

Global long-term temperature outcomes of incremental versus transformational ambition scenarios for NDCs updates by 2020

How can Paris Agreement commitments be improved now to close the gap to 1.5°C
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29 November 2019

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Summary

The current level of near-term emissions reductions governments put forward in their Nationally Determined Contributions (NDCs) is not consistent with the Paris Agreement's goal of limiting warming to 1.5°C, and puts the world on track for almost double that limit. If not enhanced, these NDCs would put the 1.5°C limit out of reach. Under the Paris Agreement and its implementing decisions all parties are required to bring forward revised and more ambitious NDCs by 2020 so as to progress towards meeting its long-term temperature goal. The 2020 deadline is the first agreed global moment since the adoption of the Paris Agreement where governments are required to come forward with more ambition, and as such is the first of the five-year 'ratchet up' cycles embedded in it. A key question then is what level of change do we need to see to bring the NDCs in line with the Paris Agreement's temperature goal?

We seek to answer this question by looking at how much an updated set of NDC targets for 2030 would need to raise collective mitigation ambition in order to help close the ambition gap and keep the 1.5°C limit within reach. We develop a series of NDC update scenarios, each based on a different level of ambition in 2030, and we look at what happens if a consistent increase in ambition levels were continued over the century. This allows us to compare how different levels of near-term ambition affect the emissions gap in 2030 and the level of warming in 2100. Our findings show that:

- **An incremental increase in ambition in NDC targets (defined in this study as a 20% reduction in emissions below the level implied by current 2030 NDC targets) would put the 1.5°C temperature goal out of reach.** If consistent incremental increases in ambition were continued beyond 2030, we estimate warming would reach over 2°C (median 2.1°C by 2100).
- **Substantial progress towards closing the global ambition gap could be achieved through a global push in 2020 to reduce emissions in 2030 by at least 35% from where the current NDCs would take us.** However, even this "significant" ambition scenario would not meet the Paris Agreement's long-term temperature goal: if significant step-ups in ambition were taken over the period to 2030 and beyond, we find that warming would be held just below 2°C (median 1.7°C by 2100).
- **Closing the ambition gap and holding warming to 1.5°C would require a transformational ramping up of ambition for the period to 2030 and beyond.** The global emissions level in 2030 implied by NDCs would need to be reduced by 50%, and such near-term increases in mitigation effort would need to be part of long-term strategies that enable sustained increases in ambition over the following decades.
- **All countries need to increase ambition if the Paris Agreement's long-term temperature goal is to be met.** All countries have an important role to play in ramping up ambition, provided that big emitters lead the way. Scenarios in which only the biggest emitters and a handful of other countries increase the ambition of their NDC will lead to higher levels of warming compared with scenarios in which all countries update their NDCs with the same relative increase in ambition.
- **Ignoring the need to ramp up effort in the short term risks locking in fossil fuel-based infrastructure, thus slowing the pace of transformation and making it more costly, with a large risk of stranded assets.** Forward-looking mitigation planning helps reducing risks and costs: ramping up 2030 efforts is consistent with a least-cost strategy to reduce overall mitigation costs and reap substantial benefits for sustainable development in the short term.

- There are large uncertainties in the national and global implications of the current NDCs, which could be reduced through increased transparency, clarity and integrity in the 2020 updates. Such improvements would make it easier to assess collective progress and identify opportunities for improvement. However, increased transparency and integrity cannot be traded for increased ambition in mitigation targets – the two should come hand-in-hand.

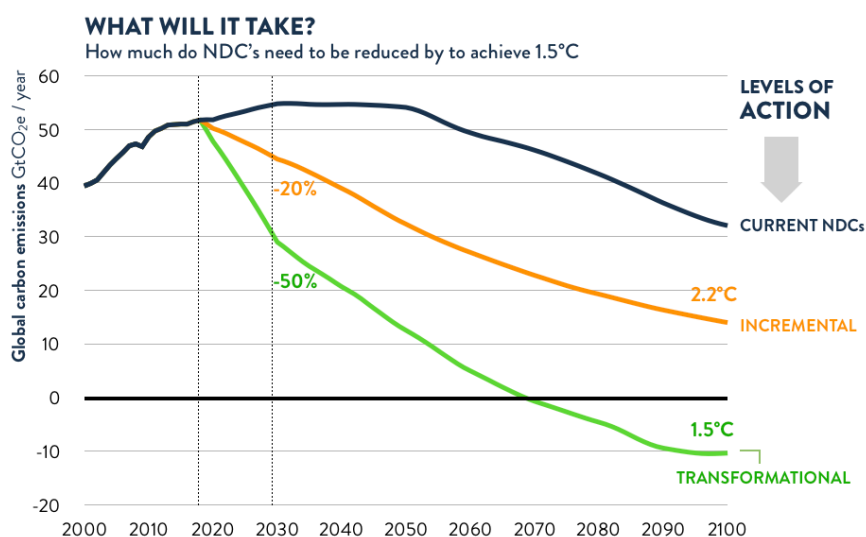


Figure 1: Global emissions pathways and end of the century temperature outcomes of reference, incremental and transformational NDC ambition ramp-up scenarios.

Our analysis shows that if governments bring forward only incremental improvements in 2020 for their NDCs for 2030, this will *not* represent a real ratcheting-up of ambition as envisioned at the core of the Paris Agreement. Instead, the Paris Agreement requires transformational increases in mitigation ambition level, starting now and continuing to mid-century and beyond.

Scenario	Reduction in 2030 emissions from current NDC levels (%)	Median global temperature increase
Current NDCs	0%	2.8°C
Minimal ambition increase	10 %	2.4°C
Incremental ambition increase	20 %	2.1°C
Significant ambition increase	35 %	1.7°C
Transformational ambition increase	50 %	Limit to 1.5°C

Table 1: The ambition ramp-up scenarios used in this analysis and their emissions levels in 2030 compared with where the current NDCs would take us. The implications of these scenarios for median global temperature increase in 2100 are shown in the right hand column: only the transformational ambition scenario, with a 50% reduction in year 2030 emissions below the current NDC level, limits warming to 1.5°C.

In addition to the improvement of national mitigation targets as described in this analysis, there are many areas that will require substantial stepping up of ambition, including:

- **Emissions reductions from international aviation and shipping (bunkers)**, where transformational changes will be required to bring existing commitments in line with the Paris Agreement that leads to full decarbonisation of these sectors.
- **Emissions and removals from land use and land use change (LULUCF)**, where urgent and coordinated increased policy action to tackle this important sector is of utmost importance for global mitigation goals, which require a substantial increase in the carbon sequestered in natural carbon sinks.
- **Finance flows and carbon markets**, where international climate finance and effective and environmentally robust carbon market mechanisms will play a key role in achieving the collective ambition levels required to meet the Paris Agreement goal. Weak carbon market rules could undermine the emissions reduction efforts that should result from increased NDC ambition levels.

There are numerous examples of national and sectoral analyses of mitigation potential, as well as ongoing discussions on how to ramp up individual NDCs that illustrate that transformational increases in ambition are possible. In fact, they are already happening in some sectors and countries, driven by market developments (such as cost declines in renewable and storage technologies) and the benefits for sustainable development that come with a transition to renewable energy. These transformations need to be amplified and extended to all sectors and countries to reach the scale necessary to close the emissions gap and put the world on track to limit warming to 1.5°C.

Introduction

Under the Paris Agreement, governments have committed to holding temperature increase well below 2°C above pre-industrial levels and to pursue efforts to limit this to 1.5°C. However, when current efforts and targets are aggregated to the global level, they miss the mark by a long way, resulting in global warming of about 3°C (Climate Action Tracker, 2018, 2019d; UNEP, 2019). Nevertheless, this does not mean that the 1.5°C limit is out of reach. Under the Paris Agreement, governments have agreed that their Nationally Determined Contributions (NDCs) should reflect the highest possible ambition, and that they should progress over time with the aim of bringing global emissions onto a 1.5°C-compatible pathway. The first set of new and updated NDCs is due in 2020. Similarly, as signatories to the Paris Agreement, governments have also been tasked with developing long-term low emission development strategies (LT-LEDS) that are in line with the 1.5°C limit, and are invited to submit them by 2020.

The IPCC in its Special Report on the 1.5°C limit (IPCC SR15), provides an authoritative scientific assessment of the mitigation pathways consistent with the Paris Agreement Long-Term Temperature Goal (PA LTTG): global greenhouse gas emissions need to peak by 2020, rapidly reduce to about half of 2010 levels by 2030, to reach net zero around 2070 and go negative thereafter; CO₂ emissions need to decline by about 45% by 2030, reaching net zero even earlier, by around mid-century.

