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Abstract

The Paris Agreement maps out a path for internationally coordinated efforts to curb global warming. At the centre of the Paris Agreement are Nationally Determined Contributions (NDCs) that establish countries' plans to reduce greenhouse gas (GHG) emissions as well as adapt to the impacts of climate change. However, mitigation commitments defined in NDCs are different across countries in terms of target types, coverage of sectors and gases. This makes it challenging to assess progress on countries' national contibribution. To complement the UNFCCC efforts, and facilitate the evaluation and monitoring of targets, this paper develops a methodology that harmonises countries' 2030 mitigation targets in physical units and providing clarity on sector and gas coverage. The results are used to develop the GHG Emission Trends and Targets (GETT) indicators for non-EU countries and the EU-27 covered under the International Programme for Action on Climate (IPAC). The GETT indicators support the analyses of emissions' trajectories by describing historical GHG emission trends and comparing to NDC emission targets considering different reference years and comparing across different relevant analytical categories such as emissions intensity per capita or per unit of GDP.

Keywords: Nationally Determined Contributions, GHG Emission Trends and Targets, Harmonised indicators, Paris Agreement

JEL Codes: Q54, C89, Y10

Résumé

L'Accord de Paris trace la voie à suivre pour des efforts coordonnés au niveau international visant à freiner le réchauffement climatique. Au centre de l'Accord de Paris se trouvent les contributions déterminées au niveau national (CDN) qui établissent les plans des pays pour réduire les émissions de gaz à effet de serre (GES) et s'adapter aux impacts du changement climatique. Cependant, les engagements d'atténuation définis dans les CDN diffèrent entre les pays en termes de types d'objectifs, de couverture de secteurs et de gaz. Il est donc difficile d'évaluer les progrès réalisés par rapport aux engagements d'atténuation des pays. Pour compléter les efforts de la CCNUCC et faciliter l'évaluation et le suivi des objectifs, ce document développe une méthodologie qui harmonise les objectifs d'atténuation des pays pour 2030 en unités physiques et en clarifiant la couverture des secteurs et des gaz. Les résultats sont utilisés pour créer les indicateurs de tendances et d'objectifs en matière d'émissions de GES (GETT) pour les pays non-membres de l'UE et l'UE-27 couverts par le Programme international d'action sur le climat (IPAC). Les indicateurs GETT soutiennent les analyses des trajectoires des émissions en décrivant les tendances historiques des émissions de GES et en les comparant aux objectifs d'émission des NDC, en tenant compte des différentes années de référence et en les comparant à travers différentes catégories analytiques pertinentes telles que l'intensité des émissions par habitant ou par unité de PIB.

Mots clés : Contributions déterminées au niveau national, Tendances et objectifs d'émissions de GES, Indicateurs harmonisés, Accord de Paris

Codes JEL : Q54, C89, Y10

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Acronyms and definitions

AR4	IPCC Fourth Assessment Report
AR5	IPCC Fifth Assessment Report
Baseline	A 'reference' or 'benchmark' scenario
Base value	Level of emissions in a base year
Base year	Historic reference year
BAU	Business-as-usual scenario
BTR	Biennial Transparency Report
COP	Conference of Parties
CO_2e	CO_2 equivalent of GHG emissions
UNFCCC Emission Source	Emissions from sources as identified in UNFCCC inventory
EEA	European Economic Area
ETS	Emissions Trading System
EU27	European Union
GDP	Gross Domestic Product
GETT	GHG Emission Trends and Target
GHG	Greenhouse Gas
GWP	Global Warming Potential
IPAC	International Programme for Action on Climate
IPCC	Inter-Governmental Panel on Climate Change
LULUCF	Land Use, Land Use Change and Forestry
NDC	Nationally Determined Contribution
NIR	National Inventory Report
OECD	Organisation for Economic Co-operation and Development
PA	Paris Agreement
SAR	IPCC Second Assessment Report
UNFCCC	United Nations Framework Convention on Climate Change

Executive summary

In the Paris Agreement (PA), Parties agreed to keep "the global temperature rise this century to well below 2°C and pursue efforts to limit the temperature rise to 1.5°C above pre-industrial levels". At the heart of the PA are Nationally Determined Contributions (NDCs) where Parties state their GHG emission mitigation targets and implementation efforts. Parties are required to submit an updated NDC at least every five years and demonstrate progress with each new submission, however, reflecting common but differentiated responsibilities and respective capabilities, they can present emission targets using different sectors and gases covered. This poses a challenge to monitor and compare countries' progress in a harmonised manner and assess the implications of mitigation commitments for the PA goals.

The objective of this study is to harmonise countries' mitigation targets and develop associated indicators. This is done by transforming each country's 2030 NDC mitigation target, as submitted to the UNFCCC, into a physical emissions level in million tonnes CO_2-equivalent ($MtCO_2e$) based on single-year target. Estimated physical emission targets can then be used to calculate indicators to show trends in GHG emisisons. This is referred to as the GHG Emission Trends and Target (GETT) indicator set.

Transforming NDC targets to physical units generally only requires simple arithmetic operations when using official data. However, a challenge arises when quantifying and comparing targets across different target scopes, gases covered, and the use of the global warming potential (GWP) – a conversion factor which transforms non-CO_2 GHGs to CO_2e. In those cases the methodology develops a consistent criteria to transform targets into their physical equivalent. This was not possible in the case of Saudi Arabia.

Specifically, the study clarifies sectoral and gas coverage, as well as the global warming potential applied. Eleven distinct combinations of sector-gas-GWP have been identified across countries covered under the International Programme for Action on Climate (IPAC). As the proposed methodology for quantifying 2030 emission targets is based on sectors and gases stated in the countries' official NDCs, target scopes are not adjusted to fit a common target definition. This would require additional assumptions, and could be a future application.

The contribution of this study is developing a methodology that estimates the physical emission levels of the GHG emission mitigations presented in the NDCs of 24 non-EU countries and the NDC of EU-27 covered under IPAC expressed in million tonnes of CO_2-equivalent. The resulting data allow for the development of indicators that compare historical GHG emissions expressed in physical terms as absolute values or as emissions' intensities with projected GHG emissions in various ways (e.g., difference between historical annual emissions level and target emissions level, expression of this difference in percentage of historical annual emissions level, and cumulative gap over years).

The proposed indicators enable a breadth of analyses of countries' progress towards their NDCs in a harmonised manner with transparency of scope. Such analyses would usefully complement the tracking of progress under the Biennial Transparency Report (BTR) under the Paris Agreement. Finally, the proposed GETT indicators will feed into the set of climate-related indicators for IPAC and feature in the IPAC climate action dashboard, https://www.oecd.org/climate-action/ipac/dashboard.

1 Introduction

The OECD's International Programme for Action on Climate (IPAC) was developed to support countries to assess their climate action, facilitate the adoption of best practices, and promote peer exchange. A cornerstone of the IPAC is the development of a set of indicators that provide information on climate action to help countries monitor their actions and performance.

A key element of the indicator set is information that helps compare current or historical country-level greenhouse gas (GHG) emissions with official emission targets for 2030. In order to enable this comparison, and facilitate the tracking of progress towards GHG emission targets, emission target types, which vary across countries, must be harmonised with common metrics, namely GHG emissions in physical terms for 2030 for each country.

Using a semi-automatised methodology for collecting GHG emission targets from Nationally Determined Contributions (NDCs) under the Paris Agreement,[1] IPAC has quantified emission targets in physical terms for individual countries for 2030 based on single-year target (or single-year indicative value in case of multi-year target).[2] These target emission levels have been used as a reference value for indicators on Greenhouse Gas Emission Trends and Targets (GETT) that feature in the IPAC Climate Action Dashboard (https://www.oecd.org/climate-action/ipac/dashboard).

This paper presents the methodology and the data sources used to determine country-level GHG emissions targets in line with their NDCs, and their characteristics for the group of IPAC countries, with the exception of Saudi Arabia, which was not possible to do.[3] Assessing whether the targets are ambitious enough and how countries intend to achieve them, including the possibility of using international offsets, is outside the scope of this paper. In other words, difference between historical emission level and 2030 target presented in this paper should be interpreted as the difference if achieved only through domestic emission reductions.

Estimated physical emission targets are based on countries' official NDC emission targets, which have different emission scopes (sectors and gases) and may use different Global Warming Potential (GWP) coefficients. As such, estimated physical emission targets are not directly comparable across countries (Briner and Prag, 2013[1]) unless the target scopes are the same or when comparing relative changes across countries.

The main text presents the methodology, GHG emission target results and the proposed GETT indicators. The information base to translate targets into physical terms stems from UNFCCC official data, including

[1] Developed by joint-work from the OECD Environment and Statistics and Data Directorates to compile a harmonised database on GHG emission and removal targets in NDCs.

[2] See Table 3.1. and Paragraph 21 for target types.

[3] IPAC countries are: all OECD countries (Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye, United Kingdom, United States), partner economies (Brazil, People's Republic of China, India, Indonesia, South Africa), six prospective members (Argentina, Brazil, Bulgaria, Croatia, Peru, Romania), an EU country (Malta), and other G20 country (Saudi Arabia).

countries' NDCs, complemented by OECD sources (i.e., State of the Environment Questionnaire, National Accounts data on GDP and Economic Outlook). Specific country observations, data sources and treatment are presented in the Annex.

2 The UNFCCC Stocktake and Submission of GHG Emission Targets

The centrepiece of the international climate governance regime is the United Nations Framework Convention on Climate Change (UNFCCC) negotiated at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. The Convention established a broad set of substantive principles, including the principle of "common but differentiated responsibilities and respective capabilities", but does not contain binding commitments to reduce greenhouse gas emissions. The UNFCCC establishes some commitments for developed and developing countries, but principally acts as a procedural instrument establishing reporting and information sharing obligations.

At the 21st session of the Conference of Parties (COP) in Paris, on 12 December 2015, Parties to the UNFCCC reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low-carbon future. The Paris Agreement (PA) builds upon the Convention and, for the first time, brought virtually all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects.[4] As such, it charts a new course in the global climate effort.

The Agreement, and consequent contributions to climate mitigation, are nationally determined, rather than enforced in a top-down manner. The PA sets out the goal of limiting average global warming to 2ºC above pre-industrial levels and identifies a further need for efforts to confine the increase to 1.5ºC.

The basis of the PA is a non-binding "bottom-up" approach. Countries submit contributions reflecting their highest possible ambition; these are referred to as "nationally determined contributions" (NDCs). NDCs present targets to progressively mitigate GHG emissions and enhance their adaptive capacity to climate change together with information necessary for clarity, transparency and understanding.

