Credible Contributions:
Bolder Plans for Higher Climate Ambition in the Next Round of NDCs

Version 1 | June 2024

Energy Transitions Commission

Insights Briefing

The Energy Transitions Commission (ETC) is a global coalition of leaders from across the energy landscape committed to achieving net-zero emissions by mid-century, in line with the Paris climate objective of limiting global warming to well below 2°C and ideally to 1.5°C.

Our Commissioners come from a range of organisations – energy producers, energy-intensive industries, technology providers, finance players and environmental NGOs – which operate across developed and developing countries and play different roles in the energy transition. This diversity of viewpoints informs our work: our analyses are developed with a systems perspective through extensive exchanges with experts and practitioners. The ETC is chaired by Lord Adair Turner who works with the ETC team, led by Ita Kettleborough (Director), and Mike Hemsley (Deputy Director).

The ETC's ***Credible Contributions: Bolder Plans for Higher Climate Ambition in the Next Round of NDCs*** briefing was developed in consultation with ETC Members, but it should not be taken as members agreeing with every finding or recommendation. The ETC team would like to thank the ETC members, member experts and the ETC's broader network of external experts for their active participation in the development of this briefing.

The ETC Commissioners not only agree on the importance of reaching net-zero carbon emissions from the energy and industrial systems by mid-century but also share a broad vision of how the transition can be achieved. The fact that this agreement is possible between leaders from companies and organisations with different perspectives on and interests in the energy system should give decision-makers across the world confidence that it is possible simultaneously to grow the global economy and to limit global warming to well below 2°C. Many of the key actions to achieve these goals are clear and can be pursued without delay.

Learn more at:

www.energy-transitions.org
www.linkedin.com/company/energy-transitions-commission
www.twitter.com/ETC_energy
www.youtube.com/@ETC_energy

Front cover and Report design: Burnthebook. Cover photos by Meizhi Lang, Made From The Sky and Anders J on Unsplash.

Contents

Introduction

At the 21st UNFCCC Conference of Parties (COP21) in Paris in 2015, 196 countries adopted the Paris Agreement and its target to limit global warming to well below 2°C, and ideally 1.5°C, compared to pre-industrial averages – a major step forward in climate diplomacy. The Paris Agreement overcame the limitations of the "Convention and Protocol" model, introduced at the Kyoto Protocol in 1997, which set binding commitments for developed countries, and established a new "Pledge, Review and Ratchet" approach.

Under this new approach, countries agreed to communicate and undertake **"nationally-determined contributions" (NDCs)** in line with the goals of the Paris Agreement, accounting for national circumstances, capabilities and priorities. Countries are also required to submit new and updated NDCs every five years, including a ratchet up in their contribution's ambition to reflect progress achieved. Collectively, these NDCs are intended to provide a clear direction for action, and inform on the global progress to meeting the long-term goals of the Paris Agreement.

But, nearly 10 years after COP21, and 30 years after the 1st COP, global greenhouse gas (GHG) emissions are at an all-time high (58.9 $GtCO_2e$), and continue to increase.[1] All countries must submit their new NDCs (commonly referred to as "NDCs 3.0") by COP30 in Brazil in 2025, setting new, more ambitious emissions reduction targets for 2035, informed by the outcomes of the Global Stocktake (GST) agreed at COP28. Estimates suggest that the delivery of the targets set by current NDCs ("NDCs 2.0") could result in over 2.5°C of global warming by 2100; if, in addition, long-term emissions targets[2] were delivered (e.g., commitments to reach net-zero by 2050 or 2060), warming in 2100 might be limited to +2.1°C compared to pre-industrial levels.[3]

In the run up to and after previous COPs, the ETC has assessed the additional emissions mitigation opportunity arising from climate pledges and has evaluated the potential impact of pledges and plans announced at those meetings.[4] But crucially, neither existing NDCs nor COP announcements will result in the necessary emissions reductions estimated above unless they are translated into national commitments with clear implementation plans, and those plans are put into action.

As individual countries update their NDCs in the lead up to COP30, this report therefore sets out recommendations on how "NDCs 3.0" can, and should, evolve to catalyse the much needed climate action to keep 1.5°C within reach. Its key conclusions are:

- **Ambition can triple** based on current technology progress and national, sectoral and COP28 commitments. Targets in current NDCs ("NDCs 2.0") are only expected to deliver approximately 6 $GtCO_2e$ of mitigation per year by 2035 relative to those that current policies are expected to deliver. If governments were to reflect the rapid technological progress already being made, existing national policies, existing commitments from industry and the ambitious commitments governments made at recent COPs in their "NDCs 3.0", overall ambition levels could be almost three times higher – delivering 18 $GtCO_2e$ of mitigation per year in 2035, assuming commitments are delivered. This level of ambition would be roughly compatible with a +2°C trajectory, but further action on halting deforestation, early thermal coal phase-out, and faster progress in hard-to-abate industry and transport sectors is required to align to 1.5°C.

- **More ambitious NDCs are critical, as ambition encourages action.** Success in the low-carbon transition to date has been driven by industry's response to ambitious government targets. Higher ambition in NDCs, and stronger links between targets and supporting policies at the national level, provides a clear direction of travel to industry and reduces market uncertainty – driving a positive ambition loop between government targets and industry action which can further accelerate the deployment of clean energy technologies. Industry is already delivering a rapid transition and is ready to go further.

---

1 UNEP (2023), *Emissions Gap Report 2023*.

2 Known as LTSs or LT-LEDS. As per Article 4, paragraph 19, of the Paris Agreement, countries are invited to submit a strategy for long-term low-emissions development (LT-LEDS). These strategies are different from the shorter-term NDCs (which operate on ten-year horizons) and establish a guiding long-term vision on which NDCs and policy are based. To date, 37% of Parties to the Paris Agreement, representing 73% of global GHG emissions, have submitted an LT-LEDS. See ClimateWatch (2024), *Explore Long-Term Strategies (LTS)*.

3 Climate Action Tracker (2023), *December 2023: Warming Projections Global Update*

4 ETC (2021), *Keeping 1.5°C Alive*; ETC (2022), *Degree of Urgency*; ETC (2023), *COP28: A High-Level Assessment of Mitigation Proposals*.

- **But ambition alone will not ensure adequately rapid progress.** NDCs should therefore also clearly set out the policies and investments needed to deliver the targeted emissions reductions; and where countries set conditional targets, their NDCs should clearly describe the assistance required to deliver them. Clear implementation plans will increase confidence that targets will be delivered, stimulating business investment and further technological progress in a self-reinforcing circle.

We set out our assessment of how the format, ambition, and implementation of NDCs can be improved in five sections:

1. NDCs as the foundation of global efforts to combat climate change.
2. Shortcomings of existing "NDCs 2.0" in addressing the climate crisis.
3. The opportunity and need for "NDCs 3.0" to reflect and reinforce progress.
4. A blueprint for what "NDCs 3.0" would ideally include.
5. What is required to make "NDCs 3.0" successful.

Recognising the remit of ETC's expertise, this report focuses on energy-related components of NDCs, and briefly discusses actions in tangential sectors such as the agriculture, forestry and land use (AFOLU) sector. The ETC would welcome complementary analysis from peers on sectors not fully covered in this report.

NDCs as the foundation of global efforts to combat climate change

1

1.1 What are NDCs?

The Paris Agreement saw a major shift in approach to **climate change mitigation diplomacy,** from the top-down "Convention and Protocol" approach established in the Kyoto Protocol, which set binding obligations for developed countries[5] to reduce GHG emissions, to a bottom-up "Commit, Review and Ratchet" approach agreed at COP21 where almost all countries[6] submit NDCs to the over-arching objective of limiting global warming to well below 2°C.

NDCs have been the cornerstone of the success of the Paris Agreement. In their NDCs, countries commit to 10-year economy-wide emissions reductions targets ("Pledge"), which must be updated every 5 years ("Review"), and whose ambition must be greater than its previous iteration ("Ratchet").[7] While NDCs are mandatory under the Paris Agreement, they can and do vary greatly in overall ambition and detail since they are nationally-determined to reflect national circumstances, capabilities and priorities. However, the targets themselves are not legally-binding, and are flexible in terms of their coverage and format.

The official guidance for NDC setting, known as the Katowice Climate Package, was adopted in 2018 at COP24 [Exhibit 1.1]. Though it preserves the flexibility endowed to countries, it provides a unified framework for setting NDCs,[8] and includes provisions for capacity building and support to assist developing economies in

Katowice Guidance for NDC setting

Exhibit 1.1

	ICTU guidance section	Content (non-exhaustive)
1	Information on the reference point and target	• Reference year • Target type (e.g., absolute emissions, relative to business-as-usual or GDP, peaking dates) • Target year
2	Time frames and periods for implementation	• Period for implementation • Single- or multi-year target
3	Scope and coverage	• Sector and GHG coverage • Conditionality of target
4	Planning processes	• Domestic / international planning processes that form basis of NDC • National circumstances that shape NDC
5	Assumptions and methodological approaches	• Assumptions and methodologies used for accounting of anthropogenic GHG emissions, removals, and policy implementation
6	Considerations around fairness and ambition of target	• Explanation on how the NDC is fair and ambitious considering national circumstances
7	Contribution of NDCs to achieve Paris Agreement objectives	• Explanation on how the NDC contributes to the achievement of the Paris Agreement

Note: ICTU = Information necessary to facilitate Clarity, Transparency and Understanding of NDCs.
Source: UNFCCC (2020), *Virtual workshop on Katowice guidance on ICTU.*

[5] Then defined as "Annex I countries".

[6] 195 out of 198 countries that are part of the United Nations Framework Convention on Climate Change (UNFCCC) have signed the Paris Agreement and thus agreed to submit an NDC. See UNFCCC (2024), *Paris Agreement – Status of Ratification*.

[7] Note that some NDC targets do not cover all sectors of their respective economies, and thus not all targets in current NDCs can be coined "economy-wide".

[8] The Katowice Climate Package, commonly known as "the Paris Rulebook", provides guidance on how countries should prepare their NDCs, including: 1) what information should be included so that other countries and stakeholders can understand how each country plans to account for its greenhouse gas emissions, 2) a process for how this information will be considered and discussed, and 3) what information participating countries should share concerning adaptation priorities, plans and actions. See WRI (2024), *Navigating the Paris Rulebook*.

implementing and enhancing their NDCs. The Katowice guidance has been used by many but not all countries; this guidance will become mandatory in the third round of NDCs, due ahead of COP30 in Brazil.

Current NDCs ("NDCs 2.0") were mainly submitted in 2020–2021,[9] outlining commitments to emissions reductions by 2030. Targets in NDCs are separate from long-term net-zero targets (LTSs or LT-LEDS), usually set for 2050 (e.g., US, EU, UK), but sometimes beyond that point (e.g., 2060 for China, 2070 for India). The third round of NDCs ("NDCs 3.0") is due ahead of COP30 in Brazil in 2025. Exhibit 1.2 provides an overview of key dates for NDCs since COP21 in Paris in 2015.

1.2 The urgency of the next ratchet

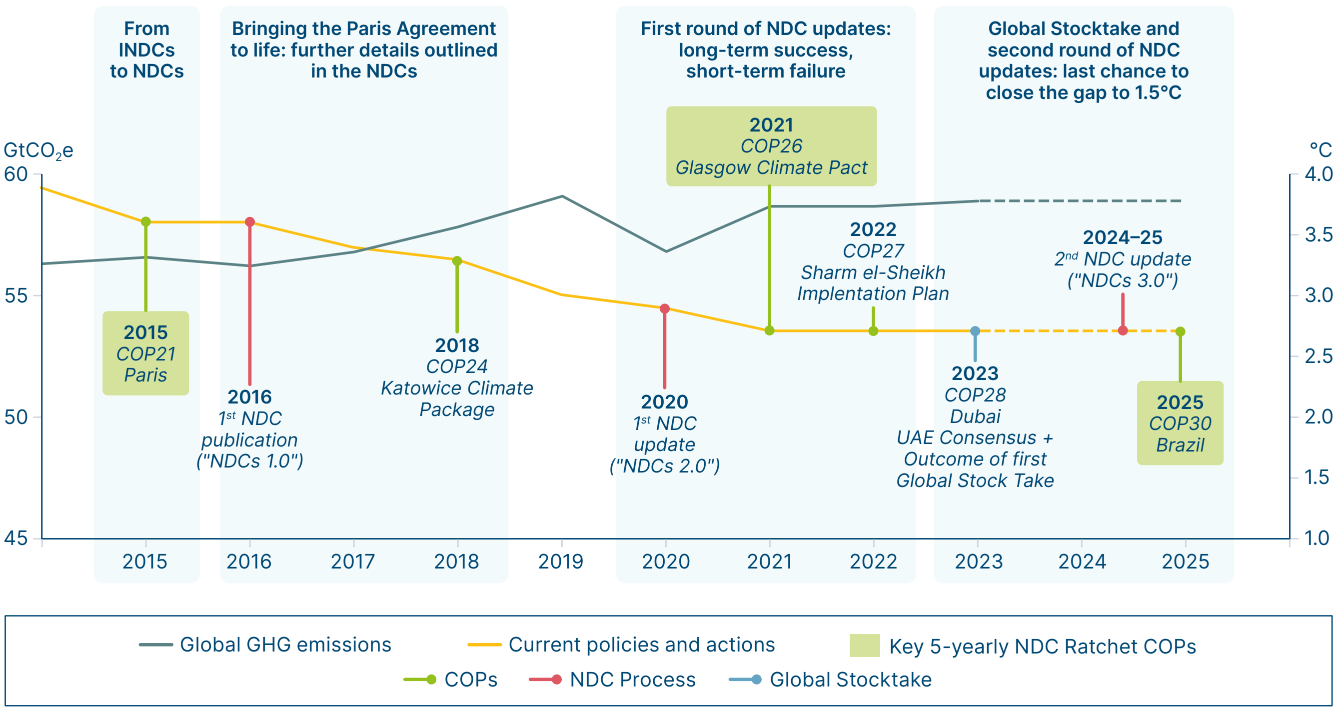
Despite the significant momentum in long-term net-zero commitments witnessed between 2019–2021,[10] and the involvement of the majority of countries to submit updated NDCs,[11] "NDCs 2.0" submitted during 2020–2021 fell short of expectations, collectively delivering only about 4 $GtCO_2e$ of additional mitigation by 2030 and leaving a 19–23 $GtCO_2e$ gap to 1.5°C.[12]

And despite successive calls at COP26 and COP27 to raise the ambition of "NDCs 2.0", Exhibit 1.3 shows that targets of "NDCs 2.0" submitted in 2020 would only limit global temperature increase to 2.3–2.7°C by 2100 relative to pre-industrial level – at present, it is estimated that **global average temperatures have already risen by 1.3°C.**[13]

Evolution of NDCs throughout COPs

Exhibit 1.2

Evolution of global GHG emissions (left) and 2100 global temperature increase (right)
In $GtCO_2e$ (left) and °C relative to pre-industrial averages (right)



Note: INDCs = Intended Nationally Determined Contributions; emissions and temperature outcomes post-2023 are assumed constant for illustrative purposes.

Source: Systemiq analysis for the ETC; Climate Action Tracker (2023), *Warming Projections Global Update December 2023.*

9 NDCs submitted in 2020–2021 were not second NDCs per se. Rather, they were updates to countries' first NDCs. NDCs submitted in 2025 will hence officially be countries' second NDCs. However, to clearly distinguish NDCs submitted in 2020–2021 from those due in 2025, and in line with UNFCCC which refers to 2025 NDCs as "NDCs 3.0", we refer to 2020–2021 NDCs as "NDCs 2.0" and 2025 NDCs as "NDCs 3.0".

10 From five countries in 2018 to 119 countries in 2021, including notable additions of China and India, bringing estimated warming by 2100 from 2.6°C down to 1.8°C. See Exhibit 5 of ETC (2021), *Degrees of Urgency* and Exhibit 1.3 of this report.

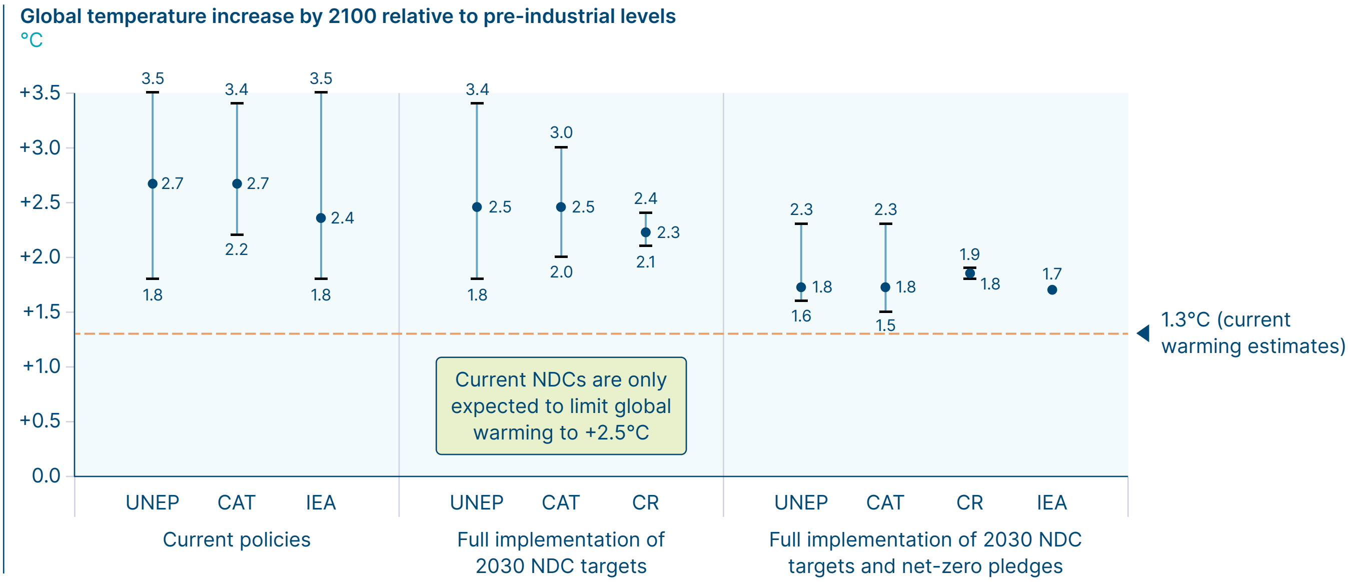
11 180 out of 196 countries at the time submitted updated NDCs.