Looking at where the present NDCs and current policies would take us, the IPCC SR15 found that they would lead to GHG emissions levels in 2030 of 52 – 58 GtCO₂eq/year, far exceeding the level that would be consistent with the PA LTTG (25 – 30 GtCO₂eq/year). The IPCC concluded that following the trajectory set by the current NDCs would push the 1.5°C limit out of reach, even if very challenging increases in the scale and ambition of emissions reductions were achieved after 2030. This finding has been confirmed by independent assessments of climate pledges and actions (Climate Action Tracker, 2019e; UNEP, 2019), which estimate that under current policies, warming of 1.5°C will likely be reached by 2035 [2030-2043], and 2.0°C by 2053 [2044-2067] (Climate Action Tracker, 2019e).

This huge gap in global mitigation ambition (often referred to as the “emissions gap”) means that there is an urgent need for most governments to scale up their short- and medium-term mitigation targets and develop a long-term vision to bring their emissions trajectory in line with the Paris Agreement 1.5°C limit. A number of opportunities exist for countries to update their NDCs and/or establish long-term mitigation targets, and many of them are currently being discussed by civil society, academia and governmental organisations [see for instance (Climate Action Network Europe, 2018; Climate Transparency, 2019; COMMIT project, 2018b; German Federal Environment Agency, 2018; Marcu et al., 2019; WWF International, 2018)].

Notably, UN Secretary-General António Guterres urged countries to incorporate increased action across-the-board on climate mitigation into their NDCs, and to present updated mitigation commitments at the 2019 Global Climate Action Summit, which he hosted in New York on September 23, 2019. While 71 countries had signalled the intention to enhance ambition of their NDC (UNDP, 2019), this was not reflected in the announcements by Heads of State at the summit. Only 58 countries, mostly small emitters, ended up in the official list of the Climate Ambition Alliance launched on the same day (Presidencia de Chile, 2019).

Similarly, Chile as presidency of COP25 has indicated that climate ambition will be a key focus of the climate summit. It has also put forward a proposal for a new NDC target that, if approved, could represent a substantial increase in ambition and give an important leadership signal (Climate Action Tracker, 2019a). However most of the biggest emitters have not expressed an intention to increase the ambition of their 2030 domestic mitigation commitments. What is more, the contributions to

international climate finance, although increased, still fall short of the needs implied by the Green Climate Fund's project pipeline (Climate Home, 2019; Green Climate Fund, 2019).

Despite the high expectations that a large number of countries will step up their climate commitments in the next twelve months, there is little understanding and scientific evidence of how individual commitment updates would compare with what is required under the Paris Agreement, and what the global impact of such updates would be. Here, we start bridging this knowledge gap by developing a number of scenarios that evaluate different options for NDCs updates, reflecting different ambition levels, and analysing their global implications by using two main metrics: the emission gap in 2030 and 21st century warming levels.

Methodology

This analysis builds up on the work of the Climate Action Tracker (CAT), which estimates the collective effect of current NDCs on global emissions, and their implications for temperature rise by the end of the century if a consistent level of effort were sustained after 2030 (Climate Action Tracker, 2015, 2018). Our reference scenario reflects our best guess of what global emissions levels and warming consequences are as implied by the current NDCs (including conditional NDC targets) and current trends, taking into account the fact that some countries are on track to overachieve their current NDC targets.¹ After 2030, the emissions projection for this scenario assumes a mitigation effort that is consistent with the ambition of the NDC. Baseline estimates of emissions from international aviation and marine activities and from land-use, land-use change and forestry (LULUCF) are also included, following the CAT methodology (for more information, see Annex I). The reference scenario would lead a global warming of 2.8°C in 2100.

Starting from this baseline, we create a number of commitment update scenarios, which represent different degrees of collective global ambition. For each scenario we define the level of ambition increase in 2030 using the percentage change in emissions levels from the reference scenario, and assume consistent increases in ambition levels throughout for the rest of the century using the methods described below. We also assume proportional decreases in emissions from international aviation and marine emissions. The scenarios² we create are:

- minimal ambition scenario (10% decrease in emissions below reference pathway in 2030, and a consistent increase in ambition from 2030 onwards),
- incremental ambition scenario (20% decrease in emissions below reference pathway in 2030, and a consistent increase in ambition from 2030 onwards),
- significant ambition scenario (35% decrease in emissions below reference pathway in 2030, and a consistent increase in ambition from 2030 onwards).

To illustrate the importance of action from *all* countries for *collective* ambition increase, we create two variants of each of the ambition scenarios: one where only the countries³ covered individually by the Climate Action Tracker (representing 80% of global GHG emissions) update their NDCs, and one where *all* countries update their NDCs.

¹ Uncertainties in our emissions estimate for the 2030 come from uncertainties in which sectors and gases are covered by the NDCs, and in how targets are defined; these are explained further in the *Uncertainties* section below, and in Annex III.

² For a full description of the scenarios refer to Annex II

³ Argentina, Australia, Bhutan, Brazil, Canada, Chile, China, Costa Rica, Ethiopia, EU, Gambia, India, Indonesia, Japan, Kazakhstan, Mexico, Morocco, Nepal, New Zealand, Norway, Peru, Philippines, Russia, Saudi Arabia, Singapore, South Africa, South Korea, Switzerland, Turkey, United Arab Emirates, Ukraine, and the United States.

We also calculate the percentage ambition increase that would be needed up to 2030 in order to put all countries collectively onto a pathway that would limit warming to 1.5°C (see 1.5°C pathways description below). **This gives us our transformational ambition scenario, with emissions in 2030 that are 50% lower than current NDC levels.** We then assess what would happen if only the CAT countries were to achieve a 50% increase in ambition by 2030 (assuming that they would apply a consistent increase in ambition from 2030 onwards), using the same methods as for the scenarios described above.

Translating near-term targets into warming levels

In order to evaluate the long-term temperature implications of specific short-term emissions targets, complete emissions pathways for all countries until the end of the century are needed. We apply the same methodology⁴ that the Climate Action Tracker (CAT) uses to extrapolate such emissions pathways to the second half of the century. This method uses publicly available⁵ data from various Integrated Assessment Models (IAMs), which represent feasible techno-economic emissions pathways for the future world economy under various given boundary conditions. The data is publicly available as the AR5 scenario database and provides least-cost pathways for a wide range of mitigation ambition levels.

The pathway extension method is based on the assumption that the level of mitigation effort at any point in time corresponds to the relative position of an emissions pathway in a set of pathways from the AR5 database. We extend the ambition level based on an underlying IAM with the same level of ambition set for 2030, thus ensuring that the pathway beyond 2030 is consistent in terms of socio-economic and technological developments as reflected in the IAM, such as production and price effects, technology learning. This methodology ensures that the long-term projection is as consistent as possible with shorter-term action or pledges by accounting for the inertia of near-term actions. Note that the increase in ambition in 2050 and beyond is more-than-proportional than the increase in 2030. This is because improvements in investment and climate mitigation goals in the first half of the century will generally lead to an energy system transformation pathway with more-than-proportional emissions reductions in the second half of the century (compared with reference scenario), consistent with economies of scale, avoidance on lock-ins and other dynamics observed in early action scenarios in the IAMs.

Having developed an emissions pathway for each of our ambition scenarios,⁶ we then estimate the resulting global temperature increase in 2100 by inputting each emissions pathway into the climate model MAGICC V.6 (Meinshausen, Raper, & Wigley, 2011), and following the methodology used by the Climate Action Tracker. All estimates for global temperature increase refer to the median (“best estimate”) climate model projection for a specific emissions scenario, within a range of climate system / carbon cycle uncertainty.

Finally, to facilitate comparison of mitigation efforts between scenarios we also calculate the *emissions gap* in 2030 between each emissions pathway and a representative 1.5°C compatible pathway (see below for a description of this pathway). We can then compare the level of ambition required to close the gap with the amount of mitigation effort needed to shift from a pathway based

⁴ For a full description of the pathway extension methodology refer to the Climate Action Tracker methodology page: <https://climateactiontracker.org/methodology/global-pathways/>

⁵ AR5 scenario database: <https://secure.iiasa.ac.at/web-apps/ene/AR5DB/dsd?Action=htmlpage&page=welcome#>

⁶ Note that we use the pathway extension methodology for the minimal, incremental and significant ambition pathways, both for cases in which all countries and only CAT countries raise ambition, as well as for the scenario in which only CAT countries achieve a transformational increase in ambition. The transformational scenario for all countries is provided by a representative 1.5°C compatible pathway constructed using pathways from the IPCC’s SR15.

on current policies (using the Climate Action Tracker's Dec 2018 current policies pathway⁷) to the reference NDC scenario. For further information, we refer to a publication under review which uses the same underlying methodology⁸. The publication also related various ambition levels to selected climate impacts.