Countries, party to the Agreement, must submit a new or updated NDCs every five years and the efforts should represent a progression compared to previous NDCs. So far, 195 Parties have submitted at least their first NDC and the majority have communicated a new or updated NDC (UNFCCC, 2024[2]).

Implementation of each NDC will be reported through the biennial transparency reports (BTRs) under the Enhanced Transparency Framework. BTRs are to be submitted by countries every two years with a self-assessment of their progress drawing on national information and indicators. The first country BTRs are to be submitted by 31 December 2024.

Therefore, individual country information on the implementation of emission targets may only be made available in 2025 depending on the countries' submission dates of BTRs. IPAC GETT indicators will fill the gap, providing information on current emission targets and trends, with official information based on countries' individual targets. In this paper, targets presented in the subsequent sections are calculated

[4] 195 Parties out of 198 Parties to the Convention are Parties to the Paris Agreement as of 23 February 2023.

using information provided on NDCs submitted to the UNFCCC up to 30/07/2023. GHG emission data will be updated as new data is available (e.g., GHG emission data of Annex-I countries on an annual basis or upon NDC updates).

The UNFCCC is also carrying out a global stocktake to assess the collective progress of mitigation towards the goals agreed in the Paris Agreement (UNFCCC, 2019[3]). The first global stocktake will conclude in 2023 and will take place every five years thereafter.

3 Methodology for Determining GHG Emission Targets for 2030

In their NDCs, countries set GHG emission targets with information necessary for clarity, transparency and understanding such as reference point, time frames, scope and coverage. However, targets are not constructed uniformly since countries have different approaches.

That is, countries may use different target types[5] and, more significantly, can set targets covering different sectors (e.g., inclusion of the land use, land use change and forestry sector, LULUCF[6]) and GHGs (Briner and Prag, 2013[1]; Hood, Briner and Rocha, 2014[4]).[7] This means that the coverage of targets is different across countries and not necessarily comparable to the coverage of GHG emission inventories.

Furthermore, to aggregate countries' GHG emissions with CO_2 emission equivalents it is necessary to use a global warming potential (GWP) coefficient;[8] a set of GWP coefficients based on different versions of IPCC assessment reports may be applied. Consequently, it is difficult to compare across countries, monitor mitigation efforts, or determine the distance to targets when different metrics are used.

Approach

Drawing on the UNFCCC NDC Registry, Table 3.1 summarises the mitigation targets presented by IPAC countries, organised by type. Note that the targets do not sum to the total number of IPAC countries and EU-27, because some countries present more than one target in their NDC, and that the main target type "emission % reduction from base value" covers 42 countries because it is the common target presented by the 27 EU member countries in their NDC.

Details on the data treatment and sources for each country are presented in Annex A. Harmonised templates have been developed to capture the detailed characteristics of NDC targets. These templates will allow for more efficient update, use, and dissemination of comparable indicators on NDC characteristics.

[5] "Target type" refers to the way the GHG emissions target is formulated, this can be in physical terms, a percentage reduction from base year, an emission intensity level, among others.

[6] LULUCF is a greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities (UNFCCC, 2022e).

[7] GHGs are atmospheric gases responsible for causing global warming and climate change. The UNFCCC requires each Annex I country to report emissions and removals of direct GHGs (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3)) (UNFCCC, 2022e).

[8] GWP is an index that allows for expressing all GHGs in terms of CO_2 emission equivalents; they are the combined effect of the differing times greenhouse gases remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation (UNFCCC, 2022e).

Table 3.1. IPAC Country 2030 Emission Targets

Type of target	Definition	Number of IPAC countries
Physical Emissions (single year)	Fixed emission level in physical terms in a specified single target year.	7
Physical Emissions (multiyear budget)	Fixed emission level in physical terms over a specified multiyear period.	3
Emission % Reduction from Base Value	Emission targets calculated relative to an emission level in a specified year (base year).	42
Emission % Reduction from BAU	Emission targets calculated relative to the emission level according to a business-as-usual scenario (BAU).	8
Emission Intensity % Reduction	Emission intensity targets calculated relative to the emission intensity in a specified year (base year). Intensity targets are expressed in terms of GDP.	2
Year of Peak Emissions	A year in which emissions are expected to peak or reach an absolute maximum level of emissions.	1
Annual Emission Abatement	Constant annual emission reduction from a baseline scenario by the specified target year, expressed in physical terms.	1

Note: Several countries include multiple targets and/or target types in one NDC submission. Emission % reduction from base value identifies 42 countries, because it includes 27 EU member countries individually, however they present a common NDC.
COP 26 encourages Parties to communicate an NDC in 2025 with an end date of 2035, and in 2030 with an end date of 2040, and so forth every five years thereafter.
Source: Last NDC submitted to UNFCCC NDC Registry as of 12/10/2022.

The methodology to develop a set of GETT indicators consists of first putting all targets under a common denominator, namely a physical emissions target for 2030 expressed in million tonnes of CO_2equivalent. This is done by applying transformations to country-level data to derive 2030 emission targets in physical terms, depending on how countries present their targets and what information is provided in their NDCs.

If the country NDC target is defined for 2030 in physical terms (i.e., in tonnes of CO_2-equivalent), the GETT indicators maintain the target as presented, otherwise, targets are put into physical emission levels for 2030. The transformations are relatively simple but depend on how the target is presented in the NDC. The criteria is the following:

i. Information is taken from official sources. First, target data is taken from each country's NDC. When additional information outside of the NDC is required to transform the presented target into a physical emissions level for 2030, data is taken in a sequenced hierarchy detailed in the Annex.
ii. The NDC single year target for 2030 is used to calculate the physical emission target, even if countries also express multiple single year targets and/or multiyear (emission budget) targets. Only Saudia Arabia does not present a target for 2030, it presents a national abatement target which does not allow to calculate a physical emission target.
iii. If the NDC presents both an unconditional and a conditional target, the unconditional one is taken. In the cases where only a conditional target is presented, the conditional one is taken; this is the case for three IPAC countries.[9]
iv. In cases where targets for different scopes of gases and sectors are included, targets covering the largest set of gases and sectors are used. When it is unclear whether or not the target includes LULUCF, it is assumed to include LULUCF.
v. When the target is expressed as a range of values, with a minimum and maximum target to be achieved, the mid-point value is taken.
vi. To achieve their target, countries may consider the use of offsets (see Annex A for the overview of countries explicitly mentioning offsets in NDCs). These are not considered in this methodology,

[9] Countries may present both unconditional and conditional targets. The former are country level targets and the latter are targets that depend on international support. The three IPAC countries which only present conditional targets are India, Türkiye and South Africa.

since the objective is to determine the emission target in physical terms, not assess how it will be achieved.

vii. EU member states are not covered. This is because the EU and its 27 member states collectively submit a common NDC.[10] Achieving the EU target relies on the EU Emissions Trading System (ETS), a multi-country and multi-sector cap-and-trade scheme, where companies can trade emission permits within the EEA. Hence, it is impossible to assess a priori where (sector and country) emission abatement will occur. Some form of economic modelling would be required to project future emission reduction under the ETS in individual countries and a dedicated methodology could be developed. This is, however, not the purpose of this study.

Of the seven target types presented in Table 3.1, four types require target transformations to calculate the physical emission targets of countries covered under IPAC:

- emission percentage reduction from a base value;
- emission percentage reduction from a business-as-usual scenario;
- emission intensity percentage reduction; and
- annual emission abatement.

Concerning the remaining three target types, (1) “physical emission targets” does not require treatment, (2) “targets expressed as the peak year of emissions” does not allow for quantification in physical terms (there is no IPAC country which only included a peak year target), and (3) “targets expressed as an emission budget” (multiyear targets) is not considered as explained in point ii.

The general approach for each target transformation considered in this paper is described in the sections below.

Estimating emission percentage reduction from a base value target

If the base value is given directly in the NDC, it is taken, and the target percentage reduction is applied. If the base value is not explicit, the historical emissions corresponding to the base year indicated in the NDC are taken from the UNFCCC GHG inventory with the same scope of gases and sectors as the target. Thus, when the base value is not explicit, the calculated target will have the same GWP as the UNFCCC GHG inventory regardless of the GWP stated in the NDC.

When targets are expressed as percentage reductions, the GWP of the calculated physical emissions target always takes the GWP of the base value. The GWP used to report emissions in CO_2e in the UNFCCC inventory is usually taken from AR4 or AR5 for Annex 1 countries[11] and SAR for non-Annex 1 countries.[12] Hence, when the base value is taken from the UNFCCC inventory, the estimated physical emissions target is aligned with the GWP used in the UNFCCC inventory.

[10] The EU submitted its intended NDC (INDC) on March 6, 2015, which became the EU NDC with the ratification of the Paris Agreement in October 2016. In December 2020, the European Council endorsed a strengthened binding EU target of a net reduction of domestic emissions of at least 55% by 2030 compared to 1990, and a corresponding revised NDC was submitted, to the UNFCCC on 17 December 2020. To deliver on the enhanced target, in July 2021, the Commission adopted a series of proposals to revise all relevant policy instruments.

[11] Out of non-EU IPAC countries, UNFCCC Annex I countries are Australia, Canada, Iceland, Japan, New Zealand, Norway, Switzerland, Türkiye, United Kingdom and United States.

[12] Out of non-EU IPAC countries, UNFCCC non-Annex I countries are Argentina, Brazil, Chile, China, Colombia, Costa Rica, India, Indonesia, Israel, Korea, Mexico, Peru, Saudi Arabia and South Africa.

Estimating emission percentage reduction from a BAU scenario targets

All countries covered under IPAC that present targets as a percentage of BAU, present the BAU scenario in their NDC, from which their target percentage reduction is applied. Since targets are expressed as percentage reductions, the GWP of the calculated physical emissions target always takes the GWP of the BAU scenario.

Estimating emission intensity percentage reduction targets

No IPAC country that presents emission intensity percentage reduction targets provides the base emission intensity in their NDC. Consequently, the base emission intensity is calculated using the GDP of the base year, taken from the OECD's National Accounts Data on GDP (OECD, 2024[5]). The GDP unit used is purchasing power parity (PPP) at 2015 constant exchange rate USD.

The target percentage reduction is applied to the estimated base emission intensity to calculate the target emission intensity. Finally, the physical emissions target is estimated by multiplying the target emission intensity by projected GDP, taken from the OECD Economic Outlook No 109, in the target year (OECD, 2021[6]).

Since targets are expressed as percentage reductions, the GWP of the calculated physical emissions target always takes the GWP of the base emissions value used to calculate the base emission intensity.