12 19–23 $GtCO_2e$ gap was relative to a 2021 point of view. See Climate Action Tracker (2021), *Glasgow's 2030 Credibility Gap.*

13 Climate Action Tracker (2023), *December 2023: Warming Projections Global Update*

Range of projections for global temperature increase

Exhibit 1.3



Note: Ranges reflect uncertainty associated with carbon cycles and climate modelling. UNEP = United Nations Environment Programme, CAT = Climate Action Tracker, CR = Climate Resources, IEA = International Energy Agency.

Source: UNEP (2023), *Emissions Gap Report: Broken Record;* Climate Action Tracker (2023), *Warming Projections Global Update;* Climate Resource (2023), *COP28: Entering a 1.5°C world, It's Time for a Fossil Fuel Exit;* IEA (2023), *World Energy Outlook*.

"NDCs 3.0" are now due before November 2025 and will be delivered for COP30 in Brazil, with submissions expected well ahead by February 2025.[14] But we are running out of time. The IPCC stated in 2020 that to have a 50% chance at limiting global warming to 1.5°C by the end of the century, the world would need to cut CO_2 emissions to net-zero by around mid-century, and limit cumulative emissions between 2020–2050 to 500 $GtCO_2$.[15] Four years of continued emissions above 40 $GtCO_2$ per annum suggest that the remaining global carbon budget for 1.5°C as of 2024 is of just around 340 $GtCO_2$, and latest developments in climate science suggest it may be smaller still, as low as 210 $GtCO_2$.[16] At the current rate of emissions, the global carbon budget for a +1.5°C temperature increase limit will be depleted in just five to nine years.[17]

"NDCs 3.0" are therefore an important milestone in keeping the ambition of 1.5°C alive, and align short-term emissions reduction targets with recent COP pledges and the long-term goals of the Paris Agreement. Beyond ambition, these new NDCs will need to catalyse action and implementation across all countries to bend the curve on emissions.

[14] Under Article 4.9 of the Paris Agreement, supported by Decision 1/CP21 (2013), Parties to the Paris Agreement are mandated to submit their NDC to the UNFCCC 9 to 12 months prior to the relevant COP.

[15] IPCC (2021), *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the 6th Assessment Report of the Intergovernmental Panel on Climate Change.*

[16] Estimate taken from Forster & al. (2023), *Indicators of global climate change 2022: annual update of large-scale indicators of the state the climate system and human influence.*
Source mentions the global carbon budget for a +1.5°C temperature increase stood at 250 $GtCO_2$ as of 2022. Given emissions of approximately 40 $GtCO_2$ in 2023, this leaves a 1.5°C-aligned carbon budget of 210 $GtCO_2$ as of the beginning of 2024.

[17] Taking global CO_2 emissions of 40.9 $GtCO_2$ for 2023 from Global Carbon Project.

Shortcomings of current NDCs in addressing the climate urgency

2

Following the review of existing sources and discussions with national and international policymakers, it is generally considered that current "NDCs 2.0" possess, in general, three shortcomings that undermine their effectiveness at catalysing climate action:

1. **Ambition:** emissions trajectories resulting from stated targets in NDCs, and the temperature outcomes they imply, are not consistent with the long-term objectives of the Paris Agreement.
2. **Implementation:** NDCs generally lack information on how stated targets will be met (e.g., on policies, intended investments, and financing needs), and often fail to reflect existing national strategies and policies.
3. **Consistency, coverage, and granularity:** existing "NDCs 2.0" lack consistency in the types of targets they contain, the GHGs and sectors covered by targets, and the level of detail across both targets and measures to reach those targets.

These shortcomings are visible at both global and country levels. This section therefore sets out how these shortcomings can be observed on aggregate, and how they are reflected in individual NDCs of selected countries.

2.1 Global view of the shortcomings of NDCs

In 2023, the United Nations Environment Programme (UNEP) highlighted the gap between the path that current "NDCs 2.0" would lead to, and what is required for a Paris-aligned pathway.[18] Specifically, this gap can be broken down into [Exhibit 2.1]:

- An **implementation gap** of around 6 $GtCO_2e$ in 2035 between current policies and targets of "NDCs 2.0". Implementation gap refers to the difference in projected emissions resulting from current climate policies and emissions reductions that would result from the full implementation of NDCs targets.[19] Thus, at present, governments need to tighten climate policies, both within and outside NDCs, in order to deliver even the limited ambition that current "NDCs 2.0" contain.
- An **ambition gap** of 11–19 $GtCO_2e$ in 2035 versus a 2°C-compatible pathway, increasing to 23–30 $GtCO_2e$ for a 1.5°C-compatible pathway.[20] Ambition gap refers to the difference in projected emissions from the implementation of targets relative to a reference trajectory – here that of 1.5/2°C pathways. It is therefore clear that even under the assumption that all NDC targets are implemented by 2035, including those that are conditional, there is still a significant gap to what is required to meet the goals of the Paris Agreement.

Put simply, the aggregate level of global ambition implied by current "NDCs 2.0" falls well short of what is required to achieve the goals of the Paris Agreement. Additionally, many "NDCs 2.0" fail to provide detail on the policies that will be put in place to achieve the level of ambition they describe.

The Katowice guidance on NDCs has not fully resolved the shortcomings regarding **consistency, coverage** and **granularity** of NDCs, commonly observed since the first generation of NDCs.[21] The current guidance is voluntarily flexible to give countries leeway to drive climate action in line with their national circumstances, and countries have large degrees of freedom regarding how they interpret that guidance. But this flexibility comes with serious drawbacks, in particular, in limiting the ability to aggregate the ambition of NDCs and to track progress towards emissions reductions, which were highlighted in the Global Stocktake ahead of COP28.[22] It also makes it very difficult for the private sector to infer demand for particular technologies at a global or regional level.

---

[18] UNEP (2023), *Emissions Gap Report*.

[19] Climate Action Tracker (2023), *Global Emissions Time Series*.

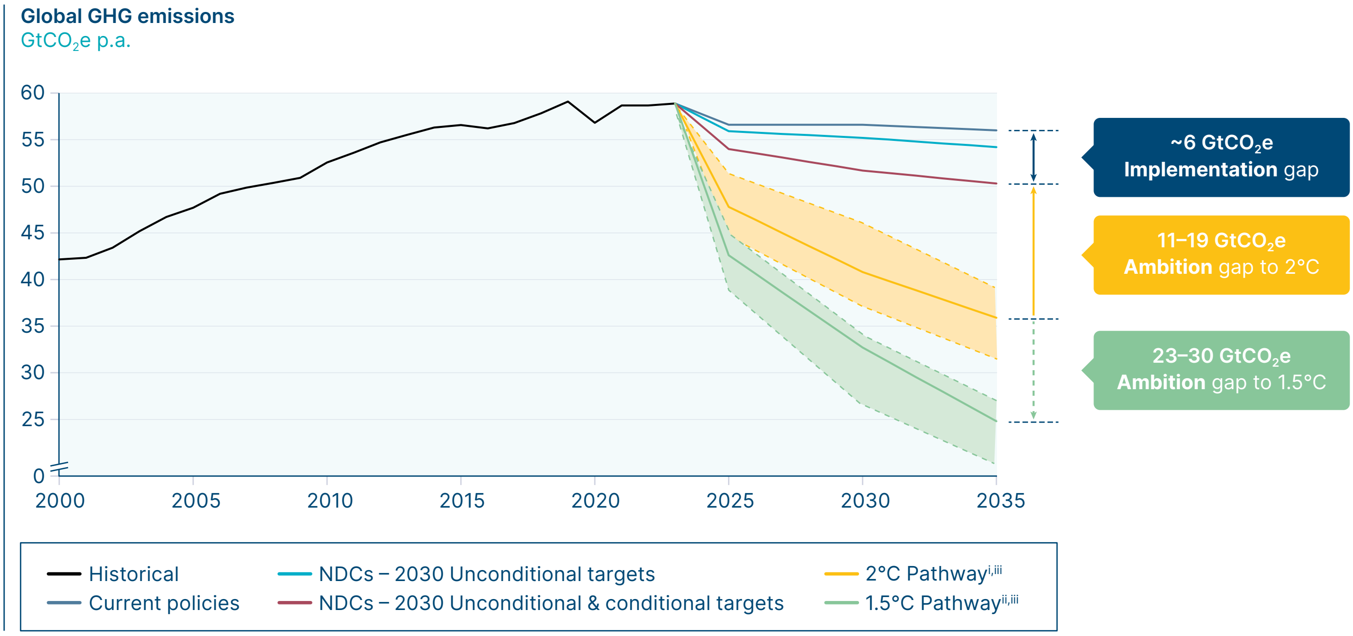
[20] For a 50% chance at limiting global warming to 1.5°C with no or limited overshoot, UNEP estimates that annual global GHG emissions need to be in the range of 20–27 $GtCO_2e$ by 2035 (10^{th}–90^{th} percentile range). For a 67% chance of limiting global warming to 2°C, that estimate is 32–39 $GtCO_2e$ by 2035. See UNEP (2023), *Emissions Gap Report*.

[21] ETC (2016), *Pathways from Paris: Assessing the INDC opportunity*.

[22] UNFCCC (2023), *Technical Dialogue of the First Global Stocktake*.

Global GHG emissions projections for selected scenarios

Exhibit 2.1



Note: [i] Based on IPCC Working Group III Sixth Assessment Report scenario class c1 (limit warming to 1.5°C (>50%) with no or limited overshoot). [ii] Based on IPCC Working Group III Sixth Assessment Report scenario class c3 (limit warming to 2°C (>67%)). [iii] Range corresponds to range between tenth and nineteenth percentile, central line corresponds to median. [iv] Not all countries have adopted 1.5°C as their official target.

Source: Systemiq analysis for the ETC; IPCC (2022), *Metadata Browser: Data for Figure SPM.5 - Summary for Policymakers of the WGIII Contribution to the IPCC AR6;* UNEP (2023), *Emissions Gap Report: Broken Record.*

Specifically, the current Katowice guidance for NDC-setting does not resolve a lack of:

- **Consistency**: the guidance does not require countries to set specific target types, despite the Paris Agreement explicitly calling for countries to set absolute emissions reduction targets in their NDCs.[23] Exhibit 2.2 shows that a majority of countries have set targets either relative to business-as-usual ("BAU") scenarios or Gross Domestic Product (GDP), or targets that do not explicitly specify emissions reductions (e.g., % by a certain date). These types of targets make unclear the level of ambition of countries and strongly depend on assumptions that underpin "baseline scenarios" (e.g., GDP and population growth, growth in energy demand and how that demand is met, etc.). Additionally, this lack of consistency across target types makes it hard to aggregate implied emissions reductions, and to have a clear view of the direction of travel for global emissions.[24]

- **Coverage**: the guidance still allows for incomplete coverage of targets across sectors and GHGs [Exhibit 2.2] – while all NDC targets include CO_2, not all include methane and other GHGs. While such flexibility is useful for countries to prioritise those sectors and GHGs that are most relevant to their national context, it means that significant shares of current GHG emissions are not being covered by NDCs.[25]

- **Granularity**: current targets, for the most part, are set at an economy-wide level and not broken down at a sectoral level, which undermines their transparency and readability.

This flexible guidance and its variable interpretations by countries result in broad discrepancies from one NDC to another, which limits cross-country comparability and the assessment of collective progress towards the goals of the Paris Agreement.

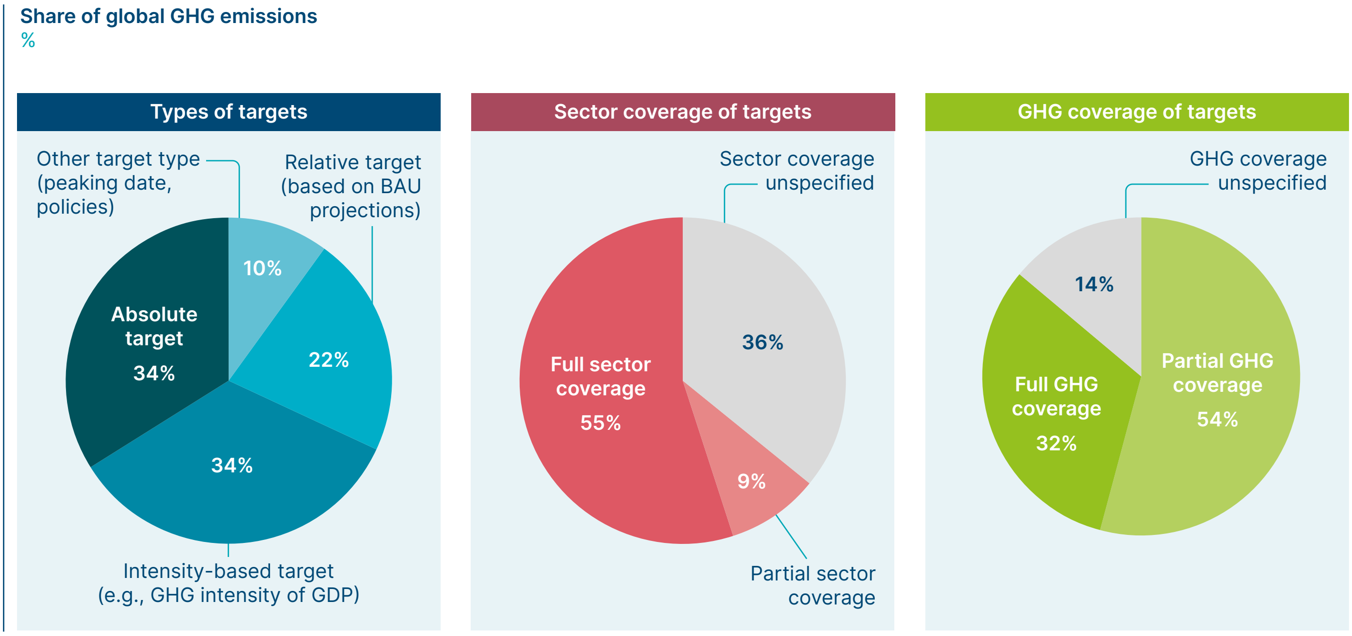
[23] As per Article 4, paragraph 4 of the Paris Agreement text, developed countries should set economy-wide, absolute emissions reduction targets while developing economies are encouraged to move towards such targets over time. See UN (2015), *Paris Agreement text.*

[24] It is estimated that global emissions in 2030 would be 51.9–54.8 $GtCO_2e$ based on the implementation of all unconditional NDC targets – this is the equivalent of a 5% uncertainty range. This range is greater still when accounting for the uncertainty of implementation of conditional NDC targets. See UNFCCC (2023), *NDC Synthesis Report 2023.*

[25] For example, emissions from international aviation and shipping are not accounted for in NDCs – see Section 4 of this report.

Types of targets of "NDCs 2.0" and coverage

Exhibit 2.2



Note: IPCC guidance breaks down economy-wide emissions in five emission sectors: energy, IPPU (Industrial Processes and Product Use), agriculture, LULUCF (Land-use, Land-use Change and Forestry), and waste. GHG in IPCC guidance include: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3).

Source: ClimateWatch (2024), *Online Explorer: Nationally Determined Contributions (NDCs);* UNFCCC (2023), *NDC Synthesis Report.*

All of the above therefore suggests **three priorities for "NDCs 3.0" due before COP30:**

1. To increase the overall ambition of emissions reduction targets, in line with the goals of the Paris Agreement and the UAE consensus.[26]
2. To make clear how stated targets will be implemented, including the contribution of existing policies, how their scope and scale will be tightened over time, and what financing needs they imply.
3. To improve the coverage and clarity of targets in NDCs, to make them more consistent, detailed, and ensure they cover all sectors and GHG emissions.

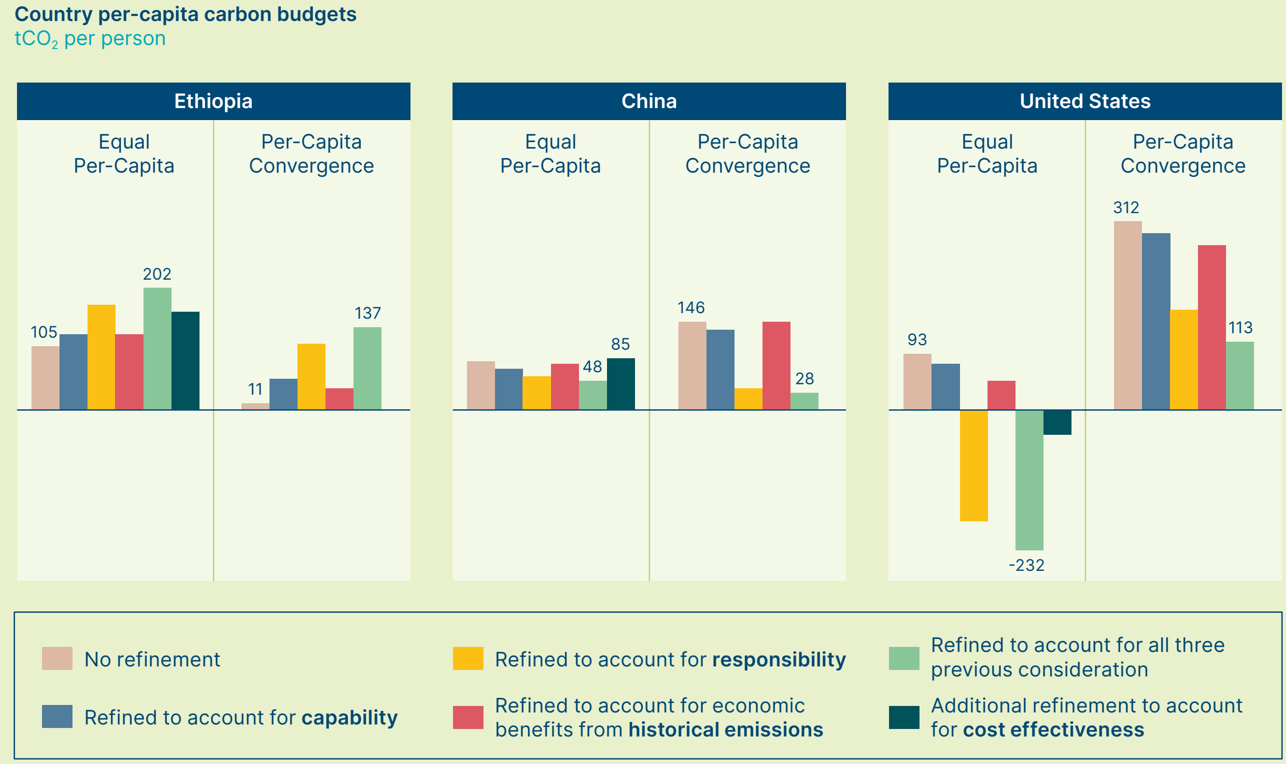
2.2 Shortcomings of NDCs by country groups

The previous section clarifies the shortcomings of current "NDCs 2.0" at the global level. While issues around the configuration of information contained in NDCs can be generalised, the materiality and nature of ambition and implementation issues vary by country. We have assessed country NDCs against these two issues and have broadly defined three archetypes to categorise countries' NDCs.

