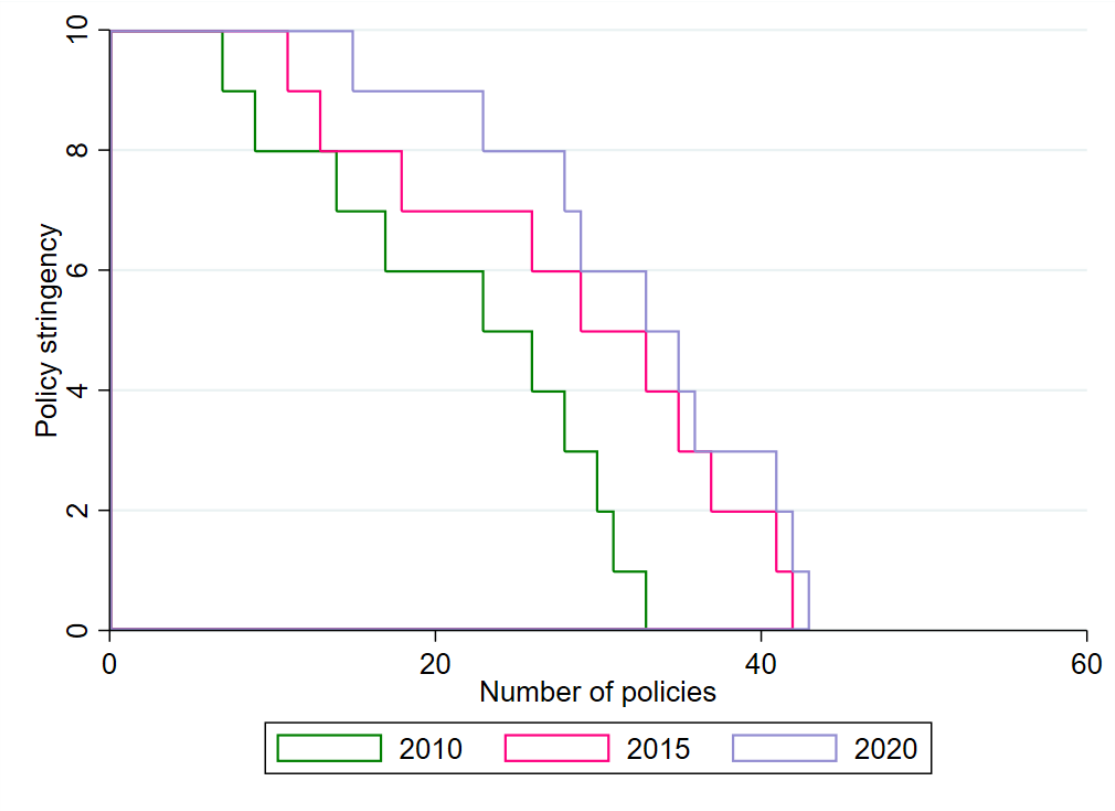
Selected country-specific analyses

One of the major purposes of the CAPMF is to inform country-specific analyses to track country's climate action across time. This can feature in country-specific IPAC deliverables (e.g. IPAC Country Notes) or other OECD products more generally (e.g. OECD Environmental Performance Reviews). This section exemplifies some of the CAPMF's potential applications on the United Kingdom

The United Kingdom expanded its climate action substantially between 2010-2020 (Figure 3.5). The United Kingdom increased the number of climate-relevant policies from 33 in 2010 to 42 in 2015 and 43 in 2020. It also increased the policy stringency of existing policies. Yet, new policy adoption and strengthening of existing policies slowed down between 2015-2020 compared to the previous 5-year period.

Figure 3.5. The United Kingdom expanded its climate action substantially between 2010-2020

Number and stringency of policies, ordered by policy stringency: the United Kingdom, 2010, 2015, 2020

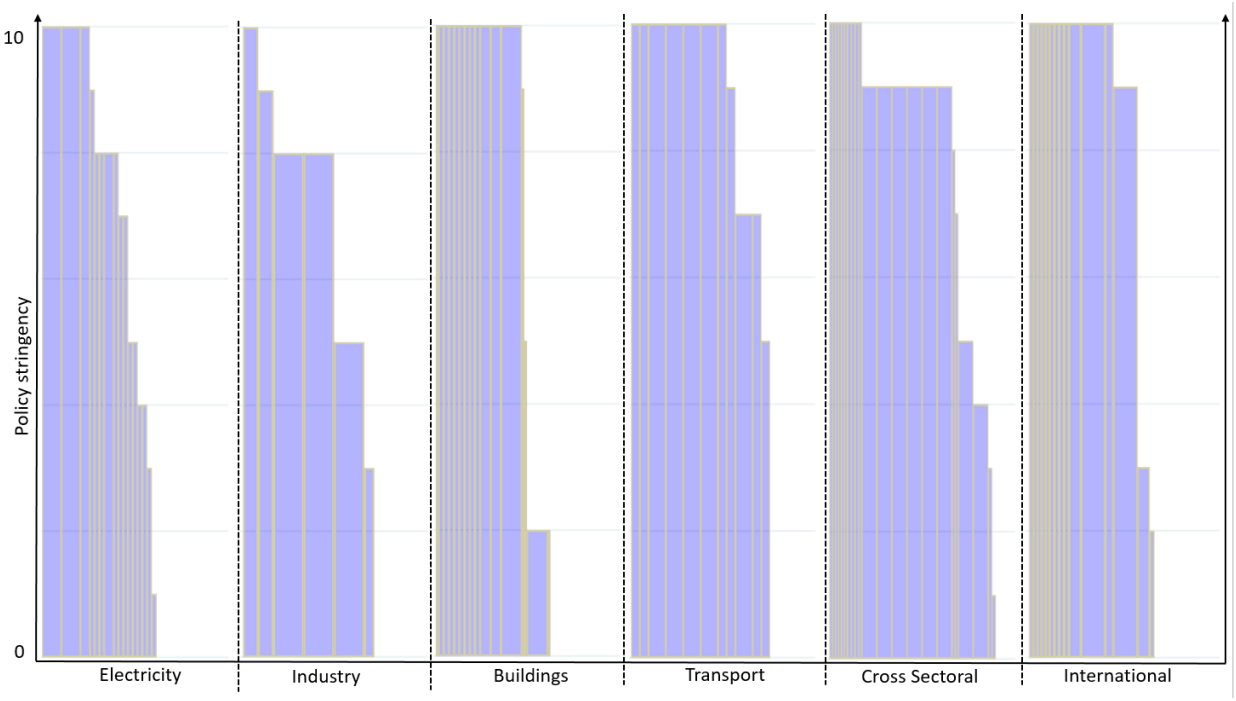


Source: Authors.

In 2020, the United Kingdom had a well-balanced policy approach, adopting policies in all measured policy areas (Figure 3.6). It put particular emphasis on transport and cross-sectoral policies. The transport sector is also the sector with the highest emissions share across all energy sectors, signalling good policy alignment. To further reduce transport-related emissions, the United Kingdom could consider additional policy options adopted by other countries, such as explicit carbon pricing policies or phasing out of passenger cars with internal combustion engines (although, this is currently being consulted on).

Figure 3.6. The United Kingdom had a well-balanced policy approach in 2020

Number of policies and policy stringency by building block and disaggregated by sector: The United Kingdom, 2020



Source: Authors.

