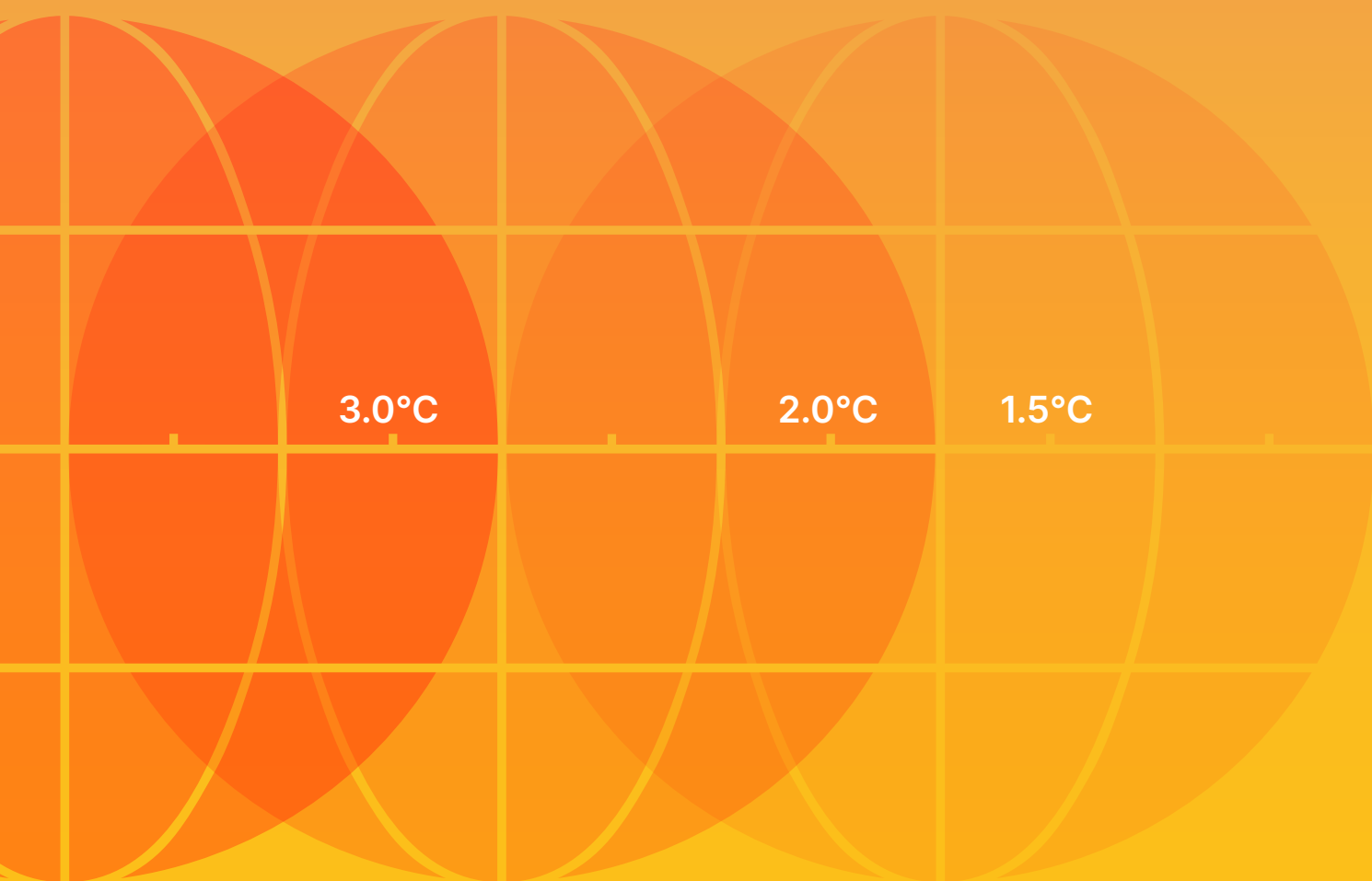


The Keeping 1.5°C Alive Series

Degree of Urgency: Accelerating Action to Keep 1.5°C on the Table

November 2022



Energy
Transitions
Commission

Degree of Urgency

Accelerating Action to Keep 1.5°C on the Table

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 Faustine Delasalle (Vice-Chair), Ita Kettleborough (Director), and Mike Hemsley (Deputy Director). Our Commissioners are listed on the next page.

Degree of Urgency: Accelerating Action to Keep 1.5°C on the Table was developed by the Commissioners with the support of the ETC Secretariat, provided by SYSTEMIQ. This briefing paper has also been developed in close consultation with experts from companies, industry initiatives, international organisations, non-governmental organisations and academia.