[26] The UAE consensus, also referred to as "Outcome of the first global stocktake", refers to the final text agreed by countries as result of negotiations at COP28 in Dubai in 2023.

Per-capita carbon budget for 1.5–2°C warming for selected countries and allocation methods

Exhibit 2.3



Note: Labels in legend are slightly adapted from the sources to reflect "fair share" dimensions described in Box 1. Equal per-capita and per-capita convergence concepts are explained in Box 1. Equal per-capita values vary across countries as they are derived from independent national studies. In a single global study, all equal per-capita values for a given refinement would be identical across countries.

Source: K. Wiliges et al. (2022), *Fairness critically conditions the carbon budget allocation across countries.*

It is important to note that assessing the ambition of an individual NDC is challenging, and inherently relies on a point of view on how the remaining carbon budget should be allocated across countries – Box A makes these challenges clear. To assess implementation, we look for more detailed targets, or further information (e.g., policies) on around how countries plan to deliver the overall target contained in their NDC, alongside any national decarbonisation strategies which countries would have already established.

Archetype 1 – Clearly defined ambition, unclear implementation (approximately 30% of global GHGs)[27]
Archetype 1 countries are typically upper-middle or high-income countries, including the likes of the EU, the US, or Norway. Their NDCs usually contain unconditional,[28] absolute emissions reduction targets that cover all sectors and GHGs, consistent with IPCC guidelines for national GHG inventories.[29] They tend to display higher mitigation ambition relative to other archetypes from a least-cost perspective (usually in the 2–3°C range, see Box A and Exhibit 2.4), but have lower ambition from a fair share perspective, reflecting higher historical emissions and financial capability. Despite the fact that many of these countries have detailed national decarbonisation strategies, their NDCs often fail to provide details on how targets will be achieved.

An **example of Archetype 1** is the EU, which has set an unconditional, absolute target that includes a 55% reduction in annual emissions by 2030 compared to its 1990 baseline.[30] Climate Action Tracker (CAT) assesses this target as resulting in a slightly above

[27] Based on 2022 data from ClimateWatch's PIK dataset. Excludes emissions from the land-use, land-use change and forestry (LULUCF) sector. ClimateWatch (2024), *Historical GHG Emissions*.

[28] Unconditional targets in NDCs are those that countries plans to achieve, while conditional targets are more ambitious but contingent on external support received, often in the form of financial assistance, technology transfer, or capacity building.

[29] The IPCC guidelines for national GHG inventories provide details regarding how countries should account for national emissions, in particular the breakdown and coverage of sectors and GHGs, and also contains information about the global warming potentials (GWPs) which countries should use when producing their GHG inventories. See IPCC (2006), *Guidelines for National Greenhouse Gas Inventories.*

[30] European Union (2023), *Update of the NDC of the European Union and its Member States.*

2°C pathway on a least-cost basis, but closer to a 3°C pathway on a fair share basis.[31] Current policies are expected to bridge half of the gap between today's emissions and the NDC target for 2030.[32]

Archetype 2 – Unclearly defined ambition, unclear implementation (66% of global GHGs)[33]

Archetype 2 countries span a wider income range, from lower-income to upper middle-income countries, including the likes of China, India, Argentina, or Saudi Arabia. Their NDCs contain variable types of targets, in some cases, absolute emission targets are defined, but in most, emissions reduction targets are relative to GDP or to BAU pathways; in some cases, "peaking dates" are specified. Where the targets are defined on a relative basis, many of these NDCs fail to provide the information necessary to translate relative targets into absolute emissions reductions by 2030 (e.g., clear definition of assumed GDP growth or BAU pathways).

Their NDCs tend to display lower mitigation ambition relative to Archetype 1 on a least-cost basis, usually in the 3–4°C range.[34] On a fair share basis, however, NDC targets from Archetype 2 countries can show levels of ambition that are sometimes higher than Archetype 1 (e.g., China or India) or sometimes lower (e.g., Argentina or Saudi Arabia). This reflects Archetype 2 countries' lower historical emissions, lower current per-capita emissions (except in the case of China) and in some cases lower financial capability.[35]

Similarly to Archetype 1, Archetype 2 countries also fail to provide sufficient details on how their targets will be achieved, with a distinction between countries that do have mitigation policies in place but fail to reflect them in their NDCs (labelled as "Archetype 2A") and countries that have yet to develop tangible mitigation policies ("Archetype 2B").

An **example of Archetype 2A** is China, which has set an unconditional dual target to peak emissions before 2030 and to reduce the GHG intensity of its GDP by over 65% from a 2005 baseline.[36] Given the International Monetary Fund's (IMF) GDP forecasts for China, this target is expected to result in a roughly two-fold increase in China's emissions, from 6.9 $GtCO_2e$ in 2005 to 12.3 $GtCO_2e$ by 2030.[37] CAT assesses this target as resulting in a 2–3°C pathway on a fair share basis but in a close to 4°C pathway on a least-cost basis.[38] In its current "NDC 2.0", China provides significant detail on actions taken between 2015–2018, but fails to clearly explain how it intends to reach its 2030 target despite having adopted compelling mitigation policies which are leading to significant deployment of low-carbon technologies, for example, in its 14th Five-Year Plan. For this reason, it falls within Archetype 2A.

An **example of Archetype 2B** is Saudi Arabia, which has set an unconditional target to reduce, avoid and remove 278 $MtCO_2e$ by 2030 relative to a BAU scenario, for which baseline emissions are not specified in its NDC. Using an external BAU scenario,[39] CAT assesses this target as resulting in a slightly above 2°C pathway on a least-cost basis, but closer to a 3°C pathway on a fair share basis.[40] Saudi Arabia falls within Archetype 2B because, in addition to not providing sufficient details in its NDC on how its target will be implemented, it has yet to develop compelling policies to substantially bring down emissions and diversify away from fossil fuels.

Archetype 3 – Clear ambition and implementation but requires support for delivery (approximately 4% of global GHGs)[41]

Archetype 3 solely consists of UN-designated least-developed countries (LDCs), such as Bangladesh, Ethiopia or Haiti. They typically have developed their NDCs with the support of technical assistance (TA) facilities (e.g., the NDC Partnership, the United Nations Development Programme (UNDP) Climate Promise), which support countries with developing their NDCs based on national priorities upon their request.

---

31 Systemiq analysis for the ETC; Climate Action Tracker (2023), *EU Country Assessment* and the *European Union National GHG Inventory database*.

32 Current policies are expected to deliver 500 $MtCO_2e$ of reduction by 2030, with a gap between current emissions and NDC target of 1,045 $MtCO_2e$.

33 Based on 2022 data from ClimateWatch's PIK dataset. Excludes emissions from the LULUCF sector. See ClimateWatch (2024), *Historical GHG Emissions*.

34 Climate Action Tracker (2023), *Various Country Assessments*.

35 Amongst Archetype 2 countries, India's current NDC presents higher ambition than that of other countries on a fair share basis, compatible with a <3°C pathway. See Climate Action Tracker (2023), *India's NDC*.

36 Ministry of Ecology and Environment of the People's Republic of China (2021), *China's Achievements, New Goals and New Measures for Nationally Determined Contributions*.

37 Systemiq analysis for the ETC.

38 CAT's assessment of China's NDC target from a "fair share" perspective is high due to methodology and given material historic emissions (13% of cumulative emissions to date), high per-capita emissions (8 vs. 5.4 tCO_2 for Europe) and ability of China to pay for emissions mitigation. See Climate Action Tracker (2023), *China Country Assessment;* Our World in Data (2023), *Per capita, national, historical: how do countries compare on CO_2 metrics ?*

39 Based on a scenario developed by the King Abdullah Petroleum Studies and Research Center (KAPSARC). See CAT (2023), *Saudi Arabia Country Assessment*.

40 Ibid.

41 Based on 2022 data from ClimateWatch's PIK dataset. Excludes emissions from the LULUCF sector. See ClimateWatch (2024), *Historical GHG Emissions*.

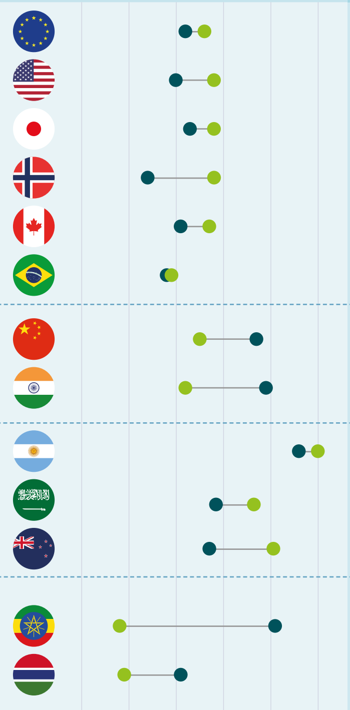
Archetype 3 countries usually set emissions reduction targets relative to a BAU scenario, which are usually broken down into sector-level, and sometimes sub-sector-level targets. Because of limited financial, institutional and technology capacity, their targets are often split into both conditional and unconditional elements. When aggregated, these targets are for the most part well below a 1.5°C-aligned pathway on a fair share basis, though higher on a least-cost basis (2–4°C pathway).[42]

The NDCs of these countries are designed as investable development plans, in which economy-wide targets are supported by a detailed list of measures and associated funding needs to deliver ambition. Despite high ambition and clear plans, there is significant uncertainty around the ability of these countries to implement their plans given limited institutional capacity and governance, and uncertainty over whether the financial support required to deliver "conditional" commitments will be forthcoming.

Ethiopia is one such country – it has set a target to reduce its annual emissions by 70% by 2030 relative to a BAU scenario, with 20% of the target being unconditional and 80% being conditional on external funding.[43] CAT assesses this target as being 1.5°C-aligned on a fair share basis, but as 4°C-aligned on a least-cost basis.[44] This target is supported by a detailed list of measures, for which it is estimated that annual investments of $35 billion are needed.[45]

NDC archetypes as per ETC classification

Exhibit 2.4

	Ambition					Implementation		
	Share of global GHG emissions	Type of target	Conditionality	Sector and GHG coverage	CAT assessment on level of ambition ● least cost vs. ● fair share 0°C 1°C 2°C 3°C 4°C 5°C	Sufficient information to support target implementation	Existing national decarbonisation strategies	Existing climate policies are reflected in NDCs
Archetype 1	30%	Absolute	Unconditional	Complete		No	Yes	No
Archetype 2 A	66%	Relative to BAU or intensity -based	Mostly unconditional	Partial		No	Yes	No
Archetype 2 B		Relative to BAU or intensity -based	Mostly unconditional	Partial		No	No	No
Archetype 3	4%	Relative to BAU	Mostly conditional	Complete		Yes	Yes	Yes

Note: Countries listed are representative of archetypes but are not an exhaustive list, NDCs defined within an archetype possess most of the attributes described, but their exact content may slightly differ. Temperature-based assessments of NDC targets are taken from Climate Action Tracker (CAT). Though CAT rounds its temperature assessments to the nearest whole °C, we have derived temperature assessments to the nearest decimal °C by triangulating between three data points: emissions compatible with the lower whole °C, emissions compatible with the higher whole °C, and emissions associated with the NDC target. From top to bottom, country flags refer to the EU, the US, Japan, Norway, Canada, Brazil, China, India, Argentina, Saudi Arabia, New Zealand, Ethiopia and The Gambia.

Source: Systemiq analysis for the ETC of Climate Action Tracker (2024), *Country NDC Assessment (Various)*; ClimateWatch (2024), *Historical GHG Emissions.*

[42] Climate Action Tracker (2023), *Various Country Assessments.*

[43] Climate Action Tracker (2023), *Ethiopia Country Assessment.*

[44] Ibid.

[45] Ibid.

Box A **Challenges of assessing the ambition of individual NDCs**

To assess whether individual country NDCs are adequately ambitious to be compatible with any specified temperature increase limit (e.g., +1.5°C or +2°C) requires an agreed allocation of the remaining global carbon budget across countries.

But there is no global consensus on the "fair" basis for that allocation. As a result, each country can assume a different allocation basis, and each can claim that its NDC is compatible with a specific global temperature limit, even though the aggregate of all NDCs greatly exceeds that limit.

Several different bases for determining "fair" shares have been proposed and are discussed at length in the relevant literature. These include:

- **Historic cumulative responsibility**: according to this principle, fair shares of future per-capita emissions should result in equal per-capita total cumulative emissions, taking account of past historic emissions as well as those still to occur.
- **Equality of future emissions,** under which future emissions are allocated on the basis of equal per-capita rights, with two possible approaches: [46]
  - Equal-per-capita (EPC) approach, where all remaining emissions are allocated equally across every living person, regardless of current emission levels.
  - Equal-per-capita convergence (PCC) approach, where per capita emissions progressively reach equal levels for all living people, accounting for different starting points in emissions and population. Note that either of the two approaches described can be based either on current and/or future population projections.
- **Capability**: under this principle, the pace of emissions reductions, whether absolute or relative to a rising business-as-usual (BAU) level, should reflect the country's "capability" to afford emissions reductions investment and other actions, which will depend on the country's level of economic development, often measured by GDP per capita or the Human Development Index. This reflects the fact that low-income countries may not be able to afford emissions reductions actions which can easily be afforded in high-income countries.
- **Cost effectiveness**: here, the fair allocation of residual emissions is determined by the relative cost effectiveness of emissions abatement in different countries, often measured by GDP-based welfare loss. This approach focusses on how much it would cost to abate emissions, and thus recognises that technological progress makes it far cheaper to reduce new emissions today than it would have been to reduce past historical emissions.

The relative merits of these principles are debated, and it is possible to argue that "fairness" should reflect a weighted combination of the different approaches.[47] As a result, there is no universally-agreed definition of what constitutes a fair share of remaining emissions. Exhibit 2.3 shows the very different results across countries which would result from the application of different principles.

The ETC has not taken a position on what constitutes the correct/fair approach to carbon budget allocation across countries. But for the purposes of illustration, we refer to two approaches developed by Climate Action Tracker (CAT), an organisation which assesses both the ambition and content of selected NDCs. In their assessments, CAT compare individual country NDC targets with the those which would be compatible with specific global temperature objectives on the basis of either:

- A **"least-cost approach"**, where CAT estimates the transition pathways for different countries which would result in global least cost reduction, given the differing potential for different countries to reduce emissions.
- A **"fair share approach"**, where CAT takes into account a range of academic study results that offer different viewpoints of what could be fair, including considerations on historical responsibility, capability, equality and cost effectiveness.[48] Their estimates here necessarily reflect specific choices about the relative weight to be attached to the different principles.

It is important to note that the results from CAT's modelling only express ***a*** point of view, and cannot be regarded as providing an authoritative resolution to the debates over what fairness implies.

[46] K. Wiliges & al. (2022), *Fairness critically conditions the carbon budget allocation across countries*.

[47] Combinations can include responsibility, capability and need, capability / costs, staged approaches or equal cumulative per capita emissions. See Climate Action Tracker (2023), *Fair share methodology*.

[48] Climate Action Tracker (2023), *Fair share methodology*.

The opportunity and need for "NDCs 3.0" to reflect and reinforce progress

3

Despite continued growth in global GHG emissions, the energy transition has gathered significant momentum over the past decade, and is already making a visible impact on the pace of growth of global emissions.[49]

This rapid pace of progress, coupled with a changing macroeconomic environment, is already **raising challenges** such as high borrowing costs (exacerbating a known barrier to progress in some emerging markets and developing economies),[50] supply chain constraints, and increasing grid connection backlogs and permitting delays that risk slowing the overall pace of progress. But a growing body of evidence shows how they can and are being overcome.[51]

Yet "NDCs 2.0" do not reflect this reality, nor the feasible pace of emissions reductions it entails. And industry is calling for governments to raise ambition, and make clear the link between national policies and targets, to provide greater market certainty in which companies can invest in, and deploy, low-carbon solutions.[52] It is therefore crucial that countries reflect this rapid progress and raise the ambition of targets in their "NDCs 3.0".

This section describes both the opportunity and the need for **more ambitious NDCs** in five sub-sections:

1. Over the past decade, clean energy technologies have progressed at a faster pace than anticipated, and many are reaching tipping points beyond which accelerated progress is inevitable.
2. This potential has, in part, been enabled, and reflected, by increased public policy support, which, in turn, has encouraged companies and sectors to make more ambitious emissions reduction commitments.
3. The potential was further recognised at COP28 by national commitments, in particular relating to renewables deployment and energy efficiency, which, if delivered, will result in significant emissions reduction.
4. Together, this combination of technological progress, public policies, national and industry commitments implies that it would be possible to achieve a reduction of 18 $GtCO_2e$ by 2035 relative to that expected from currently enforced policies. This is three times the level of ambition implied by current "NDC 2.0" targets.
5. "NDCs 3.0" should therefore ideally reflect this potential. Doing so will increase the pressure to design policies which will deliver the targeted emissions reductions and create greater certainty with which companies can invest to seize the potential.

3.1 Rapid technological progress and prospects for faster emissions reductions

Technological progress and associated cost reductions for several low-carbon technologies have progressed at a faster pace than currently reflected in "NDCs 2.0", and will continue to do so.