Estimating annual emission abatement targets

Saudi Arabia presents an annual emission abatement target. However, to estimate the target in terms of physical emissions, a baseline scenario relative to which emissions will be reduced must be specified. However, since no baseline scenario is provided in their NDC the physical emissions target cannot be estimated. Therefore, this target transformation is not possible.

Classifying targets

To facilitate comparison and grouping of physical emission targets according to their scope, a target index is constructed which identifies target scopes, classifying targets according to their sector coverage, gases included, and GWP used. The target index is a combination of three ordered numbers, according to the following structure: (i) the first number corresponds to sectors[13]; (ii) the second to gases, and (iii) the third to GWP used for calculation. For example, a target which covers all sectors including LULUCF, all GHGs, and is expressed in 100-year time horizon GWP AR4 has a target index of 1.1.4.

If the gas and sector scope or GWP is not clearly defined in NDC, it is interpreted that the sectors are total economy, including LULUCF, and that gases and GWP are aligned to the emission inventory of the reference country. Across all IPAC countries' estimated physical emission targets, there is a total of eleven distinct target indices. The details are presented in Table 3.2.

[13] Sectors and gases are included in the guidance on information to facilitate clarity, transparency and understanding of NDCs as elements of scope and coverage (UNFCCC, 2019[11]) and the target index contributes to expressing the content of NDCs in a structured manner.

Table 3.2. Estimated 2030 Physical Emission Targets and Target index Key

Sectors	Sectors Index	Gases	Gases Index	100-year GWP	GWP Index
Total incl. LULUCF	1	All GHGs	1	SAR	2
Total excl. LULUCF	2	All GHGs + indirect CO_2	2	AR4	4
Total incl. LULUCF, incl. international aviation	3	Kyoto basket (all GHGs except for NF_3)	3	AR5	5
		CO_2, CH_4, N_2O, HFCs, PFCs	4	unclear	0
		CO_2, CH_4, N_2O	5		
		CO_2 only	6		
		unclear	0		

4 Results

Classifying the calculated 2030 emission targets of the countries covered under IPAC results in 11 distinct target indices. The calculated targets range from 6 $MtCO_2e$ to 10,146 $MtCO_2e$, which is a wide range representative of the diversity across OECD and non-OECD countries. The target calculation results are presented in Table 4.1 together with target index for non-EU IPAC countries and EU-27. Estimated targets are harmonised within a target index.

Targets expressed in physical terms facilitate the comparison of a country's historical emissions with their target, when historical emissions align with the target calculation in scope (sectors, gases and GWP). As the estimated physical targets are based on official NDCs and does not involve emission estimation per sector or gas, the scope of targets is consistent with their respective NDCs. This means targets in physical terms retain the target scope set in that country's NDC or the countries official inventory when reference year emissions have to be taken from UNFCCC GHG inventory.

Figure 4.1 presents historical GHG emissions level and 2030 target emissions level per country. Scope (sectors and gas) and GWP for historical emissions level are aligned to those used for the target calculation. The graphs are grouped according to the target index (see Table 4.1).

Table 4.1. Estimated 2030 emission targets for non-EU countries

Country	NDC target as submitted	IPAC estimated 2030 emission level (million tonnes of CO_2e)	Target index, (format: sectors.gases.GWP, Table 2)	UNFCCC submission version of the NDC (submission dates)
Argentina	349 MtCO2e	349.00	1.4.2	2nd NDC (02/11/2021)
Australia	43% emission reduction from 2005	354.03	1.1.5	4th NDC (16/06/2022)
Brazil	50% emission reduction from 2005	1176.27	1.3.2	4th NDC (21/03/2022)
Canada	40-45% emission reduction from 2005	425.93	1.1.5	3rd NDC (12/07/2021)
Chile	95 MtCO2e	95.00	2.1.4	2nd NDC (09/04/2020)
China	65% reduction of emission intensity from 2005	10,146.28	1.6.2	2nd NDC (28/10/2021)
Colombia	169.44 MtCO2e	169.44	1.3.0	2nd NDC (30/12/2020)
Costa Rica	9.11 $MtCO_2e$	9.11	1.3.2	3rd NDC (29/12/2020)
EU-27	min. 55% emission reduction from 1990	2093.29	3.2.4	2nd NDC (18/12/2020)
Iceland[14]	55% emission reduction from 1990	5.98	1.1.5	2nd NDC (18/02/2021)
India	45% reduction of emission intensity from 2005	3,837.17	1.3.0	2nd NDC (26/08/2022)
Indonesia	32% emission reduction from 2030 BAU	1954.08	1.5.2	3rd NDC (23/09/2022)
Israel	27% emission reduction from 2015	57.67	1.3.2	2nd NDC (29/07/2021)

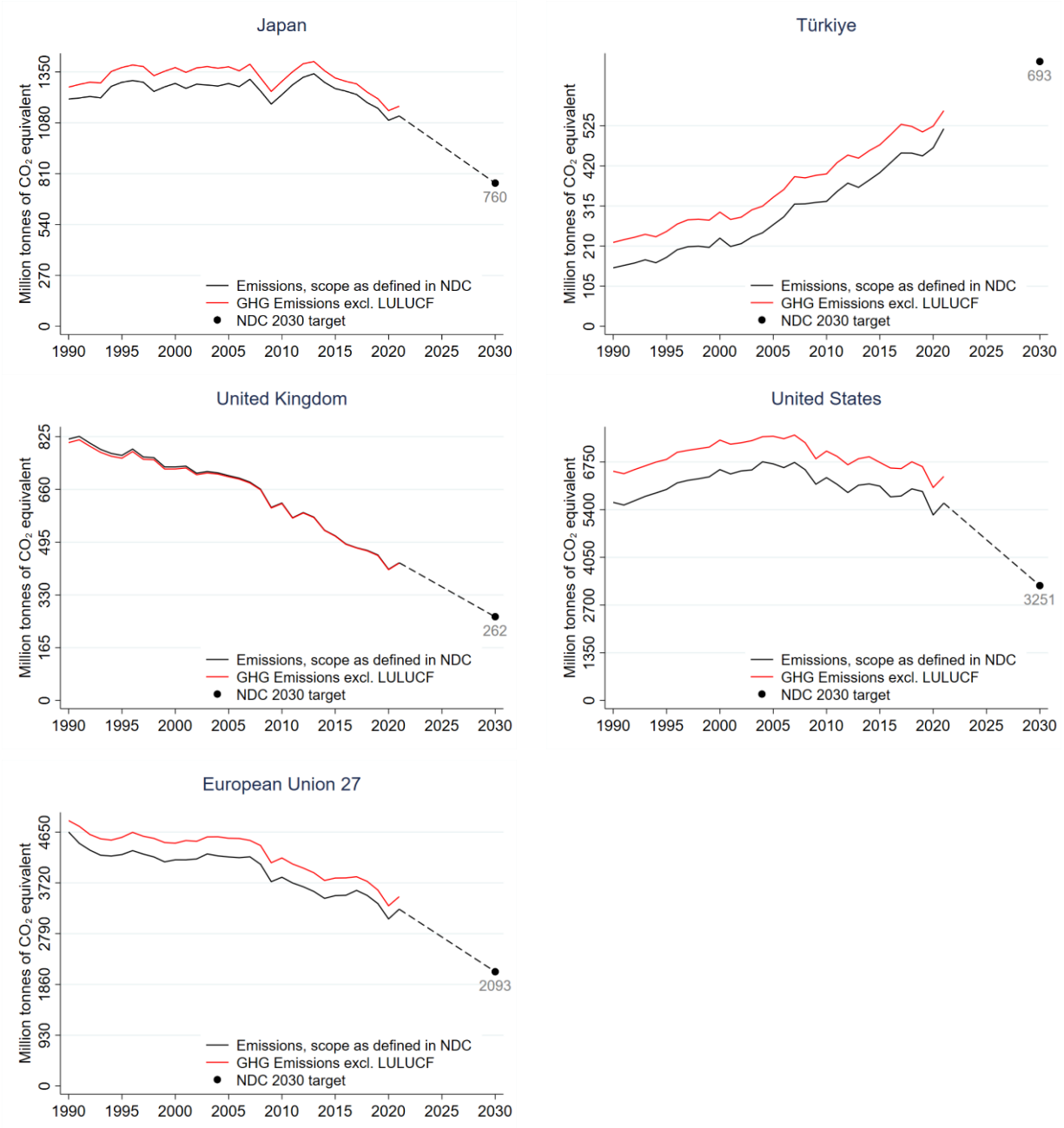
[14] NDC of Iceland states that "Iceland's enhanced ambition target of 55 percent net emissions reduction refers to the joint target of the countries involved [EU27 and Norway]; the individual share and commitments of each country is then determined by commonly agreed rules." "Iceland is committed to a target of (at least) 55 percent net reduction of greenhouse gas emissions by 2030 compared to 1990, acting jointly with the European Union and its Member States and Norway to achieve this target, within the framework of their climate cooperation agreement." This paper applied 55 percent reduction target to Iceland, because commonly agreed rules for the latest NDCs have not yet been established.

Country	NDC target as submitted	IPAC estimated 2030 emission level (million tonnes of CO_{2e})	Target index, (format: sectors.gases.GWP, Table 2)	UNFCCC submission version of the NDC (submission dates)
Japan	46% emission reduction from 2013	760.32	1.1.4	4th NDC (22/10/2021)
Korea	40% emission reduction from 2018	436.56	1.3.2	3rd NDC (23/12/2021)
Mexico	35% reduction from 2030 BAU	644.15	1.3.0	3rd NDC (17/11/2022)
New Zealand	50% emission reduction from 2005	43.00	1.1.5	2nd NDC (03/11/2021)
Norway	55% emission reduction from 1990	22.95	1.1.5	3rd NDC (03/11/2022)
Peru	208.8 $MtCO_2e$	208.80	1.3.2	2nd NDC (18/12/2020)
Saudi Arabia	278 $MtCO_2e$ (target set for annual abatement for 20202030)	Impossible to calculate due to lack of information in the NDC	1.0.2	2nd NDC (23/10/2021)
South Africa	350-420 $MtCO_2e$	385.00	1.4.2	2nd NDC (27/09/2021)
Switzerland	min. 50% emission reduction from 1990	27.08	1.2.0	3rd NDC (17/12/2021)
Türkiye	41% reduction from BAU scenario in NDC	693.25	1.1.4	1st NDC (13/04/2023)
United Kingdom	min. 68% emission reduction (from 1990 for CO_2, CH_4, N_2O and from 1995 for HFCs, PFCs, SF_6 and NF_3)	261.59	1.1.4	3rd NDC (22/09/2022)
United States	50-52% emission reduction from 2005	3,251.15	1.1.4	2nd NDC (22/04/2021)

Note: See Annex A for details of NDCs, including if the targets considers use of offsets. UNFCCC submission version of the NDC shows the version of the NDC that was available on UNFCCC NDC registry at the time of the review. Note that 2nd version could mean either updated first NDC or second NDC (for more information see https://unfccc.int/NDCREG).
Source: Calculated based on last NDC submitted to UNFCCC NDC Registry and UNFCCC inventory as of 30/07/2023. More recent data will be available on the IPAC dashboard.