This briefing paper draws heavily on work developed by Climate Action Tracker (CAT) and the International Energy Agency (IEA), and ETC knowledge partners BloombergNEF. We warmly thank our knowledge partners and contributors for their inputs.

This report constitutes a collective view of the Energy Transitions Commission. Members of the ETC endorse the general thrust of the arguments made in this publication but should not be taken as agreeing with every finding or recommendation. The institutions with which the Commissioners are affiliated have not been asked to formally endorse this briefing paper.

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

Our Commissioners

Mr. Bradley Andrews,
President - UK, Norway, Central Asia &
Eastern Europe – Worley

Mr. Spencer Dale,
Chief Economist – bp

Dr. Ani Dasgupta,
President and Chief Executive Officer –
World Resources Institute

Mr. Bradley Davey,
Executive Vice President, Head of
Corporate Business Optimisation –
ArcelorMittal

Mr. Jeff Davies,
Chief Financial Officer – L&G

Mr. Pierre-André de Chalendar,
Chairman and Chief Executive Officer –
Saint Gobain

Mr. Agustin Delgado,
Chief Innovation and Sustainability
Officer – Iberdrola

Dr. Vibha Dhawan,
Director General, The Energy and
Resources Institute

Mr. Will Gardiner,
Chief Executive Officer – DRAX

Dr. Thomas Hohne-Sparborth,
Head of Sustainability Research –
Lombard Odier Investment Managers

Mr. John Holland-Kaye,
Chief Executive Officer – Heathrow Airport

Mr. Fred Hu,
Founder, Chairman and Chief Executive
Officer – Primavera Capital

Ms. Mallika Ishwaran,
Chief Economist – Royal Dutch Shell

Dr. Timothy Jarratt,
Chief of Staff – National Grid

Ms. Zoe Knight,
Managing Director and Head of the HSBC
Centre of Sustainable Finance – HSBC

Mr. Jules Kortenhorst,
Chief Executive Officer – Rocky Mountain
Institute

Mr. Mark Laabs,
Executive Chairman – Modern Energy

Mr. Richard Lancaster,
Chief Executive Officer – CLP

Mr. Li Zheng,
Professor and Executive Vice President
– Institute of Climate Change and
Sustainable Development, Tsinghua
University

Mr. Li Zhenguo,
Founder and President – LONGi

Mr. Martin Lindqvist,
Chief Executive Officer and President –
SSAB

Mr. Johan Lundén,
Senior Vice President, Project and Product
Strategy Office – Volvo Group

Ms. Laura Mason,
Chief Executive Officer – L&G Capital

Dr. María Mendiluce,
Chief Executive Officer – We Mean
Business

Mr. Jon Moore,
Chief Executive Officer – BloombergNEF

Mr. Julian Mylchreest,
Executive Vice Chairman, Global Corporate
& Investment Banking – Bank of America

Ms. Katherine Neebe,
Chief Sustainability & Philanthropy
Officer – Duke Energy

Ms. Damilola Ogunbiyi,
Chief Executive Officer – Sustainable
Energy For All

Mr. Paddy Padmanathan,
Vice-Chairman and Chief Executive
Officer – ACWA Power

Ms. Nandita Parshad,
Managing Director, Sustainable
Infrastructure Group – EBRD

Mr. Sanjiv Paul,
Vice President, Safety Health and
Sustainability – Tata Steel

Mr. Alistair Phillips-Davies,
Chief Executive – SSE

Mr. Andreas Regnell,
Senior Vice President, Head of Strategic
Development – Vattenfall

Mr. Menno Sanderse,
Head of Strategy and Investor Relations –
Rio Tinto

Mr. Siddharth Sharma,
Group Chief Sustainability Officer – Tata
Sons Private Limited

Mr. Ian Simm,
Founder and Chief Executive Officer –
Impax Asset Management

Mr. Mahendra Singhi,
Managing Director and Chief Executive
Officer – Dalmia Cement (Bharat) Limited

Mr. Sumant Sinha,
Chairman, Founder and Chief Executive
Officer – ReNew Power

Lord Nicholas Stern,
IG Patel Professor of Economics and
Government – Grantham Institute – LSE

Ms. Alison Taylor,
Chief Sustainability Officer – ADM

Dr. Günther Thallinger,
Member of the Board of Management,
Investment Management, Sustainability –
Allianz