Many **clean energy technologies have scaled faster** than previously anticipated:

- In 2020, projections estimated that global solar PV and wind installed capacity would respectively reach 1,320 GW and 980 GW by 2025 – these projections were already surpassed in 2023.[53,54] Since 2020, the annual rate of wind and solar capacity additions has more than doubled in the EU, and more than tripled in China.[55]
- Similarly, 2020 estimates suggested that 42 million passenger electric vehicles (EVs)[56] would be on

49 Energy-related CO_2 emissions grew by 900 Mt between 2019 and 2023 – without the growing deployment of solar PV, wind, nuclear, heat pumps and electric vehicles, growth in emissions would have been 3x higher, or 2.7 $GtCO_2$. See IEA (2024), *CO_2 emissions in 2023*.

50 For further discussion of this, see ETC (2023), *Financing the transition*.

51 See ETC (2023), *Streamlining planning and permitting to accelerate wind and solar deployment*; ETC (2023), *Better, Faster, Cleaner: Securing clean energy technology supply chains*; Songwe & Stern (2023), *Finance for climate action: scaling up investment for climate and development*; Blended Finance Taskforce (2023), *Better Guarantees, Better Finance*.

52 See We Mean Business Coalition's business-backed *Fossil to Clean* campaign. Available at: https://www.wemeanbusinesscoalition.org/fossil-to-clean/.

53 IEA (2020), *World Energy Outlook*.

54 BloombergNEF (2024), *Online Explorer: solar and wind short-term forecast*.

55 Ibid.

56 Includes battery-electric and plug-in hybrid vehicles.

the road by 2025.[57] In 2023, 41 million EVs were already in use, with another 40 million of new EV sales projected across 2024 and 2025 globally.[58] In Europe and China, for example, EVs now make up respectively one out of four and one out of three new vehicle sales.[59]

This is the result of both significant **cost declines and rising performance:**

- The global average price of **silicon cells,** the building blocks of solar panels, fell by 92% between 2011–2023, and by 60% between 2020–2023 alone.[60] In parallel, global average silicon module efficiency increased from ~18% to ~24% between 2011–2023.[61]
- The price of **onshore wind turbines,** decreased by one third between H1 2010 and H1 2023, even with a slight increase in price from 2020 levels resulting from supply chain constraints.[62] Increasing rotor size since 2010 has enabled a 2.5x increase in power output capacity per turbine.[63]
- The average **battery pack price for EVs** fell by 87% between 2011 and 2023 while energy density doubled over the same period.[64,65] As a result, the average sticker price of EVs could reach parity with that of internal combustion engine (ICE) vehicles in the next 2–4 years, but the total cost of ownership (TCO) is already lower in key geographies.[66]

Accelerations in deployment and cost reductions of key low-carbon technologies can largely be attributed to industry responding to strong government ambition in key markets (backed by policies). Past performance is not indicative of future results, but there are clear signs that the progress witnessed over the last decade will continue, and even accelerate. In particular [Exhibit 3.1]:

- Annual **solar PV installations** are forecasted to more than double by 2035, from 445 GW in 2023 to 980 GW, bringing cumulative installed capacity to 11,160 GW, in line with requirements for 1.5°C.[67]
- **Annual wind installations** are expected to increase four-fold by 2035, from 120 GW in 2023 to 475 GW, bringing cumulative installed capacity to 3,080 GW.[68]
- Annual sales of EVs are estimated to more than quadruple by 2035, from 14 million today to 60 million.[69]

Where **barriers** are evident, or arising, these are largely a function of the transition itself, and the rapid pace of change it incurs:

- Low-carbon technologies are typically much more capital intensive than their fossil equivalents. Increased global borrowing costs – particularly prohibitive in some emerging and developing economies (EMDEs) – risk slowing down the pace of the transition.
- Rapid technological deployment, in particular for renewables, has led to grid backlogs and permitting delays in many countries.
- Rapid build-up in clean technology manufacturing capacity and its geographic concentration in Southeast Asia, especially in China, have led some countries to express economic security and/or unfair trade concerns. Some of these countries have acted on these concerns and implemented trade barriers, which risk increasing the cost, and slowing down the pace of, the transition to clean energy.

However, in all of these cases, actions are or can be taken to overcome these issues.[70]

Beyond solar PV, wind and EVs, the technologies needed to decarbonise all sectors of the economy, including harder-to-abate sectors, have become increasingly mature [Exhibit 3.2]. In buildings, light industry, aviation and trucking, these solutions are already commercially available:

---

[57] IEA (2017), *Global EV Outlook*.

[58] BloombergNEF (2023), *Long-term Electric Vehicle Outlook*.

[59] Ibid.

[60] BloombergNEF (2024), *Interactive data tool – Solar spot price index*.

[61] BloombergNEF (2023), *Solar cell and module efficiency improves steadily*.

[62] On a per MW-basis, including installation costs, costs have increased by 9% in H1 2023 compared to H1 2020. See BloombergNEF (2023), *Global Wind Market Outlook 2H 2023*.

[63] Maximum wind turbine rotor diameter increased from 170 to 220m between 2010–2022. See DNV (2020), *Offshore wind power expands globally*.

[64] BloombergNEF (2023), *Lithium-Ion Battery Price Survey*.

[65] BloombergNEF (2023), *Long-term Electric Vehicle Outlook*.

[66] Total cost of ownership (TCO) is the comprehensive financial estimate of all direct and indirect costs associated with owning an asset, including elements such as initial purchase, maintenance, and operating costs. See BloombergNEF (2023), *Long-term Electric Vehicle Outlook*.

[67] BloombergNEF (2024), *Online Explorer: solar short-term forecast (Mid scenario)*.

[68] BloombergNEF (2024), *Online Explorer: wind short-term forecast (Mid scenario)*.

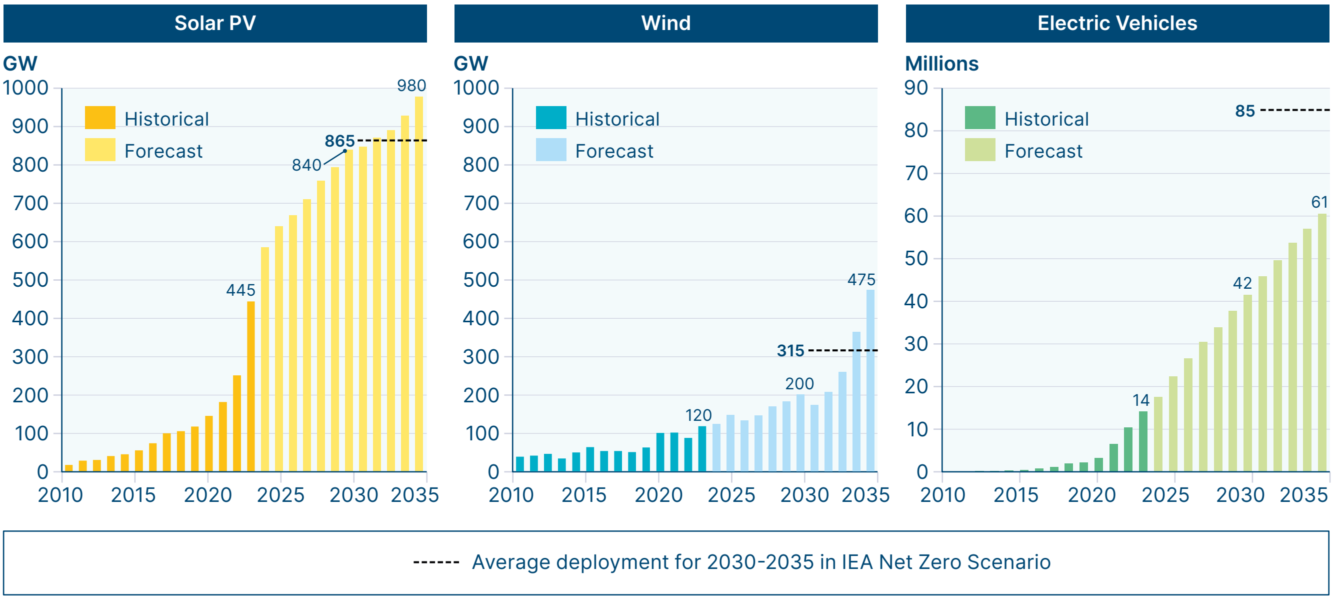
[69] BloombergNEF (2024), *Long-term Electric Vehicle Outlook*.

[70] See ETC (2023) *Streamlining planning and permitting to accelerate wind and solar deployment*; ETC (2023), *Better, Faster, Cleaner: Securing clean energy technology supply chains*; Songwe & Stern (2023) *Finance for climate action: scaling up investment for climate and development*; Blended Finance Taskforce (2023) *Better Guarantees, Better Finance*.

Projected deployment of solar PV, wind and EVs globally by 2035

Exhibit 3.1

Annual deployment of clean energy technologies
Solar and wind: global annual capacity installations; electric vehicles: global annual sales



Note: Data for electric vehicles includes both battery electric and plug-in hybrid passenger vehicles. Values are rounded.

Source: BNEF (2024), *2Q Global PV Market Outlook*. BNEF (2024), *1H Global Wind Market Outlook*. BNEF (2023), *Long-Term Electric Vehicle Outlook*. IEA (2023), *World Energy Outlook*. IEA (2024), *Global EV Outlook*.

- **Global residential heat pump sales** have increased by almost 30% since 2020, and 11% between 2021 and 2022 alone amidst record high natural gas prices.[71] In Europe, 16% of the stock of buildings is equipped with a heat pump, from 11% just 4 years ago.[72] In the United States, there are now more heat pumps than gas boilers sold each year.[73]
- **Industrial heat pumps** are now viable solutions to provide low- and ultra-low temperature (0–200°C) process heat in many industrial sectors, which accounts for around 45% of global industrial heat today.[74]
- **Sustainable aviation fuel (SAF)** offtake agreements between fuel suppliers and airlines experienced a significant increase in contracted volume, from nine to 22 billion litres between 2021–2022.[75] However today, SAF accounts for less than 0.5% of total fuel used in global aviation.[76]
- One out of ten trucks sold in China in the last quarter of 2023 was electric, up from just 4% a year ago, putting the electrification of trucking just a few years behind that of passenger cars in the world's largest automotive market.[77] Sales of electric trucks in Europe and the US also continue to grow, albeit at a slower pace.[78]

For other harder-to-abate sectors of the economy, such as steel, aluminium, ammonia, cement and shipping, most decarbonisation technologies have moved from pilot to demonstration stage and are expected to become commercially mature over the next decade:

- Progress in **low-carbon alumina** refining is notable in Australia and Brazil, where electric boilers have been commercially installed and electrically-powered mechanical vapour recompression has been successfully demonstrated.

[71] IEA (2023), *Global heat pump sales continue double-digit growth.*

[72] European Heat Pump Association (2023), *European Heat Pump Market and Statistics Report 2023.*

[73] IEA (2023), *Global heat pump sales continue double-digit growth.*

[74] WBCSD (2022), *Industrial heat pumps: it's time to go electric.*

[75] IEA (2023), *Tracking Clean Energy Progress: Aviation.*

[76] BloombergNEF (2024), *2024 Sustainable aviation fuel outlook: Getting Airborne.*

[77] "Trucks" refer to both medium- and heavy-duty commercial trucks, "electric" refers to both electric and fuel-cell powered vehicles. See BloombergNEF (2024), *China's clean-truck surprise defies EV slowdown: Hyperdrive.*

[78] Year-on-year growth in e-truck sales in Europe and the US reach 41% and 5% respectively. See BloombergNEF (2024), *Commercial vehicles decarbonization monthly.*

Projects, for example led by Elysis in Canada and Norsk Hydro in Norway, are advancing inert anodes to decarbonise primary aluminium production.[79]

- In October 2022, the first **commercial-scale emission-to-liquids** plant, the Shunli CO_2-to-methanol plant, was commissioned in China, with a production capacity of 110 kt. Similarly, the world's first industrial dynamic[80] green power-to-ammonia demonstration plant is under construction in Denmark.[81]
- In the **shipping** sector, the orderbook for new build ships as of January 2024 saw 249 new-build orders for ammonia-ready vessels (9.3% of orderbook by gross tonnage) and 247 for methanol-ready vessels (6% of orderbook by gross tonnage), respectively a 1.7x and a 4.5x increase from the orderbook as of January 2023.[82]

Tipping points – already achieved or within reach

It is useful to think about how these technology developments relate to the concept of "tipping points".[83] This concept suggests that after an initial period of gradual development, deployment, and cost reduction, major technologies achieve a scale and pace of cost reduction beyond which further developments become strongly self-reinforcing and unstoppable, even if policy support for development

Technological readiness of decarbonisation solutions across sectors

Exhibit 3.2

Sectors	Share of global GHG emissions	Technological readiness of decarbonisation solutions: Pilot (TRL 5)	Demonstrator (TRL 7)	Full-Scale Commercial (TRL 9)
Clean Hydrogen	n.a.			Electrolysers, SMR/ATR + CCS
Buildings	28%			Residential Heat Pumps, Electric Boilers
Light Industry	13%		Thermal Energy Storage	Industrial Heat Pumps
Aviation	2%	Hydrogen, Battery Aircraft Power-to-Liquid SAF	Non-HEFA Biofuels	HEFA Biofuels
Trucking	2%		Hydrogen Heavy Trucks	Battery Electric Mid/ Heavy Trucks
Steel	7%		H_2-based DRI-EAF, BF-BOF + CCS, Smelting Reduction + CCS	EAF, Electrolysis-EAF, Electrowinning-EAF
Aluminium	2%	Electric Calcination, Hydrogen Calcination	Inert Anodes, MVR	Electric Boilers, Hydrogen Boilers
Ammonia	2%		Methane Pyrolysis	Electrolysis, Methane Reformer + CCUS, Methane Pyrolysis
Cement / Concrete	8%	Alternative Chemistries	Carbon Mineralisation	CCS, Industrial & Biomass Wastes
Shipping	3%	Ammonia- and Methanol-native Vessels		Ammonia- and Methanol-ready Vessels

Note: SMR = Steam Methane Reformation; ATR = Autothermal Reformation; CCS = Carbon Capture and Storage; SAF = Sustainable Aviation Fuel; HEFA = Hydroprocessed Esters and Fatty Acids; DRI-EAF = Direct Reduced Iron-Electric Arc Furnace; BF-BOF = Blast Furnace-Basic Oxygen Furnace; MVR = Mechanical Vapour Recompression. EAF = Electric Arc Furnace.

Source: Mission Possible Partnership (2022), *Sector Transition Strategies (multiple)*. World Green Building Council (2019), *Bringing Embodied Carbon Upfront*. Our World in Data (2020), *GHG Emissions by Sector*.

[79] IEA (2023), *Tracking Clean Energy Progress: Aluminium*.

[80] "Dynamic" in this context refers to the ability of ammonia production to adjust to fluctuations in hydrogen production from variable renewable energy-powered electrolysers. Ammonia will only be produced when hydrogen can be produced from a sufficient supply of renewable energy, without relying on electricity storage.

[81] IEA (2023), *Tracking Clean Energy Progress: Chemicals*.

[82] Clarksons Research (2023), *Green Technology Tracker: January 2023*; Clarksons Research (2024), *Tracking "Green" Technology Uptake*.

[83] Tipping points refer to critical thresholds at which phenomenon's experience a significant acceleration, caused by self-reinforcing feedback loops. See Systemiq analysis for the ETC; *The Breakthrough Effect: How To Trigger A Cascade Of Tipping Points To Accelerate The Net Zero Transition*.

is reduced. The dynamics of deployment of mature clean energy technologies suggest they are close to, or have even reached, said tipping points in most markets [Exhibit 3.1].

As technologies reach tipping points, their deployment often accelerates dramatically, and as a result, estimates of future technology deployment from recognised expert organisations often fail to reflect the significant acceleration that this implies.[84] Historical examples of this phenomenon, and an S-curve adoption of solar and wind, is already visible in many geographies [Exhibit 3.3].[85]

Furthermore, this self-reinforcing pattern can trigger what is known as **"tipping cascades",** with progress beyond a tipping point in one sector triggering a similar self-reinforcing loop in another sector.[86] One such example would be the rapidly declining costs of solar PV and wind and their impact on the economics of green hydrogen, expected to deliver ~25% of mitigation in these hard-to-abate sectors in 2050.[87] If solar PV can be delivered at ~$20/MWh, and if electrolyser and system costs also fall significantly, green hydrogen could be produced at a cost of ~$1.7/kgH$_2$, close to being competitive with a grey hydrogen cost of $1.6/kgH$_2$.[88]

Several indicators suggest that solar PV, wind and EVs are reaching, or have already passed, their tipping point. For example:

- As of the first half of 2023, wind or solar were the cheapest source of new build power generation in markets representing 82% of global power supply, and new renewable generation was cheaper than existing fossil-based generation in more than half of the world.[89]

- In 2023, parity or near-parity between the total cost of ownership of battery-electric sport utility vehicles (BE-SUVs) and of SUVs powered by internal combustion engines (ICEs) was visible in two key markets, the US and China.[90]

Other technologies by contrast still require significant policy support to reach their tipping points, and "NDCs 3.0" should clearly describe the policies and actions needed to achieve this. It is also a possibility that some technologies may never reach tipping points given significant cost premiums (e.g., SAF or low-carbon shipping fuel). Progress so far strongly suggests that tipping points in almost all technologies required to deliver a net-zero global economy could be reached in the next 10 years, unlocking the potential for rapid emissions reductions thereafter.

Continued strengthening of enabling conditions (e.g., accelerated permitting, financing mechanisms, market design), and further, stronger policy support will still be required to ensure that these technologies are deployed at the pace required to meet climate objectives, driving growth even faster than is now inevitable, but the need for that support will decline over time.

---

[84] Systemiq (2023), *The Breakthrough Effect: How to trigger a cascade of tipping points to accelerate the net zero transition.*

[85] In the context of the adoption of a new technology, an S-curve illustrates the three stages of adoption: a gradual start, an acceleration in growth due to technological and cost improvements, and an eventual stabilization as market saturation approaches. Wind and solar are currently in the second stage, i.e. accelerated growth. See Systemiq analysis for the ETC (2023), *The Breakthrough Effect: How To Trigger A Cascade Of Tipping Points To Accelerate The Net Zero Transition.*

[86] Ibid.