4 Limitations

The CAPMF provides a wealth of structured and harmonised data. However, they come with some limitations. This section discusses three caveats to keep in mind for the interpretation of results from the CAPMF. These include:

- the CAPMF provides no information on implementation or enforcement,
- the CAPMF does not reflect policy effectiveness, and
- the CAPMF may not accurately reflect countries' policy approaches because it does not cover all climate actions and policies and because country circumstances may differ.

First, the CAPMF measures climate actions and policies as they are in law, but it does not account for the *implementation or enforcement of climate policies*. While it is difficult to observe whether policies are enforced or not, future work could attempt to include variables that monitor policy implementation. Note also that the preliminary evidence presented in Section 3 suggests that countries with a higher number of adopted policies and above-average policy stringency are associated with larger emissions reductions, suggesting that countries implemented and enforced their policies.

Second, the applications of the CAPMF should be interpreted in an informative, not in a normative way. In particular, it is important to keep in mind that policy stringency and policy coverage does not per se reflect policy effectiveness, and stringency needs to be interpreted carefully for some policies. By no means, the CAPMF suggests that all countries should adopt all policies to the highest possible level. Instead, different policy mixes may be required to achieve countries' emission reductions targets and the goals of the Paris Agreement more generally, depending on national circumstances. For example, a country with only a few adopted policies may be highly effective in terms of reducing GHG emissions if it has the right policy mix in place. Conversely, a country with many policies in place might not be able to reduce GHG emissions if its policy mix is not well-tailored to its circumstances. Countries have different starting positions and very specific circumstances regarding their abatement potential. For example, even a relatively moderate carbon price could trigger large amounts of GHG emission reductions in a country with vast low-cost abatement potential. Conversely, a high carbon price may hardly trigger any emissions reductions if applied to sectors that lack commercially viable zero-carbon alternatives.

While the CAPMF does not reflect policy effectiveness, it allows to draw some policy conclusions when combined with data on GHG emissions. For example, if a country with few adopted policies and large policy stringency does not experience emissions reductions, then the recommendation could be to make use of other, currently not adopted policies. Conversely, if a country with many adopted policies and low policy stringency does not experience emissions reductions, the recommendation could be to strengthen existing policies. Besides such descriptive policy conclusions, more policy insights could be drawn from cross-country empirical analysis, which could be carried out as future work (Section 5).

Third, countries have different policy approaches which need to be taken into account in the interpretation of the results from the CAPMF. Policy approaches are defined as policies that are generally accepted and considered legitimate in a specific country at a specific point in time (Cerna, 2013[49]). Countries' policy approaches to climate mitigation are the result of a complex interaction of multiple factors, including the resource base (e.g. Nordic countries may not have subsidies for solar PV for good reasons), legal traditions (e.g. carbon taxes in the European Union are levied nationally and require unanimity, which is why the EU

chose to adopt an ETS), and path dependence (e.g. countries opting for ETS, but not carbon tax). Consequently, some policies included in the CAPMF may not be part of some countries' policy approach. For example, certain policies included in the CAPMF may not be relevant in some countries because of lack of relevant resources (e.g. subsidies for solar PV in countries with low insolation) or lack of relevance (e.g. subsidies for renewable electricity in countries with already decarbonised electricity systems). In addition, the selection of most policies in the CAPMF is not based on multilateral agreements nor does it reflect each countries' national circumstances.

Another reason for why countries' policy approaches may not be fully reflected in the CAPMF are *data availability* constraints. In fact, the CAPMF does not cover all climate actions and policies. Strictly speaking, any conclusion and interpretation from the CAPMF is only valid for the *measured* climate actions and policies. Not accounting for the unmeasured climate actions can lead to misleading interpretation, notably in cross-country comparison. However, the relevance of this problem will decrease as new policies and actions are integrated into the CAPMF. While the CAPMF is the most comprehensive structured and harmonised climate policy database to-date and an excellent starting point for a more comprehensive data collection exercise, there are several climate actions and policies that are currently not captured. Annex Table C.4 presents a list of the most relevant policies and provides reasons why these are not included in the CAPMF.

5 Conclusions and next steps

This paper presents the CAPMF, the most comprehensive, structured and internationally harmonised climate mitigation policy database to date. The CAPMF covers 128 policy variables that are grouped into 56 policies of 52 IPAC countries from 2000-2020. Using this granular data, the CAPMF allows for a stocktaking of countries' climate policies. Insights from this stocktaking include:

- Countries expanded their climate action between 2000-2020, increasing both the number of adopted policies covered by the CAPMF and their policy stringency. Interestingly, countries diverged in terms of policy coverage, but converged in terms of average policy stringency of adopted policies. This indicates that countries with below average policy coverage and policy stringency did well in terms of strengthening existing policies but did not keep pace with new policy adoption.
- Policy adoption varies considerably across countries and instruments. In 2020, the number of adopted policies varies between 13 and 45. In addition, 28 out of 52 countries (accounting for 39% of IPAC GHG emissions) had more policies adopted than the IPAC average. In 2020, policy adoption also varies across policies, ranging from 0 (e.g. participation in CORSIA which starts in 2021) to 52 (ratification of at least one of the major international climate agreements).
- Countries with relatively larger policy adoption or larger average policy stringency are associated with deeper GHG emissions reductions between 2015-2019. This holds true for total GHG emissions, GHG emissions intensity and GHG emissions per capita. This result is, of course, not causal, requiring thorough empirical analysis.

Work to be carried out in the future can be divided into three work streams: i) continuation and expansion of policy stocktaking and data collection; ii) data publication and visualisation; iii) empirical applications.

Continuation of *policy stocktaking and data collection* of the CAPMF granular policy data would involve four issues:

a) Data will be collected on modules that are foreseen to be filled in the next biennium, including policies on agriculture, LULUCF, waste, and climate finance (see light red modules in Figure 2.1).

b) The geographic scope of the CAPMF could be extended to capture policies in other world regions (e.g. Latin America, Africa) in co-operation with other international bodies such as the United Nations.

c) The CAPMF could include other policy variables in already existing modules when data become available or is collected through questionnaires. This could include policies to promote sustainable transport modes or zero-carbon industrial processes (e.g. through tax credits, rebates), climate governance (e.g. domestic or international climate envoy, stakeholder engagement) or internal carbon prices based on the social cost of carbon or GHG emissions that feed in governments planning and procurement decisions. Data collection would be also aligned with the data collection that will be carried out under the OECD IFCMA. This would exploit synergies between the two work streams while reducing the reporting burden on countries.

d) As new data will not necessarily be available from 2000 or from 2010, a methodology on how to integrate new data in the CAPMF would need to be developed. This is to disentangle the expansion of policy adoption that is due to data availability from the one that is due to policy adoption.

The CAPMF database will be made publicly available on OECD.Stat. The underlying climate policy data will be shared with countries for verification prior to publication of the database. A selection of indicators will be visualised on the IPAC Climate Action Dashboard. A dedicated *data visualisation* tool will be developed to showcase the richness of the CAPMF's policy data to policy makers, practitioners and the general public. The data explorer would allow practitioners to tailor the CAPMF to their country-specific circumstances. For example, the explorer would allow users to select or deselect specific policy variables to better reflect countries' emissions profiles or policy approaches.