Mr. Thomas Thune Anderson,
Chairman of the Board – Ørsted

Dr. Robert Trezona,
Founding Partner, Kiko Ventures – IP Group

Mr. Jean-Pascal Tricoire,
Chairman and Chief Executive Officer –
Schneider Electric

Ms. Laurence Tubiana,
Chief Executive Officer – European Climate
Foundation

Lord Adair Turner,
Chair – Energy Transitions Commission

Senator Timothy E. Wirth,
President Emeritus – United Nations
Foundation

Mr. Zhang Lei,
Founder and Chief Executive Officer –
Envision Group

Dr. Zhao Changwen,
Director General, Senior Fellow,
Department of Industrial Economy –
Development Research Center of the State
Council P.R. China

Ms. Cathy Zoi,
Chief Executive Officer – EVgo

Major ETC reports and working papers



Global Reports



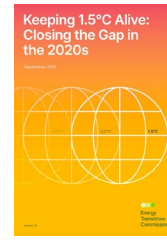
Mission Possible outlines pathways to reach net-zero emissions from the harder-to-abate sectors in heavy industry (cement, steel, plastics) and heavy-duty transport (trucking, shipping, aviation).



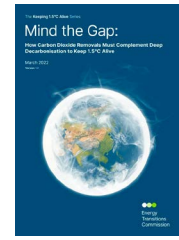
Making Mission Possible (2020) shows that a net-zero global economy is technically and economically possible by mid-century and will require a profound transformation of the global energy system.



Making Mission Possible Series (2021-2022) outlines how to scale up clean energy provision to achieve a net-zero emissions economy by mid-century.



Keeping 1.5°C Alive (2021) a COP26 special report outlining actions and agreements required in the 2020s to keep 1.5°C within reach.



Mind the Gap (2022) highlights how carbon dioxide removals must complement deep decarbonisation through clean electrification to keep 1.5°C alive.

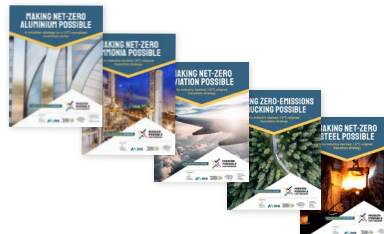


Sectoral and cross-sectoral focuses

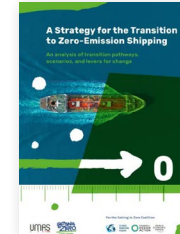


Sectoral focuses provided detailed decarbonisation analyses on six of the harder-to-abate sectors after the publication of the **Mission Possible** report (2019).

As a core partner of the MPP, the ETC also completes analysis to support a range of sectoral decarbonisation initiatives:



MPP Sector Transition Strategies (2022): a series of reports that aim to guide the decarbonisation of seven of the hardest-to-abate sectors. Of these, four are from the materials industries: aluminium, chemicals, concrete, and steel, and three are from the mobility and transport sectors – aviation, shipping, and trucking.



The Next Wave: Green Corridors (2021) raises ambitions to look at how specific trade routes between major port hubs where zero-emission solutions are demonstrated and supported can accelerate the speed of shipping's transition.



Geographical focuses



China 2050: A Fully Developed Rich Zero-carbon Economy (2019) describes the possible evolution of China's energy demand sector by sector, analysing energy sources, technologies and policy interventions required to reach net-zero carbon emissions by 2050.

Canada's Electrification Advantage in the Race to Net-Zero (2022) identifies 5 catalysts that can serve as a starting point for a national electrification strategy led by Canada's premiers at the province level.



A series of reports on the Indian power system and outlining decarbonisation roadmaps for Indian industry (2019-2022) describe how India could rapidly expand electricity supply without building more coal-fired power stations, and how India can industrialise whilst decarbonising heavy industry sectors such as steel.



Phase 1 and 2 of Setting up industrial regions for net zero (2021 & 2022) explore the state of play in Australia and opportunities for transition to net-zero emissions in five hard-to-abate supply chains – steel, aluminium, liquefied natural gas, other metals and chemicals.