[87] Using ETC's Accelerated but Clearly Feasible (ACF) scenario from the 2023 report *Fossil Fuels in Transition,* considering the share of hydrogen and hydrogen-derived fuels in final energy demand for aviation, shipping, steel and chemicals, and assuming 85% of green hydrogen supply in 2050, consistent with assumptions in the ACF. See ETC (2023), *Fossil fuels in transition.*

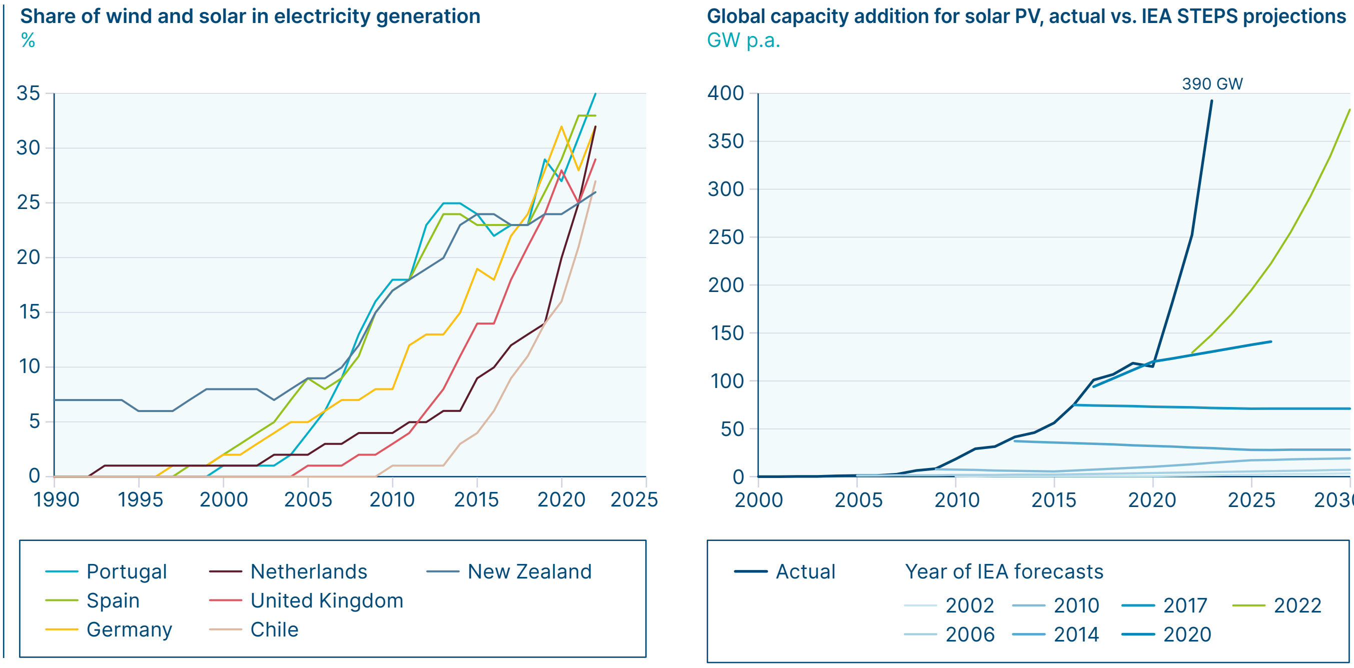
[88] Estimates for green hydrogen production costs are for a 100 MW plant, supplied by solar PV at $20/MWh, assuming lower bound of alkaline electrolyser CAPEX from China of $600/kW. Grey hydrogen production costs assume a SMR plant capacity of 575 MW and gas costs of $17/MWh, and excludes carbon pricing. Levelised production costs exclude transportation and storage costs. See BNEF (2023), *Hydrogen Project Valuation Model (H2Val 1.1.4).*

[89] BloombergNEF (2023), *1H 2023 LCOE Update.*

[90] US: TCO of BE-SUVs was 1% lower than that of ICE-SUVs, China: TCO of BE-SUVs was 2% higher than that of ICE-SUVs. BloombergNEF (2023), *Long-term Electric Vehicle Outlook.*

S-curve adoption pattern of renewable energy

Exhibit 3.3



Note: STEPS = Stated Policies Scenario, this scenario reflects current policies enforced at the time of publication and can be considered as a business-as-usual scenario.

Source: Enerdata (2023), *World Energy & Climate Statistics – Yearbook;* BNEF (2023), *4Q Global PV Market Outlook;* IEA (Various), *World Energy Outlook*.

3.2 Growing policy support and sectoral commitments

The rapid pace of past and potential future technological progress has been enabled in part by policy support, and further policy support will be needed to drive progress at the pace required to meet climate objectives. This support should encompass a variety of policy levers, including direct support to low-carbon solutions (e.g., subsidies for EV purchases), constraints on fossil-based solutions (e.g., bans on ICE vehicle sales, carbon pricing) or realigning policy frameworks to reflect technological developments (e.g., power market redesign). In many countries, **key elements of that policy support** have now been put in place:

- In the US, the Inflation Reduction Act (IRA) of 2022, has provided extensive tax credit and subsidy support for a wide range of clean technologies, including wind, solar PV, batteries and EVs and Carbon Capture, Use and Storage (CCUS) projects.[91] Investment in clean technology manufacturing has increased dramatically from $140 billion to $240 billion between just 2021–2023.[92]
- Under the EU's Emissions Trading System (ETS), which covers around 40% of the EU's emissions,[93] one tonne of emitted carbon now trades at around 60 €/tCO_2, a three-fold increase from 2020 levels, with peaks of 100 €/tCO_2 reached in 2023.[94] The introduction of the Carbon Border Adjustment Mechanism (CBAM) further tightens the grip on industrial emissions, preventing carbon leakage in international trade, and levelling the playing field with imports. The EU also introduced a blending mandate for SAFs in 2023, requiring that SAFs make up 6% of total aviation fuels in 2030 and 20% in 2035.[95] The EU has also introduced a ban on new ICE vehicles sales after 2035.[96]
- India is expected to set emissions reduction mandates for cement, steel, petrochemicals, and pulp & paper industries, supported by the start of carbon trading in 2025.[97]

[91] US EPA (2023), *Summary of Inflation Reduction Act provisions related to renewable energy.*

[92] Rhodium Group & MIT-CEEPR (2024), *Clean Investment Monitor.*

[93] European Commission (2024), *What is the EU ETS?*

[94] EMBER (2024), *Carbon Price Tracker.*

[95] Argus Media (2023), *EU publishes renewables, SAF blending mandates laws.*

[96] S&P Global (2023), *EU approves law banning sales of new petrol, diesel cars from 2035.*

[97] Reuters (2023), *India to set emission reduction mandates for 4 sectors, to start carbon trading from 2025.*

Amidst a tightening of regulations and growing confidence in the ability of technologies to scale and deliver deep and rapid emissions reductions, countries are now setting increasingly ambitious targets. For example:

- The EU has set a legally-binding target to reach 42.5% of renewable energy by 2030, implying continued deep decarbonisation of its power sector.[98]
- The US has set a non-binding goal to achieve close to zero emissions power systems by 2035, of which a version has since been inscribed into law by many states.[99,100]
- China's target to reach 1,200 GW of installed renewable capacity by 2030, although not legally-binding, is likely to be achieved five years ahead of schedule, with total renewable energy deployment by 2030 now likely to exceed 4,300 GW.[101,102]

Furthermore, the technological progress described in Section 3.1 is unlocking new frontiers for the decarbonisation of harder-to-abate sectors, and pushing industry to make **more ambitious commitments to decarbonisation,** in particular:

- Major companies and group of companies have set net-zero emissions targets by mid-century:
  - Companies accounting for around 35% of global steel production have set net-zero emissions targets by and around 2050, with some even setting interim targets for 2030.[103]
  - In aviation, members of the International Air Transport Association (IATA), representing more than 80% of global air traffic (both passenger and cargo), have committed to net-zero emissions by 2050.[104]
  - While 35% of shipping companies have made clear commitments to achieving net-zero emissions by mid-century, 70% of all shipping emissions must now reach net-zero by 2050 under the International Maritime Organisation's (IMO) updated strategy.[105, 106]
- Buyer commitments are also driving the uptake of low-carbon products as direct support to decarbonisation efforts from companies:
  - 17 major consumers of concrete have committed to using at least 50% low-carbon concrete by 2030.[107]
  - 36 major consumers of steel have committed to using at least 50% low-carbon steel by 2030.[108]
  - 60 companies – across airports, airlines and fuel suppliers – have pledged to use/supply 10% of SAFs by 2030.[109]
  - 96 major industrial players from across harder-to-abate sectors have joined forces in the First Movers Coalition to accelerate the development of high-potential, low-carbon solutions by catalysing investment and creating credible demand signals to build early market demand for low-carbon products.[110]
- Growing momentum around the decarbonisation of sectors is driving efforts to scale-up low-carbon technology manufacturing, creating new opportunities to attract **investments and drive economic growth:**
  - Existing solar PV manufacturing capacity, if fully utilised, could already deliver what is necessary to meet demand under a 1.5°C trajectory, six years ahead of target. The rapid expansion of solar PV manufacturing capacity and the resulting supply glut imply that current facilities are operating at 50% of nameplate capacity.[111]
  - Amidst rapidly growing sales of EVs and economic incentives, in particular those offered by the IRA in the US, total installed battery manufacturing capacity is now three times that of current demand. If announced projects are realised, this would leave just a 10% gap with what is required in a 1.5°C trajectory by 2030.[112]

---

[98] European Commission (2023), *Directive 2023/2413 of the European Parliament and of the Council.*
[99] US Department of State (2021), *The long-term strategy of the United States: Pathways to net-zero greenhouse gas emissions by 2050.*
[100] CleanEnergy States Alliance (2024), *Table of 100% Clean Energy states.*
[101] Of which ~ 3,370 GW from solar PV and ~ 950 GW of wind. See BloombergNEF (2024), *Short-term forecast for renewable capacity.*
[102] AFRY (2023), *China expects to achieve its 2030 wind and solar ambitions ahead of schedule in 2025.*
[103] Systemiq analysis for the ETC; LeadIt (2024), *Green steel tracker.*
[104] IATA (2021), Our *commitment to fly net-zero by 2050.*
[105] Maersk Mc-Kinney Moller Center (2022), *Ready, set, decarbonise ! Are shipowners committed to a net zero future?*
[106] Maersk Mc-Kinney Moller Center (2023), *Setting sail on a sustainable course.*
[107] WBSCD (2022), *17 major concrete-consuming businesses pledge to use 100% net-zero concrete by 2050.*
[108] Climate Group (2024), *About SteelZero.*
[109] World Economic Forum (2020), *Clean skies for tomorrow.*
[110] See *First Movers Coalition.* Available at: https://initiatives.weforum.org/first-movers-coalition/home
[111] IEA (2024), *Advancing clean technology manufacturing.*
[112] Ibid.

3.3 National commitments made at COP signal that countries have recognised this potential

Recognising both the growing urgency for climate action and the potential for rapid technological progress and cost reduction, countries have increasingly made ambitious commitments and pledges at recent COPs. In particular:

- COP28 in 2023 achieved a cross-country commitment to triple the global installed **renewable energy capacity** by 2030. Although not binding, this creates an expectation for countries to collectively achieve ~6,000 GW of solar PV (~5x 2022 installed capacity), 2,700 GW of wind (~3x vs. 2022) and ~1,800 GW of hydro (up 25–30% from 2022).[113,114]

- In addition, countries at COP28 committed to double the global average annual rate of **energy efficiency** improvements by 2030, from ~2%–4% p.a. Box B discusses some of the challenges associated with this target, and how it can be translated into "NDCs 3.0". Put together, commitments around renewables and energy efficiency support countries' efforts to "transition away from fossil fuels in the global energy system" which has also been agreed at COP28.

- **Food and land-use** – several government-led global efforts were initiated in recent years to reduce emissions from food and land-use. At COP26 in 2021, more than 100 countries, home to 85% of the world's forests, committed to halt and reverse forest loss and land degradation by 2030.[115] At COP27 in 2022, Brazil, Indonesia and the Democratic Republic of Congo (DRC) further signed a Rainforest Protection Plan for the preservation and restoration of critical ecosystems.[116] Finally, at COP28 in 2023, 159 countries adopted the Declaration On Sustainable Agriculture, Resilient Food Systems, And Climate Action, through which they committed to "conserving, protecting and restoring land and natural ecosystems" as well as to shifting from higher greenhouse gas-emitting practices to more sustainable production and consumption approaches.[117]

- **Methane** – The first notable global commitment to abate methane emissions was the Global Methane Pledge launched at COP26 in 2021. 155 country participants, representing over 50% of global anthropogenic methane emissions, pledged to take voluntary actions to contribute to a collective effort to reduce methane emissions by 30% by 2030 relative to 2020, which would yield ~2.5 $GtCO_2e$ of mitigation.[118] This effort was recently supplemented at COP28 by the unveiling of the Oil & Gas Decarbonisation Charter to which 50 companies, representing 40% of global oil production, have signed up. Amongst other targets, signatories have committed to near-zero upstream methane emissions by or before 2050.[119] Despite low to negative marginal abatement costs, in particular in the oil and gas sector, the implementation of these pledges has been lacking: global methane emissions in the energy sector rose by 2.5% in 2023 relative to 2022.[120]

However, several past pledges have not been delivered, and new pledges will only be valuable if turned into action. But the fact that countries have made these commitments reflects growing recognition that technological progress and cost reduction makes them achievable. It is therefore crucial for countries to reflect this potential in the ambition of "NDCs 3.0".

---

[113] IEA (2023), *Net Zero Roadmap – Update*; Climate Analytics (2024), *Tripling renewables by 2030: Interpreting the global goal at the regional level*.

[114] The COP commitment to triple the installed capacity of renewables does not mean that the installed capacity of each renewable technology can and should be multiplied by three. Some renewable technologies, such as solar and wind, are much easier to deploy at scale than others, such as hydro and geothermal, which is why the installed capacity of some technologies will have to increase by more than 3x and that of others by less than 3x, which, on average, is meant to yield a 3x increase in the total renewable capacity.

[115] UK Prime Minister's Office (2021), *Press release: Over 100 leaders make landmark pledge to end deforestation at COP26*.

[116] NY Times (2022), *Brazil, Indonesia and Congo Sign Rainforest Protection Pact*.

[117] COP28 UAE Presidency (2023), *COP28 UAE Declaration On Sustainable Agriculture, Resilient Food Systems, And Climate Action*.

[118] CCAC (2024), *About the Global Methane* Pledge; CAT (2023), *COP28 initiatives will only reduce emissions if followed through*.

[119] COP28 Presidency (2023), *Oil & Gas Decarbonization Charter launched to accelerate climate action*. Available at: https://www.cop28.com/en/news/2023/12/Oil-Gas-Decarbonization-Charter-launched-to--accelerate-climate-action

[120] IEA (2024), *Global Methane Tracker*.

Box B Translating energy efficiency commitments in NDCs

At COP28, countries agreed to "double the global average annual rate of energy efficiency improvements by 2030" in line with the outcomes of the Global Stocktake.

This target reflects the outputs from the IEA's Net Zero Emissions (NZE) scenario which requires such doubling of the annual rate of energy intensity improvement from the current 2% p.a. to over 4% by 2030 to limit global warming to 1.5°C.[121]

Energy intensity is defined as primary energy use per unit of GDP. While it does factor in energy efficiency improvements, including both technical efficiency improvements and changes to primary energy demand resulting from fuel switching (e.g., electrification of road transport), it also considers structural economic shifts, in particular the shift from industry to more service-based economies, which inherently improves energy intensity metrics.[122]

It is thus unclear what is implied by this target agreed at COP, in particular given there is no single way to isolate and measure energy efficiency improvements across sectors of the economy – this is why energy intensity metrics are often used as a proxy.

To better reflect progress in improving economy-wide energy efficiency, countries could support their NDCs with information on primary energy consumption per energy service provided, such as energy consumed to produce a tonne of steel, to drive a car for a kilometre or to heat a square metre of residential floorspace, recognising that aggregating these metrics to provide an economy-wide view of progress would be complex.

3.4 Feasible ambitions for "NDCs 3.0"

Ambition within individual NDCs should ideally reflect a global vision of the pace of emissions reduction which is now feasible. In this section, we therefore set out what reductions could result from the combination of unstoppable roll out of the technologies which are now moving beyond tipping points plus the delivery of global, national and sectoral commitments.

Our analysis suggests that about 18 out of the 34 $GtCO_2e$ gap in emissions in 2035 between stated policies and emissions reduction required for 1.5°C could be closed if the more mature clean technologies scaled in line with expectations and if countries and sectors delivered the commitments made [Exhibit 3.4].[123]

Out of these 18 $GtCO_2e$, around 11.1 $GtCO_2e$, or roughly two-thirds, could be delivered through the expected deployment of clean energy technologies, ahead of what current policies are expected to deliver, and energy efficiency gains [Exhibit 3.4].[124] This includes:

- **5.8 $GtCO_2e$ from renewables,** based on the global pipeline of projects, and in line with the global commitment to triple renewables which exceeds capacity implied by national plans.[125,126]
- **0.6 $GtCO_2e$ from displaced oil demand** as a result of the uptake of electric vehicles, based on expected global sales resulting from the superior economics of EVs compared to conventional internal combustion engine (ICE) vehicles.[127]
- **4.8 $GtCO_2e$ from energy efficiency improvements** if the COP28 commitments to double energy efficiency gains from 2% to 4% can be achieved. These gains could come from greater electrification of end uses (approximately 1.8 $GtCO_2e$),[128] especially in road transport (EVs) and in buildings (heat pumps), progress in technical and material efficiency (approximately 2 $GtCO_2e$), and cleaner cooking, with the switch from traditional fuels (e.g., charcoal) to modern fuels (e.g., LPG) (~ 1 $GtCO_2e$).

[121] IEA (2021), *Net Zero by 2050 A Roadmap for the Global Energy Sector*.

[122] Service-based economies tend to be less energy-intensive than industry-based economies for a given amount of GDP creation.

[123] There is a 34 $GtCO_2e$ gap in 2035 between the level of annual emissions that stated policies are expected to deliver (56 $GtCO_2e$) and what is required for a 1.5°C-aligned pathway (22 $GtCO_2e$). See IPCC (2023), *Synthesis Report Of The IPCC Sixth Assessment Report (AR6)*.