Finally, the policy data of the CAPMF could be used to carry out a number of *qualitative and quantitative analyses* in co-operation with other OECD Committees (e.g. Economic Policy Committee, Committee for Innovation, Industry and Entrepreneurship). This work stream would have large synergies with the IFCMA. While Section 3 included some descriptive evidence on the relationship between the number of adopted policies and its policy stringency and reductions of GHG emissions, more research is needed to infer causal relationships using econometric techniques. Potential research questions could include:

- Investigating the environmental effectiveness of climate policy instruments and different policy mixes. This analysis would shed light on the relative importance of different types of policies or instruments and could carve out the effectiveness under different country contexts. Results from this research agenda could provide support for evidenced-based and tailored policy recommendations, one of the key aims of the IPAC Programme.
- Assessing the socio-economic effects (e.g. employment, investment, productivity, income distribution) of climate policies. This research agenda would contribute to the continuation of OECD analysis on the effects of environmental policies on economic and environmental outcomes.

Annex A. Glossary

- **Building block**: Level 1 of Figure 2.1. Climate actions and policies are divided in three types:
    - **Sectoral policies** are defined as policies that can be constrained to or are designed to apply to a specific source or economic sector
    - **Cross-sectoral policies** refer to policies that cut across more than one emission's source or sector. These are overarching policy areas to mitigate or remove domestic GHG emissions that cannot be easily attributed to a specific sector refer to policies that cut across more than one emission's source or sector.
    - **International policies** refer to policy commitments associated with international covenants or agreements where more than one country participates.
- **Module**: Level 2 of Figure 2.1. In each building block, policies are disaggregated into modules, including by sectors (e.g. electricity, transports) or by topic (e.g. GHG emission targets, international co-operation).
- **Climate actions and policy instruments (or "policies" in short)**: Level 3 of Figure 2.1. This is the unit of interest for all results presented in Section 3. These are policy instruments or other actions that have the explicit intent of achieving declared policy objectives to advance mitigation or are non-climate policies which are expected to have a material effect on GHG emissions.
- **Policy instruments** are institutional vehicles or tools through which governments facilitate the implementation of domestic and international objectives. Their effectiveness will depend on several issues associated with their operation, including government's capacity to enforce, the possibility of economic agents to change their behaviour, and the broader policy landscape.
    - **Market-based instruments** are policy instruments that use markets, prices and/or other monetary means to provide incentives for producers and consumers to reduce or eliminate environmental and other externalities.
    - **Non market based instruments** are instruments that work through the imposition of certain obligations or by installing non-monetary incentives to change behaviour (e.g. directly regulated by the government such as standards, information instruments, voluntary approaches)
- **Policy variables**: Level of Figure 2.1. Policy variables refers to specific characteristics of each policy (e.g. permit price of an ETS, level of FiT).
- **Policy stringency**: The degree to which climate actions and policies incentivise or enable GHG emissions mitigation at home or abroad. It is based on the in-sample distribution across all countries and all years (see Section 2)

Annex B. Details on policy variables

Annex Table B.1. Detailed information on policy variables

Country and time coverage, data source and description

Climate policy	Country and time coverage	Detailed description	Data source
Sectoral actions and policies			
For each sector (electricity, industry, transport, buildings)			
Emissions trading schemes	All IPAC countries, from 2005	An emissions trading scheme (ETS) or cap-and-trade is a market-based instrument that aims at controlling and reducing emissions in a cost-effective manner. The CAPMF includes two policy variables on ETS. First, the average permit price observed in each year in EUR per tCO_2e. Currencies other than EUR were converted to EUR using 2020 real exchange rates. Second, the coverage of GHG emissions differentiated by CO_2, CH_4, N_20 and all other GHG. Coverage of GHG gases is weighted by the contribution of each gas to global GHG emissions. The CAPMF also includes all sub-national ETSs. For those, the permit price is weighted by the share of the sub-nationals GHG emissions on total national GHG emissions. If data on sub-national GHG emissions was not available, GDP data was used.	IPAC CAPMF data collection based on ICAP and World Bank
Carbon tax	All IPAC countries, from 1990	Carbon taxes are levied on carbon emissions to reduce carbon emissions. The CAPMF includes one policy variable on carbon taxes in each sector. This is the nominal tax rate measured in USD per tCO_2e. Currencies other than USD were converted to USD using 2020 real exchange rates. The CAPMF also includes sub-national carbon taxes. For those, the nominal tax rate was weighted by the share of the sub-nationals GHG emissions on total national GHG emissions. If data on sub-national GHG emissions was not available, GDP data was used.	IPAC CAPMF data collection based on ICAP, IEA, I4CE, and World Bank
Fossil fuel excise taxes	All IPAC countries, from 1990	Fuel excise taxes are levied on fossil fuels, implicitly putting a price on the carbon content of those fuels. The CAMPF includes up to 5 different policy variables for each sector, representing the most commonly used energy products. The CAPMF only takes into account a fuel in a sector if the fuel accounts for more than 5% of global energy consumption. The CAPMF measure the nominal tax rate in the sector in the following way: Coal and LPF (USD/ton), natural gas (USD/MWh), diesel, gasoline, kerosene and fuel oil (USD/litre). Currencies other than USD were converted to USD using 2020 real exchange rates. Caloric values to transform some tax rates into the ones above are taken from IEA. If country-specific caloric values were not available, the regional average was used (e.g. for EU countries).	IEA and IPAC CAPMF data collection based on (OECD, 2022[50]) and European Commission
Reform of fossil fuel subsidies	43 countries, from 2010	Fossil fuel support (FFS) refer to government action that provide a benefit or preference for fossil-fuel consumption. The CAPMF includes one policy variable for FFS in each sector. This is the share of sector-specific FFS based on the OECD Inventory on total tax revenues. Using a bottom-up method of estimating government support to fossil fuels, the OECD Inventory includes direct budgetary transfers and tax expenditures that provide a benefit or preference for fossil-fuel production or consumption. The data in the Inventory are obtained from official government sources. They are as comprehensive as possible, but not exhaustive; more data may be available for countries with relatively more transparency in their budget books. Furthermore, the Inventory does not make any judgment on whether or not support measures are inefficient. Note that the CAPMF uses the category 'other sector' as a proxy for industry support as support for industry contributes the biggest share to this category.	(OECD, 2021[19])

