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# Comparing the Sequence of Climate Change Mitigation Targets and Policies in Major Emitting Economies

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**Takeshi Kuramochi** leads projects that analyse greenhouse emission scenarios for major emitting economies as well as subnational and non-state actors. Takeshi has published more than 30 peer-reviewed articles and numerous other research reports. Since 2016, Takeshi contributes to the annual UNEP Emissions Gap Reports as a lead author on the chapter assessing G20 countries' progress on emission reductions. Externally, Takeshi serves as a member of the UNFCCC Race to Zero campaign's External Peer Review Group and Science Base Targets initiative's Scientific Advisory Group. Prior to joining NewClimate Institute, Takeshi worked at the Institute for Global Environmental Strategies (IGES, Japan) and at the Copernicus Institute of Sustainable Development, Utrecht University, where he is currently a visiting researcher.

**Santiago Woollands** focuses on projects related to the quantitative analysis of GHG emissions trajectories and the implementation of emissions reduction policies at the national and subnational level. He is also involved in projects in the area of climate finance, focusing on issues of Paris alignment of international and multilateral

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**ABSTRACT** *The Paris Agreement requires that countries submit and update their Nationally Determined Contributions (NDCs) to mitigate global climate change. This study projected greenhouse gas emissions to evaluate the progress of 25 countries towards their original and updated NDCs. It found that almost one-quarter of the countries submitted more ambitious, updated NDCs without adopting sufficient policies to meet their original targets. Additionally, in most countries, updated NDCs lead to emissions above current policies. The findings also suggest that these patterns are influenced by national constraints, especially reliance on fossil fuels. Appropriate sequencing of ambition raising and policy adoption is urgently needed to translate the Paris Agreement into action.*

**Keywords:** comparative analysis; climate policy; greenhouse gas projections; global stocktake; nationally determined contributions

## 1 Introduction

The Paris Agreement sets long-term goals to strengthen the global response to climate change. It aims to hold the increase in global average temperature to well below 2°C and to pursue efforts to limit it to 1.5°C above pre-industrial levels. To achieve this goal, it recognises the need to peak global greenhouse gas (GHG) emissions as soon as possible (UNFCCC 2015). In this context, Parties to the agreement are invited to submit self-determined pledges, or Nationally Determined Contributions (NDCs), in line with their capabilities and responsibilities, and to implement actions to meet them. These NDCs often include 2030 emissions targets that reflect the climate change mitigation component of countries' pledges.

organizations. Santiago holds a master's degree in Public Policy Analysis from the Willy Brandt School of Public Policy at the University of Erfurt, where he specialised in the energy transition. His master's thesis investigated the political economy of fiscal stimulus spending and the green recovery in the context of the COVID-19 pandemic.

**Ioannis Dafnomilis** is actively involved in the analyses of global climate change mitigation pathways using quantitative integrated assessment modelling and research tracking climate action and progress towards sustainable targets. His interests especially focus on improving the climate policy – climate modelling interface, sustainable transitions and short- to long-term mitigation pathways. His experience and research consists of multidisciplinary and international collaborations on multiple topics covering a broad area of climate policy and energy transition themes.

**Mia Moiso's** work centres on the global efforts to reduce temperature increase to 1.5°C, with a particular focus on climate policy in Europe, the Middle East and North Africa. She leads the Climate Action Tracker project at NewClimate Institute. Before joining NewClimate, Mia worked on sustainable finance and climate and energy policy in the EU. She holds a master's degree in Energy Policy and a bachelor's degree in Political Science and Middle Eastern studies from Sciences Po Paris. Mia's working languages are English, French, Finnish and Spanish.

**Mark Roelfsema** is working at Utrecht University on the SENTINEL project that aims to link together different climate- and energy models into a new modelling framework to support EU policymakers and give details about different aspects of the low-carbon energy system. Before this position, he worked at PBL where he was a policy researcher in the field of international climate change and conducted quantitative research to advise policymakers. The subjects he worked on were domestic climate- and energy policies of large countries, non-state actors, and policies that are linked with climate change. He has also worked at Radboud University where he researched climate policy, and also set up an energy modelling course for master's students and taught diverse courses on climate- and energy topics

The full implementation of targets included in NDCs submitted in the lead-up to the Paris Agreement would be insufficient to meet its collective goals (Rogelj et al. 2016). Adopted policies in many countries are expected to lead to more emissions compared to original NDCs. Years after the Paris Agreement, half of the G20 economies were projected to miss their NDCs (den Elzen et al. 2019). Many non-G20 countries also need to adopt additional policies to meet their NDCs (Kuramochi et al. 2021). Although policy options to reduce emissions exist, many of them remain absent in major emitting countries (Nascimento et al. 2022c).

Countries are expected to improve their NDCs over time, closing the gap between national ambition and global goals. At least once every five years, countries should communicate updated NDCs that represent their highest possible ambition. This ambition-raising process has started; in the lead-up to the Conference of Parties in Glasgow, most countries submitted updated NDCs that would result in 2030 emissions 7 per cent lower than original targets (den Elzen et al. 2022). In 2021, emissions projections resulting from adopted policies are also 15 per cent lower than estimated in 2015 for the G20 as a group (Nascimento et al. 2022b). This shows that both NDCs and policies improved over time. However, little national evidence connecting this round of NDC updates and adopted policies is available.