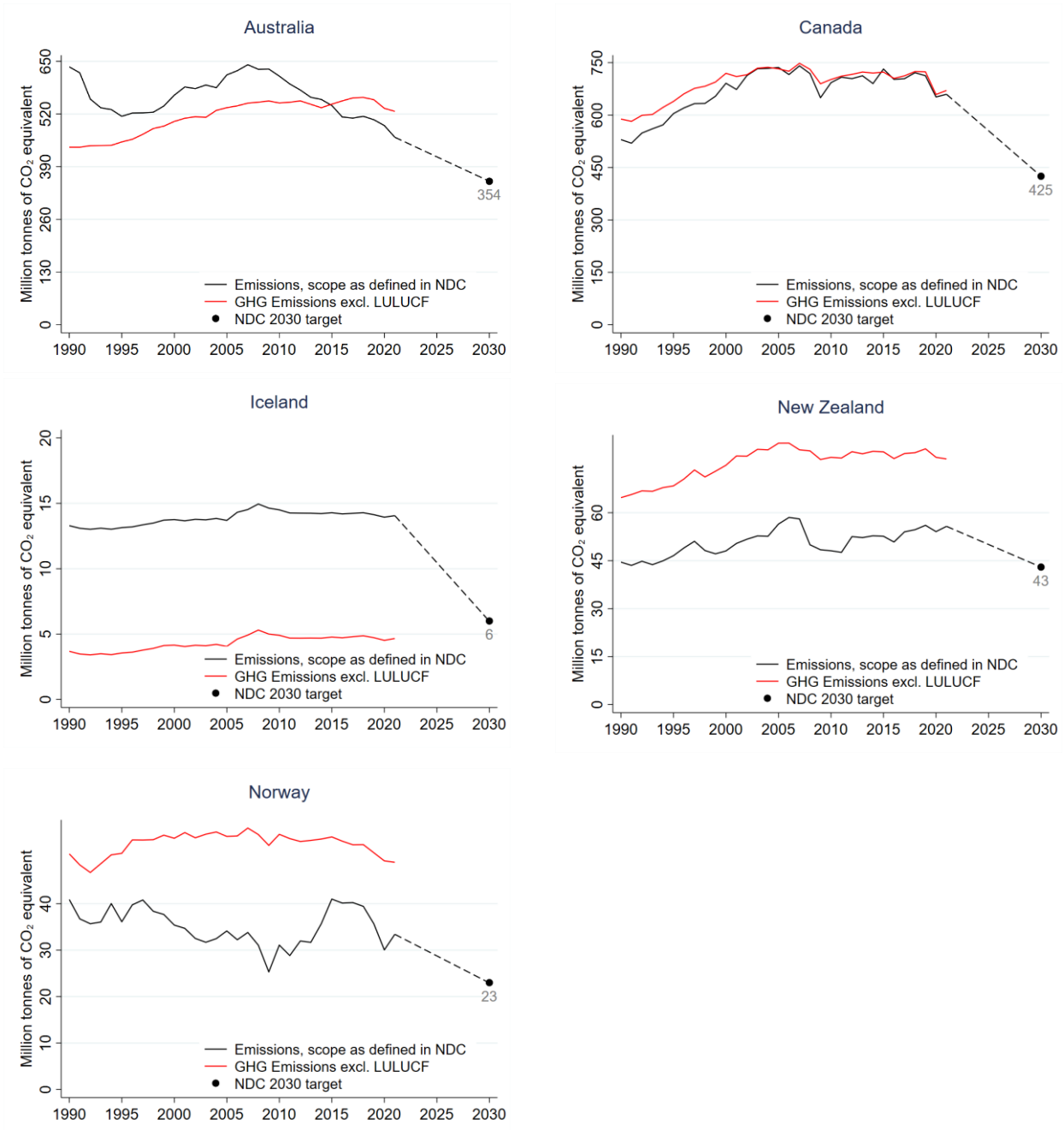
Figure 4.1. Emissions and targets for non-EU countries grouped according to target index

A. Target index 1.1.4



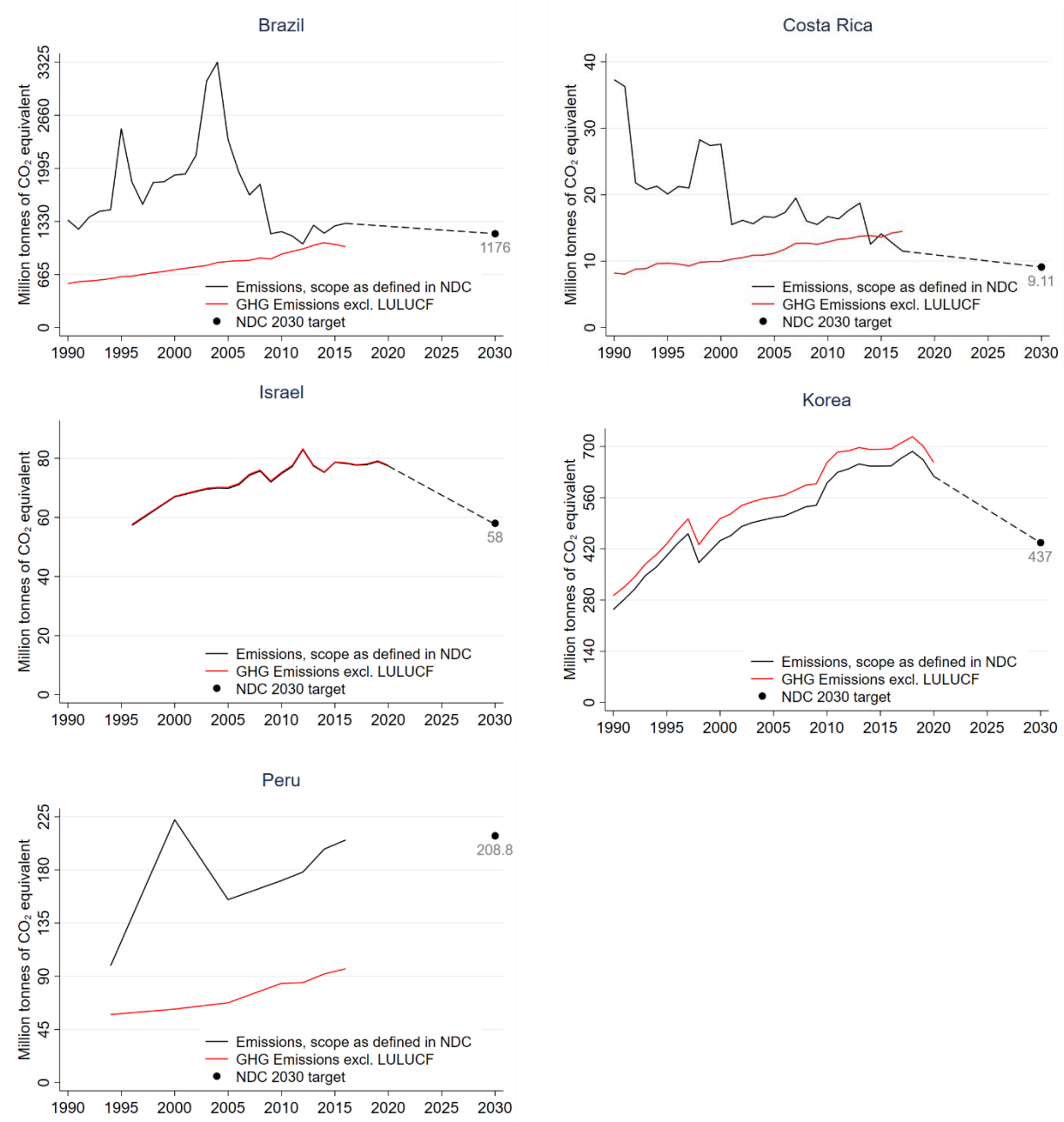
Note: Target index 1.1.4 refers to targets that include all sectors, all gases and use GWP AR4. Countries in this panel have the same NDC target scope except EU27 which include international aviation and indirect CO_2. The Figure for EU-27 here is shown according to their NDC scope. Comparison between emission targets and current emissions do not consider offsets.

B. Target index 1.1.5



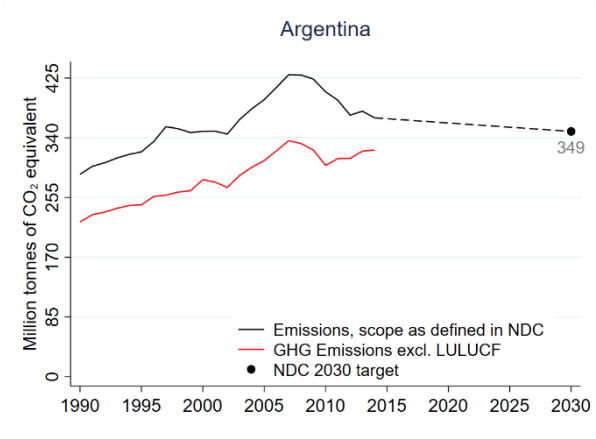
Note: Target index 1.1.5 refers to targets that include all sectors, all gases and use GWP AR5. Comparison between emission targets and current emissions do not consider offsets.