Contents

The Energy Transitions Commission	2
Our Commissioners	3
Introduction	7
Chapter 1	11
Achievements at COP26: significant milestone but chances of keeping 1.5°C alive “hanging by a thread”	
Chapter 2	15
Position going into COP27: some progress in renewables, EVs, and harder-to-abate sectors, but minimal on NDCs, coal phase-out and deforestation	
2.1 Limited progress to increase commitments	16
Nationally determined contributions	16
Country level sector pledges	17
Private sector Commitments	18
2.2 Public policy to deliver already existing commitments – significant progress in some developed countries	18
2.3 Zero-carbon technologies increasingly competitive	19
2.4 Good progress in some sectors, but disappointing on methane, deforestation and coal	20
Chapter 3	23
Facing reality at COP27: a dwindling climate budget and commitments inconsistent with 1.5°C	
Chapter 4	29
Accelerating progress across multiple sectors and technologies	
Chapter 5	33
Closing the “financing gap” critical to keep 1.5°C on the table	
5.1 The scale of capital investment for net-zero	34
5.2 Financial transfers to phase-out coal generation, halt deforestation and scale carbon removals	37
Acknowledgements	41

Introduction

One key objective of the COP26 climate conference in 2021 was to “keep 1.5°C within reach”, agreeing to actions which could deliver at least a 50-50 chance of limiting global warming above preindustrial levels to 1.5°C, in line with the recommendations of the IPCC’s 2018 and 2022 reports.

Ahead of COP26 the Energy Transitions Commission, working closely with the UK COP26 Presidency, published a report, “Keeping 1.5°C alive: actions for the 2020s”. This report assessed progress already achieved and described further actions in six key areas which could be taken at Glasgow to keep the 1.5°C objective within reach:

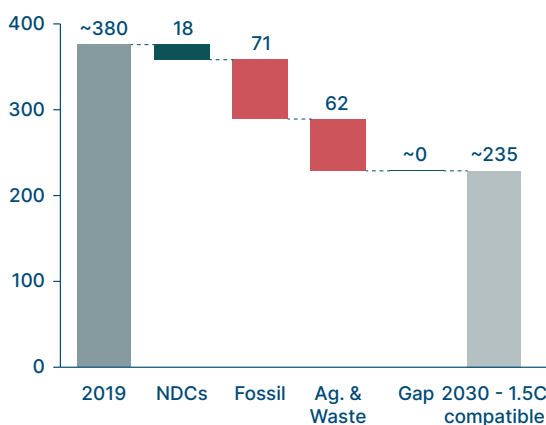
- **Methane:** Accelerating methane emissions reductions from fossil fuel sources (e.g. gas flaring, venting, leaking), agriculture and waste.
- **Nature based solutions:** Halting deforestation and increasing afforestation.
- **Power:** Agreeing no new coal power and phase-out of unabated coal alongside rapid renewables roll-out.
- **Road transport:** Transitioning from fossil-fuelled vehicles to battery electric vehicles.
- **Industry, Buildings, Aviation, Shipping:** A rapid expansion of green hydrogen for industry and long-distance transport (steel, ammonia, sustainable aviation fuel), transition from gas boilers to heat pumps.
- **Energy and Resource efficiency:** Improving efficiency through building and appliance standards, improved public transport and waste management.

In total we estimated that feasible action on methane could deliver a 40% cut in methane emissions by 2030 and that actions along the other dimensions could deliver an 18 Gigatonne (Gt) reduction in 2030 CO₂ emissions below the level implied by NDC commitments [Exhibit 1].

It's critical to accelerate action in 6 key areas to keep a 1.5°C world on the table

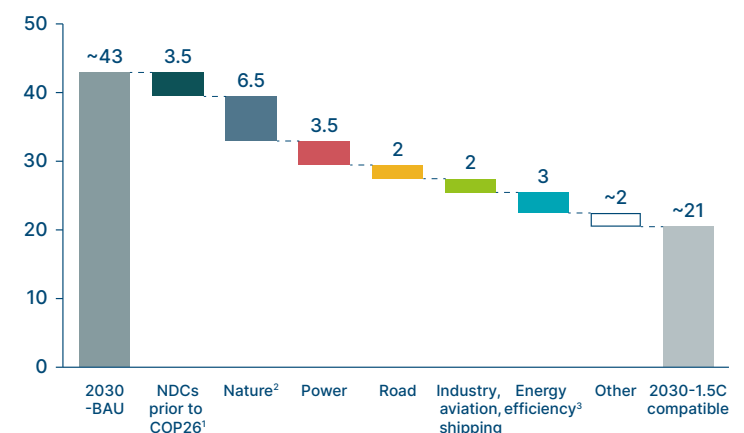
Global CH₄ emissions

Mt per annum



Global CO₂ emissions

Gt per annum



NOTE: (1) 3.5 GtCO₂ is the estimated carbon dioxide impact of the NDCs, taking the mid-point of the estimated impact range of unconditional (3.3 GtCO₂e) and conditional (4.7 GtCO₂e) commitments from Climate Action Tracker's (CAT) Emissions Gap estimates as of November 2021. ETC estimated a further 18 MtCH₄ are included in NDCs, equivalent to 0.5 GtCO₂e if using a 100-year multiplier. (2) Nature based solutions and carbon dioxide removals; (3) Includes resource efficiency.
SOURCE: Climate Action Tracker (CAT)