1.5°C pathways

To assess what a transformational increase in ambition would entail, we use a subset of pathways from the IPCC's SR15 database⁹ that are consistent with the PA LTTG. Note that the IPCC's SR15 refers to pathways consistent with the PA LTTG as "no- or limited overshoot" pathways. "Limited overshoot" refers to an overshoot of peak warming above 1.5°C by less than 0.1°C: in these pathways median warming peaks below 1.6°C around mid-century and then drops to below 1.5°C by 2100 with at least 66% chance, which is equivalent to a median warming of around 1.3°C by 2100. , We apply sustainability criteria defined in the IPCC SR15 to these "no- or limited overshoot" pathways: bioenergy with carbon capture and sequestration (BECCS) [0,5 -5 GtCO₂/yr in 2050], and afforestation and reforestation [0,5 - 3,6 GtCO₂/yr in 2050]. This means that pathways with very large carbon dioxide removal requirements are excluded. We find the median of these Paris Agreement compatible pathways, and then use this median pathway to calculate the total emissions reduction in 2030 from the current NDC reference level.

Results: Implications of different short-term ambition levels for warming levels

Minimal increase

Starting from a reference scenario with a temperature outcome of 2.8°C warming at the end of the century, our analysis shows clearly that a minimal increase in the ambition of 2030 NDCs targets of 10% below the reference 2030 NDC levels would lock global mitigation action into an emissions pathway that peaks too late and declines too slowly (see Figure 2) to limit warming in line with the Paris Agreement. If consistent minimal increases in ambition levels were continued beyond 2030, we estimate warming would reach almost 2.4°C (see Table 2).

Incremental increase

An incremental increase in ambition, defined here as a 20% reduction in emissions from NDC levels, would also leave us far off track¹⁰. While this scenario would peak emissions much sooner, around 2020, the subsequent fall in emissions would be too slow to limit warming to 1.5°C. If incremental increases in ambition were continued beyond 2030, we find that the global average temperature would climb by more than 2°C. **Incremental action therefore does not represent the real ratcheting-up of ambition envisioned at the core of the Paris Agreement.**

Significant increase

Substantial progress towards closing the global ambition gap could be achieved through a global push in 2020 to reduce emissions in 2030 by at least 35% from where the current NDCs would take us. This scenario starts to take us in the right direction, but is still not enough to place us on a

⁷ See the climate action tracker website for more information <https://climateactiontracker.org/methodology/current-policy-projections/>

⁸ Geiges, A., Parra, P. Y., Andrijevic, M., Hare, W., Nauels, A., Pfleiderer, P., Schaeffer, M., and Schleussner, C.-F.: Incremental improvements of 2030 targets insufficient to achieve the Paris Agreement goals, *Earth Syst. Dynam. Discuss.*, <https://doi.org/10.5194/esd-2019-54>, in review, 2019. <https://www.earth-syst-dynam-discuss.net/esd-2019-54/>

⁹ <https://data.ene.iiasa.ac.at/iamc-1.5c-explorer/#/workspaces>

¹⁰ See annex IV for regional results

pathway compatible with the Paris Agreement's long-term temperature goal: if significant step-ups in ambition were taken over the period to 2030 and beyond, warming would be held just below 2°C.

Transformational increase

Of all the scenarios we consider, only the transformational ambition scenario, with a 50% drop in emissions below NDC levels in 2030, achieves a sufficient pace of emissions reductions after 2020 to close the emissions gap and limit warming to 1.5°C. Hence **only a transformational step-up in ambition to 2030 and beyond is compatible with the Paris Agreement's long-term temperature goal.**

Key benchmarks for this transformational ambition scenario include:

- a 50% drop in emissions below NDC levels in 2030;
- at least a 40% drop in emissions in 2030 below 2010 levels¹¹
- a reduction in the emissions gap in 2030, from 24 GtCO₂e for the reference scenario to zero in the transformational scenario.

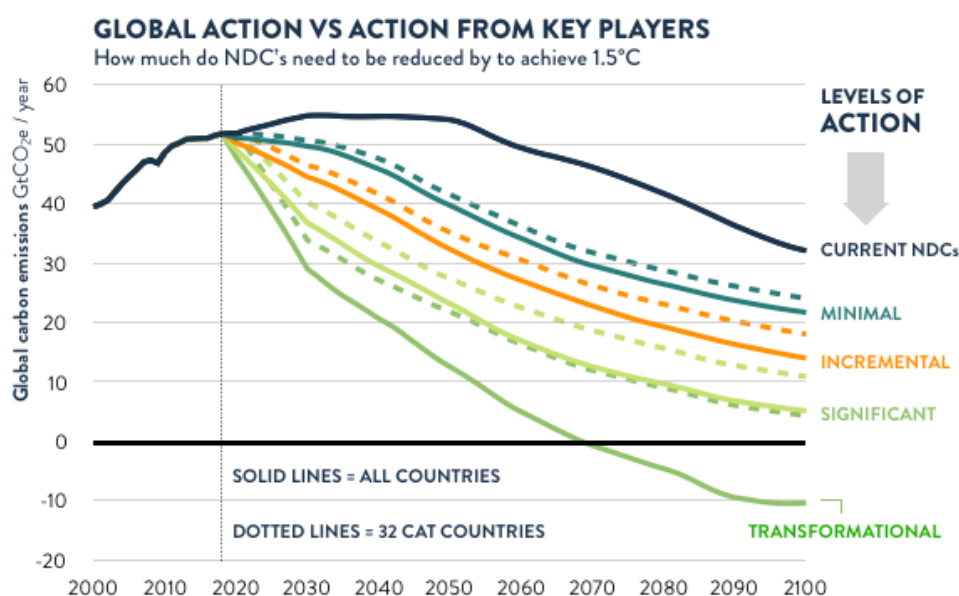


Figure 2: Global emissions pathways (including land-use, land-use change and forestry (LULUCF) and marine and aviation) for the reference (current NDCs) and ambition ramp-up scenarios. For comparison, a 1.5°C compatible pathway is also shown.

¹¹ The IPCC's SR15 found that pathways that limit warming to 1.5°C with no or limited overshoot have global greenhouse gas emissions levels in 2030 that are 40-50% below 2010 levels.

Scenario	Reduction in global 2030 emissions from current NDC levels (%)	Change compared to global 2010 emissions (%)	Estimated global median temperature increase 2100
Reference scenario (current NDCs)		+12 %	2.8 °C
Climate Action Tracker (CAT) countries			
Minimal ambition increase	7%	+ 4 %	2.4 °C
Incremental ambition increase	15 %	- 4.5 %	2.2 °C
Significant ambition increase	26 %	- 17.5%	1.9 °C
Transformational ambition increase	38%	-30%	1.65°C
All countries			
Minimal ambition increase	10%	+ 2%	2.35°C
Incremental ambition increase	20%	-8.5%	2.1°C
Significant ambition increase	35%	- 24.5 %	1.7 °C
Transformational ambition increase	50%	- 40 %	1.3°C ¹²

Table 2: The effects that all the different levels of near-term ambition have on long-term temperature rise. Median warming levels are given for the year 2100 for each scenario; upper rows show pathways where only the CAT countries update their targets, and lower rows show pathways in which all countries update their targets.

The greatest emissions reductions are achieved when all countries increase their ambition compared with a scenario in which only the big emitters enhance their mitigation efforts (See table 2). However, the impact of relatively smaller emitters depends on the overall degree of ambition. For the incremental ambition pathway, larger emitters dominate impacts on temperature. However, at higher levels of global ambition the contributions of smaller emitters become more important. In other words, **all countries have an important role to play in ramping up ambition, provided that big emitters lead the way.**

Opportunities for ramping up ambition

As our analysis shows, transformational ambition, understood here as a 50% emissions in 2030 below where the current NDCs would take us, is needed urgently to keep the door open to hold global warming to levels consistent with Paris Agreement Long-Term Temperature Goal. While these ambition levels might seem very high or politically infeasible at first glance, **multiple examples from around the world, as well as key market trends, show that a substantial ramping up of ambition is not only possible, but is already happening in many sectors and countries.**

Opportunities at the national level

There are large uncertainties in the national and global implications of the current NDCs (see section Uncertainties around quantifying NDCs), which could be reduced through increased transparency, clarity and integrity in the 2020 updates. However, increased transparency and integrity cannot be traded for increased ambition in mitigation targets, which is the focus of this analysis.

¹² The mean end-century warming for the 1.5°C compatible pathways considered in this analysis is 1.3°C; the mean peak warming is 1.5°C.

To start with, looking at countries that have already updated their mitigation targets (e.g. Morocco), or are planning to do so (e.g. Costa Rica, Chile, the EU28), and countries that are already overachieving their current NDC targets with current¹³ (e.g. India, Russia, Turkey) or planned policies (e.g. Saudi Arabia, Ukraine), it becomes clear that substantial improvement in NDCs targets is feasible in a large number of countries.