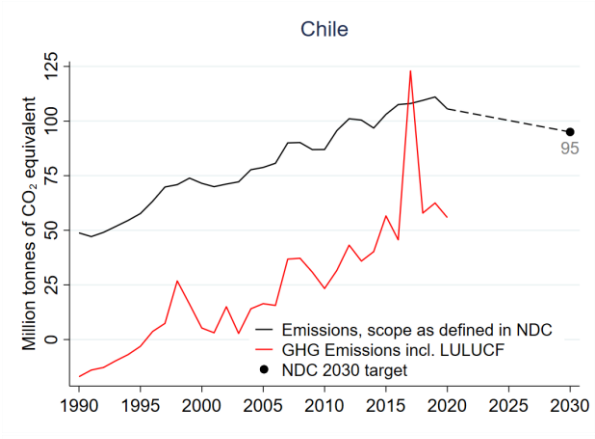
C. Target index 1.3.2

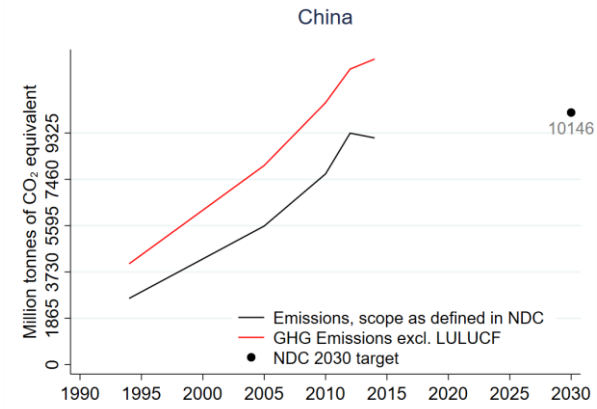


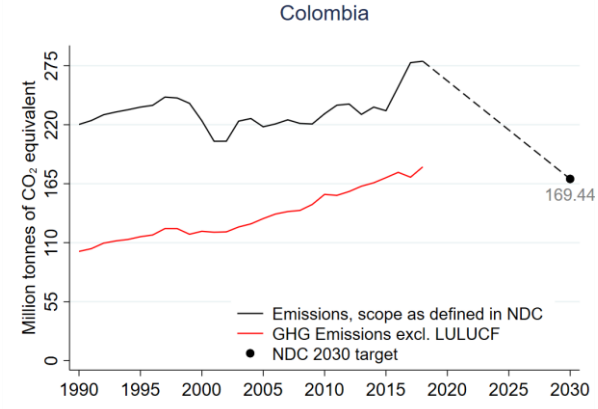
Note: Target index 1.3.2 refers to targets that include all sectors, all gases except NF_3 and use GWP SAR. Comparison between emission targets and current emissions do not consider offsets.

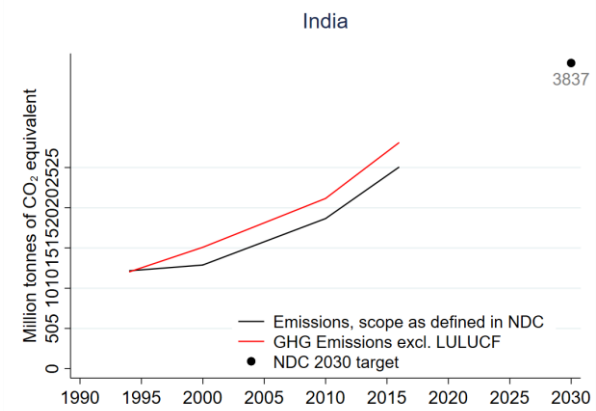
D. Other target indices

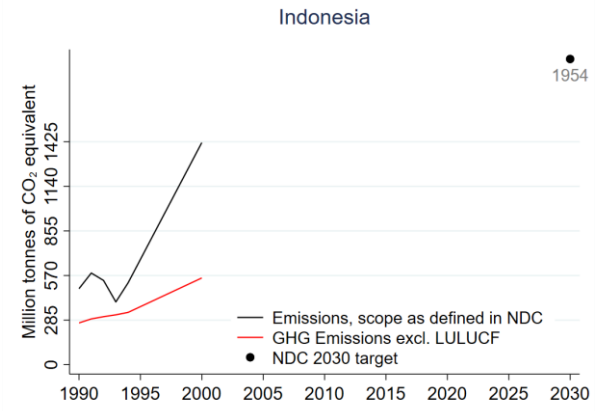


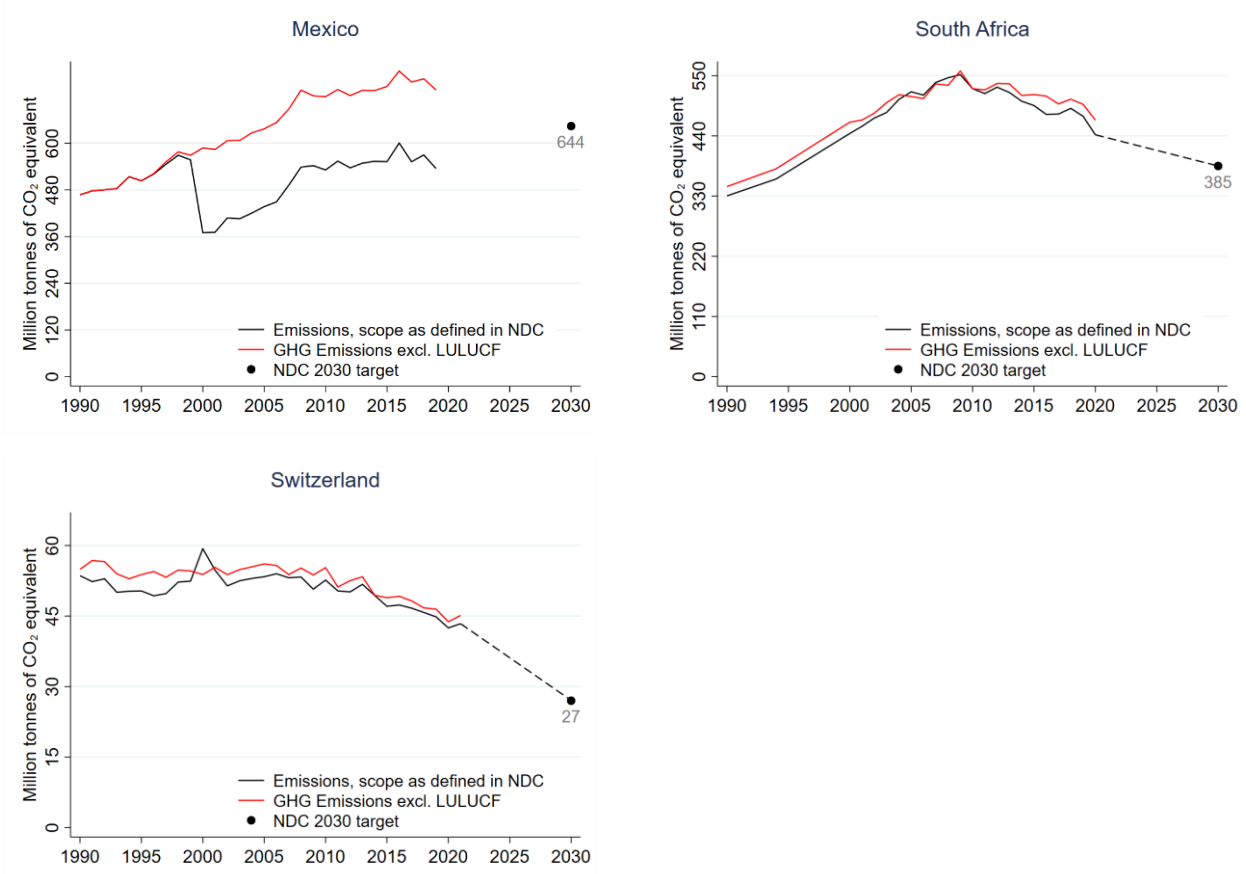












Note: countries in panel C have varying NDC scope indices as presented in Table 3. Comparison between emission targets and current emissions do not consider offsets.

5 GHG Emission Trends and Target (GETT) Indicators

The GHG Emission Trends and Target (GETT) indicators are based on the quantification of 2030 NDC targets in physical terms for all but one of the countries covered under IPAC presented in section 4. The indicators serve different analytical purposes and are constructed with simple transformations of the physical emissions targets using measures such as GDP and population and compared to historical emissions. As in section 4, historical data are presented in terms of their respective target emission scope to allow for emissions trends and target comparison within a country.

Therefore, the GETT indicators can be used to monitor countries' performance by comparing targets and historical emissions, but direct comparison of physical emissions across countries is not possible, unless the target scope is the same. In general, only relative changes can be compared across countries.

Proposed Indicators

The indicators presented are not exhaustive and the indicator set may be expanded if further representations of emission trends and trajectories are needed.

Set 1: Physical Emissions

1.a. Difference between annual emissions and 2030 target (ΔE)[15]

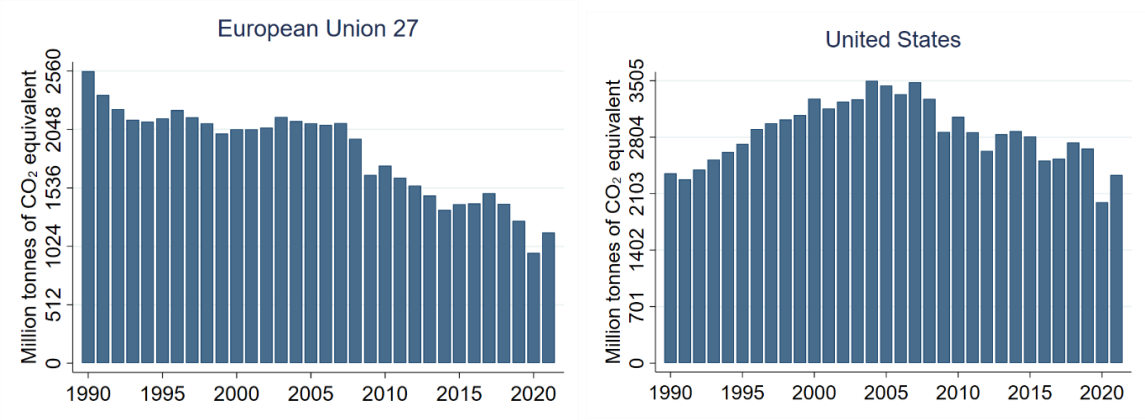
To determine countries' distance between their domestic emissions and their 2030 targets, the 2030 target quantified in physical terms can be compared with the emissions level in some year. To construct this indicator, GHG emissions data are taken from the UNFCCC inventory (i.e., GHG emissions from countries based on territory principle) and the estimate of the physical emissions target is used. The scope (gas and sector coverage) and GWP of emissions are aligned to those that are used for the 2030 target calculation to enable meaningful comparisons. See equation [1].

$$\Delta E_{it} = E_{it} - E_{i2030target} \qquad [1]$$

Where $\Delta \boldsymbol{E_{it}}$ is difference between annual emissions and 2030 target in country $\boldsymbol{i}$ and time $\boldsymbol{t}$, $\boldsymbol{E_{it}}$ is the countries historical emissions and $E_{i2030target}$ is the 2030 target in physical terms. Figure 5.1 depicts an example of countries annual emissions difference from their 2030 targets.