Electricity			
Feed in tariffs for solar PV and wind	48 countries, from 2010	Feed-in tariffs (FiT) are policy instruments that spur investments into renewable energy by offering fixed long-term contracts to renewable energy producers. The CAPMF includes four policy variables on FiT: First, the contract length of the FiT for both solar photovoltaic and wind power. Second, the price of the FiT for both technologies. The price of the FiT is normalised by the global levelised cost of electricity to account for falling technology costs, following the EPS 2022 update.	(OECD, 2022[51])
Auctions for solar PV and wind	All IPAC countries, from 2008	Renewable energy auctions are competitive tenders issued by the government to install a specific capacity of renewable capacity. The CAPMF includes four policy variables on auctions: First, the contract length of the auction for both solar photovoltaic and wind power. Second, the auction price, normalised by the global levelised cost of electricity to account for falling technology costs for both technologies. If multiple auctions are held in one year, the contract length and the price are calculated as the weighted average (by capacity) of those auctions.	IEA
RPS with tradeable renewable energy certificates	All IPAC countries, from 1990	Renewable energy portfolio standards (RPS) mandates electricity generators to cover a specific share of their output by renewables. In most cases, RPS allow trading of renewable energy certificates to comply with the standard at lower cost. The CAPMF includes one policy variable: the mandated percentage of renewable production on total production. The CAPMF also includes sub-national RPS. These are constructed as weighted averages (by total electricity generation) of sub-national RPS.	IPAC CAPMF data collection based on (Dechezleprêtre et al., 2021[52]) complemented with REN21 and RES Legal Europe
Ban on the construction of new and phase out of existing unabated coal power plants	All IPAC countries, from 1990	Bans and phase-outs are regulatory instruments that mandate the cessation of the construction (ban) or the usage (phase out) of certain activities, here unabated coal power plants. The CAPMF includes 4 policy variables. First, the due date (i.e. the year when the ban or phase out will be effective) for both bans and phase outs. Second, the legal status of both instruments. For these, the CAPMF distinguishes between (i) announcement, (ii) enshrined in law and (iii) achieved.	IPAC CAPMF data collection
Air pollution standards for coal power plants	40 countries, from 2000	Air emission standards require coal power plants to observe specific emission limit values. The CAPMF includes four policy variables. They correspond to the emission limit values of four air pollutants: Nitrous oxide (NOx), Sulfur oxides (SOx), Particulate Matter (PM) and Sulphur.	OECD, (Dechezleprêtre et al., 2021[52])
Planning for renewables expansion	44 countries, 2010-2019	Planning for renewables refers to integrated transmission and (renewable) generation planning in combination with resource data and siting. It is a key enabling condition to expand generation from renewable energy sources. The CAPMF includes one policy variable. This is the final score for planning for renewables in the RISE database to ensure consistency with the underlying data. This score is derived from a questionnaire, containing seven planning-related questions such as whether renewable energy is included in transmission planning or whether there are policies on resource data and siting.	(World Bank, 2020[53])
Transport			
Congestion charges	All IPAC countries, from 1990	Congestion charge is a daily levy imposed on drivers who chose to drive within a given area of a city. The CAPMF includes one policy variable. This is the price at peak hour of a city's congestion charges. The CAPMF only considers so-called 'cordon charge' (i.e. a charge imposed on a private vehicles upon entering a central area of a city within a certain hour of the day), following (Croci, 2016[54]). Prices for peak hours are most suited because the charge has the largest effect during peak hours. To account for different city sizes, the price is weighted by the 'exposure' (i.e. the share of the population in the functional urban area on the country's total population).	IPAC CAPMF data collection
Ban on the sales of new and phase out of conventional passenger cars	All IPAC countries, from 1990	Bans and phase-outs are regulatory instruments that mandate the cessation of the purchase (ban) or the usage (phase out) of certain activities, here passenger cars with internal combustion engines. The CAPMF includes 4 policy variables. First, the due date (i.e. the year when the ban or phase out will be effective) for both bans and phase outs. Second, the legal status of both instruments. For these, the CAPMF distinguishes between (i) announcement, (ii) enshrined in law and (iii) achieved.	IPAC CAPMF data collection
Fuel economy standards	All IIPAC countries,	Fuel economy standards are regulatory instruments that limit the maximum amount of energy that may be consumed by a product. The CAPMF	IEA (passenger cars), (World Bank, 2020[53])

	from 1990	includes two policy variables: the existence of fuel economy standards for either passenger cars or heavy-duty vehicles.	(heavy-duty vehicles)
Mandatory fuel economy labels for light duty vehicles	All IPAC countries, from 1990	Mandatory energy labels for passenger cars provide information on the fuel economy of passenger cars. The CAPMF includes one policy variable. This is whether a country adopted a mandatory energy label for passenger cars	IEA
Share of rail on total surface transport public expenditure	All IPAC countries, from 1995	Public expenditure in rail infrastructure provides alternatives to private car journeys. The CAPMF includes one policy variable. This is the share of central government's investment in rail as a share of total central government's investment in surface transport. Public expenditure of sub-national jurisdictions is not included because of data availability.	(OECD, 2022[55])
Motorway speed limits	All IPAC countries, from 1990	A speed limit is the maximum speed at which a vehicle may legally travel on a particular stretch of road. The CAPMF includes one policy variable. This is the general speed limit on motorway expressed in km/h. If a country includes a range for highways in federal countries, the average is taken. The data is set to missing if motorways do not exist.	IPAC CAPMF data collection, based on (ITF, 2020[56]), (WHO, 2018[57]), (World Bank Group, 2022[58])
		Buildings	
Financing mechanisms for energy efficiency	44 countries, 2010-2019	Financing mechanisms for energy efficiency refer to public financial instruments that help channel finance towards energy efficiency. The CAPMF includes one policy variable. This is the final score for financing mechanisms in the RISE database to ensure consistency with the underlying data. This score is derived from a questionnaire, asking about the existence of eight financing mechanisms in each the residential and the commercial sector. Financing mechanisms include, e.g., whether discounted "green" mortgages exist or whether energy services agreements such as pay-for-performance contracts are in place.	(World Bank, 2020[53])
Ban and phase out of fossil-fuel heating systems	All IPAC countries, from 1990	Bans and phase-outs are regulatory instruments that mandate the cessation of the purchase (ban) or the usage (phase out) of certain activities, here heating with gas or oil. The CAPMF includes 8 policy variables. First, the due date (i.e. the year when the ban or phase out will be effective) for both bans and phase outs and for oil and gas boilers. Second, the legal status of both instruments and both technologies. For these, the CAPMF distinguishes between (i) announcement, (ii) enshrined in law and (iii) achieved.	IPAC CAPMF data collection
Minimum energy performance standards of appliances	All IPAC countries, from 1990	Minimum energy performance standards (MEPS) are regulatory instruments that limit the maximum amount of energy that may be consumed by a product. The CAPMF includes four policy variables: the existence of mandatory MEPS for the following four appliances: (i) Freezer, (ii) Refrigerator, (iii) Lighting, and (iv) Air Conditioner.	IEA
Mandatory energy labels for appliances	All IPAC countries, from 1990	Mandatory energy labels for domestic appliances provide information on the energy consumption of those. The CAPMF includes four policy variables. These refer to whether or not a mandatory energy label is in place for the following four appliances: (i) Freezer, (ii) Refrigerator, (iii) Lighting, and (iv) Air Conditioner.	IEA
Building energy codes	All IPAC countries, from 1990	Building energy codes are regulatory instruments that specify minimum energy efficiency standards for residential and/or commercial buildings. The CAPMF includes two policy variables: the existence of building energy codes for both residential and commercial buildings. The CAPMF distinguishes between voluntary and mandatory building codes. Following the IEA methodology, it also includes building codes that were adopted on a sub-national level.	IEA
		Industry	
Financing mechanisms for energy efficiency	44 countries, 2010-2019	Financing mechanisms for energy efficiency refer to public financial instruments that help channel finance towards energy efficiency. The CAPMF includes one policy variable. This is the final score for financing mechanisms in the RISE database to ensure consistency with the underlying data. This score is derived from a questionnaire, asking about the existence of eight financing mechanisms in the industry sector. Financing mechanisms include, e.g., whether energy services agreements such as pay-for-performance contracts are in place or on-bill financing/repayment are in place.	(World Bank, 2020[53])
Minimum energy performance standards	All IPAC countries, from 1990	Minimum energy performance standards (MEPS) are regulatory instruments that limit the maximum amount of energy that may be consumed by a product. The CAPMF includes one policy variables: the	IEA