Furthermore, a number of analyses of mitigation potential at the national level or proposals put forward by some countries illustrate that **proposals for individual NDC enhancements in a number of countries are consistent with a substantial ramping up in ambition levels**. Here, we present five examples:

- In the last year, Chile has moved forward with a series of new policies to cut GHG emissions, including a plan to phase-out coal (which accounts for roughly 40% of the electricity mix) for power production by 2040, and an electromobility strategy. If these policies were fully implemented, it is estimated that by 2030 emissions could be reduced 25% below the current unconditional NDC level (Climate Action Tracker, 2019b). More recently, Chile has put forward a proposal for an updated NDC for public consultation. The unconditional target in this new NDC proposal, would be roughly in line with planned policy projections, and be 26% the current NDC level, while the conditional target (assuming removals from LULUCF are excluded) would be 53% lower than the current NDC. These targets, if adopted and followed by a comprehensive set of policies, could represent a substantial improvement in Chile's climate ambition, as required by the ratcheting up mechanism of the Paris Agreement.
- In February 2019, Costa Rica outlined its pathway towards net-zero emissions by 2050 in the National Decarbonisation Plan 2018-2050, which includes strategies for emissions reductions in all sectors of the economy. It has been estimated that, if fully implemented, the policies in the Decarbonisation Plan could lead to 2030 emissions levels that would be 21-25% below the current NDC target emissions level (Climate Action Tracker, 2019).
- Since its first NDC was submitted, the European Union has adopted various new measures that have the potential to reduce emissions beyond its NDC level. These include new renewable energy and energy efficiency goals, driven by rapid cost reductions, the reform of the emissions trading scheme (EU ETS), and a new directive on emissions reductions in the buildings sector. In addition, a number of EU member states have also adopted additional policies, such as plans to phase out coal power plants. Considering these developments, the EU is currently discussing the update of its NDC mitigation target. The European Parliament has recommended an upgrade from the current "at least 40% below 1990" target to a 55% target (European Parliament, 2018), while independent organisations have requested much more ambitious reductions of 60% (German Federal Environment Agency, 2018) to 65% (Climate Action Network Europe, 2018). The more ambitious proposals would translate to an improvement of 33-42% below emissions levels implied in the current NDC; only the most ambitious proposal (of 65%) would be close to our transformational ambition improvement benchmark.
- The Australian Government, when submitting its NDC to reduce emissions 26-28% below 2005 levels by 2030, ignored the advice of its national Climate Change Authority who recommended an emissions target for 2030 that went far beyond the current target and would have translated to an emissions reduction target of 45-63% below 2005 levels (CCA, 2014, 2015). An estimate for least-cost domestic emissions pathways for Australia show a

¹³ Our reference NDC pathway already includes the effect of countries which are overachieving their NDC with currently implemented policies, given that the projected 2030 emissions level for 2030 is our best estimate for the maximum amount of emissions that the atmosphere will see and is more useful to predict warming outcomes than the NDC level.

similar range of 44-61% (Climate Analytics, 2018a). Compared to the current NDC, the CCA range would translate to an improvement of 26-50% below emissions levels in 2030 implied in the current NDC, getting close to our transformational ambition improvement benchmark.

- Although China's mid-century low-carbon strategy is still under development, preliminary analysis shows that under least cost mitigation pathways, China's CO₂ emissions would achieve a relatively low peaking around the year 2025, and could achieve deep reductions after peaking, especially after 2030 (COMMIT project, 2018a; Dong, Hua, & Yu, 2018; Peng, Yang, Wagner, & Mauzerall, 2017). If non-CO₂ emissions would follow a similar trend¹⁴, the total emissions levels implied by these scenarios would translate to an improvement of 26-56% below the current upper end of China's NDC target¹⁵

There is also a number of examples of ambitious longer-term targets that look beyond 2030. An increasing number of countries and sub-national jurisdictions have announced or are in the process of formulating net-zero emissions strategies and targets, sometimes with a timeframe much earlier than 2050 (e.g. Denmark, Sweden). The processes related to the elaboration of such strategies, as well as the process to turn them into official legislation in many jurisdictions, proves that transformational ambition for climate legislation can be supported by a large range of stakeholders within a large variety of democratic processes set in place to set in place regulation with long-term, economy-wide implications. Examples of frontrunners in long-term climate legislation like the UK highlight the importance of not only setting up ambitious climate mitigation targets, but also of turning them into national laws and regulations. Such climate legislation creates a consistent framework for the development and implementation of climate policy that can survive changes in power and uncertainties related to emissions cycles.

It is important to note that some countries have weaker current NDC targets than others, and the socioeconomic realities, natural endowments (e.g. large forest sinks), as well as institutional and financial capacity to implement climate policies are diametrically different across countries. This means that our definition of a "significant" increase in ambition at the global level (35% drop from current NDC emissions levels) may only represent an incremental change in some national contexts, while it could be transformational in some others. Further specific country-level analysis will be needed to better understand what ramp-up in ambition different countries could achieve (see *Further Work* section below).

Opportunities for specific sectors

Another important trend that can support transformational ambition for emissions commitments updates is the remarkable cost decrease in renewable energy (RE) related technologies that has been observed since 2014, when most of the NDCs were prepared. For instance, the unsubsidised levelised cost of electricity (LCOE) of solar PV and wind have decreased by about 50% and 30% respectively between 2014 and 2019 (LAZARD, 2019), while lithium-ion battery costs have fallen by more than 60% (Climate Analytics, 2018b). These very positive trends are expected to continue around the world, as the market for RE continues to grow systematically, opening the possibility of achieving much larger RE shares and bigger emissions reductions at the same cost that was planned in the original NDC. For example, this was one of the drivers for the EU to increase its Renewable Energy target, which has supported and enabled a discussion to enhance the NDC without additional costs.

¹⁴ Since external estimates refer only to the CO₂ portion of the NDC, we add non-CO₂ emissions levels by reducing the non-CO₂ emissions level estimated by the CAT in 2030 proportionally.

¹⁵ For China the indicative improvements are calculated compared to the higher end of the CAT estimate of China's NDC intensity target, these reductions would translate to a 15-50% improvement if compared to the non-fossil fuel share target of China's NDC.

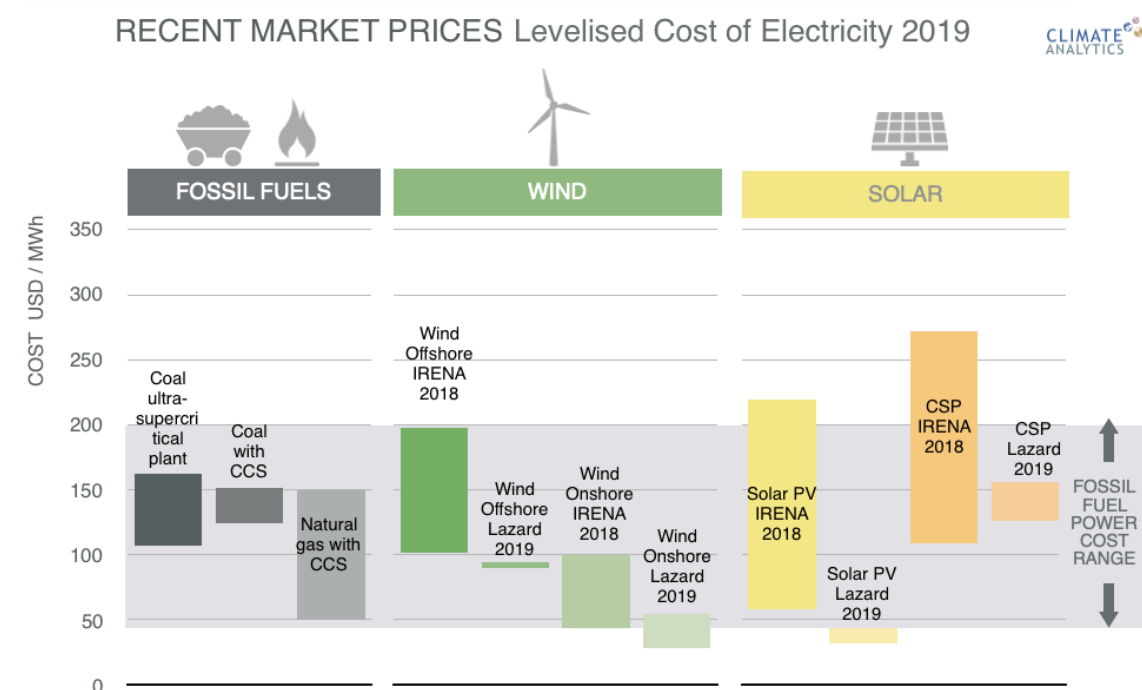


Figure 3: Levelised Cost of Electricity of different generation technologies in 2019. Source: Own elaboration based on Lazard analysis (LAZARD, 2019) and IRENA (IRENA, 2019).