[15]Comparison between emission targets and current emissions do not consider offsets

Figure 5.1. Examples of Annual Difference from Target



Note: Comparison between emission targets and current emissions do not consider offsets.

1.b. Percentage difference between annual emissions and 2030 target (%ΔE)

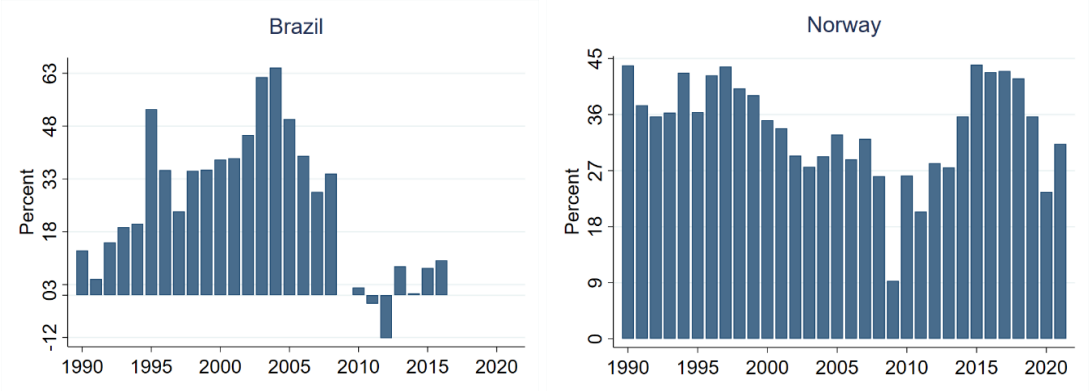
To deal with the scaling issue between large and small emitters, the 2030 physical emissions target can be expressed as a percentage change from the emissions level in some year. To construct this indicator, emissions data are taken from the UNFCCC inventory (adjusted to the same emission scope) and the estimated physical emissions target is used. Percentage difference between annual emissions and 2030 target, %ΔE, is expressed in equation [2].

$$\%\Delta E_{it} = \frac{\Delta E}{E_{it}} \times 100 \qquad [2]$$

where variables are as defined in equation [1].

For example, if a country has 40% of annual difference in 2019, it means that this country has to reduce current emissions by 40% to reach the 2030 target, provided this country aims to achieve the target by reducing domestic GHG emissions without relying on international offsets (see Figure 5.2).

Figure 5.2. Examples of Annual % Difference from Target



Note: Comparison between emission targets and current emissions do not consider offsets.

1.c. Estimated cumulative emission gap from last data-available or a selected year to 2030 target (Gap)

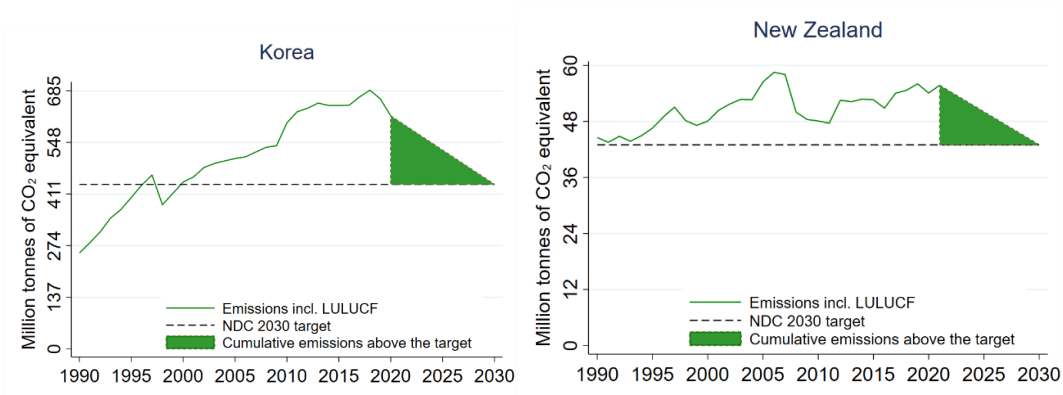
This indicator determines a country's estimated emissions gap from the last year for which emissions data are available to the target year.[16] This indicator is a simplified representation of the estimated cumulative emissions generated to achieve the target. The trajectories presented in Figure 5.3 are based on a linear assumption. However, different trajectories will have different cumulative effects on the overall concentration of GHGs in the atmosphere. As more information is available, it will be possible to project expected emissions trajectories and estimate the cumulative emissions more precisely to determine the full impact of countries climate policies.

The gap is defined as the sum of the difference between annual emission trajectory and the target level over the period between the last data-available year to the 2030 target, assuming a linear trajectory.[17] Calculating the gap allows for a better representation of emission concentration over a period. As real emissions data become available, it can be compared to the linear scenario in order to analyse the emissions impact of how a country achieves its target. To construct this indicator, emissions data are taken from the UNFCCC inventory (adjusted to the emission scope of NDCs) and the estimated physical emissions target is used. The gap in country i, Gap_i, is expressed as:

$$Gap_i = \sum_{k}^{2030} (E_{ik} - E_{i2030_{taget}}) \qquad [3]$$

where E_{ik} are linearly projected emissions in year k starting from the last data-available year and $E_{2030\,target}$ is the emission target. This indicator is only applied to countries whose latest emissions level is higher than the 2030 emissions target to avoid depicting an increasing emissions trajectory towards 2030.

Figure 5.3. Examples of Estimated Cumulative Emission Gap



Note: Comparison between emission targets and current emissions do not consider offsets.

[16] Calculations in this study rely on official inventory data from the UNFCCC and OECD. The latest data available in the inventory varies by country. Thus, cumulative emissions are calculated from the latest data available year to the 2030 target.

[17] A linear emissions reduction trajectory should represent the average reduction scenario. However, a country's actual emissions gap can be smaller if countries reduce faster (less cumulative emissions) or larger if countries reduce slower (more cumulative emissions).

1.d. Percentage of cumulative emission gap compared to cumulative emissions from last data-available year to 2030 target (%Gap)

To deal with the scaling problem between large and small emitters, the cumulative emission gap can be expressed in percentages. That is the cumulative gap (the triangle presented in the diagram above) divided by the total cumulative emissions under the linear trajectory from the current year to 2030. To construct this indicator, emission data are taken from the UNFCCC inventory and OECD (adjusted to the emission scope of NDCs) and the estimated physical emissions target is used. An example of estimated cumulative emissions gap is presented in Table 5.1. The higher the percentage, the further away a country is from eaching its emission target. The indicator $\%\mathrm{Gap_i}$, for country i, is expressed as:

$$\%Gap_i = \frac{Gap_i}{\sum_k^{2030} E_{ik}} \times 100 \qquad [4]$$

where all variables are as defined above.

Table 5.1. Country Examples of % Estimated Cumulative Emission Gap

Country	Cumulative emission (NDC scope) reduction share of total cumulative emission from last data point to 2030
Argentina	4.6%
Australia	27.5%
Brazil	9.9%
Canada	34.9%
Switzerland	37.4%
Chile	10%

Note: As the last data-available year varies across countries, the cumulative period towards 2030 can be different between countries. Consequently, % estimated cumulative emission gap cannot be directly compared across countries. Comparison between emission targets and current emissions do not consider offsets.

Set 2: Emissions Intensity per unit of GDP

GHG targets can also be assessed in terms of emissions per GDP. The growth rate of emissions per unit of GDP reflects the economy's efficiency in decoupling emissions from output. To construct this indicator, emission data are taken from the UNFCCC inventory (adjusted to the emission scope of NDCs) and the estimated physical emissions target is used. GDP values for PPP in 2015 at constant USD is taken from the OECD Economic Outlook 109 ((OECD, 2021[6])).

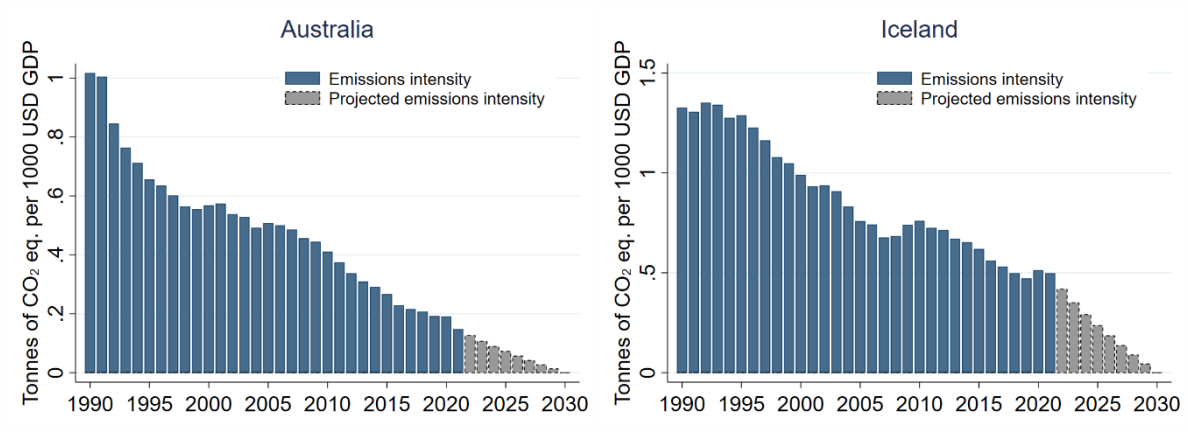
2.a. Difference between annual emissions per GDP and 2030 target ($\Delta\hat{Y}$)

The difference between annual intensity and target intensity, for which example figures are shown in Figure 5.4 is calculated as:

$$\Delta\hat{\mathrm{Y}}_{it} = \hat{\mathrm{Y}}_{it} - \hat{\mathrm{Y}}T_{\mathrm{i2030}} \qquad [5]$$

Where $\Delta\hat{\mathrm{Y}}_{it}$ is difference between annual emissions per GDP and 2030 target in country i and year t, $\hat{\mathrm{Y}}_{it} = \mathrm{E_{it}} / \mathrm{GDP_{it}}$ and $\hat{\mathrm{Y}}T_{\mathrm{i2030}}$ is the target emissions level per unit of estimated GDP (see Figure 5.4).

Figure 5.4. Examples of Annual Difference of Emissions Intensity from Target



Note: Comparison between emission targets and current emissions do not consider offsets.