Global analyses show that an ambition gap exists between countries' updated NDCs and adopted policies (den Elzen et al. 2022). However, country-specific analyses are better suited to inform and guide national mitigation efforts. For example, countries that are projected to meet their NDCs are well positioned to increase their ambitions. Alternatively, countries projected to miss their targets need to adopt more stringent policies. Several studies have investigated the warming effect of updated NDCs (Höhne et al. 2021; Meinshausen et al. 2022) but no peer-reviewed, multi-country analysis to date has investigated whether individual countries are expected to meet their updated NDCs under currently adopted policies. Up-to-date assessments of countries' policies and NDC targets are key to improving accountability under the Paris Agreement.

In our research, we prepared and compared emissions projections implied by countries' adopted policies and NDC targets. First, we developed a framework to identify countries' ambition-raising patterns that consider their progress towards both original and updated targets. Second, we prepared up-to-date emissions projections to 2030 under

**Nicklas Forsell** is a senior research scholar in the Integrated Biosphere Futures Group of the IIASA Biodiversity and Natural Resources Program. He devoted over a decade to scientific work in a variety of areas, including: systemic thinking, sustainability, climate change, climate legislation, economics, governance and greenhouse gas reporting. His research experience stretches from biophysical modelling in the areas of ecosystems, forestry, and agriculture to economics, finance, and integrated assessment. He obtained a PhD in Forest Economics from the Swedish University of Agricultural Science (SLU) and the French National Institute for Agricultural Research (INRA) in Toulouse.

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NDC targets and adopted policies. These projections show whether countries are expected to meet their NDCs and enable the proposed framework to identify ambition-raising patterns. Finally, we analysed whether architectures of climate policy constraints are associated with countries' ambition-raising patterns. In our research, we analysed 25 economies<sup>1</sup> that together represent four-fifths of global emissions (Crippa et al. 2021; FAOSTAT 2022).

## 2 Analytical Approach

This section presents important elements of our analytical approach. First, we introduce the ambition-raising framework, which is an idealised sequence of ambition raising and policy adoption leading to emissions reductions (Section 2.1). Although the pathways leading to improvements in climate change mitigation efforts are complex, a conceptual framework can assist in identifying cross-national patterns beyond determining whether a country is projected to miss or meet their NDC targets. Second, we introduce architectures of national climate policy constraints (Section 2.2), which are country characteristics that influence national climate action (Lamb and Minx 2020). We use them to explore the national-level relationship between patterns of ambition raising and national constraints of climate policy.

### 2.1 Ambition-Raising Framework

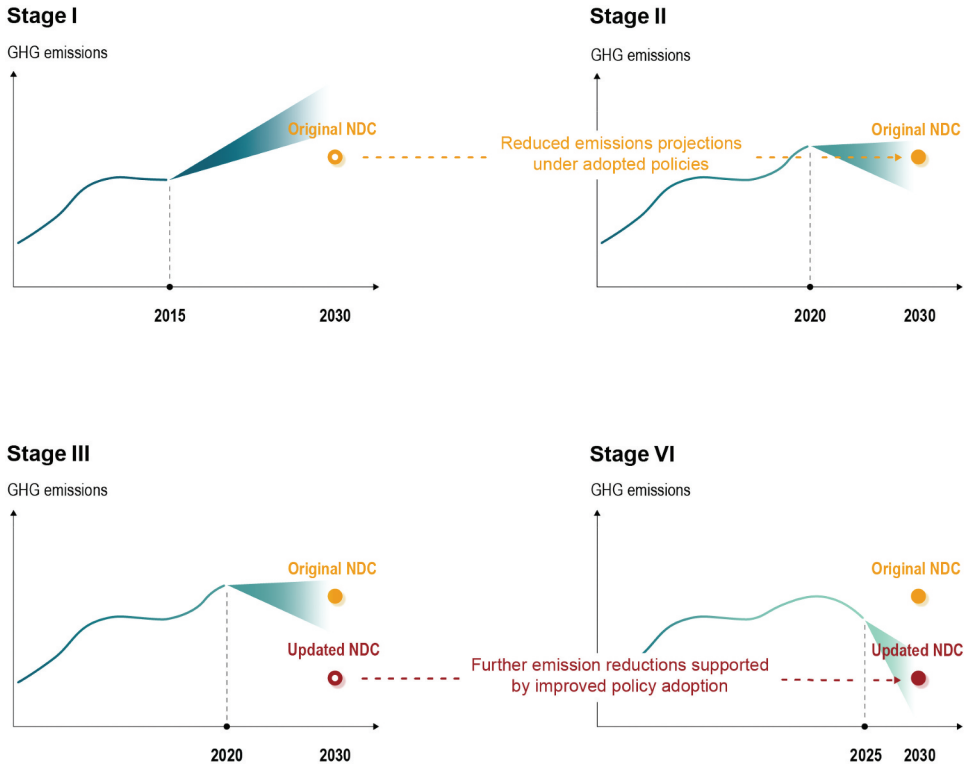
The Paris Agreement establishes an ambition-raising mechanism for countries to improve their domestic mitigation efforts, which here refer to countries' NDCs and policies. The mechanism is based on the principle that more ambitious NDCs guide the adoption of more stringent national policies to reduce emissions (Figure 1).