Current NDCs are based on pre-2015 information about the mitigation costs that can be regarded as outdated today thanks to remarkable progress in RE technology costs. These fundamental shifts in the energy landscape provide the enabling environment for the much-needed increase in near-term ambition to be reflected in the new round of NDCs: countries could achieve much larger emissions reductions at the same, or even lower cost than what was foreseen for the current NDC. Analyses looking at the improvement potential of NDCs have found that simply updating NDCs to reflect more up-to-date RE technology costs could reduce target emissions by several percentage points; for example, 2030 emissions levels in Chile could drop by up to 10% (Fekete & Nascimento, 2019; Fekete, Nascimento, & Lütkehermöller, 2019).

There are also considerable benefits for sustainable development associated with increasing mitigation efforts and ambition consistent with the Paris Agreement (Climate Action Tracker, 2019f; Climate Analytics, 2019a, 2019b) (Markandya et al., 2018; Vandyck et al., 2018). For example, shifting to renewable energy and phasing out fossil fuels can reduce air pollution and its associated health impacts (such as respiratory diseases), improve energy access in rural areas, and provide income-generating opportunities (Chang et al., 2017; Ürge-Vorsatz, Herrero, Dubash, & Lecocq, 2014). In cities a shift to low carbon electricity, transport and buildings, combined with increases in energy efficiency, can lead to more sustainable urban environments and communities, provided that effective policies are put in place. There are also many examples of how pursuing sustainable development goals can reduce the costs of mitigating climate change by enabling the systems transformations needed to reduce emissions rapidly (Climate Analytics, 2019b).

Areas where focused attention on raising ambition is needed

While these examples around the world open the door for optimism about high ambition mitigation targets, there are many areas that will require substantial stepping up of ambition:

Emissions reductions from international aviation and shipping (bunkers):

The focus of our scenarios is on collective ambition levels, therefore in our scenarios we assume a proportional increase in ambition levels for international emissions not covered by NDCs. To do this, we apply the same percentage reductions in each scenario to the baseline estimates of emissions from international aviation and shipping. However, emissions reductions from international aviation and shipping activities are currently not on track for a transformational increase in ambition.

The United Nations International Maritime Organization (IMO) has agreed to a reduction in total GHG emissions from international shipping by at least 50% by 2050, compared with 2008 levels, and to pursue efforts towards phasing them out entirely.

While these targets are a first good step, they are far away from the full decarbonisation required under the Paris Agreement for all sectors, and substantial improvements will need to be made to bring these commitments in line with a transformational ambition scenario. A key issue to be resolved for these sectors is the reliance on emissions offsetting, which cannot replace effective measures to achieve full decarbonisation of these sectors, such as the scaling up of investment for research and development on zero carbon technology options.

Emissions and removals from land use and land use change (LULUCF)

The main figures and estimates in this analysis refer to emissions levels excluding LULUCF. However, in all low carbon emissions scenarios, the LULUCF sector plays a key role and a substantial increase in the carbon sequestered in natural carbon sinks is essential to achieve the overall emissions reductions required. Forest fires, which are becoming more frequent in a warming world, together with lack of sufficient policy action in key geographies to stop deforestation and land degradation are at odds with this need of rapidly increasing carbon sinks. Urgent and coordinated increased policy action to tackle this important sector is of utmost importance for global mitigation goals.

Domestic efforts, finance flows and carbon markets:

All the scenarios presented in this analysis assume that all emissions reductions are achieved domestically. In reality, some countries have far more potential to reduce emissions compared to their current NDC levels than others. Additionally, contributions to climate change mitigation based on equity considerations (e.g. historical responsibility, per capita emissions convergence, etc) would lead to much lower emissions allowances for a number of countries than what least-cost emissions pathways focusing on domestic potential imply. In this context, international climate finance and effective and environmentally robust carbon market mechanisms will play a key role in achieving the collective ambition levels required to achieve the Paris Agreement goal. However, one significant risk is that the rules for the Paris Agreement market mechanisms will not be sufficiently robust to ensure that all emissions reductions are *real* and are only counted towards one NDC. Weak rules could cause the use of these market mechanisms to undermine the ambition levels of NDC targets, rather than enhance them.

Uncertainties around quantifying NDCs

While all the results presented in the main body of this analysis correspond to a central estimate, which is our best guess of the emissions pathways implied by current NDC levels, it must be highlighted that there are large uncertainties around the emissions levels implied by current NDCs. These uncertainties mainly relate to:

- **Sector or gas coverage:** many NDCs have mitigation targets that do not cover all the sectors and GHGs contributing to the country's total emissions. Adding to this issue, the scope of coverage is not always clearly stated in an NDC, leaving room for interpretation. These issues increase

uncertainty about the NDCs' intended emissions levels. When assessing emissions targets, the intended reductions only apply to the covered part of emissions, while the emissions reductions from the not-covered sectors and gases remains uncertain. In 2016, 99.1% of global emissions (excl. LULUCF and bunkers) came from countries that submitted NDCs. However, only 91.7% of their emissions were covered in their NDCs¹⁶. This reduces the targeted part of global emissions to 89.9% (2016). Moving towards economy-wide targets – as required by the Paris Agreement – would improve the transparency and clarity of NDCs, and thereby facilitate the aggregation of NDCs at the global level. For some countries, raising emissions coverage to 100% would have a considerable effect on the level of mitigation ambition achieved. However, such improvements must not be done *instead* of real ambition enhancements for sectors and gases already covered (see annex III for more details on sector and gas coverage uncertainties).

- **Sectoral contribution to mitigation efforts:** many NDCs with economy wide targets are not explicit about the underlying contribution of different sectors to the achievement of their mitigation targets. This makes assessing the compatibility of sectoral national targets and emissions projections with the NDC targets challenging. Assessing the contribution of LULUCF emissions / removals to the NDCs, which is often ambiguous (Fyson & Jeffery, 2019) (see Annex III for further information) is particularly challenging. Estimates suggest that such ambiguity creates substantial uncertainty in the role of LULUCF in 2030 mitigation targets, of up to 3 GtCO₂/year (Fyson & Jeffery, 2019). In addition, there is a substantial difference between the level of anthropogenic LULUCF emissions assumed by IAMs and the level reported by countries in their national GHG inventories (Grassi et al., 2018).
- **NDC emission intensity:** some NDCs define their mitigation commitments as a reduction of emissions intensity per GDP (8) or per capita (5). This effectively makes their NDC target a moving one, which changes proportionally to economic or population growth projections. Even though the number of countries that chose this type of mitigation target is rather low, they represented 16% of global emissions in 1990, with a strong increase over the past years, to 35% in 2016³. Ten countries state a reduction compared to base year intensities, one states a reduction compared to business-as-usual, while two countries submitted absolute emissions intensity per capita targets. To quantify this type of targets, one needs the level of GDP and/or population in the target year, making it impossible to derive an exact target level with total certainty. Additionally, several of the currently available NDCs with intensity targets, including big emitters, have NDCs that do not cover their entire emissions, which introduces further uncertainty about the intended future emissions levels.
- **Targets in comparison with a baseline scenario:** many NDCs (79) define their mitigation commitments as a reduction of emissions below a business-as-usual or reference scenario. These countries represented 13.8% of global emissions in 1990, with a strong increase over the past years, to 17.3% in 2016³. While the emissions levels implied by this type of NDC are straightforward to calculate, many of the assumptions behind the reference scenario differ considerably from independent projections of the socioeconomic and economic drivers behind emissions, which in some cases results in inflated reference scenarios. The fact that some NDCs cover only a fraction of total emissions also adds additional uncertainty to business-as-usual targets. To address some of these problems, our study uses the emissions levels consistent with current policy projections whenever available, if countries have targets which they are overachieving due to inflated reference scenarios.

¹⁶ This assessment is based on emissions data from PRIMAP-hist v2.0 HISTCR, excluding LULUCF, with GWP from IPCC AR4 and addresses the sectors Energy, IPPU, Agriculture, Waste and Other, and the Kyoto GHGs CO₂, CH₄, N₂O, HFCs, PFCs, SF₆ and NF₃. See Annex III for more information.

Conclusion

Achieving the Paris Agreement Long-term Temperature Goal requires transformative systemic change across the whole economy and society, rather than incremental change. It is critical that countries increase the ambition of their current emissions reductions targets to levels that are in line with the required change at the scale and pace consistent with the Paris Agreement 1.5°C limit. This increased ambition must then be reflected through the implementation of a set of credible policies.