[124] Methodology: for clean technology deployment, mitigation comes from the additional renewable power production that would come from the deployment of current renewable energy project pipeline compared to projected production in IEA STEPS. We assume excess renewable power generation displaces average fossil-based power generation in the IEA STEPS. Similarly for EVs, mitigation comes from the reduced oil consumption resulting from the expected penetration of EVs in BNEF's Economic Transition Scenario in excess to that of STEPS. For energy efficiency, given 2x pledge is aligned to IEA NZE, we assume reduced energy demand between STEPS and NZE displaces fossil fuel use, allocating a probability across sectors depending on our confidence in the ability of countries to deliver pledged reductions.

[125] BloombergNEF (2024), *Online Explorer: solar short-term high forecast*; BloombergNEF (2024), *Online Explorer: wind short-term forecast*; IHA (2023), *World Hydropower Outlook*.

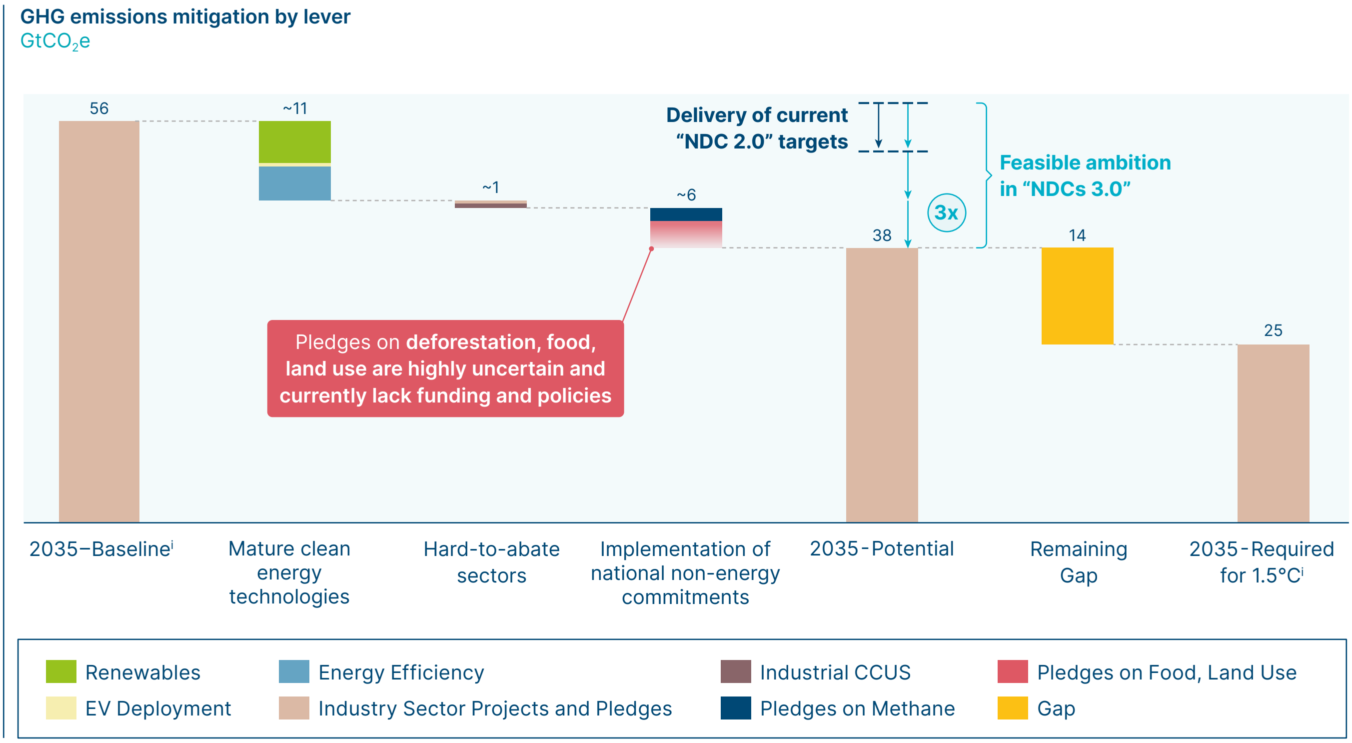
[126] IEA (2023), *World Energy Outlook;* BloombergNEF (2024), *1Q Global PV Market Outlook;* BloombergNEF (2023), *2H Global Wind Market Outlook*; IHA (2023), *World Hydropower Outlook*.

[127] IEA (2024), *Global EV Data Explorer*; BloombergNEF (2023), *Long-term Electric Vehicle Outlook*.

[128] 1.8 $GtCO_2e$ excludes mitigation from the uptake of EVs in the fleet, already accounted for in the 0.6 $GtCO_2e$ of mitigation from EVs.

Potential global emissions mitigation by 2035 across levers

Exhibit 3.4



Notes: [i] Estimates are taken from UNEP (2023), *Emissions Gap Report: Broken Record,* mitigation from renewables and energy efficiency assumes the full implementation of global pledge to triple renewable capacity and double annual energy efficiency improvements by 2030 made at COP28, mitigation from hard-to-abate sectors excludes the decarbonisation of power supply which is considered under "Mature clean energy technologies". Mitigation from "Pledges on Methane" include the impact of both the Global Methane Pledge (GMP) and the Oil and Gas Decarbonization Charter (OGDC) and overlap, methane emissions from agriculture under GMP are considered in "Pledges on Food, Land Use". Projections include all GHGs, but estimates of mitigation levers focus on CO_2 and CH_4 emissions.

Sources: Systemiq analysis for the ETC; ETC (2023), *Fossil Fuels in Transition;* ETC (2023), *COP28: A High-Level Assessment of Mitigation Proposals;* IEA (2023), *Net Zero Roadmap – Update;* IEA (2023), *World Energy Outlook;* IEA (2023), *Global EV Data Explorer;* IEA (2024), *CCUS Projects* Database; BNEF (2024), *Interactive Data Tool – Capacity;* BNEF (2023), *Long-Term Electric Vehicle Outlook;* BNEF (2023), *CCUS Projects* Database; Mission Possible Partnership Sector Transition Strategies; https://www.missionpossiblepartnership.org/sector-transition-strategies IPCC (2023), *Synthesis Report Of The IPCC Sixth Assessment Report (AR6).*

We conservatively estimate that an additional 1.1 $GtCO_2e$ can be delivered through the decarbonisation of harder-to-abate sectors [Exhibit 3.4].[129] This includes:

- **0.4 $GtCO_2e$ from non-CCUS industry decarbonisation** projects that have reached final investment decision (FID).[130] This includes abatement of both energy and non-energy (i.e. process) emissions.
- **0.7 $GtCO_2e$ from the roll-out of CCUS** in industry.[131]

By 2035, significantly larger reductions in the hard-to-abate sectors should however be attainable with stronger policy support, accelerating the progress of new technology development and deployment.

Lastly, we estimate that 6 $GtCO_2e$ of mitigation could be delivered if national commitments made at recent COPs on food and land use and methane were fully implemented [Exhibit 3.4].[132] This includes:

[129] Methodology: estimates for non-CCUS decarbonisation comes from our assessment of the likelihood that MPP sectors reach 1.5°C-compatible emissions trajectory by 2035, based on current pipeline. These exclude mitigation from CCUS and power decarbonisation. Mitigation from industrial CCUS is estimated based on project pipeline databases compiled by IEA and BNEF.

[130] Based on MPP Sector Transition Strategies for aluminium, ammonia, cement, steel, aviation, and shipping. Available at: https://www.missionpossiblepartnership.org/sector-transition-strategies/

[131] Average of projected CCUS capacity estimates from BloombergNEF (2023), *CCUS Projects Database;* IEA (2024), *CCUS Projects Database*; MPP (various), *Sector Transition Strategies.*

[132] Methodology: our estimate for food and land-use is based on a Systemiq analysis of the global emissions abatement potential of diet shifts, avoided waste, agricultural productivity gains, and the greater adoption of sustainable agriculture practices. Our estimate for deforestation leans on an academia-based Systemiq analysis of the emissions abatement potential for reduced deforestation in Brazil, Indonesia and the Democratic Republic of Congo (DRC), in light of the Rainforest Protection Plan adopted at COP27. Our estimate for methane is based on analysis from Climate Action Tracker on the impact potential of COP26 and COP28 pledges.

- **4 $GtCO_2e$ from pledges on food and land-use.** Of these, 50% are expected to come from changes to the food system (e.g., diet shifts, avoided waste, alternative proteins) whilst the remaining 50% can be achieved by a reduction in deforestation.

- **2 $GtCO_2e$ from pledges on methane:** of which 1 $GtCO_2e$ from energy-related methane emissions with the delivery of the Global Methane Pledge (GMP) and the Oil and Gas Decarbonisation Charter (OGDC), recognising the significant overlap between pledges, and another 1 $GtCO_2e$ from waste-related methane emissions through the delivery of the GMP.[133, 134]

In summary, this analysis implies that if "NDCs 3.0" reflected current deployment trends plus the commitments which countries and sectors have made, their combined ambition for emissions reduction over the next decade would be almost three times that implied by the targets of current "NDCs 2.0", in addition to what current policies are expected to deliver.[135]

3.5 The need for stronger NDCs to reflect and reinforce this potential

Sections 3.1–3.4 described how rapid progress of green technologies, enabled by growing policy support and reflected in national, sectoral and global commitments, could deliver very significant reductions in emissions over the next ten years. But it is important to recognise that:

- Even if the potential reductions estimated in Section 3.4 were achieved, there would still be a significant gap versus a path compatible with limiting global warming to +1.5°C. The feasible mitigation shown in Section 3.4 would only put the world on an emissions trajectory close to that of +2°C pathways.

- These reductions will not be achieved unless national, global and sectoral commitments are translated into and supported by clear policies, implementation plans and specific investments.

- Emissions reduction targets set out in previous "NDCs 2.0" fall far short of reflecting these potential reductions, and are often not supported by clear implementation plans.

There is therefore a major opportunity, and a need, for national policymakers to set stronger "NDCs 3.0" to close the ambition and implementation gaps [Exhibit 2.1]. Some of this gap may be closed by unstoppable technological progress even if NDCs do not reflect that potential. But far more will be closed if NDC targets and implementation plans more closely reflect both technological possibilities and the national and sectoral commitments made at COPs and in other fora.

Increased NDC ambition, and stronger links between NDC targets and supporting policies, will increase investor, business and consumer confidence in the potential for, and inevitability of, rapid progress, and as a result will strengthen the self-reinforcing cycle of technological progress and cost reduction in the rising deployment which is already observable in many sectors. High-ambition industry is calling for governments and national policymakers to prioritise delivering high ambition NDCs, which makes clear the direction of travel and provides the certainty needed to scale investments in these technologies. With this clarity, industry can support governments in achieving more ambitious targets.

To achieve this level of ambition, policymakers will need to react quickly to respond to barriers and bottlenecks as they arise – from increased borrowing costs to active management of planning and permitting processes and more.

Governments should recognise that achieving highly ambitious NDC targets will deliver benefits beyond climate change mitigation. It is widely accepted that the transition to a net-zero global energy system will offer significant improvements to public health, and improve energy security by increasing the share of locally-produced low-carbon energy and reducing dependence on imports.[136] Furthermore, reflecting the rapid technology deployment described in Section 3.1 in NDCs is an opportunity for countries to catalyse investment in low-carbon technology manufacturing, and capitalise on the economic growth it can offer.

Section 4 sets out what the NDCs should ideally include to achieve this result.

---

133 Climate Action Tracker (2023), *COP28 initiatives will only reduce emissions if followed through.*

134 Methane emissions reduction target under the GMP for agriculture is accounted for in pledges on food and land use.

135 UNEP estimates that full implementation of both conditional and unconditional NDC targets by 2035 could deliver ~ 6 $GtCO_2e$ of mitigation in addition to what current policies are expected to deliver, when our analysis suggests ~ 18 $GtCO_2e$ could be delivered by technology scale-up and assuming countries deliver on national pledges made at COP28. See UNEP (2023), *Emissions gap report.*

136 See, for example, IPCC (2022), *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.*

Chapter 2 made clear the shortcomings of current “NDCs 2.0” across ambition, implementation, and the configuration of information contained, whilst Chapter 3 highlighted the material progress made by several low-carbon technologies, and their potential to significantly reduce emissions by 2035.

“NDCs 3.0” represent an opportunity for countries to reflect the rapid pace of progress of the energy transition, addressing past NDC shortcomings and making them key drivers of accelerated progress over the next ten years. This report recognises that the range of national circumstances and government capacities across countries will inevitably lead to different quality of NDCs; but ultimately, increasing ambition and improving their format to drive further implementation should always be the aim, regardless of national contexts.

To achieve this objective, all NDCs should ideally:

- **Reflect the potential** for rapid progress that technological advances and cost reductions have made possible, and the **level of ambition** that would result from the delivery of national and industry sector commitments.
- Set out **targets in a clear, comprehensive, and increasingly standardised** fashion, as this will enable cross-country comparison and facilitate the assessment of their credibility.
- Specify the actions relating to implementation which can ensure that targets are achieved, in particular, investment and climate finance required to achieve stated targets.

Exhibit 4.1 illustrates what **“NDCs 3.0” should ideally include,** which this section lays out and explains in further detail.

4.1 Ambition: Reflecting the rapid progress of low-carbon technologies

Chapter 2 made clear the difficulties of allocating the carbon budget for a given temperature outcome across individual countries, given the challenges explained in Box A. These challenges make it difficult to make definitive assessment of whether the level of ambition of each individual NDC is compatible with agreed global climate objectives. This lack of a clear mechanism for translating globally agreed targets into fair or cost-efficient targets at a national level is unlikely to be resolved soon.

But more extensive global agreement is possible on the opportunity that technological change is creating for a rapid energy transition. As Chapter 3 described, technological progress now makes it possible to plan for a faster, and less costly energy transition than seemed feasible when the NDC process was launched at COP21 in Paris. And this reality was recognised at COP28, and reflected in the commitment to triple global renewable energy deployment by 2030 and to double the pace of annual energy efficiency improvements.

But that rapid progress is not captured in the current NDCs. IRENA analysis suggests that the NDCs of G20 countries entail commitments to having just 4.6 TW of renewable energy capacity installed by 2030 (versus

Framework for "ideal" "NDCs 3.0" and comparison with current NDCs

Exhibit 4.1

Category	Sub-category	Current NDCs	Ideal "NDCs 3.0"
Ambition	Level of ambition	• Fail to reflect reality of technology deployment • Not aligned to the long-term targets of countries	• Reflect the rapid pace of technological progress • Reflect ambition implied by the implementation of COP commitments • 2035 targets aligned with emissions trajectories implied by long-term targets
	Assumptions underpinning targets	• Do not reflect rapid cost declines of mature clean technologies • Do not reflect higher technological maturity of technologies in hard-to-abate sectors	• Reflect both rapidly declining costs and improving technological maturity of low-carbon technologies
Format and coverage	Target type	• Variable (absolute, intensity-based, relative to BAU projections, peaking dates)	• Absolute reduction targets, or relative targets with necessary information to be translated to absolute targets
	Target coverage	• Incomplete for some sectors and GHGs	• Cover all sectors and GHGs
	Target granularity	• Economy-wide targets only	• Economy-wide targets • Sector- and GHG- specific targets
	Article 6 mechanisms	• Unquantified contribution to overall emissions reductions target	• Quantified contribution of Article 6 mechanisms to overall targets • Rationale for significant reliance
	Conditionality	• Lack of specificity on what is required to deliver conditional targets • Overall conditional emissions reductions are binary	• Quantified international finance required • Information on forms of external support required • Progressive conditionality (i.e. parts of conditional targets can be delivered with partial support)
Implementation	Strategic vision	• Does not reflect a clear strategic vision of energy system transformation	• Targets and policies reflect a clear strategic vision of energy system transformation
	Clear sectorial policies	• Do not provide detail on policies required to achieve targets across sectors	• Quantified contribution of existing policies • Tightening of existing policies and new policies required to meet sector-level targets

Note: Comparison to current NDCs applies to most but not all NDCs.
Source: Systemiq analysis for the ETC.

around 3 TW today). This falls far short of the 6.4 TW which would result from current trends and policies, and still more so compared with the 9.4 TW required in the G20 alone if the COP28 target of tripling global capacity by 2030 is to be achieved.[137]

A crucial priority in the development of "NDCs 3.0" is therefore to ensure that all NDCs reflect the potential for rapid progress, ideally referring to common agreed assumptions and global targets.

To be regarded as ambitious, "NDCs 3.0" should therefore:

1. Reflect an ambitious, yet feasible pace of deployment of low-carbon technologies, particularly those that are already seeing rapid growth today. While policymakers should reflect national circumstances around technology transfer and costs on technology deployment rate, they should be confident in their ability to set targets at least in line with projections from authoritative sources such as the IEA, which have in the past tended to underestimate the actual scale of deployment.[138]

2. Be underpinned by assumptions that reflect the reality of rapidly declining costs for several low-carbon technologies, similar to those shown in Exhibit 4.2. While assumptions made by policymakers can fall outside of these bounds, there should be clear justification for any major divergence in assumptions that would translate into significantly higher cost projections than those outlined in Exhibit 4.2. Box C describes the guidelines which should be used to ensure that NDCs reflect global cost trends and avoid bias, and to enable comparison of assumptions and level of ambition between different countries.

[137] IRENA (2023), *NDCs and renewable energy targets in 2023: Tripling renewable power by 2030.*

[138] Carbon Brief (2023), *The rapid rise of solar continues to outpace IEA outlooks – but remains short of what would be needed for 1.5°C.*

Box C Modelling guardrails for robust target-setting

In calculating ambition behind NDCs, many countries use energy system and/or economy wide models to understand mitigation potential. All models which underpin quantitative NDC targets should possess guardrails on both inputs and outputs to ensure the accuracy and integrity of the results they produce.