Ideally, original NDCs include a 2030 target to reduce emissions below those implied by policies adopted (Figure 1: stage I). This is a fundamental component of NDC targets since they are expected to reflect the highest possible ambition (Höhne et al. 2017b). Once these NDCs are adopted, they stimulate national action and positively affect the rollout of climate change mitigation technologies (Iacobuta et al. 2018; Tolliver et al. 2020), which reduce emissions projections under adopted policies (Figure 1: stage II). Some delay between the adoption of NDCs and policies is expected since NDC formulation is often disconnected from other in-country processes (Röser et al. 2020). However, policies eventually adopted should lead to emissions below the NDC.

Once a country is projected to meet its original NDC, it is well positioned to improve that target (Figure 1: stage III). Five years after the adoption of the Paris Agreement, between 2020 and 2021, several countries updated their NDCs. Since updated NDCs are often more ambitious than previous ones (den Elzen et al. 2022), a country would be projected to miss its updated NDC shortly after it was produced. However, over time additional policy adoption is expected to reduce emissions further, so that countries also meet their updated NDCs (Figure 1: stage IV).

This framework relies on two concepts: ambition raising and policy adoption.

Operationalising ambition is challenging. Approaches to evaluating the ambition of NDCs often rely on "moral obligation" or "technical efficiency" principles (Höhne et al. 2017a). The former compares NDCs to emissions allowances under distinct equity

**Figure 1.** Sequencing ambition raising and policy adoption reduces emissions over time

approaches, such as historical responsibility – i.e., those who emitted more in the past have lower emissions allowances (Robiou du Pont and Meinshausen 2018). The latter assesses NDC ambition against technical pathways necessary to reach global decarbonisation (Aldy et al. 2016). Our analysis does not assess the level of ambition and fairness of NDCs. We consider them to be intrinsically heterogeneous, and decided to focus on *ambition raising*. This concept captures the process of enhancing NDCs, independently of how they fare in comparison to different ambition evaluation approaches. We estimated the emissions associated with original and updated NDC targets and evaluated whether updated NDCs result in lower or higher emissions by 2030.

To operationalise *policy adoption*, we prepared emissions projections associated with countries' adopted policies (Roelfsema et al. 2022). Most NDCs contain emissions targets for 2030, so projecting emissions based on policies up to 2030 enables a direct comparison of countries' policies and targets. First, we identified climate policies adopted with a potential effect on GHG emissions projections. We then evaluated whether there is sufficient evidence of their implementation. For example, policies that aim at achieving a certain renewable electricity share are only included in the quantification when there are sufficient instruments supporting the uptake of

renewables, such as auction schemes or subsidies, and/or whether the observed historical renewables growth is aligned with the aims of the policy. Finally, once the relevant policies were identified and analysed, we estimated their effect on emissions using different models (Section 3).

As a result of this idealised framework and our operationalisation, four groups of countries can be identified:

- **Ambition raising follows sufficient policy adoption:** includes countries that follow the ambition-raising sequence up to stage III. These countries are projected to meet their original NDCs and submitted a more ambitious updated NDC. However, adopted policies remain insufficient to meet the updated NDC. These countries have a good track record and have set updated NDCs that guide additional mitigation efforts.
- **Ambition raising without sufficient policy adoption:** includes countries that submitted more ambitious updated NDCs. However, policies remain insufficient to meet the original NDC. These countries focus on the ambition-raising element of their pledges but overlook or delay national policy adoption. Meeting their updated NDCs requires substantial climate policy expansion.
- **Ambition raising with limited effect:** includes countries that are already projected to meet their updated NDCs. The updated NDCs are still expected to positively influence policy adoption, since they represent an improvement compared to original targets. However, in this case updated NDCs result in more emissions compared to policies and are not expected to guide substantial additional climate change mitigation efforts.
- **No ambition raising:** includes countries that did not increase the ambition of their original NDCs. For example, countries that did not submit updated NDCs or submitted updated NDCs including the same emissions target. This category includes countries that missed the opportunity to raise the ambition of their NDC independently of whether they are expected to meet their original NDCs.

## 2.2 *Architectures of National Climate Policy Constraint*

Countries' NDCs are influenced by their national circumstances (Tørstad et al. 2020), including institutions, interests and ideas (Hall et al. 1997). In our analysis, we evaluate whether equivalent national circumstances also affect ambition raising.

Instead of focusing on individual constraints (or enablers), we relied on previous research that identified national architectures of climate policy constraint. These architectures are “mutually reinforcing national conditions that are stable and resistant to intervention” and affect climate policy (Lamb and Minx 2020). They account for combinations of, instead of individual factors, such as exposure to corruption and economic reliance on fossil fuel production and extraction. In Lamb and Minx (2020), countries are grouped into five architectures of climate policy constraints based on their similarity in distinct constraints. We analysed the prevalence of these architectures across countries to identify whether countries categorised in architectures with higher constraints to national climate policy also exhibit a lack of appropriate sequencing between ambition and policy adoption.