Our analysis clearly shows that an incremental increase in the ambition of 2030 NDCs targets would lock global mitigation action into an emissions pathway that peaks too late and declines too slowly to limit warming in line with the Paris Agreement. Incremental action therefore does not represent the real ratcheting-up of ambition envisioned at the core of the Paris Agreement. Only the transformational ambition scenario of at least a 50% reduction in emissions levels below current NDCs is able to reach the deep emissions reductions needed to achieve a 1.5°C compatible pathway consistent with the Paris Agreement goal.

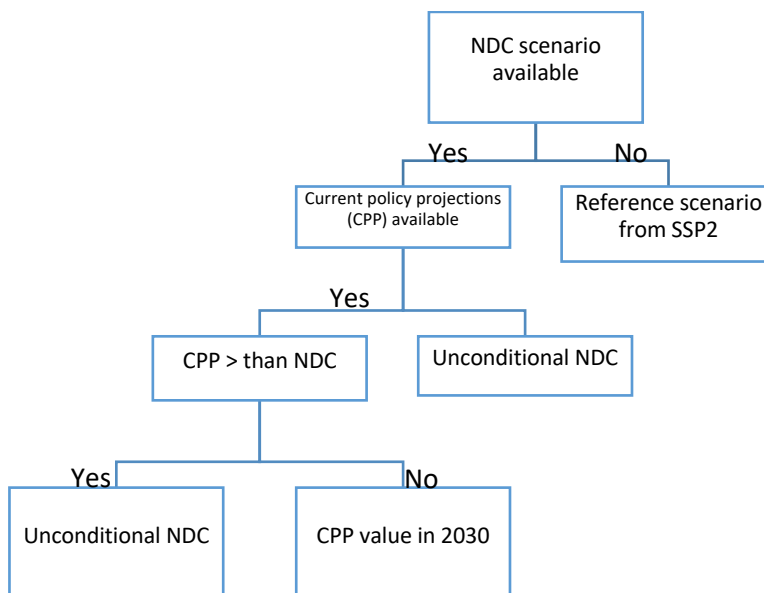
Our findings illustrate how different levels of ambition in the short term can have very different implications for the long-term emissions pathways and global temperature outcomes. It is clear that immediate action is needed both to close the ambition gap in 2030 and to urgently enhance the implementation of mitigation policies, in order to enable a trajectory of deep and rapid emissions reductions into the future.

Finally, our analysis demonstrates that while this level might seem daunting at first sight, there are numerous examples of national and sectoral analyses of mitigation potential, as well as ongoing discussions on how to ramp up individual NDCs that illustrate that transformational increases in ambition are possible. In fact, they are already happening in some sectors and countries, driven by market developments (such as cost declines in renewable and storage technologies) and the benefits for sustainable development that come with a transition to renewable energy. These transformations need to be amplified and extended to all sectors and geographies to reach the scale necessary to close the emissions gap and put the world on track to limit warming to 1.5°C.

This analysis has shown that incremental change is not sufficient to limit warming to 1.5°C, and that all countries have a role to play in ramping up ambition. However, further work is needed to extend the global benchmarks for ramping up ambition to the national level. This will need to include detailed analysis of how different countries and sectors can achieve transformational mitigation action, for example through switching to renewable energy, phasing out coal, avoiding natural gas, decarbonising steel production, shifting to electrical vehicles. In addition, the concept of achieving net zero emissions – and the growing number of pledges to do so – will need to be explored in order to clarify what this means for near-term emissions reductions. A particular challenge for understanding the implications of “net zero” will be to reduce and/or clarify the uncertainties relating to the role of LULUCF in both reducing emissions and in achieving carbon dioxide removals.

ANNEX I - NDC target used in reference scenario

We use the following rules to select the NDC level of a country in 2030 for our reference scenario:



Here are some examples of what the operationalisation of this decision tree means for specific countries in our reference scenario:

Australia: [NDC is taken](#). Australia's emissions (excl. LULUCF) have increased by about 1% per year on average, since 2014, when the federal government repealed the carbon pricing system.

India: [current policy scenario](#). Our analysis shows that India can achieve its NDC target with currently implemented policies, i.e. it would not have to put any other policies in place. Under current policy projections, greenhouse gas emissions (excluding LULUCF) are projected to reach a level of 3.2–3.3 GtCO₂e in 2020 and 4.5–4.6 GtCO₂e in 2030. This is a 48–52% increase in emissions from 2010 levels by 2020 and a more than doubling of 2010 levels by 2030.

Japan: [NDC is taken](#). Japan's NDC includes an emissions reduction target of 26% below 2013 levels in 2030 (Government of Japan, 2017), which translates to a 18% reduction from 1990 levels, excluding LULUCF, but including LULUCF credits in the target year.

Russia: [CPP low](#). According to our latest estimates, Russia's currently implemented policies will lead to emissions of between 2.6 and 2.7 GtCO₂e in 2020 and between 2.8 and 3 GtCO₂e in 2030 (both excluding LULUCF), which is 0-4% and 6-14% above 2016 emission levels, respectively. This represents a decrease in emissions from 1990 levels of 27-29% in

USA: [NDC for 2025](#). The US NDC set a target of reducing its emissions by 26% to 28% below 2005 levels by 2025, including LULUCF. Although the Trump Administration has indicated that it intends to withdraw from the Paris Agreement and stop implementation of the NDC, it legally remains in place until 4 November 2019.

ANNEX II - NDC update scenario description

Group 1 - High emitting countries: Only CAT countries (80% of global emissions) change their NDC targets according to the level of effort chosen for each scenario

Group 2 - All countries update their NDCs: All countries change their NDC targets according to the level of effort chosen for each scenario

Scenarios

- **Reference scenario:** this describes that we use the lowest emissions level in 2030 of the following options: current policy projections, planned or additional policy projections, commitments. We assume countries will update their NDC to the lowest emissions level from the options above. Detailed description for each country in Annex 1.
- **Minimal ambition increase scenario:** decrease of 10% below emissions level in 2030 in the reference scenario and linearly interpolating from latest historical year up to 2030. LULUCF, marine and aviation emission scenarios are also selected to be consistent with the 10% below present projections in 2030 reduction. For countries with a 2050 target, we assume the improvement happens proportionally for both 2030 and 2050 emission levels.
- **Incremental ambition increase scenario:** decrease of 20% below emissions level in 2030 in the reference scenario and linearly interpolating from latest historical year up to 2030. LULUCF, marine and aviation emission scenarios are also selected to be consistent with the 20% below present projections in 2030 reduction. For countries with a 2050 target, we assume the improvement happens proportionally for both 2030 and 2050 emission levels.
- **Significant ambition increase scenario:** decrease of 35% below emissions level in 2030 in the reference scenario and linearly interpolating from latest historical year up to 2030. LULUCF, marine and aviation emission scenarios are also selected to be consistent with the 35% below present projections in 2030 reduction. For countries with a 2050 target, we assume the improvement happens proportionally for both 2030 and 2050 emission levels.
- **Transformational ambition increase scenario:** a representative 1.5°C pathway that is compatible with the Paris Agreement's long-term temperature goal.

In our reference scenario, we use the CAT pathways for land-use, land-use change and forestry (LULUCF) emissions and bunkers; in each ambition scenario, the corresponding percentage reductions to emissions in 2030 is applied to LULUCF and bunkers emissions.

Annex III - Uncertainties

Sector and gas coverage uncertainties

Many NDCs have mitigation targets that do not cover all the sectors and GHGs contributing to the party's total emissions. Adding to this issue, the scope of coverage is not always clearly stated in an NDC, leaving room for interpretation. Both problems create uncertainty about the NDCs' intended emissions levels. When assessing emissions targets, the intended reductions only apply to the covered part of emissions, while the emissions from the not-covered sectors and gases remain uncertain. As the share of emissions for a certain sector and gas changes over time, the percentage of national emissions covered by an NDC is not constant. Therefore, for each NDC that does not have a total coverage, information is necessary on the not-covered part of emissions in the target years, which can produce uncertainties even in the clearest and most easily quantifiable base year targets.

An analysis of all NDCs shows that the percentage of party's emissions covered by its target can be as low as few percent. Based on 2016 emissions, for the group of NDCs with business-as-usual targets (BAU), the party with lowest coverage only covers 25.9% of its total emissions, while for the NDCs with base year targets (BYT) it is 71.9%, for emissions intensity targets (ITT) it is 50.3%, and for other target types (OTT) the lowest coverage is 3.3%. This assessment and all following values are based on emissions data from PRIMAP-hist v2.0 HISTCR (Gütschow, Johannes; Jeffery, Louise; Gieseke, 2019)(Gütschow et al., 2016), excl. LULUCF, with GWP from IPCC AR4 and addresses the sectors Energy, IPPU, Agriculture, Waste and Other, and the Kyoto GHGs CO₂, CH₄, N₂O, HFCs, PFCs, SF₆ and NF₃.