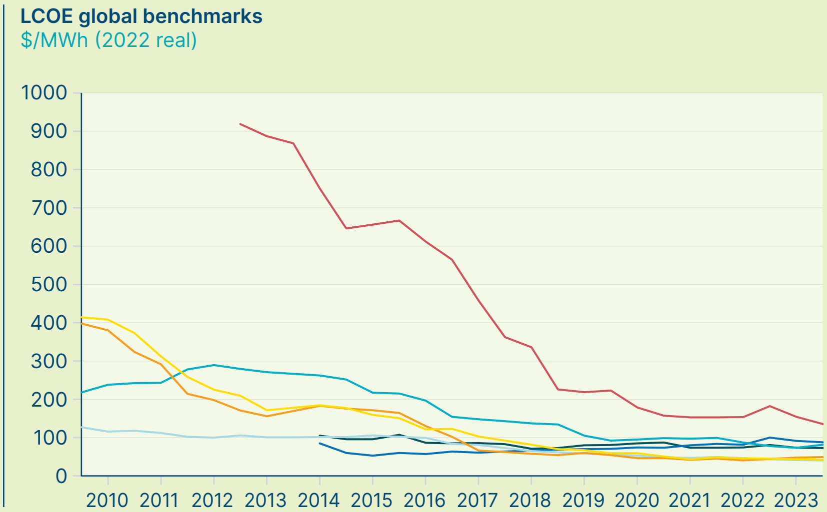
On inputs, particular attention should be given to **cost** assumptions, in particular in the context of rapidly declining costs for some of those technologies described in Section 3.1 and Exhibit 4.2, as the technology used to meet a given demand for energy services and associated emissions strongly dependent on this assumption.

Guardrails are equally important to sense-check outputs from models, to ensure that results do not exceed a given system boundary and are not biased towards specific outcomes. These include, but are not limited to, verifying the reliance of final energy demand on:

- **Fossil fuels,** expected to meet just 10-25% of energy demand in a net-zero energy system by 2050. This represents a sharp decline in demand for fossil fuels from today's levels of 75–95% for oil, 55–70% for gas, and 80–85% for coal,[139] required in any credible plan to achieve 1.5°C or well-below 2°C. Residual use of fossil fuels in 2050 is mainly expected to occur in heavy industry sectors such as chemicals, steel and cement, where alternatives are either unavailable or not cost-competitive.[140]
- **Carbon Capture, Use and Storage (CCUS),** where it is expected that in a net-zero energy system almost all emissions from the residual use of fossil fuels are neutralized through CCUS (equivalent to 10–15% of final energy demand), in particular in those applications where emissions result from processes (e.g., cement, chemicals) rather than energy use.[141]
- **Hydrogen**, expected to meet around 15% of energy demand in a net-zero energy system by 2050, mostly as a fuel for shipping (whether ammonia or methanol), steelmaking and power system balancing.[142]
- **Bioenergy**, with a maximum sustainable potential of ~50 EJ, representing around 5% of final energy demand in 2050, mostly used in the pulp & paper industry or for the production of bio-jet fuel.[143]
- **Carbon Offsets and Removals** (CDR), used in addition to, and not instead of, deep and rapid decarbonisation to i) limit overshooting of the global carbon budget due to an insufficient pace of emissions reductions, ii) compensate for non-CO_2 GHG emissions, and iii) neutralise residual CO_2 emissions from incomplete capture of CCUS and some very limited continued use of unabated fossil fuels where CCUS cannot be applied, with cumulative maximum potential of 150 $GtCO_2$ between now and 2050.[144]

Levelised cost of electricity (LCOE) generation from selected sources

Exhibit 4.2



	Current LCOE ($/MWh)	% change between 2014 and 2023
PV fixed-axis	40	-80%
PV tracking	50	-70%
Onshore wind	40	-60%
Offshore wind	80	-70%
Utility-scale battery (4h)	135	-80%
CCGT	90	+5%
Coal	70	-30%

Note: The LCOE is the long-term breakeven price a power project needs to recoup all costs and meet the required rate of return. The global benchmarks are capacity-weighted averages using the latest country estimates. Offshore wind includes offshore transmission costs. Coal- and gas-fired power include carbon pricing where policies are already active. LCOEs do not include subsidies or tax credits or transport, storage and distribution costs. Table values have been rounded to the nearest ten. CCGT = Combined Cycle Gas Turbine.

Source: BNEF (2023), *Levelized Cost of Electricity 2H 2023.*

4.2 Format and coverage: Clear and comprehensive targets in line with global definitions

Chapter 2 described the variety of formats and coverage which undermine the comparability and value of current NDC targets. While official guidance for NDC setting exists (see Section 1), it voluntarily provides countries with significant degrees of freedom to reflect national context and circumstances. This section sets out how “NDCs 3.0” could be designed, beyond existing guidance, to increase their effectiveness in catalysing climate action.

NDC target types: relative versus absolute
Exhibit 2.2 showed the wide variety of target types contained in current NDCs, many of which, in particular those that are relative to BAU baselines or intensity-based (e.g., relative to GDP), do not allow a definitive comparison between planned emissions and carbon budgets.

Because the global carbon budget is measured in absolute terms, any compatible target should also be measured in absolutes, even if there are disagreements about how much absolute reduction each country should deliver, independent of stated ambition.

“NDCs 3.0” should therefore ideally include absolute emissions reduction targets for 2035, or combine relative targets (baseline- or intensity-based) with the necessary information to translate target into equivalent absolute emissions reduction (e.g., with GDP projections or projected emissions in baseline scenario clearly stated alongside the relative target).

Coverage of targets: sectors and gases
Exhibit 2.2 showed that a significant proportion of global emissions are not covered within NDC targets: this reflects, in particular, the incomplete coverage of GHGs and sectors.

Including all sectors and GHGs in NDC target is crucial since:

1. The long-term objectives for the Paris Agreement, which requires reaching net-zero emissions globally some time by 2050, will not be achieved unless all emissions are comprehensively addressed.

2. Including all sectors and GHGs in NDC targets will enhance both their transparency and credibility.

Ideal targets for “NDCs 3.0” should therefore cover all sectors and GHGs, consistent with IPCC guidelines.[145] This implies:

- Explicit targets, at a minimum for methane and N_2O emissions reduction, and ideally for all GHG described in IPCC guidelines,[146] as well as for CO_2.

- Explicit targets for emissions from Energy, as well as Agriculture, Food and Land Use (AFOLU), Industrial Processes and Product Use (IPPU) and the waste sectors.

- Explicit targets for each country’s contribution of international aviation and shipping emissions.

These emissions, which account for about 5% of global GHG emissions today and which in the case of aviation are growing rapidly, are increasingly subject to oversight and regulation by the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO), both of which now possess sector-wide net-zero goals for 2050.[147, 148] But these emissions are not currently required to be included in NDCs. Ideally they should be, with countries making clear how they will contribute to achieving the global goals, and how their own share of international aviation and shipping emissions will change over time.[149]

Granular targets by sectors
As well as covering all sectors and GHGs in aggregate numbers, NDCs should also ideally include as much granular data as possible on the current and future intended path of emissions by specific sectors of the economy. For instance:

---

139 ETC (2023), *Fossil Fuels in Transition: Committing to the phase-down of all fossil fuels*.

140 Ibid.

141 ETC (2022), *Carbon Capture, Utilisation and Storage in the Energy Transition: Vital but Limited*.

142 ETC (2021), *Making the hydrogen economy possible*; ETC (2023), *Fossil fuels in transition*.

143 ETC (2021), *Bioresources within a net-zero emissions economy*; ETC (2023), *Fossil fuels in transition*.

144 ETC (2022), *Mind the Gap*; ETC (2023), *Fossil fuels in transition*.

145 Sectors include: energy, industrial processes and product use (IPPU), agriculture, forestry, and other land use (AFOLU), waste, other. GHGs include: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, halogenated gases, NO_x, CO, NMVOCs, SO_2. See IPCC (2019), *2019 Refinement to the 2006 IPCC guidelines for national greenhouse gas inventories*.

146 Ibid.

147 GHG emissions from international shipping and aviation taken as 2.9% and 1.6% of global emissions respectively, with projected growth to 2050 of up to 130% and 100% respectively. International aviation estimated at 63% of total emissions from aviation. See IMO (2020), *4th IMO GHG study*; H. Ritchie (2022), *CO_2 emissions from aviation have doubled in the last 30 years, and are likely to keep rising*.

148 ICAO’s goal covers CO_2 emissions only, whilst the IMO’s target is for all GHGs. See: ICAO (2022), *Long-term global aspirational goal of net-zero carbon emissions by 2050*; IMO (2023), *IMO GHG strategy*.

149 T&E (2021), *Aviation and shipping emissions and national climate pledges*.

- Within sub-components of the energy sector, separately defined targets for electricity decarbonisation, road transport, buildings, and industry are essential to ensure that plans are credible and to increase investor, business, and consumer understanding of the details of the required transition.
- And targets for methane emissions reductions will need to separately identify emissions from fossil fuel production from waste and agriculture in order to create a credible link between targets and implementation plans.
- For example, the Mission Possible Partnership has produced industry-backed global decarbonisation pathways for seven hard to abate industry and transport sectors.[150] Transcribing these at national level would provide greater transparency on the trajectory of progress in these sectors.

It is not crucial that these more granular targets are explicitly mentioned in NDCs, although NDCs could be seen as an opportunity to aggregate existing disparate policies. But at a minimum, targets in NDCs should make clear reference to the document which would contain such information.

Quantified contribution from Article 6 mechanisms for emissions trading between countries

Article 6 of the Paris Agreement aims to define the rules on how countries can cooperate through carbon markets to reduce their emissions. Under Article 6, emissions reductions could in some cases be traded, with certified removals in one country sold to another. Where a country achieves removals but sells them to another, these removals cannot count towards the selling country's emissions reduction target, but instead can reduce net accounted emissions in the purchasing country.

Such mechanisms could allow countries to buy removals from countries which have large potential to remove carbon via nature-based solutions such as reforestation, or which are low-cost locations for Direct Air Carbon Capture (DACC) because of cheap renewable energy supply and accessible carbon storage capacity.

The "rulebook" of Article 6 was completed at COP26. COP27 initially, then COP28, aimed to operationalise the mechanisms for trading to begin, but several key details outlined in Box D are still under discussion.[151] As a result, NDCs which describe significant reliance on purchases of sales of removals are dependent on these details being resolved soon.

In current NDCs, more than 45%[152] of countries have disclosed their intention to use mechanisms under Article 6, either as buyers to reach stated NDC targets, where the availability of these mechanisms can be an enabling condition for conditional targets, or as sellers of credits, with the sale of removals credits assumed to provide financial flows to support low-carbon economic growth.[153] Some countries such as New Zealand rely on assumed Article 6-compliant purchases of removals to deliver the majority of their net emissions reductions to 2030.[154]

Ideally, NDCs should provide quantified information on the proposed contribution of Article 6 purchases or sales in delivering overall net emissions reductions and describe why these assumptions are credible.

- For countries that assume significant purchases of removals, NDCs should make clear why this reliance on purchased removals is required, and why it is assumed to be feasible and a lower cost option than further domestic emissions reductions. The widespread availability and rapidly falling costs of low-carbon technologies outlined in Section 3 highlights how for most countries, achieving close to net-zero emissions domestically is possible.
- NDCs which assume large sales of Article 6 removals should clearly recognise that these removals do not count towards domestic emissions reductions, but might provide a useful flow of finance to support low-carbon growth across the economy.

---

150 See MPP Sector transition strategies, Available at: https://missionpossiblepartnership.org/sector-transition-strategies/

151 I. Johnstone & J. L. Resendiz (2024), *Article 6 in focus: Outcomes from COP28*.

152 45% of Parties have the "intention to use" at least one of the mechanisms under Article 6, whilst 32% of Parties mentioned the "possibility of using" at least one of the mechanisms. See UNFCCC (2023), *NDC Synthesis Report*.

153 UNFCCC (2023), *NDC Synthesis Report*.

154 International offsets only are expected to deliver 66% of New Zealand's current NDC target. See: New Zealand Government (2021), *New Zealand's first Nationally Determined Contribution*.

Box D Challenges of operationalising Article 6 of the Paris Agreement

Article 6 is a key component of the Paris Agreement, which allows countries to cooperate to reduce their emissions. While the rulebook of Article 6 has been completed at COP26, sticking points that prevent the operationalisation of the different mechanisms still remain. This box lays out the different mechanisms under Article 6, and key elements that have led to a stalemate in international negotiations.

Article 6 mechanisms

- **Article 6.2 – Bilateral trading of carbon credits.** Countries can exchange carbon credits, known as Internationally Transferred Mitigation Outcomes (ITMOs). These ITMOs can already be traded today as countries decide on their own guidelines for credit trading.[155]
- **Article 6.4 – New global carbon market.** Article 6.4 will replace the Clean Development Mechanism (CDM) that enabled carbon trading under the Kyoto Protocol. These credits, referred to as A6.4ERs, can be bought by countries, companies and individuals alike. Unlike ITMOs, they must be authorised according to UNFCCC guidelines. Beyond mitigation, Article 6.4 is design to support sustainable development and mobilize private sector participation in climate mitigation.[156]
- **Article 6.8 – Non-market approaches (NMA)**. Provides a framework for climate cooperation between countries on technology transfer or capacity building, but without involving the trading of emissions.[157]

Key challenges

Contentious issues with Articles 6.2 and 6.4 have resulted in the failure of countries to adopt the final text around the implementation of Article 6 mechanisms. In particular:

- The lack of integrity of the rules around carbon removals, in particular with considerations around avoided emissions, additionality, measurability, and permanence, for Article 6.4.[158]
- Despite being operational, the lack of infrastructure and legal clarity around bilateral emissions transfer and accounting under Article 6.2 creates a significant risk of double-counting emissions reductions.[159]

Clear bounds on conditionality – making NDCs clear investment plans

As part of the Paris Agreement, high-income countries are expected to provide support to low and lower-middle income countries to enable their transition while achieving economic growth. This is because low and lower-middle income countries often lack the financial, institutional and technology capacity to enact their transition on their own. As a result, many of their NDCs contain both some unconditional targets, which will be implemented with domestic resources, and conditional targets, which are more ambitious but subject to international support.[160]

Under the Paris Agreement, and by extension the Katowice guidance, targets can be conditional on international climate finance, technology transfer and availability, technical cooperation, capacity-building support, the availability of market-based mechanisms (Article 6.2 and 6.4, see previous section) on the capacity of forest and other ecosystems to absorb CO_2 emission.[161]

Conditional elements of NDCs are material – global emissions in 2030 would be 3.5 $GtCO_2e$ lower than the projected 52–55 $GtCO_2e$ baseline[162] if conditional elements of NDCs were fully implemented, and global GHG emissions implied by current NDC targets would not peak by 2030 unless all conditional targets are fully implemented. [163,164]

Ideally, **"NDCs 3.0" should make clear:**

- What emissions pathway could be achieved without external support, given the trends in technology and cost described in Chapter 3.

---

[155] Zero Carbon Analytics (2023), *Article 6 of the Paris Agreement at COP28: What is at stake ?*
[156] Ibid.
[157] Ibid.
[158] S&P Global (2023), *COP28: Lack of progress on Article 6 likely to further limit carbon market growth.*
[159] Ibid.
[160] Climate Resource (2023), *NDCs Methodology*.
[161] Ibid.
[162] Based on the full implementation of unconditional NDC targets. See UNFCCC (2023), *NDC synthesis report*.
[163] Based on the difference of averages of projected emissions range. See UNFCCC (2023), *NDC synthesis report*.
[164] UNFCCC (2023), *NDC synthesis report*.

- What reductions, or avoidance of emissions growth, can only occur only with external support.
- Why, and in what specific forms, is external support required.

For **international climate finance,** NDCs should make explicit the amount of finance required, and by when, to deliver on conditional targets, ideally further breaking down these conditional targets to allow partial implementation should all international finance not be delivered. Turning NDCs into clear investment plans will help Multilateral Development Banks (MDBs) mobilise the public and private finance required to deliver on higher ambition.

At present, analysis suggests that out of $4.5 trillion required to deliver current NDC targets, $1.6 trillion in investment are required to unlock conditional targets.[165] In comparison, just $100 billion of concessional climate finance has been pledged by developed economies to support mitigation and adaptation efforts of developing countries. Given the scale of investment required to deliver conditional targets, and their importance in overall emissions reductions, conditional targets in "NDCs 3.0" should contain clear, quantified investment needs to increase pressure on the international community to scale up climate finance.

Considerations around financing needs to achieve NDC targets are particularly important in light of the discussions around the New Collective Quantified Goal (NCQG) on Climate Finance due to take place in the lead up and at COP29 in 2024.[166]

Exhibit 4.3 assesses how far existing NDCs meet the various criteria which we have described in this section. Except for some of those developed by low and lower-middle income countries with support from technical assistance programs,[167] few meet all or even most of the criteria outlined in this section. This defines the need and opportunity for major improvements in the development of "NDCs 3.0".

Assessment of current NDCs with respect to ideal "NDC 3.0" framework

Exhibit 4.3

Category	Sub-category	What an NDC would ideally include	Country-level assessments						
			Archetype 1			Archetype 2		Archetype 3	
			🇪🇺	🇺🇸	🇧🇷	🇨🇳	🇮🇳	🇬🇲	🇪🇹
Format and coverage	Target type	Absolute emissions target or equivalent	✓	✓	✓	✗	✗	✓	✓
	Target coverage	Coverage of all sectors and GHGs	✓	✓	✓	✗	✗	~	~
	Target granularity	Sector-specific targets	✗	✗	✗	✗	✗	✓	✓
		GHG-specific targets	✗	✗	✗	✗	✗	✗	✗
	Article 6 mechanisms	Quantified contribution of Article 6 to overall target	✓	✓	~	✗	✗	✓	✓
	Conditionality	Clear definition of external support needed						~	✓

✓ Fully aligned with ideal NDC ~ Partially aligned with ideal NDC ✗ Not aligned with ideal NDC

Note: Countries shown in this table are deemed representative of defined archetype, exceptions can occur in given archetypes.

Source: Systemiq analysis for the ETC.

165 Investment figures are cumulative over the implementation period of NDC targets, presently up until 2030. See: World Resources Institute (2023), *9 things to know about NDCs*.

166 By decision 1/CP. 21, paragraph 53, parties decided that prior to 2025, the CMA shall set a New Collective Quantified Goal on Climate Finance from a floor of $100 billion per year to support mitigation and adaptation efforts of developing economies. See UNFCCC (2023), *New Collective Quantified Goal on Climate Finance*.