Here, we briefly describe the five architectures of climate policy constraints from those with the highest to the lowest level of constraint (Lamb and Minx 2020). “Oil and gas states” heavily rely on revenues from fossil fuel extraction and production. Countries in this group face many challenges to adopting climate policies, have high levels of subsidies for fossil fuels and weaker institutions compared to other groups. They are followed by the “fragile states” group, which includes several low-income countries. Like the first, this group still has high levels of fossil fuel subsidies and few climate policies. It is responsible for a very low share of global emissions, and its members usually have low emissions per capita. The third group is named “coal-dependent development” and includes several fast-growing economies that often rely on high shares of coal to power their economic and energy use growth. The countries in this group are very diverse and “tend to occupy the middle-ground of political economic constraints” (Lamb and Minx 2020, pp. 9–10). The fourth group, named “fractured democracies”, includes several high-income countries that are advanced in strengthening their institutions, but have failed to substantially reduce corruption and suffer from low trust in their institutions. Finally, the fifth group with the lowest levels of constraint is “wealthy OECD” countries. This group includes several OECD countries which have substantial climate policies, stronger institutions and high levels of climate change awareness. In our research, the 25 economies analysed<sup>2</sup> are categorised as follows:

- **Oil and gas states:** Egypt, Iran, Saudi Arabia and United Arab Emirates.
- **Fragile states:** Ethiopia, Mexico and Morocco.
- **Coal-dependent development:** China, India, Indonesia, Russia, South Africa, Thailand, Turkey and Viet Nam.
- **Fractured democracies:** Argentina, Brazil and Colombia.
- **Wealthy OECD:** Australia, Canada, the EU27, Japan, South Korea, the United Kingdom and the United States.

### 3 Methods

To analyse ambition raising, we estimated and compared the effect of policies and NDC targets on projected emissions in 2030. We then mapped countries to different categories depending on their ambition-raising patterns. Finally, we analysed the prevalence of architectures of climate policy constraint across these categories to investigate whether they are associated with countries’ ambition-raising patterns.

The 25 economies analysed cover different income groups and continents. The selection covers all G20 and selected non-G20 economies with substantial emissions, such as Iran and Viet Nam. Limiting the country scope allows for sufficiently detailed analysis of countries’ targets and policies. Analysing these 25 economies also supports international accountability of NDC targets covering most global emissions. We present greenhouse gas emissions in terms of 100-year global warming potentials from the IPCC Fourth Assessment report to allow for aggregation of different gases (IPCC 2007).



### 3.1 *Original and Updated NDC Scenarios*

In our NDC scenarios, we calculated absolute emissions targets based on information presented in countries' NDCs (Table S1).

We analysed progress towards countries' unconditional NDC targets, which they aim to meet without international support. In the absence of fully unconditional targets, we assessed progress towards countries' conditional targets. This is the case for Egypt and South Africa. Ethiopia only had a conditional target in its original NDC but included an unconditional one in its updated NDC. To avoid comparing different types of targets, we did not quantify Ethiopia's original target and only assess progress towards their updated unconditional target. Additionally, the United States' original NDC only covers the period up to 2025. We used emissions projections implied by the United States' policies in 2025 when assessing progress towards the original NDC. In our research, original NDCs are those submitted around the adoption of the Paris Agreement and updated NDCs include targets submitted before September 2022.

### 3.2 *Policy Scenario*

We created a range for emissions based on selected policies that collectively cover all sectors of the economy. The results correspond to the middle of the range of the models. We conducted a careful analysis to define which policies should be included in the quantification for each country. Each selected policy has a set of quantifiable indicators, such as fuel efficiency standards or a renewable target. We used these indicators to estimate the emissions associated with each policy and then subtracted that effect from a reference scenario. We combined projections prepared using multiple models<sup>3</sup> that use different strategies to estimate the effect of policies, thereby reducing some of the uncertainty associated with policies' quantification (Supplementary Material). The policies' selection and methods for estimating the effect of policies in each model are outlined in Nascimento et al. (2022a).

In our analysis, we assume that the selected policies will be fully implemented. However, diverse factors, such as countries' economic and political circumstances, will probably affect their implementation. Policies in force may also be dismantled with administration changes (Jotzo et al. 2018). The actual emissions of these countries in 2030 is intrinsically uncertain. However, this policy scenario constitutes our best-available estimate of the effect of policies as of June 2022. All projections are harmonised to official historical emissions based on country GHG inventories (Table S2).

### 3.3 *Mapping Countries to Ambition-Raising Categories*

All countries analysed communicated 2030 emissions targets with their NDCs.<sup>4</sup> We compared the absolute levels of emissions in 2030 between the policies and NDC scenarios to categorise countries into ambition-raising categories. Although our analyses result in a range of emissions in 2030 (Table S2), we assess whether a country is projected to meet its NDC based on the middle of the current policy range.

### 3.4 National Constraints to Ambition Raising

Once countries were mapped to the ambition-raising categories (Section 2.1), we identified whether specific architectures of constraint are related to countries' ambition-raising patterns. For this purpose, we explored the prevalence of these time-invariant country characteristics across ambition-raising categories.