		level of the mandatory MEPS for industrial motors. There are five different levels of stringency, expressed in International Energy efficiency classes (IE), IE1 being the lowest class and IE5 the highest.	
Energy efficiency mandates	44 countries, 2010-2019	Energy efficiency mandates for large energy users include a range of requirements that must be met to save energy. The CAPMF includes one policy variable. This is sum of the final score for energy efficiency mandates for large consumers and incentives for commercial and industrial consumers in the RISE database to ensure consistency with the underlying data. This score is derived from a questionnaire, containing a total of 11 questions. Topics of these questions include mandatory energy efficiency target, energy audits, energy-management systems or energy manager in the facility. For each mandate, countries receive a score of 33.3 if they answer yes to one or more questions and 0 if they answer no to all questions.	(World Bank, 2020[53])
Cross-sectoral actions and policies			
GHG emissions targets			
NDCs	All IPAC countries, from 2015	Nationally Determined Contributions (NDCs) are one of the key elements of the Paris Agreement signed in 2015. The CAPMF includes five policy variables. These include i) sectoral scope (e.g. economy-wide, including or excluding LULUCF), ii) GHG emissions scope (e.g. CO_2, CH_4, N_20, and other GHG), iii) target form (e.g. single-year or multi-year), iv) target type (e.g. absolute, intensity, trajectory, BAU, etc.) and v) target specificity (e.g. maximum, minimum, range).	IPAC CAPMF data collection based on countries' NDC submission complemented with data from (Climate Watch, 2021[59])
Net-zero targets	All IPAC countries, from 1990	Net-zero emissions targets are long-term targets when a country aims to reach net-zero carbon or GHG emissions. The CAPMF includes four policy variables. These include i) target year, ii) sectoral scope (e.g. Energy, IPPU, Agriculture, LULUCF, Waste, Other), iii) GHG emissions scope (e.g. CO_2, CH_4, N_20, and other GHG), and iv) institutional arrangement (e.g. announced, in policy document, in law).	IPAC CAPMF data collection based on (Jeudy-Hugo, Lo Re and Falduto, 2021[60])
Public RD&D expenditure			
Public Research, Development and Demonstration expenditure	33 countries from 1990	Public expenditure for Research, Development and Demonstration (RD&D) provides financial means for research activities, leading to innovation and new products and services. The CAPMF includes 6 policy variables related to different energy-related RD&D categories. These include (i) Energy Efficiency, (ii) Carbon Capture and Storage, (iii) Renewables, (iv) Nuclear, (v) Hydrogen and Fuel Cells, and (vi) other Power and Storage technologies (e.g. electric power conversion or AC/DC conversion). Public expenditure is normalised by GDP, following the EPS.	(IEA, 2022[61])
Fossil fuel production policies			
FFS reform for fossil fuel production	43 countries, from 2010	Reform of fossil fuel producer support refers to limiting transfers or expenditures to producers of fossil fuels. Fossil fuel production encompasses the following activities along the supply chain such as exploration and extraction, bulk transportation and storage and refining and processing. The CAPMF includes one policy variable. This is the amount of fossil fuel producer support normalised by tax revenue. Data is taken from the OECD Inventory. Please refer to the entry under sectoral policies for the limitations of this database.	(OECD, 2021[19])
Bans and phase outs of fossil fuel extraction	All IPAC countries, from 1990	Bans and phase-outs are regulatory instruments that mandate the cessation of new (ban) or existing (phase out) infrastructure to extract fossil fuels. The CAPMF includes 4 policy variables. First, the due date (i.e. the year when the ban or phase out will be effective) for both bans and phase outs. Second, the legal status of both instruments. For these, the CAPMF distinguishes between (i) announcement, (ii) enshrined in law and (iii) achieved.	IPAC CAPMF data collection
Policies to reduce fugitive methane emissions	23 countries from 1990	Policies to reduce fugitive methane emissions aim to reduce energy-related methane emissions. The CAPMF includes one policy variable. This is the score for methane policies in the IEA methane tracker database (ranging from 0-7). The score includes policies such as restrictions on flaring or venting, as well as taxes or charges on emissions and mandatory technology use.	IEA
Climate governance			

Independent climate advisory body	All IPAC countries, from 1990	Independent climate advisory bodies are councils to assess the countries' climate performance and/or to advise on climate policies. The CAPMF includes five policy variables. These include i) the existence of a climate advisory body, ii) whether the body is established by law, iii) the number of members of the council, iv) the number of secretariat's members and v) the annual budget.	IPAC CAPMF data collection
International policies			
International climate co-operation			
Participation in international climate agreements	All IPAC countries, from 1990	International climate agreements are key to tackling climate change as they provide a common understanding of the problem, and its solutions while laying out common targets. The CAPMF includes six policy variables. These include whether a country participates in one of the six key international agreements in a given year: i) the Montreal Protocol, ii) the Montreal Amendment, iii) the Kigali Amendment to the Montreal Protocol, iv) the UNFCCC framework convention, v) the Kyoto protocol, and vi) the Paris Agreement. Given countries' diversity in legal tradition, the CAPMF considers a country to be participating to an agreement for all legal forms of consenting to be bound to the agreement (ratification, approval, acceptance, accession or succession).	IPAC CAPMF data collection based on UNFCCC
Participation in international climate initiatives	All IPAC countries, from 1990	Participation in international climate initiatives (ICIs) is a key channel of international co-operation to achieve climate goals. The CAPMF includes one policy variable. This is the number of selected climate initiatives a country participates in. The CAPMF uses the Global Climate Action portal (NAZCA portal) to help anchor and orient initiatives included in the CAPMF. While the NAZCA portal predominantly lists initiative from non-state actors, the CAPMF only takes initiatives into account for which at least one national government (along other sub-national governments or corporate actors) is a member. This restricts the sample to 57 initiatives.	IPAC CAPMF data collection based on (UNFCCC, 2022[62])
Participation in international emissions pricing from aviation or shipping	All IPAC countries, from 1990	Pricing of emissions from international aviation and maritime transport refers to market-based instruments intended to lower emissions from those transport modes. The CAPMF includes three policy variables. These are i) the price level of emissions from international aviation, ii) the price level of emissions from international maritime transport and iii) countries' participation in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The CAPMF considers the price level of emissions from international transport whenever the price applies for transport routes between different countries (e.g. aviation within the European Union). Other international agreements on mitigation policies in those sectors are under consideration.	IPAC CAPMF data collection
International public finance			
Banning governments' export credits for new unabated coal power plants	All IPAC countries, from 1990	Bans are regulatory instruments that mandate the cessation of an activity, here providing export credits for unabated coal power plants. The CAPMF includes one policy variable. This is whether or not such a ban is adopted.	IPAC CAPMF data collection
Banning public finance for unabated fossil fuel infrastructure abroad	All IPAC countries, from 1990	Bans are regulatory instruments that mandate the cessation of an activity, here providing public finance for fossil fuel infrastructure abroad. The CAPMF includes one policy variable. This is whether or not such a ban sis adopted.	IPAC CAPMF data collection
GHG emissions data and reporting			
GHG emissions reporting and accounting	All IPAC countries, from 2015	GHG emissions reporting and accounting provide information on countries GHG emissions sources, supporting the identification of priority areas. The CAPMF includes two policy variables. First, whether countries adopted GHG emissions accounting following the System of Environmental Economic Accounting (SEEA) - an internationally agreed accounting framework. Second, an assessment of countries' submissions of GHG Inventories based on UNFCCC Annual Inventory Review Reports. For Annex I countries, the CAMPF sums the number of issues reported in Table 3 and Table 5 of the Annual Inventory Reviews. For non-Annex I countries, the CAPMF includes the completeness of mandatory components related to GHG inventories in the Biennial Update Reports. If	Eurostat, IPAC CAPMF data collection based on UNFCCC