167 Technical assistance programmes for NDCs are initiatives aimed at supporting countries fulfill their commitments under the Paris Agreement, including NDCs. These programmes offer support such as capacity building, technology transfer, financing mechanisms and policy development, and play a crucial role in helping countries, in particular low-income countries, in overcoming barriers to NDC planning and implementation.

4.3 Implementation: Supporting NDC targets with clear strategic planning

Chapter 3 made clear that policymakers should feel confident to raise the ambition of "NDCs 3.0" given the rapid progress of low-carbon technologies. It is also essential to **reduce the current implementation gap** by including in NDCs clear definition of the investments and other actions required to deliver emission reduction targets, and of the policies which will drive that investment.

These implementation plans will be most effective if they include both:

- A strategic vision for the evolution of the country's energy system, and of its land use.
- Clear description of the policies which will deliver energy system and land use change, for example targets for renewable energy deployment, or bans on the sale of fossil fuel equipment.[168]

Strategic vision

Emissions will only be reduced, or their growth curtailed in those countries where low income makes further growth unavoidable, if the energy system changes to allow energy services to be delivered in a low-carbon fashion. This will require some combination of:

- Shifts in the balance of final energy consumption from the current dominant use of fossil fuels to greater use of electricity across sectors.
- Decarbonisation of electricity generation.
- The use of hydrogen and sustainable bioenergy in place of fossil fuels.
- The vital but limited application of CCUS to continued fossil fuel use whether in industry or power generation.

A clear vision for the intended balance between these different factors, and how rapidly they can develop, will provide greater certainty within which investors, businesses and energy users can plan investments in energy-producing or -consuming equipment. NDCs should therefore include, or reflect, a strategic vision of how the balance of energy production and use will evolve over time, and demonstrate how this energy system vision translates into the targeted emission pathway. Key metrics within this strategic vision should include:

- The anticipated growth of electricity generation and consumption, the balance between different types of generation (i.e. fossil fuels versus renewables versus bio-based), and the resulting carbon intensity (in grams of CO_2 per kWh) of electricity generation.
- The anticipated continued consumption of coal and gas in electricity generation and in industry.
- The anticipated consumption of oil in road transport, shipping and aviation.
- The anticipated consumption of natural gas for building heating and cooking.

[168] ETC (2023), *Financing the transition: How to make the money flow for a net-zero economy.*

Many indicators can be used to this end, as illustrated by Exhibit 4.4. Countries could opt for indicators, or a combination of these indicators, which:

- Provide targets and inform on the deployment of low-carbon technologies (e.g., wind and solar capacity deployment, share of EV sales in total passenger vehicle sales, share of heat pumps in heating system sales).
- Provide information on changing energy demand or supply patterns by sector (e.g., total energy demand/supply and energy demand/supply mix by sector/energy vector).
- Provide detailed information on the underlying drivers of energy demand, changes in the efficiency with which a product or service is delivered by unit energy demand, and associated carbon intensity of the energy used (e.g., total demand for steel, energy intensity of steel production and carbon intensity of energy use in the steel sector).

Given the COP28 commitment by all countries to transition away from fossil fuels in the energy system, it would be helpful for the next round of NDCs and further supporting documents to detail the implications of delivering energy-related commitments for future fossil fuel demand.

This strategic vision should also include considerations around the investments and the supporting infrastructure (e.g., power grids, EV charging infrastructure) to enable the scale-up of solutions that underpin this vision of how a national energy system will evolve over time.

Similar strategic visions should be laid out for non-energy sectors, in particular for the agriculture, food and land-use sector (AFOLU), given the materiality of emissions (approximately 12 GtCO$_2$e, eq. to 20% of global GHG emissions), the recent disappointing progress and developments, and its interlinkages with

---

Example indicators to support the strategic vision of energy system transformation Exhibit 4.4

		Economy-wide, absolute emissions reduction targets in NDCs *(or equivalent)*		
		Indicators to support strategic vision		
Sector		**Low-carbon technology deployment**	**Energy demand / supply patterns**	**Demand for services, energy use and associated emissions**
Energy supply	Power	• Installed renewables capacity (in GW) • Annual capacity addition for renewables (in GW p.a.)	• Total energy supply (in EJ or TWh) • Energy supply mix[1] (in %)	• Carbon intensity of power generation (in gCO$_2$/kWh)
	Hydrogen	• Share of low-carbon hydrogen in total hydrogen supply (in %)	• Total energy supply (in EJ or TWh) • Energy supply mix[2] (in %)	• Carbon intensity of hydrogen production (in gCO$_2$/kg)
Energy demand	Buildings	• Share of heat pumps in total home heating systems (in %) • Retrofitting rate of existing building stock (in % p.a.)	• Total final energy demand (in EJ or TWh) • Final energy demand mix[3] (in %)	• Total demand for energy services[4] • Energy intensity of energy service provided (kWh or MJ/ energy service) • Carbon intensity of energy used (gCO$_2$e/energy service)
	Industry	• Hydrogen-based steel production in total production (in %) • Share of low-carbon ammonia in total ammonia production (in %)		
	Transport	• Share of EVs in total passenger vehicle sales (in %) • Share of SAF in total aviation fuel demand (in %) • Share of low-carbon fuels in total shipping fuel demand (in %)		

[1] For power, supply mix should include, at a minimum: renewables (wind, solar, hydro, bioenergy, other), nuclear, fossil fuels (coal, natural gas, oil, either abated or unabated); [2] Hydrogen mix should include: grey (from fossil fuels), blue (from fossil fuels with CCS), green (from renewables-powered electrolysis); [3] Energy demand mix should include, at a minimum: fossil fuels (coal, natural gas, oil, either abated or unabated), direct power, hydrogen and bioenergy; [4] Energy services can include total demand for road transport (pkm), total floorspace demand (km^2), total industrial output (e.g., tonnes of steel, ammonia, cement, etc.).

Note: Non-exhaustive list of indicators, indicators can be used in combination, specific units for indicators are indicative and should be adapted to suit national circumstances, indicators can exist in NDCs or in external documents explicitly referenced by NDCs.

Source: Systemiq analysis for the ETC.

the energy sector.[169,170] Such strategic vision should include how changing patterns for food production (whether for domestic consumption or export) and of bioenergy production will translate into land use change.[171] NDCs should also clearly specify the assumptions made on the scale of nature-based removals, such as reforestation, and what implications this will have for land use.

Clear sectoral policies

The strategic vision for energy system transition to lower carbon intensity will only be achieved if strong supporting policies are in place at sectoral level. NDCs should therefore specify clearly what policies will be required to drive which elements of change.

The relative importance of different policies will reflect local circumstances, but in all countries, policy definitions should ideally include:

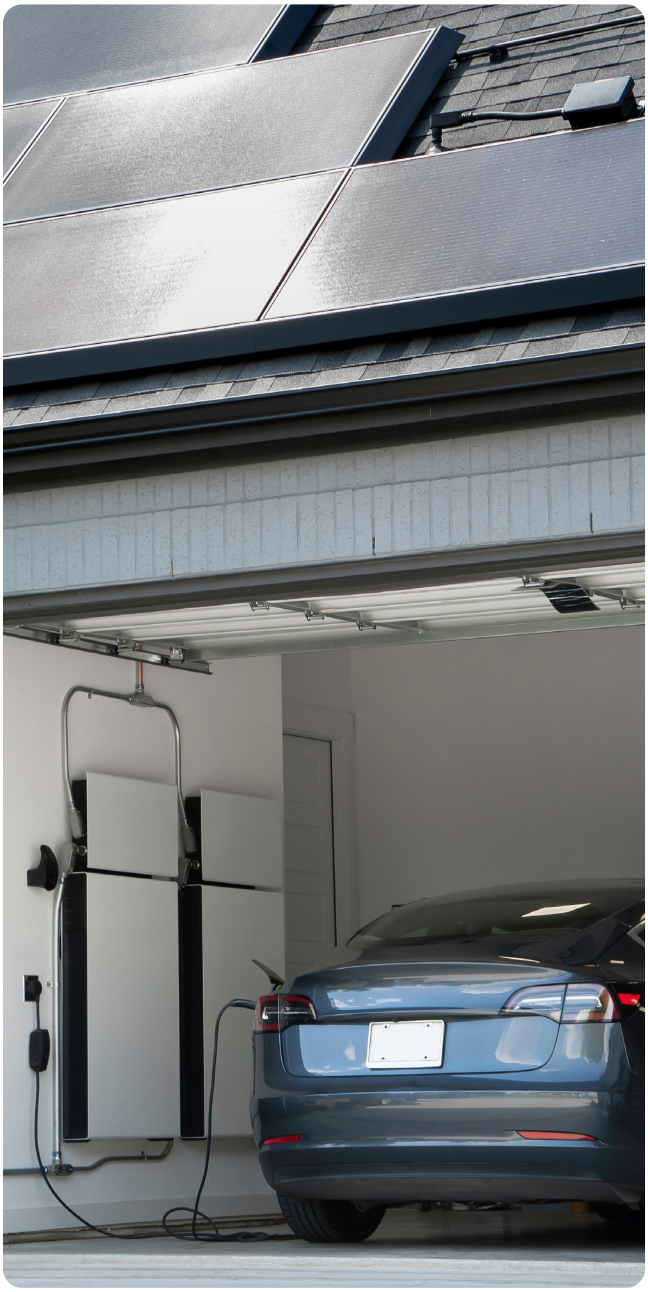
- Detailed plans and policies to drive **decarbonisation of the growing electricity system.** This should entail description of the proposed subsidies or other policies required to support the growth of renewable or bio-based power generation, and the policies needed to ensure that investments in storage, flexible generation and grid transmission capacity are sufficient to support growing electricity demand and decarbonisation.
- Clear policies to drive the **decarbonisation of road transport,** specifying for instance the pace at which EV sales might grow as a percentage of the total, and the policies and investments (e.g., in charging infrastructure) required to enable that growth.
- Clear policies to **improve energy efficiency in both residential and commercial buildings,** whether through regulations and incentives that can improve the efficiency of heating, cooling, or other appliances, or through improved building standards and insulation.

A strong package of policies which supports NDC targets will provide clear direction and increased market certainty for industry to scale up investment in low-carbon technologies, and will help governments capitalise on the opportunity offered by the manufacturing of these technologies.

Recent analysis from the ETC and BloombergNEF further highlights priority policy interventions across energy-consuming sectors to accelerate emissions mitigation.[172,173]

In the **AFOLU sector,** NDCs should describe the policies which will ensure that land use develops in the targeted fashion, halting deforestation and ensuring that any bioresource development is done in a sustainable way.

Implementation plans, and the information they contain, can either be included explicitly within the NDCs submitted by countries or exist in separate documents. In the case of the latter, NDCs should explicitly reference those documents.



[169] IPCC (2022), *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.*

[170] See Chapter 4.4 of ETC (2023), *Fossil fuels in transition.*

[171] ETC (2021), *Bioresources within a net-zero emissions economy.*

[172] See Section 5.3 of ETC (2023), *Fossil fuels in transition.*

[173] BloombergNEF (2024), *G20 Zero-Carbon Policy Scoreboard 2024.*

What is needed from "NDCs 3.0"

5

The Global Stocktake made clear that climate action must accelerate drastically if the world is to have any chance of achieving the goals of the Paris Agreement of limiting global warming to well-below 2°C, and ideally 1.5°C, which COP28 reiterated as the global benchmark. The time to act is now.

Sections 1–4 of this report set out the opportunity for "NDCs 3.0" to triple ambition to 2035 relative to that implied by the targets of current NDCs, and to improve their format to make them more effective roadmaps to catalyse climate action.

Successes to date in the transition to low-carbon energy have seen government ambition stimulating industry action, leading to rapid technology deployment and cost reductions, in a self-reinforcing cycle. This cycle can be further reinforced if the "NDCs 3.0" which countries must submit ahead of COP30:

- Significantly **raise the ambition of emissions reduction targets,** in line with the goals of the Paris Agreement. It is therefore imperative that governments make "NDCs 3.0" their priority starting today.
- **Make clear how stated targets in NDCs will be delivered,** including how existing policies will be enhanced to drive and support the required investments.
- **Improve the format of targets** contained in NDCs, to make them more consistent, comprehensive and detailed, in line with the Paris Agreement.

It is important to recognise that countries have very different contexts and capacity to support, and deliver, the required transition. The precise form which NDC improvements should take should therefore reflect this **variety of national circumstances** [Exhibit 5.1]:

- Countries with clearly defined ambition but where current policies will not fully deliver the targets (e.g., The US, the EU, Brazil) should focus on closing the implementation gap, specifying how much reduction current policies will deliver and how they existing policies will be strengthened to ensure that targets are fully achieved (Archetype 1).
- Countries with unclearly defined ambition but which are achieving rapid progress on key objectives (e.g., China, India) should develop targets which reflect the emissions reductions likely to be achieved (Archetype 2.a).
- Countries with both unclear ambition and implementation plans which still fall short of what is now technologically possible (e.g., Saudi Arabia) should ideally set clearer ambition, informed by the

Archetype-specific recommendations to improve "NDCs 3.0"

Exhibit 5.1

	Ambition	Implementation	Consistency, coverage and granularity
Archetype 1	• Reflect the impact of existing climate policies • Reflect the rapid pace of progress of mature low-carbon technologies • Reflect the impact of delivering national and sectoral pledges and commitments	• Make clear the policies required to meet targets, including how current policies will be strengthened • Reflect existing national strategies in NDCs	• Set absolute emissions reductions targets, covering all sectors and GHGs • Include sector- and sub-sector level targets and indicators
Archetype 2 A			• Set absolute emissions reductions targets, covering all sectors and GHGs, or equivalent target that can be converted to absolute emissions reduction • Include sector-level targets and indicators
Archetype 2 B		• Develop strategic thinking required to deliver ambition (including policies)	
Archetype 3		• Make clear what support is required to deliver conditional targets • Make clear plans to enforce policies required to deliver targets	

Source: Systemiq analysis for the ETC progress described in Section 3, and specify how this can be achieved (Archetype 2b).

- Countries with clear ambition and plans to deliver, but whose targets are mostly conditional (e.g., Ethiopia, the Gambia) should make clear what they require to deliver these conditional targets and ensure they have the governance in place to achieve them (Archetype 3).

This report lays out the ETC's vision of what should be the ambition of "NDCs 3.0" and what "NDCs 3.0" would ideally include to catalyse a significant increase in ambition and implementation, making clear priority areas for the different archetypes defined. We hope this guidance is useful to the international community and official bodies such as UNFCCC to support their thinking about whether official guidance for NDC setting ought to become more specific in the future. And we call for it to be used by national policy-makers in making "NDCs 3.0" the step change in climate action that the world needs.

Acknowledgements

The team that developed this briefing comprised:
Lord Adair Turner (Chair), Faustine Delasalle (Vice-Chair), Ita Kettleborough (Director), Mike Hemsley (Deputy Director), Hugo Liabeuf (lead author), Hugo Stevens (supporting lead author) with support from John Allen, Hannah Audino, Andrea Bath, Leonardo Buizza, Shane O'Connor, Rose Dortch, Apoorva Hasija, Elizabeth Lam, Tommaso Mazzanti, Viktoriia Petriv, Lizzie Petykowski, Elena Pravettoni, Caroline Randle, Jonny Xiao (SYSTEMIQ).

The team would also like to thank the ETC members and experts for their active participation:
Nicola Davidson (ArcelorMittal); Alan Thomson (Arup); Paige Marie Morse (AspenTech); Albert Cheung and Victoria Cuming (BNEF); Gareth Ramsay (bp); Justin Bin LYU and Yi Zhou CIKD); Adam Tomassi-Russell (Deep Science Ventures); Adil Hanif (EBRD); Cedar Zhai and George Wang (Envision); Keith Allott and Rebecca Collyer (European Climate Foundation); Eleonore Soubeyran (Grantham Institute, London School of Economics); Matt Prescott (Heathrow Airport); Kash Burchett, Sophie Lu and Jonathan Scott Keyes (HSBC); Francisco Laveron (Iberdrola); Yanan Fu (ICCSD); Chris Dodwell and Shahbano Soomro (Impax Asset Management); Gaia de Battista (Just Climate); Ben Murphy (Kiko Ventures); Jaekil Ryu (Korea Zinc); Freya Burton (LanzaTech); Carl Moxley (L&G); Maria Von Prittwitz (Lombard Odier); Vincenzo Cao (LONGi); Steve Smith (National Grid); Rachel Fletcher (Octopus Energy); Rahim Mahmood (Petronas); Leonardo Buizza (Quadrature Climate Foundation); Susan Hansen and James Schofield (Rabobank); Manya Ranjan (ReNew Power); Jonathan Grant (Rio Tinto); Kingsmill Bond, Greg Hopkins and Laurens Speelman (RMI); Emmet Walsh (Rothschild & Co.); Daniel Wegen (Royal Dutch Shell); Emmanuel Normant (Saint Gobain); Vincent Petit (Schneider Electric); Brian Dean (SEforAll); Paul Wilkinson (SLR Consulting); Martin Pei (SSAB); Alistair McGirr (SSE); Sharon Lo (Tara Climate Foundation); Abhishek Goyal (Tata Group); Saurabh Kundu (Tata Steel); A K Saxena (TERI); Kristiana Gjinaj (TES); Reid Detchon (United Nations Foundation); Mikael Nordlander (Vattenfall); Niklas Gustafsson (Volvo); Andrew Prag and Molly Walton (We Mean Business Coalition); Taryn Fransen, Rachel Jetel, Jennifer Layke and David Waskow (World Resources Institute); Paul Ebert (Worley); Richard Hardy (X-Links).

The team would also like to thank the ETC's broader network of experts for their input:
Nigel Topping (Ambition Loop); Ari Reeves (CLASP); Neil Grant (Climate Analytics); Azam Suleman (Department for Energy Security and Net Zero); Edd Denbee and Eugenia Sanchez (Glasgow Financial Alliance for Net Zero); Arianna Griffa and Emily Murrell (The Institutional Investors Group on Climate Change); Sarah Hertel (NDC Partnership); Lorenz Moosmann (Oeko Institut); Charles Ogilvie (Ocean Energy Pathway); Lewis Hill (World Business Council for Sustainable Development).

Energy
Transitions
Commission