## 4 Results

### 4.1 Quantifying NDC Targets and Policies

Updated NDCs generally result in lower emissions levels compared to original NDCs, except for Brazil, Mexico and Thailand (Table 1). For Brazil and Mexico, absolute

**Table 1.** Emissions (in MtCO<sub>2</sub>eq) under distinct scenarios and progress towards meeting original (2014–2016) and updated targets. The values represent the mid-point of the projection range and are rounded to the closest ten. “N/A” indicates that no target was available

	2019 levels	2030 policy	Original NDC	Updated NDC
<b>Projected to miss both original and updated NDCs (<math>n = 7</math>)</b>				
Brazil	1,030	1,770	1,200	1,320
Canada	740	720	520	420
Colombia	180	310	270	160
Indonesia	950	2,130	2,040	1,950
South Korea	710	600	540	440
Thailand	370	480	440	440
USA	6,570	4,840	4,100	3,230
<b>Projected to meet original NDC but miss updated NDC target (<math>n = 7</math>)</b>				
Argentina	340	390	480	350
Australia	550	400	440	350
EU	3,600	2,700	3,390	2,080
Japan	1,210	1,000	1,080	810
South Africa	530	450	510	390
United Arab Emirates	230	250	240	210
United Kingdom	450	310	N/A	260
<b>Projected to meet both original and updated NDCs (<math>n = 11</math>)</b>				
China	13,400	13,000	14,300	13,500
Egypt	350	430	N/A	510
Ethiopia	140	210	N/A	350
India	3,150	3,620	5,010	4,440
Iran	1,040	1,190	1,960	N/A
Mexico	740	570	760	770
Morocco	90	100	140	120
Russia	2,120	1,720	2,240	2,160
Saudi Arabia	660	740	980	840
Turkey	510	570	930	N/A
Viet Nam	460	460	880	840

emissions associated with the updated NDC resulted in higher emissions compared to the original ones due to changes in reference emissions. Even after the 2022 update, Brazil's updated NDC emissions target remains 7 per cent above the original. Mexico submitted an updated NDC in 2020 with the same percentage reduction target as the original NDC but increased the reference scenario. This results in 2030 emissions projections 2 per cent higher than the original NDC. Thailand re-submitted the original emissions target in its updated NDC.

All countries projected to meet their updated NDCs are also projected to meet their original ones (Table 1). Out of the 25 countries analysed, 11 are projected to meet their updated NDCs. These 11 countries represented 43 per cent of global emissions in 2019.

However, most countries projected to meet their targets have updated NDCs that imply a substantial increase in emissions compared to historical values. The median increase in emissions of these countries between 2019 levels and the 2030 target is 29 per cent (range: 1 per cent–59 per cent). In many cases, updated NDCs also lead to emissions substantially above policy projections. This indicates that countries could increase the ambition of their targets without additional policies. Updated NDCs are at least 30 per cent above the policies in 2030 in Viet Nam (45 per cent), Iran (40 per cent), Ethiopia (40 per cent), Turkey (40 per cent) and Mexico (30 per cent). Russian and Indian emissions are projected to be 20 per cent higher compared to their updated NDCs.

The 14 countries set to miss their updated NDCs represented 37 per cent of global emissions in 2019. Seven of these countries are projected to meet their original NDCs and used this ambition-raising cycle to set more ambitious ones (Table 1). The remaining countries set more ambitious updated targets without adopting sufficient policies to meet the previous ones.

Iran, Thailand, Indonesia, Mexico, Viet Nam, Morocco, India and Ethiopia have submitted conditional targets in addition to their unconditional ones. We find that considering the conditional targets would not substantially change the results. Iran, India, Mexico and Viet Nam are projected to meet, while Thailand and Indonesia are projected to miss both NDC targets. Considering conditional NDCs would change the results for Morocco and Ethiopia. Both countries are projected to meet their unconditional targets but miss their conditional targets. Therefore, considering unconditional targets favours these two countries.

Emissions per capita vary substantially across countries (Figure S1). Even if all countries meet their updated NDCs, per capita differences are expected to remain important in 2030.

Aggregated 2030 emissions<sup>5</sup> under policies for the group are projected to reach 40.9 GtCO<sub>2</sub>eq (range: 38.1–43.6 GtCO<sub>2</sub>eq), and 38.8 GtCO<sub>2</sub>eq (range: 37.2–40.5 GtCO<sub>2</sub>eq) under updated NDCs. Therefore, emissions associated with policies are approximately 5 per cent above NDCs in 2030. Global analyses show current policies' emissions 14 per cent above NDCs in 2030 (den Elzen et al. 2022). Our percentage difference is lower because global studies use the current policy emissions level as the value for aggregation when countries have current policy projections below NDCs. Taking the same approach, we find that emissions under current policies are 15 per cent above updated NDCs in 2030.