		an Inventory Review Report was not published in a year, the CAPMF assigns the value of the previous year.	
UNFCCC evaluation of Biennial Reports and Biennial Update Reports	All IPAC countries, from 2014	Biennial Reports (BRs) and Biennial Update Reports (BURs) are key reports that improve transparency on emissions data and countries' climate action. The CAPMF includes one policy variable. This is the harmonised score of the transparency and completeness of BR or BURs adopting the methodology of (Weikmans and Gupta, 2021[63]). The basis of this score is the UNFCCC Technical Assessment. For the BRs the CAPMF considers the adherence to the mandatory requirements of one of four sections of the submitted report. Points are accorded for completeness (50%) and transparency (50%). For the BURs, the score reflects the extent to which mandatory elements of information are included. As B(U)Rs are only submitted every other year, the values given to each country carry over to the next year. From 2024, reporting requirements under the Biennial Transparency Reports (BTRs) will be the same for all countries.	IPAC CAPMF data collection based on UNFCCC
Submission of key UNFCCC documents	All IPAC countries, from 1994	Submissions of key documents under the UNFCCC enhance transparency on emissions data and countries' climate action. The CAMPF includes five variables. These include i) GHG inventories (Annex I countries), ii) Biennial Reports (Annex I countries) or Biennial Update Reports (Non Annex I countries), iii) National Communications (NCs), iv) Nationally Determined Contributions (NDCs), v) Long-Term Low Emission Development Strategies (LT-LEDS). BTRs will be included from 2024. The CAPMF measures whether or not a country submitted the document in a timely manner following the approach of (Bernauer and Böhmelt, 2013[41]). In terms of timeliness, the CAPMF distinguished between on time (before the specific due date), late (less than two months delay) or very late (more than two months after the due date). The due dates are calculated according to UNFCCC rules stated in the convention and/or in the related in the related international agreement. No due dates apply for LT-LEDS. The values for each of the policy variables carry forward to the next years until the next submission of that document is due.	IPAC CAPMF data collection based on UNFCCC

Annex C. Supplementary tables and results

Annex Table C.1. Instruments listed in the policy framework of the 2022 IPCC Working Group III report – Classification of mitigation policies

Category	Examples of common types of mitigation policy instruments
Economic instruments	**Carbon taxes**, **GHG emissions trading, fossil fuel taxes,** tax credits, grants, **renewable energy subsidies, fossil fuel subsidy reductions, offsets, R&D subsidies, loan guarantees**
Regulatory instruments	**Energy efficiency standards, renewable portfolio standards, vehicle emission standards,** ban on SF uses, biofuel content mandates, **emission performance standards, methane regulations,** land-use controls[1]
Other instruments	**Information programs, voluntary agreements, infrastructure,** government technology procurement policies, **corporate carbon reporting**

Source: (IPCC, 2022[3])
Note: Instruments shown in bold are included in the CAPMF.
1: land-use control is likely to be added in the 2023-2024 edition of the CAPMF.

Annex Table C.2. Conceptual framework of the CAPMF by policy type

	Market-based instruments	Non market-based instruments	NDCs and other actions
Components	Carbon pricing (ETS, carbon tax, fuel excise taxes, FFS), congestion charges, Renewable electricity support (auctions, RPS, FiT), Financing mechanisms of energy efficiency, public RD&D expenditure, pricing of emissions from international aviation and maritime transport	Minimum energy performance standards, air pollution standards, fuel economy standards, building energy codes, bans and phase out of fossil fuel extraction, new coal power plants, and fossil fuel using equipment (e.g. heating, passenger cars with ICE), emission limit values, labels, planning for renewables expansion, motorway speed limits, share of rail on total surface transport public expenditure, ending export credits and public financing of fossil fuels abroad	Net-zero targets, NDCs, independent climate advisory bodies, climate education, ratification of key international climate treaties, participation in international climate initiatives, evaluation of biennial (update) reports, Submission of key documents, GHG emissions reporting and accounting

Note: Only considers components of the 2022 edition of the CAPMF. Not included are components for 2023/2024.
Source: Authors.

Annex Table C.3. Descriptive statistics of CAPMF, 2022 edition

Number and share of IPAC countries and IPAC GHG emissions in 2020; average, median and mode of policy stringency

Policy	Number of countries where adopted	Share of IPAC countries	Share of IPAC GHG emissions	Policy stringency average (all IPAC countries)	Policy stringency average (if policy adopted)	Policy stringency median (if policy adopted)	Policy stringency mode (if policy adopted)
Electricity							
Financial support for renewables: Feed-in-Tariffs	15	29%	15%	1.1	3.9	3.8	4.3
Financial support for renewables: Auctions	14	27%	74%	1.0	3.9	3.3	6.3

Financial support for renewables: Renewable energy certificates	13	25%	71%	2.0	8.2	10.0	10.0
Emissions trading scheme - Electricity	36	69%	69%	5.8	8.4	8.5	8.5
Carbon tax Electricity	11	21%	12%	1.5	7.0	8.0	10.0
Fossil fuels subsidies - Electricity	23	44%	68%	2.5	5.7	6.0	2.0
Fossil fuels excise taxes - Electricity	6	12%	2%	0.4	3.6	2.8	8.5
Ban and phase out on the construction of new unabated coal-fired power plants	31	60%	15%	2.9	4.8	4.8	4.8
Planning for renewables expansion	44	85%	100%	5.3	6.2	7.0	8.0
Air emission standards	40	77%	97%	4.9	6.4	7.8	7.8
Industry							
Emissions trading scheme - Industry	37	71%	73%	5.9	8.2	8.5	8.5
Carbon tax Industry	14	27%	13%	1.7	6.1	6.0	6.0
Fossil fuels subsidies - Industry	37	71%	85%	4.2	5.9	6.0	9.0
Fossil fuels excise taxes - Industry	22	42%	6%	1.1	2.6	2.5	2.0
Financing mechanisms available - Industry	39	75%	99%	2.6	3.5	5.0	5.0
Minimum energy performance standards for electric motors	47	90%	90%	8.4	9.3	10.0	10.0
Energy efficiency mandates	42	81%	99%	5.0	6.2	7.0	8.0
Buildings							
Emissions trading scheme coverage of	6	12%	62%	0.9	7.4	7.3	10.0