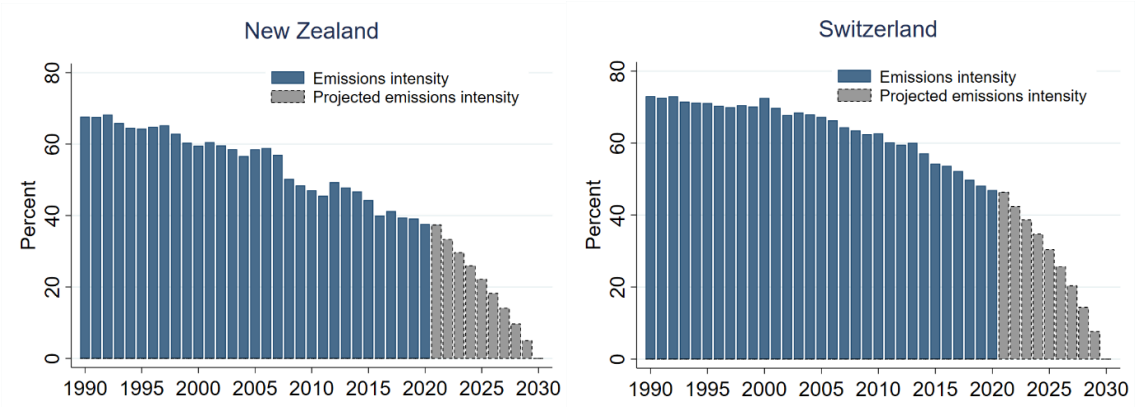
2.b. Percentage difference between annual emissions per GDP and 2030 target (%Δ Ŷ)

Yearly emissions intensity difference from the 2030 target in terms of percentages, $\%\Delta\hat{Y}_{it}$, that facilitates comparison between big and small countries is expressed as:

$$\%\Delta\hat{Y}_{it} = \frac{\Delta\hat{Y}_{it}}{(\hat{Y}_{it})} \times 100 \qquad [6]$$

where all variables are as defined in equation [5]. See Figure 5.5.

Figure 5.5. Country Examples of Annual % Difference of Emissions per unit of GDP from Target



Note: Comparison between emission targets and current emissions do not consider offsets.

Set 3: Emissions per Capita

Total emissions and targets mask underlying country specific characteristics that drive emissions such as population pressure. Per capita emissions and targets can address this. In addition, per capita emissions growth rate reflects decoupling emissions from population growth. To construct these indicators, emissions data are used from the UNFCCC inventory (adjusted to the emission scope of NDCs) and the estimated

physical emissions target is used. Population data are taken from (OECD, 2024[7]), Eurostat and UN (see Annex A for detailed data sources).

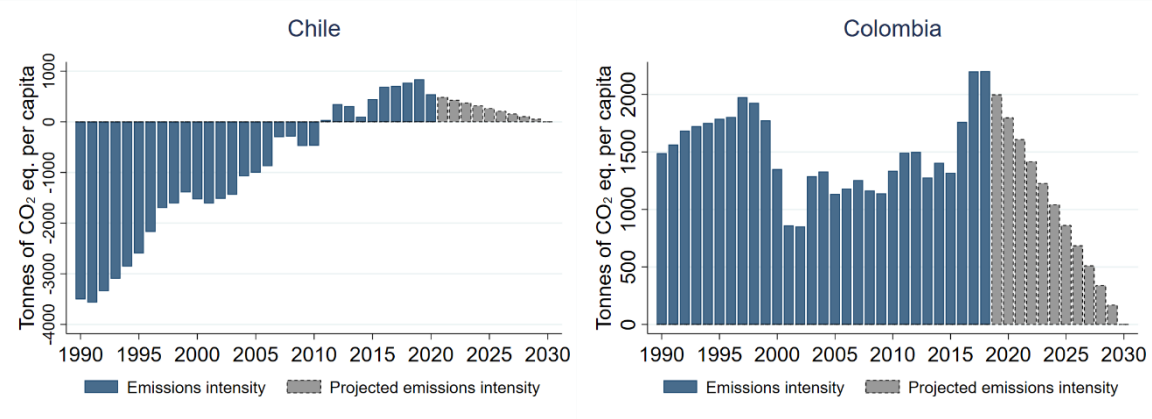
3.a. Difference between annual emissions and 2030 target per capita ($\Delta\hat{C}$)

This indicator quantifies the difference between annual emissions and 2030 target in percentage accounting for population size and it is calculated as:

$$\Delta\hat{C}_{it} = (\hat{C}_{it}) - (\hat{C}T_{i2030}) \qquad [7]$$

where $\Delta\hat{C}it$ is difference between annual emissions and 2030 target per capita in country i and time t, $\hat{C}_{it} = E_{it}/\text{Population}_{it}$ and $\hat{C}T_{i2030}$ are the emission per capita and target emission per capita. See Figure 5.6.

Figure 5.6. Country Examples of Annual Difference of Emissions per Capita from Target



Note: Comparison between emission targets and current emissions do not consider offsets.

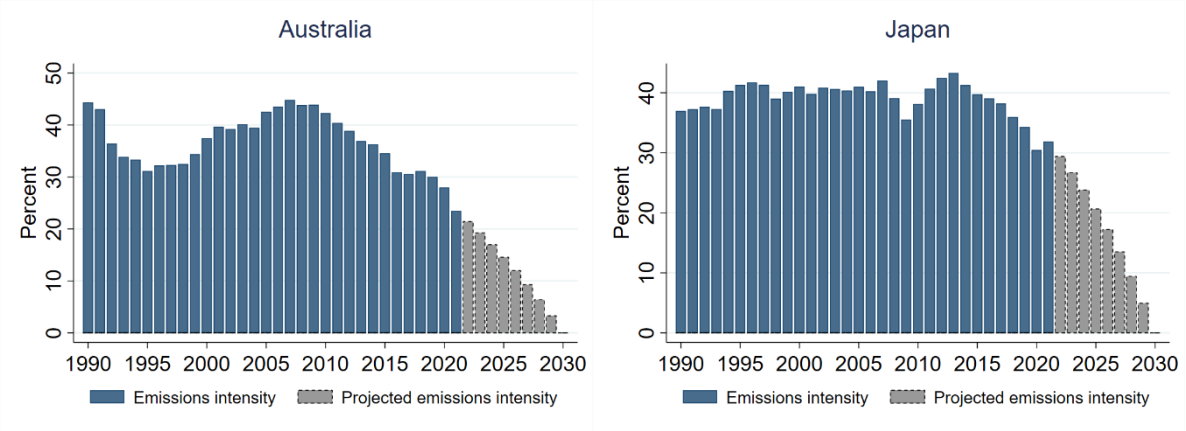
3.b. Percentage difference between annual emissions and 2030 target per capita ($\%\Delta\hat{C}$)

This indicator further increases comparability of emissions trends by computing percentage difference of emissions and targets per capita which is expressed as:

$$\%\Delta\hat{C}_{it} = \frac{\Delta\hat{C}_{it}}{(\hat{C}_{it})} \times 100 \qquad [8]$$

where all variables are as defined in equation [7]. See Figure 5.7.

Figure 5.7. Country Examples of Annual % Difference of Emissions per Capita from Target



Note: Comparison between emission targets and current emissions do not consider offsets.

Interpretation of Proposed Indicators

The indicator on annual difference from target is the principal indicator proposed to assess the progress towards the NDC targets. This indicator shows the distance between a country's current GHG emission and the targets. Indicators on cumulative gap are important, showing the impact of having higher emissions level compared to the target level over time. Indicators on emissions per unit of GDP or per capita provide an assessment of decoupling and comparability across countries with different development levels or populaitons.

The proposed indicators should be interpreted with some caveats.

- First, since NDC targets have different sector scopes (including or excluding LULUCF) and gas coverage, as well as GWP, indicators in physical terms are only comparable across countries when they have the same coverage or target index. Indicators in percentages partially correct this problem since they control for difference in scope and relative size.
- Second, emissions' data availability of UNFCCC non-Annex I countries is limited. Therefore, for those countries some data is missing.
- Third, the proposed indicators should be interpreted as the distance to the 2030 emissions considering domestic emissions. They do not consider international offsets to achieve those targets. However, the proposed indicators can be used to assess differences between current emissions and targets in different measurement units.

To address these caveats, it would be useful to develop a methodology to estimate emissions as granular as possible (e.g., per gas and per sector) to fill the gap of data availability, align the scope across countries and compare the 2030 estimated emissions level with the 2030 target emissions level.

6 Next Steps

A consistent methodology to estimate GHG emissions is critical to assess progress towards long-term emission targets. This paper calculates the physical 2030 emission levels implied by NDCs for countries covered under IPAC and EU-27 based on official sources. The EU NDC is analysed for the EU-27 in total. This approach provides the basis for the development of a set of indicators that can help assess GHG emission trends and targets from different perspectives.

The current target calculation is based on 2030 target included in the last available NDC for the target with the largest scope. This can be extended to other targets in and beyond NDCs. It will enable the evaluation of progress towards sector- or gas- specific targets, when established.

Although the physical emission targets are not directly comparable across countries, it does provide comparison within countries and across countries with similiar target scopes. The approach presented can provide the basis for future work to implement a methodology to estimate physical emission targets comparable across countries.

The updated GETT indicators are available from the IPAC Dashboard https://www.oecd.org/climate-action/ipac/dashboard.

Annex A. Methodology

Data Sources

Country national mitigation targets are taken from the latest NDCs uploaded to the NDC Registry of the UNFCCC (UNFCCC, 2022[8]). The UNFCCC Inventory (UNFCCC, 2022[9]), the OECD National Accounts data on GDP and the OECD Economic Outlook No 109 (OECD, 2021[6]) are consulted where needed to translate NDC target into physical terms. The dataset on GHG emissions by source at OECD.Stat is consulted to complement the historical GHG emissions data for UNFCCC non-Annex I countries (OECD, 2024[10]). Population data are consulted to calculate the indicator on emissions per capita. Table A.1 summarises all sources used in the general methodology.

Table A.1. Data Sources

Data / Observation	Source
Countries' latest available official NDCs.	UNFCCC NDC Registry
GHG emissions data from 1990 to 2020. Data-available years differ between countries; the UNFCCC requires Annex I Parties to report annual inventories.	These data used are National Inventory Submissions 2022 to the UNFCCC, CRF tables and GHG emissions by source at OECD.Stat.
Historical and projected GDP. The GDP variable taken is PPP (2015 constant exchange rate USD).	Historical GDP is from OECD's National Accounts data on GDP and projected GDP is fromOECD Economic Outlook No 109.
Historical and projected population	OECD (2022b) data based on National sources; Eurostat's New Cronos Demographic Database; UN Demographic Yearbook, Historical Supplement: 1947-1997, March 2000; and UN World Population Prospects, 1950-2100 (The 2015 Revision).