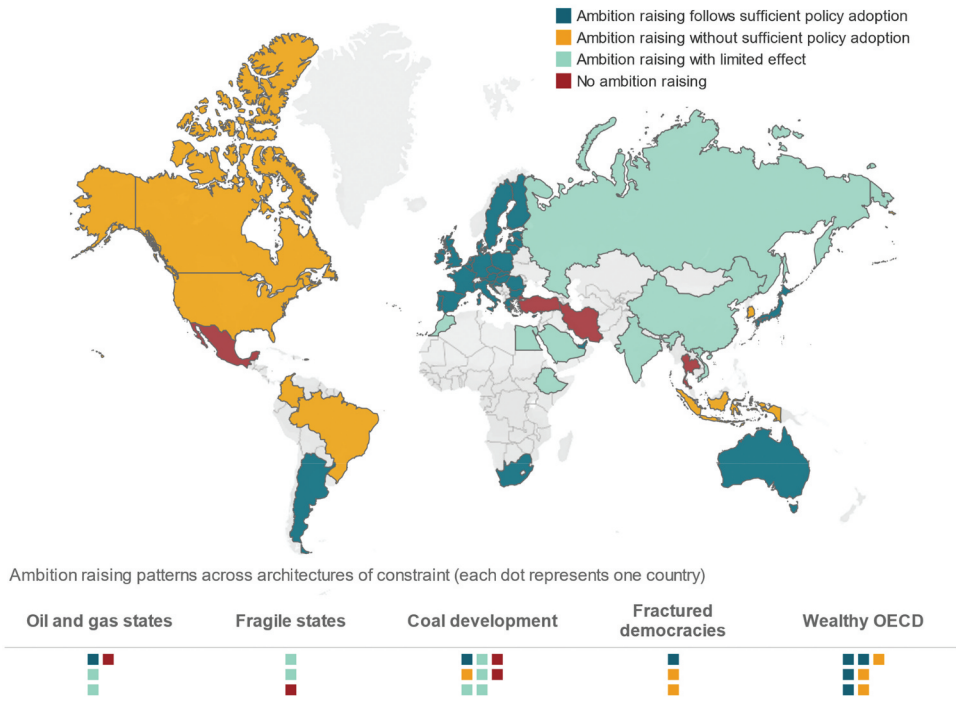
### 4.2 Patterns of Ambition Raising

Once we had quantified emissions under targets and policies, we used the framework introduced in Section 2.1 to evaluate countries’ ambition-raising patterns. In most cases, identifying countries that increased their ambition is straightforward based on 2030 emissions (Table 1). However, some cases are more difficult to assess. Brazil’s updated target is projected to result in higher 2030 emissions compared to the original NDC. The original target was a reduction of 43 per cent below 2005 levels by 2030. An upward revision of the 2005 emissions inventory resulted in higher 2030 emissions. In a subsequent update, Brazil submitted a target to reduce emissions by 50 per cent between 2005 and 2030. This percentage improvement is insufficient to offset the increase in 2005 emissions. Nonetheless, since the updated target improves the percentage reduction, we consider that Brazil increased the ambition of its NDC. We only consider that a country did not increase ambition when it did not submit an updated NDC or when it did not improve the percentage or absolute target in its updated NDC.

Over one-quarter of the countries analysed fall into the “ambition raising follows sufficient policy adoption” category (Figure 2). These countries are projected to meet their original NDCs but fall short of meeting the updated one. Australia, Argentina, the European Union, Japan, the United Arab Emirates, the United Kingdom and South

**Figure 2.** Patterns of ambition raising and associated architectures of climate policy constraint

Patterns of ambition raising: More ambitious NDCs are not necessarily associated with sufficient policy adoption



Africa have all used the latest NDC update to submit targets that take them beyond current mitigation efforts. The United Kingdom was still part of the European Union when the Paris Agreement was adopted and therefore has no original NDC. We considered it to have the same status as the European Union when it comes to its original NDC. Most of these are high-income OECD countries with the lowest estimated level of constraints.

Almost one-quarter of the countries analysed fall into the “ambition raising without sufficient policy adoption” category (Figure 2). These countries adopted more ambitious updated NDCs without adopting sufficient policies to meet the original NDC. Countries in this category are Brazil, Colombia, Canada, Indonesia, the United States and South Korea. Brazil and Colombia are considered fractured democracies, which usually have democratic systems combined with low trust in institutions. Our findings suggest that although this does not hinder ambition raising, it does increase barriers to implementing national policy and action to meet NDCs. However, most countries in the ambition-without-implementation group are wealthy OECD countries. Notably, this group includes the United States, which is currently the world’s second biggest emitter, and Canada, one of the countries with the highest per capita emissions.

Almost one-third of the countries analysed fall into the category “ambition raising with limited effect” (Figure 2). These countries adopted more ambitious updated NDCs and are directly projected to meet them. They are China, Morocco, Egypt, India, Russia, Saudi Arabia and Viet Nam. Egypt does not have an emissions target in its original NDC. In our analysis, we considered that Egypt raised its NDC ambition by adding emissions targets. We also considered that Ethiopia increased its ambition by submitting an unconditional target. The main similarity within this country group is the reliance on fossil fuels. Several countries rely on coal to power their economic growth and improve energy access, while others rely heavily on oil and gas extraction revenues. There are varying degrees of democracy, corruption and climate policies within this group. However, according to our findings, their substantial national constraints are associated with more conservative target setting. Although the strategy to set unambitious targets allows these countries to meet international requirements to improve NDC ambitions, these targets will probably have a limited effect in guiding additional emissions reductions.