GHG Building							
Carbon tax Building	17	33%	13%	1.9	5.8	7.0	7.0
Fossil fuels subsidies - Buildings	28	54%	82%	3.0	5.6	5.5	7.0
Fossil fuels excise taxes - Buildings	28	54%	11%	1.3	2.5	2.4	2.5
Financing mechanisms available - Buildings	40	77%	99%	2.7	3.5	3.0	6.0
Minimum energy performance standards of appliances	52	100%	100%	9.6	9.6	10.0	10.0
Building energy codes	46	88%	97%	6.6	7.5	10.0	10.0
Ban and phase out on fossil fuel heating systems	13	25%	7%	0.6	2.6	2.3	2.3
Mandatory energy labels for appliances	50	94%	100%	9.0	9.3	10.0	10.0
Transport							
Congestion charges	4	8%	3%	0.5	6.3	7.0	10.0
Emissions trading scheme - Transport	4	8%	56%	0.6	8.0	8.0	10.0
Carbon tax - Transport	18	35%	14%	1.9	5.6	6.0	7.0
Fossil fuels subsidies - Transport	34	65%	83%	3.9	5.9	6.0	6.0
Fossil fuels excise taxes - Transport	44	85%	48%	4.6	5.5	5.8	6.5
MEPS Transport	40	77%	86%	5.0	6.5	5.0	5.0
Labels for vehicles	40	77%	55%	7.7	10.0	10.0	10.0
Share of rail on total surface transport public expenditure	32	62%	79%	3.5	5.7	6.0	8.0
Speed limits on motorways	45	87%	96%	3.6	4.1	4.0	1.0
Ban and phase out of passengers cars with ICE	14	27%	9%	1.5	5.7	6.0	6.0
GHG emission targets							

NDCs	50	96%	90%	8.0	8.3	8.4	8.4
Net-zero target	43	83%	60%	5.1	6.1	6.5	7.8
Public RD&D expenditure							
Spending on public RD&D related to energy efficiency in % of national GDP	27	52%	38%	3.2	6.2	6.0	9.0
RD&D for CCS	22	42%	37%	2.3	5.5	5.0	9.0
RD&D for renewables	27	52%	38%	2.7	5.2	5.0	7.0
RD&D for nuclear	24	46%	37%	2.1	4.6	4.5	7.0
RD&D for hydrogen	26	50%	38%	2.9	5.8	6.0	9.0
RD&D for power and storage	27	52%	38%	3.1	5.9	6.0	9.0
Fossil fuel production policies							
Bans and phase out on fossil fuel extraction	3	6%	1%	0.2	4.2	4.3	4.5
Governments' support for fossil fuel supply	31	60%	92%	3.3	5.5	6.0	7.0
Methane reduction policies	21	40%	87%	1.6	3.9	4.0	2.0
Climate governance							
Climate advisory body	18	35%	49%	1.7	5.0	4.1	4.0
International co-operation							
Ratification of international climate agreements	52	100%	100%	9.4	9.4	10.0	10.0
Participation in international climate initiatives	52	100%	100%	7.8	7.8	8.5	10.0
Pricing of emissions from international aviation and maritime transport	31	60%	11%	1.8	3.0	3.0	3.0
International finance							
Banning governments' export credits for new unabated coal power	0	0%	0%	0.0	0.0	0.0	0.0

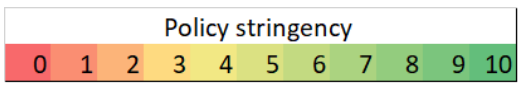
plants							
Banning public finance for fossil fuel infrastructure abroad	0	0%	0%	0.0	0.0	0.0	0.0
GHG emissions data and reporting							
Evaluation of Biennial Reports and Biennial Update Reports	42	81%	32%	4.4	5.5	4.0	3.0
Reporting to UNFCCC	49	94%	62%	6.2	6.6	7.4	10.0
GHG emissions reporting and accounting	44	85%	51%	5.3	6.3	6.5	5.0

Note: Some policies (e.g. banning governments' export credits for new unabated coal plants and public finance for fossil fuel infrastructure abroad were adopted by some countries in 2021 and, thus, do not yet show up in the table.
Source: Authors.

Annex Figure C.1. Evolution of policy adoption across CAPMF policy components, 2022 edition

IPAC average, 2010-2020

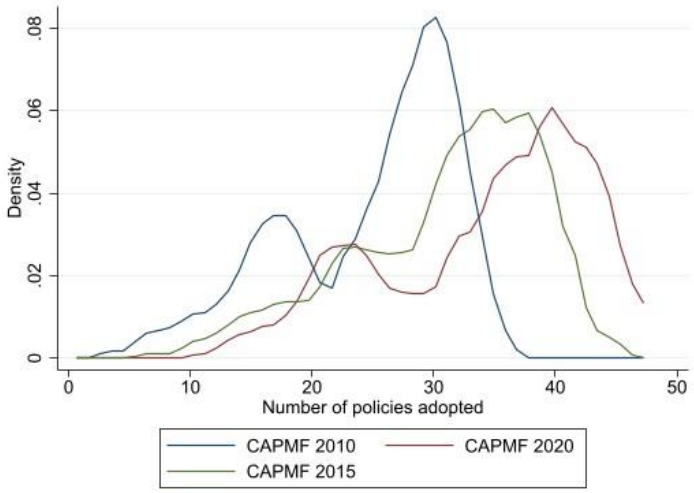
Module	Policy
Electricity	Financial support for renewables: Feed-in-Tariffs
	Financial support for renewables: Auctions
	Financial support for renewables: Renewable energy certificates
	Emissions trading scheme - Electricity
	Carbon tax Electricity
	Fossil fuels subsidies - Electricity
	Fossil fuels excise taxes - Electricity
	Ban and phase out on the construction of new unabated coal-fired power plants
	Planning for renewables expansion
	Air emission standards
Industry	Emissions trading scheme - Industry
	Carbon tax Industry
	Fossil fuels subsidies - Industry
	Fossil fuels excise taxes - Industry
	Financing mechanisms available - Industry
	Minimum energy performance standards for electric motors
	Energy efficiency mandates
Buildings	Emissions trading scheme coverage of GHG Building
	Carbon tax Building
	Fossil fuels subsidies - Buildings
	Fossil fuels excise taxes - Buildings
	Financing mechanisms available - Buildings
	Minimum energy performance standards of appliances
	Building energy codes
	Ban and phase out on fossil fuel heating systems
	Mandatory energy labels for appliances
Transport	Congestion charges
	Emissions trading scheme - Transport
	Carbon tax - Transport
	Fossil fuels subsidies - Transport
	Fossil fuels excise taxes - Transport
	MEPS Transport
	Labels for vehicles
	Share of rail on total surface transport public expenditure
	Speed limits on motorways
	Ban and phase out of passengers cars with ICE
GHG emission targets	NDCs
	Net-zero target
Public RD&D expenditure	Spending on public RD&D related to energy efficiency in % of national GDP
	RD&D for CCS
	RD&D for renewables
	RD&D for nuclear
	RD&D for hydrogen
	RD&D for power and storage
Fossil fuel production policies	Bans and phase out on fossil fuel extraction
	Governments' support for fossil fuel supply
	Methane reduction policies
Climate governance	Climate advisory body
International co-operation	Ratification of international climate agreements
	Participation in international climate initiatives
	Pricing of emissions from international aviation and maritime transport
International finance	Ending governments' export credits for new unabated coal power plants
	Ending public finance for fossil fuel infrastructure abroad
GHG emissions data and reporting	Evaluation of Biennial Reports and Biennial Update Reports
	Reporting to UNFCCC
	GHG emissions reporting and accounting