Looking at the total emissions by all parties per NDC type that are actually affected by their targets, the coverage is 95.2% / 99.8% / 81.7% / 88.4% for BAU / BYT / ITT / OTT (for 2016), with their share of global emissions being 17.3% / 38.9% / 35.3% / 7.5% (for 2016; excl. LULUCF and bunkers). Looking at the total numbers for 2016 (excl. LULUCF and bunkers), 99.1% of global emissions came from countries that submitted NDCs, while only 91.7% of their emissions were assessed to actually be targeted by their NDCs, which reduces the targeted part of global emissions to 89.9%, leaving room for improvement.

This includes countries who have not ratified their NDCs yet, and countries that announced to withdraw from the Paris Agreement. Globally, the share of not-covered emissions increased in the past, leading to a decrease in the actually addressed part of global emissions from 92.2% in 1990 to 89.9% in 2016. For the presented values assumptions were necessary when NDCs did not clearly state their scope of coverage.

Under the Paris Agreement, developed countries are to have an economy-wide target, and developing countries should move over time towards including all sectors and gases in their NDCs. Bringing all emissions under the NDCs is important for shifting towards an economy-wide approach to addressing climate change, and is fundamental for the operation of market mechanisms. We have taken a look at what would happen if all parties adopted economy-wide targets for 2030 on a country-by-country basis. We find that the impact in 2030 could range between a reduction in emissions by 43 % (Philippines) and an increase in emissions by 16 % (India), with large uncertainties that relate to our assumptions in interpreting the target and the way the target is defined. Surprisingly, in some countries that have targets compared to a reference level the impact of increasing emissions coverage is to raise emissions levels in 2030. This is because including all emissions in the reference level would increase the reference level emissions and therefore also the total target year emissions. In most cases this is cancelled out by the effect of reducing emissions in the newly added sectors, but in some cases (e.g. India) the rise in reference level emissions creates substantial legroom in the target, allowing more emissions in the target year than in the original

NDC. In such cases, the target percentage reduction in emissions would have to be raised to avoid the ambition of the target from falling. This illustrates the importance of transparency as countries move towards economy-wide targets.

LULUCF uncertainties

There are well documented uncertainties in the contribution of LULUCF to the NDCs, including uncertainties in LULUCF emissions data and ambiguity in how LULUCF mitigation will be addressed by each country (Forsell et al., 2016; Fyson & Jeffery, 2019; Grassi et al., 2017). For example, very few NDCs include a separate, quantified emissions target for LULUCF, but rather provide some LULUCF-related policies and measures, a target based on a non-emissions metric (e.g. forest stock volume), or no LULUCF target at all. In addition, very few NDCs contain explicit information on how LULUCF emissions and removals will be accounted towards the NDC mitigation target (i.e. will LULUCF be treated as any other sector, will LULUCF mitigation be measured against a different baseline, or is LULUCF mitigation treated completely separately). This makes it difficult to estimate the LULUCF emissions and removals implied by the NDCs in 2030, as well as the emissions levels anticipated in non-LULUCF sectors. According to Fyson and Jeffery (2019), ambiguity in the LULUCF component of NDCs results in an uncertainty in 2030 emissions levels of about 3 GtCO₂.

ANNEX IV – Regional results

For each scenario, the country information is aggregated to the level of the five Representative Concentration Pathway (RCP) regions in the AR5 scenario database: ASIA, MAF (Middle East and Africa), LAM (Latin America), OECD, and REF (Reforming economies, ie. Russia and former Soviet states). Some AR5 pathways do not include information for all regions explicitly. Those pathways are only taken into account for the regions they contain.

The following figures show the same analysis for the five region of the AR5 database.

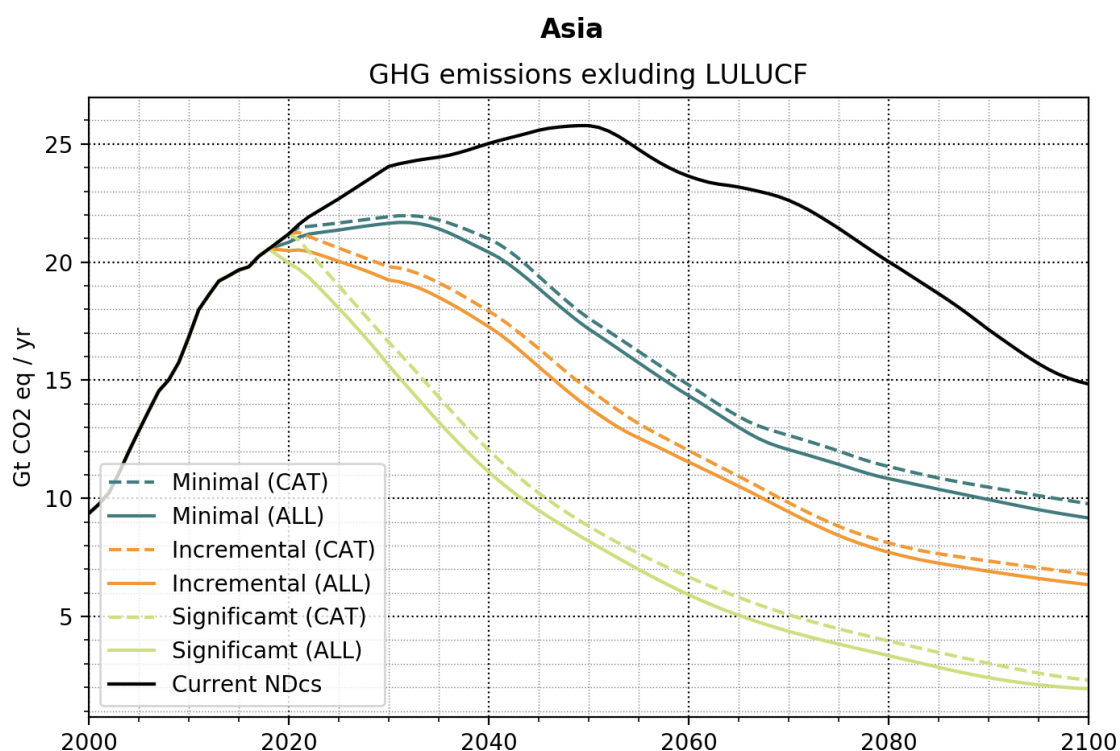


Figure 2: Emission pathways for the various scenarios for the country emission for the AR5ASIA region, excluding LULUCF, marine and aviation emissions.

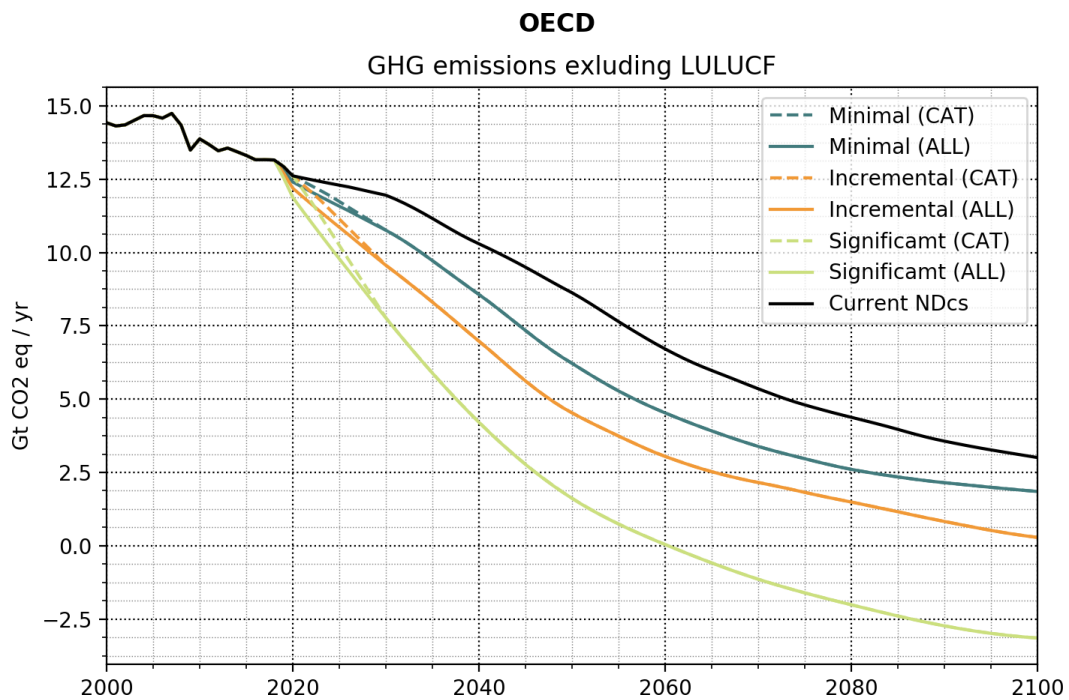


Figure 3: Emission pathways for the various scenarios for the country emission for the AR5OECD region, excluding LULUCF, marine and aviation emissions.