Finally, some countries (Iran, Mexico, Thailand and Turkey) failed to meet the call to raise the ambition of their NDCs (Figure 2). Iran has not ratified the Paris Agreement; Turkey has but did not submit an updated NDC; Thailand and Mexico submitted updated NDCs containing the same 2030 emissions target. Iran and Turkey’s original NDCs have targets that result in emissions above those implied by policies; Mexico is also projected to meet its targets. Thailand has a target that requires the adoption of additional policies. This suggests that the former three countries are well suited to improve the ambition of their NDCs.

## 5 Discussion

In our analysis, we updated historical emissions data to account for the latest governmental inventories, including those in the Biennial Update Reports and National

Communications. We also included the latest policy developments in updated current policy and NDC scenarios for all countries – which is fundamental to assess progress over time. Finally, we also evaluated countries’ NDC ambition raising accounting for policies and constraints. This perspective adds nuance to analysis of progress towards NDCs since a country projected to miss its updated NDC is not necessarily to blame, and vice versa. We highlight that NDCs are often not associated with policy adoption or do not imply emissions reductions beyond those resulting from policies.

More broadly, our findings have implications for the literature on the relationship between national and international climate politics. This literature recognises that these levels of climate politics are connected and influence one another (Tosun and Peters 2020). For example, more inclusive and comprehensive NDC preparation processes raise political awareness and improve readiness to adopt and implement national climate policies (Röser et al. 2020). However, we find that NDCs are not necessarily followed by sufficient policy adoption, even though this relationship is a tenet of the Paris Agreement’s ambition-raising mechanism (Dimitrov et al. 2019).

In addition, our findings suggest that similar mechanisms hinder national climate policy and explain variation in ambition raising. We build on the concept that institutions, ideas and interests influence countries’ national climate policy to find that they also influence ambition-raising patterns. Countries with fewer national constraints raised the ambition of the targets once they adopted sufficient policies to meet their original targets and countries with higher constraints tend to set targets that have a limited effect on national policies or completely ignore the call to raise their ambition.

Our findings contribute to the literature analysing countries’ updated NDCs but are subject to distinct limitations.

Since emission target setting is highly heterogeneous, focusing on emissions projections alone restricts the ambition-raising analysis. For example, countries being unambitious in their NDC target setting may help balance domestic priorities and lead to diverse benefits (Maor et al. 2017). This implies that unambitious NDC targets might still support climate action. However, we argue that NDC targets that do not guide countries beyond current policies are insufficient considering that the Paris Agreement calls for the “highest possible ambition”, and the urgency of reducing global GHG emissions. Identifying countries that raise the ambition of NDCs with limited effect on emissions is also important to limit free riding (Bang et al. 2016). Our analysis helps to identify countries where NDCs do not guide substantial additional mitigation efforts.

Categorising countries into the “ambition raising without sufficient policy adoption” group could also be considered overly restrictive since these countries can still adopt policies to meet their NDCs. However, most countries analysed in this category are wealthy OECD countries, which have high historical responsibility for climate change and capacity to act. Our approach enables a clearer differentiation between countries that are still projected to miss their original NDCs and countries that are projected to meet their original NDCs and have raised their ambitions.

In our research, we did not discuss the long-term implications of this sequencing since we focused on the ambition-raising process up to 2022. Incremental sequencing of ambition raising and policy adoption may lead to a convex emission curve (i.e., emissions reduction rate accelerating over time). This is problematic because it increases cumulative emissions when emissions reduction increments between the sequencing

stages are small and/or when countries delay ambition raising or policy adoption. Our framework contributes to this discussion. It shows in which countries emissions reduction increments of NDC updates do not lead to 2030 emissions below current policies. It also identifies countries that delay action by not submitting updated NDCs (delaying ambition raising) or by not adopting sufficient policies to meet their original NDCs (delaying policy adoption). Our framework does not address these issues but supports identifying them.

We also did not investigate the reasons why countries are projected to meet their targets. In some cases, this is influenced by factors beyond policy adoption (Nascimento et al. 2022b). For example, improved representation of data related to land cover substantially reduced Mexico's historical emissions levels. Since all projections are harmonised to historical data, 2030 emissions are also reduced and indicate that Mexico is projected to meet its NDC. However, these reasons do not change the estimate that countries are projected to meet (or miss) their targets. Our analysis clarifies which countries are in 2022 projected to meet their original and updated NDCs and whether this is aligned with the Paris Agreement's ambition-raising mechanism. This expands analyses that investigate progress towards NDCs.

Although the countries in this analysis represent most global emissions, the sample is small for statistical analyses. The findings of this research offer a novel perspective to evaluate ambition raising but remain insufficient to comprehensively explore the underlying mechanisms explaining different ambition-raising patterns. Replicating this analysis using national-level emission projections based on current policies for a larger sample would help identify whether the patterns observed here are maintained in a large- $N$  analysis. Analyses focusing on specific explanatory factors, such as state capacity or role of the country in international negotiations, also support exploring how national characteristics and ambition raising are related. Our findings points to the need for additional analyses that aim to understand and leverage the process of ambition raising and the relationships between national and international climate policy.