NDC Target Data

Table A.2 summarises data on each country's target (type and scope) as presented in their NDC. In the cases where transforming the NDC target requires a base value because the target is expressed as a reduction from a reference value (e.g., base emissions value, base emissions intensity, or BAU scenario), the table shows whether the base value is provided in the NDC, as well as its GWP. Finally, other comments and observations are included where needed; a recurring observation is that some countries specify a base value excluding LULUCF (gross emissions) but set their target including LULUCF (net emissions).

Table A.2. Specific Observations of 2030 NDC Target Data per Country

Country	Target type	Target sectors	Target GHGs	Target GWP	Base value given?	Base GWP	Offset explicitly mentioned	Comments and observations
Argentina	emission level	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs	SAR	N/A	N/A	Yes (remains open)	
Australia	percentage reduction from base value	Total incl. LULUCF	All GHGs	AR5	yes	AR5	Yes (remains open)	
Brazil	percentage reduction from base value	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	AR5	no	null	Yes (included)	
Canada	percentage reduction from base value	Total incl. LULUCF	All GHGs	AR5	yes	AR4	Yes (included)	Base value excludes LULUCF, and the target includes LULUCF.
Switzerland	percentage reduction from base value	Total incl. LULUCF	All GHGs + indirect CO2	AR5	yes	unclear	Yes (partly included)	Base value excludes LULUCF, and the target includes LULUCF.
Chile	emission level	Total excl. LULUCF	All GHGs	AR4	N/A	N/A	Yes (included)	
China (People's Republic of)	percentage reduction from base value of emissions intensity of GDP	unclear	CO_2 only	null	no	null	No	
Colombia	emission level	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	AR5	yes	unclear	Yes (included)	
Costa Rica	emission level	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	SAR	N/A	N/A	Yes (included)	Target includes local air pollutants.
EU-27	percentage reduction from base value	Total incl. LULUCF, incl. international aviation	All GHGs + indirect CO_2	AR5	no	null	Yes (excluded)	
United Kingdom	percentage reduction from base value	Total incl. LULUCF	CO_2, CH_4, N_2O	AR5	no	null	Yes (remains open)	UK's target is applied to two sets of gases with different base years. The two sets do not overlap and amount to all GHGs. This set pertains to a % reduction from 1990 levels.
United Kingdom	percentage reduction from base value	Total incl. LULUCF	HFCs, PFCs, SF_6, NF_3	AR5	no	null		UK's target is applied to two sets of gases with different base years. The two sets do not overlap and amount to all GHGs. This set pertains to a % reduction from 1995 levels.

Country	Target type	Target sectors	Target GHGs	Target GWP	Base value given?	Base GWP	Offset explicitly mentioned	Comments and observations
Iceland	percentage reduction from base value	Total incl. LULUCF	All GHGs	AR5	no	null	Yes (excluded)	Iceland's NDC target refers to the joint target of the countries involved [EU27 and Norway] and the individual share of each country will be determined by commonly agreed rules. This paper applied 55% reduction to Iceland.
India	percentage reduction from base value of emissions intensity of GDP	Total incl. LULUCF	Unclear	unclear	no	null	No	
Indonesia	percentage reduction from BAU	Total incl. LULUCF	CO_2, CH_4, N_2O	SAR	yes	AR4	Yes (included)	
Israel	percentage reduction from base value	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	SAR	yes	SAR	Yes (remains open)	
Japan	percentage reduction from base value	Total incl. LULUCF	All GHGS	AR4	yes	AR4	Yes (included)	Base value excludes LULUCF, and the target includes LULUCF. Base value includes indirect CO2 when compared with NIR.
Korea	percentage reduction from base value	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	SAR	yes	SAR	Yes (included)	Base value excludes LULUCF, and the target includes LULUCF.
Mexico	percentage reduction from BAU	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	unclear	yes	unclear	Yes (included)	Base value excludes LULUCF, and the target includes LULUCF. Absorption from LULUCF (not included in the base) = -158 $MtCO_2e$.
Norway	percentage reduction from base value	Total incl. LULUCF	All GHGs	AR5	yes	AR4	Yes (remains open)	Base value excludes LULUCF, and the target includes LULUCF. Norway's NDC includes the use of offsets in the event of going beyond the target of EU27. This paper interprets their lower percentage of

Country	Target type	Target sectors	Target GHGs	Target GWP	Base value given?	Base GWP	Offset explicitly mentioned	Comments and observations
								reductions not to meet that criteria.
New Zealand	percentage reduction from base value	Total incl. LULUCF	All GHGs	AR5	yes	AR5	Yes (included)	Base value excludes LULUCF, and the target includes LULUCF.
Peru	emission level	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	SAR	N/A	N/A	Yes (included)	
Saudi Arabia	annual emission abatement	unclear	unclear	null	no	null	Yes (included)	Impossible to calculate as the baseline is not provided.
Türkiye	percentage reduction from BAU	Total incl. LULUCF	All GHGs	AR4	yes	AR4	Yes (remains open)	
United States	percentage reduction from base value	Total incl. LULUCF	All GHGs	AR5	yes	AR4	Yes (remains open)	
South Africa	emission level	Total incl. LULUCF	CO_2, CH_4, N_2O, HFCs, PFCs	SAR	N/A	N/A	Yes (included)	

Source: Last NDC submitted to UNFCCC NDC Registry as of 12/10/2022.

Target Transformations

Three target transformations are used to calculate the physical emission targets of IPAC countries. Table A.3 summarises the general equations of each transformation as well as the number of countries whose NDC target is estimated in physical terms by applying that transformation.

Table A.3. General Equations of Target Transformations

Target type transformed	General transformation equation to estimate the 2030 target in physical terms	Number of IPAC countries transformation is applied to
Emission percentage reduction from base value	$2030\ estimated\ emissions = base\ emissions\ value \times (100 - percentage\ reduction)$	40
Emission percentage reduction from BAU scenario	$2030\ estimated\ emissions = BAU \times (100 - percentage\ reduction)$	3
Emission intensity percentage reduction	$2030\ target\ emission\ intensity = base\ emission\ intensity \times (100 - percentage\ reduction)$ [1] where $base\ emission\ intensity = \frac{base\ emissions\ value}{base\ year\ GDP}$ $2030\ estimated\ emissions = 2030\ target\ emission\ intensity\ x\ 2030\ projected\ GDP$ [2]	2

Target Transformations Data and Treatment

Table A.4 summarises necessary data to calculate country's estimated physical emissions target for 2030. First, the NDC target chosen per country as explained in the general methodology (Chapter 3) is specified.

Next, the target transformation, which is applied to the NDC target, as well as the base value used is specified. The base value's GWP is defined where applicable; for any NDC target to which a transformation is applied, the target GWP takes the GWP of the base value (e.g., GWP for inventory reporting if the base value is taken from the UNFCCC inventory), as all three transformations are percentage reductions from a base. NDC targets already expressed in physical terms keep whichever GWP the NDC target was set in (see Table A.2 for NDC target GWPs).

Table A.4. Specific Observations of Estimated 2030 Target Calculations per Country

Country	NDC target	Target transformation applied (see Table A.3.)	Base value(s) used	Base value GWP
Argentina	349 $MtCO_2e$	N/A	N/A	N/A
Australia	43%	$base\ emissions\ value \times (100 - percentage\ reduction)$	621.10 $MtCO_2e$	AR5
Brazil	50%	$base\ emissions\ value \times (100 - percentage\ reduction)$	2,352.53 $MtCO_2e$	SAR
Canada	42.5%	$base\ emissions\ value \times (100 - percentage\ reduction)$	739.00 $MtCO_2e$	AR4
Switzerland	50%	$base\ emissions\ value \times (100 - percentage\ reduction)$	54.16 $MtCO_2e$	unclear
Chile	95 $MtCO_2e$	N/A	N/A	N/A
China (People's Republic of)	65%	$2030\ target\ emission\ intensity = base\ emission\ intensity \times (100 - percentage\ reduction)$ $2030\ estimated\ emissions = 2030\ target\ emission\ intensity\ x\ 2030\ projected\ GDP$	base emissions value = 5,578 $MtCO_2e$ base year GDP = 7,112,147,058,357 USD 2030 projected GDP = 36,976,710,000,000 USD	SAR
Colombia	169.44 $MtCO_2e$	N/A	345.80 MtCO2e	unclear
Costa Rica	9.11 $MtCO_2e$	N/A	N/A	N/A
EU-27	55%	$base\ emissions\ value \times (100 - percentage\ reduction)$	4,651.76 $MtCO_2e$	AR4
United Kingdom	68%	$base\ emissions\ value \times (100 - percentage\ reduction)$	817.45 $MtCO_2e$	AR4
Iceland	55%	$base\ emissions\ value \times (100 - percentage\ reduction)$	13.69 $MtCO_2e$	AR4
India	45%	$2030\ target\ emission\ intensity = base\ emission\ intensity \times (100 - percentage\ reduction)$ $2030\ estimated\ emissions = 2030\ target\ emission\ intensity\ x\ 2030\ projected\ GDP$	base emissions value = 1,525.63 $MtCO_2e$ base year GDP = 3,630,663,817,212 USD 2030 projected GDP = 16,602,910,000,000 USD	SAR
Indonesia	31.89%	$BAU \times (100 - percentage\ reduction)$	2,869 $MtCO_2e$	SAR
Israel	27%	$base\ emissions\ value \times (100 - percentage\ reduction)$	79 $MtCO_2e$	SAR
Japan	46%	$base\ emissions\ value \times (100 - percentage\ reduction)$	1,408 $MtCO_2e$	AR4
Korea	40%	$base\ emissions\ value \times (100 - percentage\ reduction)$	727.6 $MtCO_2e$	SAR
Mexico	35%	$BAU \times (100 - percentage\ reduction)$	991 $MtCO_2e$	unclear
Norway	55%	$base\ emissions\ value \times (100 - percentage\ reduction)$	51 $MtCO_2e$	AR5
New Zealand	50%	$base\ emissions\ value \times (100 - percentage\ reduction)$	85.99 $MtCO_2e$	AR5
Peru	208.8 $MtCO_2e$	N/A	N/A	N/A
Saudi Arabia	278 $MtCO_2e$	N/A	null	null
Türkiye	41%	$BAU \times (100 - percentage\ reduction)$	1,175 MtCO2e	AR4
USA	51%	$base\ emissions\ value \times (100 - percentage\ reduction)$	6,635 $MtCO_2e$	AR4
South Africa	385 $MtCO_2e$	N/A	N/A	N/A

Note: Comparison between emission targets and current emissions do not consider offsets.

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