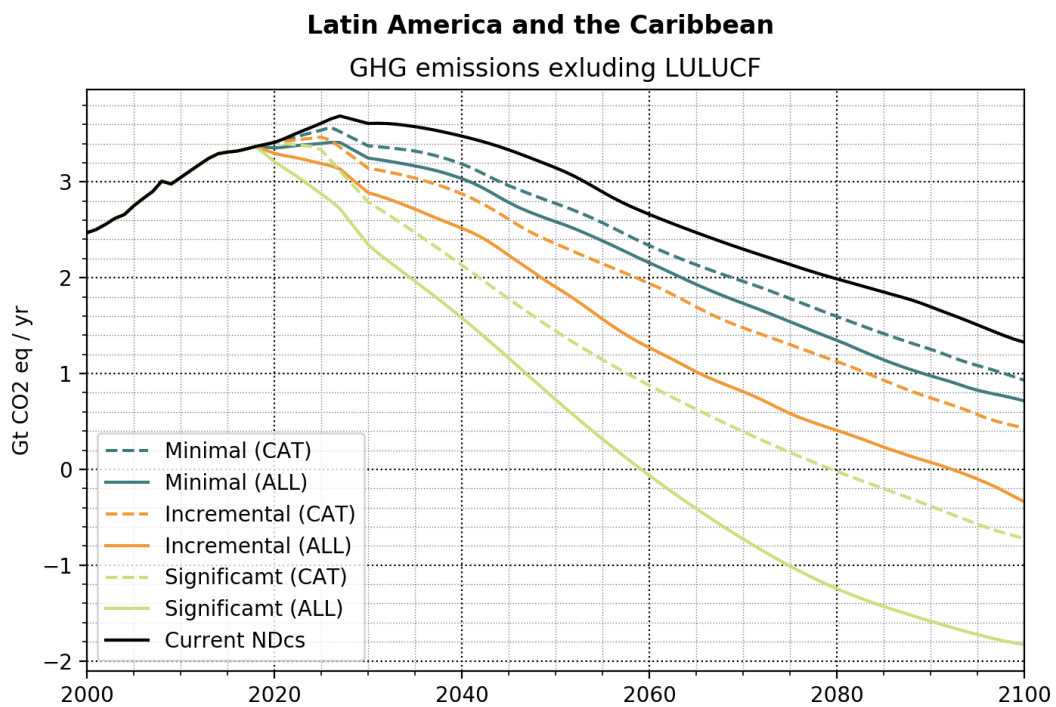


Figure 4: Emission pathways for the various scenarios for the country emission for the AR5LAM region, excluding LULUCF, marine and aviation emissions.

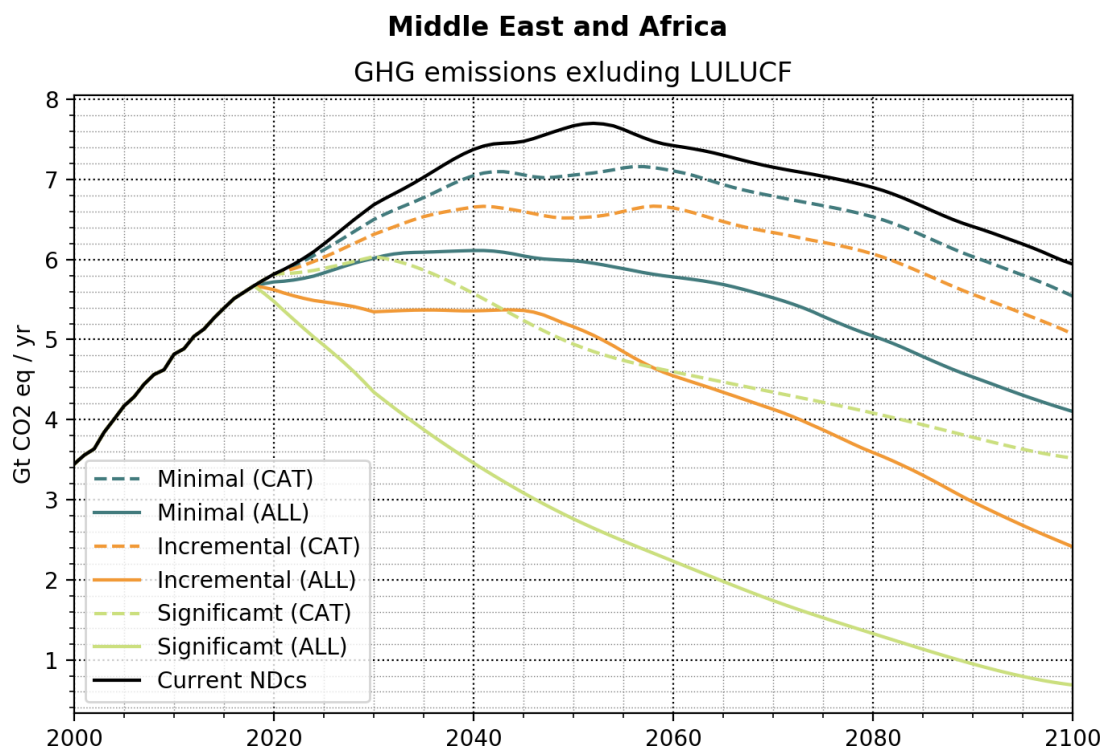


Figure 5: Emission pathways for the various scenarios for the country emission for the AR5MAF region, excluding LULUCF, marine and aviation emissions.

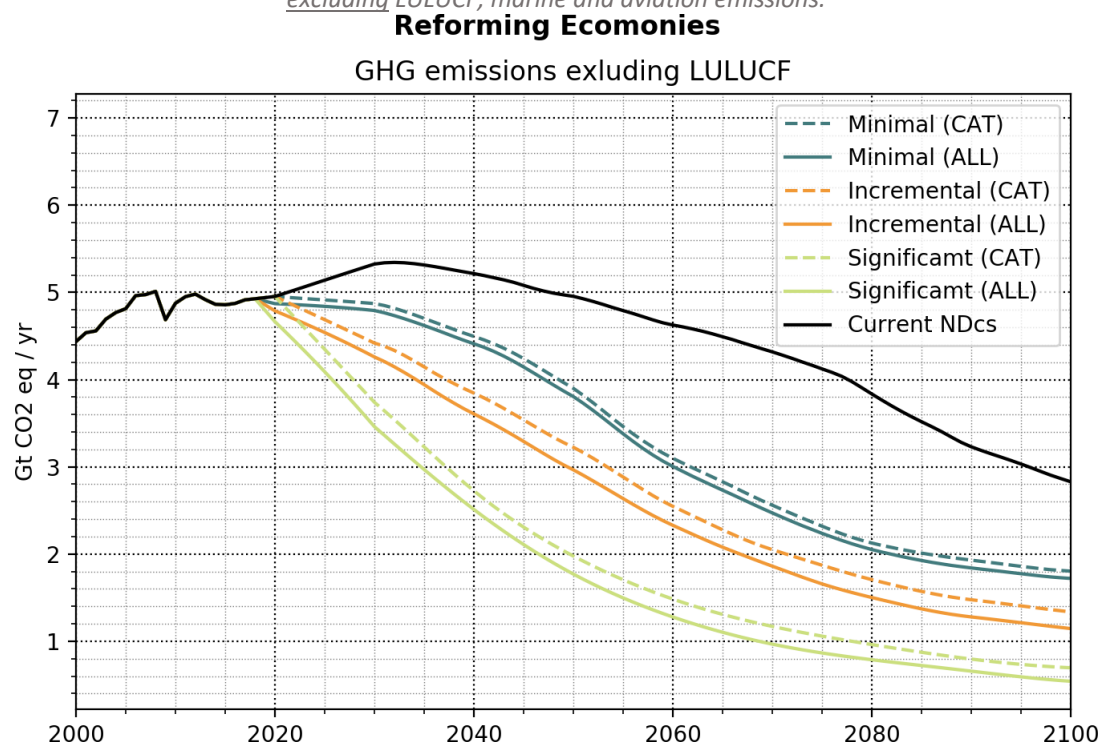


Figure 6: Emission pathways for the various scenarios for the country emission for the AR5REF region, excluding LULUCF, marine and aviation emissions.

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