## 6 Conclusions

In our research, we evaluated countries' progress towards their NDCs in the context of the ambition-raising mechanism of the Paris Agreement. We projected greenhouse gas emissions up to 2030 in line with countries' policies and compared the results to original and updated NDCs. We evaluated how countries' ambition raising, defined as the act of increasing the ambition of the emissions targets in NDCs, relates to the emissions implied by adopted policies using an idealised ambition-raising sequence as a conceptual framework. We also assessed the prevalence of national architectures of climate policy constraints to identify whether they are associated with different ambition-raising patterns.

We find that most countries need to implement additional policies to meet their NDCs. Out of the 25 countries analysed, 18 are projected to meet their original targets and 11 are projected to meet their updated NDCs. A reduction in the number of countries projected to meet their NDCs results from NDC updates representing a progression compared to the original ones. More outstanding are the 11 countries projected to meet their updated NDCs at the time they were submitted. In this case, both original and updated NDCs still

lead to emissions above current policy emissions projections in 2030. These findings suggest that several NDC updates will have a limited effect on guiding additional mitigation policies. Under this perspective, they fail in their function to bridge current national efforts to meet the long-term goal of the Paris Agreement, since ambitious NDCs guide short-term action and reduce pressure on post-2030 emissions reduction rates (Höhne et al. 2020).

Additionally, in almost one-quarter of the countries analysed, ambition raising does not follow sufficient policy adoption. Several countries have not yet adopted policies to meet their original NDCs, which were set over seven years ago. For the Paris Agreement's ambition-raising mechanism to work, countries need to adopt policies to meet their targets. Increasing the ambition of targets alone widens the credibility gap between international targets and national action and undermines the Paris Agreement. Our results indicate that many countries would need to substantially expand climate policy to meet their own NDCs.

Finally, we also investigated the relationship between these patterns of ambition raising and national constraints to climate policy. We found that countries with more national constraints are less likely to sequence ambition raising and policy adoption. Oil- and gas-producing states and countries that currently rely on fossil fuels to support economic growth tend to raise ambitions with limited effect (NDC above current policies) or not raise the ambition of their NDCs at all. This provides empirical evidence supporting the linkages between international and national climate politics and invites better coordination of these processes to ensure NDC ambition is followed by national policy adoption.

The Paris Agreement relies on sequences of NDC ambition raising and adoption of national climate policies. Evaluating NDC ambition progression at the global level shows progress in the right direction but hides important patterns observable at the national level. We find that countries need to better align international and national goals for the ambition-raising cycle of the Paris Agreement to work. Appropriate sequencing of ambition raising and policy adoption is urgently needed to translate the Paris Agreement into action.

## **Notes**

1. Argentina, Australia, Brazil, Canada, China, Colombia, Egypt, Ethiopia, the EU27, India, Indonesia, Iran, Japan, Mexico, Morocco, Russia, Saudi Arabia, South Africa, South Korea, Thailand, Turkey, United Arab Emirates, United Kingdom, the United States and Viet Nam.
2. Ethiopia, the EU27 and the United Arab Emirates are not classified in Lamb and Minx (2020). Here, we classified the UAE as an oil and gas state because of its high levels of fossil fuel rents, together with Saudi Arabia and Iran. These countries also have similar values for coal share and democratic norms. Ethiopia is classified as a fragile state due to the low levels of emissions per capita and marginal progress on climate policies and fossil fuel subsidy removal. We classified the EU27 in the wealthy OECD group.
3. Emissions projections (excluding land use, land-use change and forestry (LULUCF)) were calculated using the integrated assessment model IMAGE (Roelfsema et al. 2022) and a bottom-up model based on spreadsheet calculations that estimate the impact of policies on country-specific reference scenarios (Nascimento et al. 2022a). The final projection represents the midpoint between both models. Additionally, the LULUCF emissions projection is calculated by the GLOBIOM land use model. For further details, see Supplementary Information.



4. As of June 2023, Iran has not ratified the Paris Agreement, so we considered Iran's intended NDC as its NDC.
5. Global values result from the combination of emissions including and excluding LULUCF, depending on the scope of the NDC.

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No potential conflict of interest was reported by the authors.

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## Author Contributions

Leonardo Nascimento, Michel den Elzen and Takeshi Kuramochi contributed to the study conception and design. All authors contributed to the modelling, specifically: Nicklas Forsell and Zuelclady Araujo Gutiérrez prepared land use projections; Michel den Elzen, Ioannis Dafnomilis and Mark Roelfsema developed current policy projections for industry- and energy-related sectors using IMAGE; and Leonardo Nascimento, Takeshi Kuramochi, Santiago Woollands and Mia Moisis prepared and/or coordinated the development of projections for industry- and energy-related sectors using the bottom-up modelling approach. Data preparation and analysis were led by Leonardo Nascimento.

## Data Availability Statement

The emissions data used is available for non-commercial purposes upon request to the corresponding author. Additional datasets generated during and/or analysed during the current study are available on reasonable request. The data from this manuscript is annually updated and available at <https://themasites.pbl.nl/o/climate-ndc-policies-tool/>.

## Supplementary Material

Supplementary data for this article can be accessed at <https://doi.org/10.1080/13876988.2023.2255151>.

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