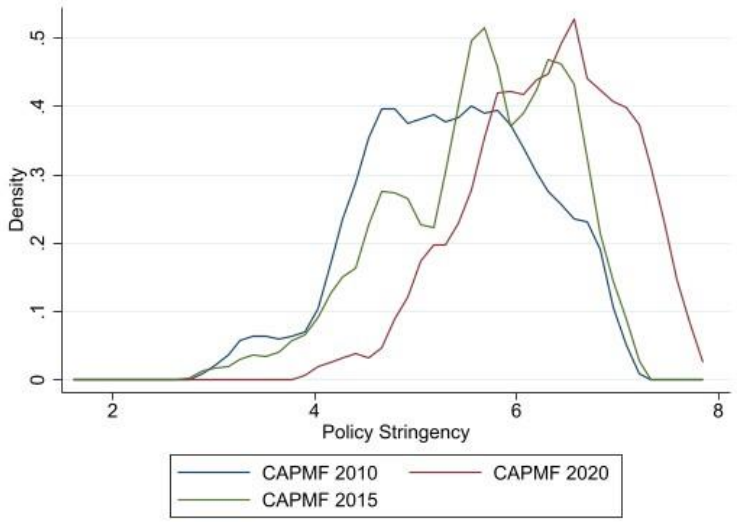
Source: Authors.

Annex Figure C.2. Countries diverged in terms of policy coverage, but converged in terms of policy stringency

Panel A: Kernel Density plot of the number of adopted policies



Panel B: Kernel Density plot of policy stringency



Note: Both graphics only include adopted policies. The number of policies as well as the policy stringency is measured on a country-year basis
Source: Authors.

Annex Table C.4. Climate actions and policies not currently covered

Policy variable	Rationale	Reason for not being included
Cross-sectoral climate policies		
Climate adaptation	As global temperatures increase, policies to adapt to climate change inevitably become more important in all countries.	Internationally comparable data on climate adaptation is not available, but is about to be collected by several actors. For example, the OECD is undertaking a stock-take of approaches to measure progress on adaptation as a first step to understand the state of play of country efforts over the course of 2022 (OECD, 2022[64]). Once data is available, this item could be included in a future version of the CAPMF subject to consultation with experts.
Green budgeting	Government budget, notably the expense side, has potentially a large impact on climate mitigation (e.g. through infrastructure investment or green public procurement)	Data on government expenditure on climate change is so far limited to a few EU countries. The OECD has developed country surveys on emerging green budgeting practices since 2020. Based on the surveys, the OECD is currently developing a composite index on green budgeting for OECD countries. Once more data on this becomes available, this item could be included in the CAPMF.
Internal carbon price (based on the social cost of carbon/GHG emissions)	Internal carbon prices, based on the social cost of carbon or other metrics, are used for governments' project appraisal or public procurement. Internal carbon prices can channel governments' investments and purchases towards low-carbon alternatives	There is no internationally comparable data on internal carbon prices. Data on the level of internal carbon prices for OECD countries was collected in the past (see e.g. (Smith and Braathen, 2015[65]) and (OECD, 2018[66])), but has not been collected since. Ongoing OECD efforts seek to restart such data collection.
Taxes on fossil fuels extraction	Fossil fuel supply taxes would reduce the incentives of developers to explore and extract fossil fuels. This would reduce the supply of fossil fuels and, thus, GHG emissions.	There is no internationally comparable database on fossil fuel supply taxes. Data collection is difficult because countries use a number of different instruments to effectively price fossil fuel extraction, including taxes on extraction, income, profits, or revenue or property income such as royalties and dividends (e.g. from state-owned enterprises) (Elgouacem et al., 2020[67]). This gap could be partially addressed by building on recent efforts to collect data on extraction taxes in the OECD PINE database.
Public RD&D for carbon dioxide	Emissions removals from technology (as opposed to NBS) are estimated to account for a	There is no publicly available data on public RD&D expenditure for removal technologies such as direct air capture. IEA has data on

Policy variable	Rationale	Reason for not being included
removal technologies	large part of emission removals in the future, but technology costs are currently high.	CCS, but this encompasses mostly CCS in combination with fossil fuels or industrial processes.
Climate education	Education in climate change can raise awareness and create knowledge, enabling people to take climate action (Anderson, 2012[68]).	Data on climate education is collected under the UN SDG framework (indicator 13.1.1). However, data is only available for 2020, which is too short a time series for inclusion in the CAPMF (see also Section 5 for next steps).
Sectoral climate policies		
Policies on power system transformation	Policies on power system transformation include policies that aim to increase power system flexibility (e.g. through batteries, interconnectors, demand-side response, etc.). These policies help enhance power system decarbonisation by enabling higher shares of variable renewables such as wind and solar PV.	There is no publicly available data on policies for power system transformation. Long-term power system plans exist, but it is difficult to extract quantitative data from them and harmonise the data to make it comparable across countries.
Sustainable mobility	Shifting to more sustainable modes of transport and reducing car dependency is one of the key climate strategies to reduce road transport's GHG emissions (OECD, 2021[69]).	There is no international comparable data on policies to promote sustainable mobility. The CAPMF includes central governments' investment in rail as share on total surface transport public expenditure. However, this does not capture investments in other sustainable modes (e.g. walking or cycling). In fact, most government actions to promote sustainable modes of transport are carried out at the sub-national level (e.g. urban planning, road and urban space allocation, investments in walking, cycling and public transport infrastructure). Future work in co-operation with CFE and/or ITF could develop policy variables to promote sustainable modes of transport.
Promotion of biofuels (e.g. biofuel mandates)	Biofuels in transport, buildings or industry could reduce GHG emissions by substituting fossil fuels.	Data on public support for biofuels (e.g. biofuel mandates) would be available. However, these policies are excluded because they risk increasing emissions from direct and indirect land use change if the feedstock does not comply with strong sustainability criteria (Havlík et al., 2011[70]) (Qin et al., 2015[71]). Future work could include policies to promote sustainable biofuels that minimise the risk of emissions from land use change.
Financial support for low-carbon vehicles (e.g. EV subsidies)	Low-carbon vehicles (e.g. EVs) emit less CO_2 emissions then ICE vehicles in most countries and can, thus, reduce transport-related emissions.	There is no internationally comparable database on financial support for EVs or other low-carbon vehicles. Most government schemes are time-limited and change frequently, which hampers data collection. This could change following the 2023 update of the PINE database which will focus on replenishing the data on subsidies in order to support this work stream.
Financial support for major buildings renovations (e.g. tax credits)	Major renovations are key to limit energy demand and GHG emissions in the building sector, notably in developed countries	There is no international database on government support programmes for major renovations. Most government programmes are time-limited and highly complex, making it difficult to track policy action and compare action across countries. The 2023 update of the PINE database will focus on replenishing the data on subsidies.
International public climate finance flows	International public climate finance flows allow governments to directly support other countries' efforts to mitigate climate change.	Measuring international public climate finance flows is complex. The Secretariat will explore data sources and propose indicators for the next biennium. This could include data from countries' UNFCCC submissions, climate-related official development assistance, or the new framework of 'Total Official Support for Sustainable Development'.

Source: Authors.

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