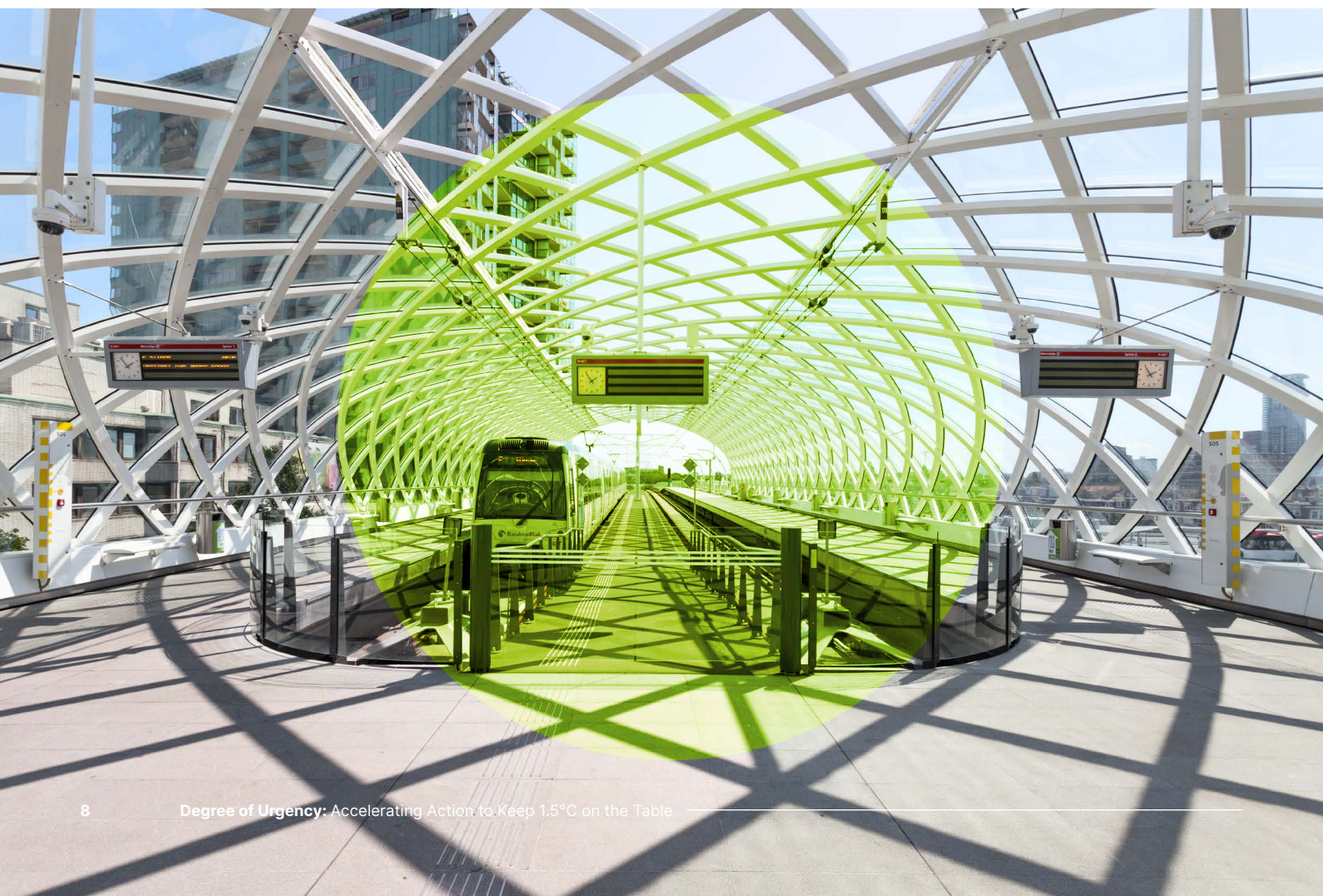
In the run up to COP27 in Egypt this November, this ETC Insights Brief provides an up-to-date assessment of progress and obstacles towards meeting the 1.5°C objective, and sets out the actions that must be taken if 1.5°C is to remain within reach.

Since COP26, and despite challenging economic and political developments that have led to significant increases in global food and energy prices, 2022 has seen significant progress towards the implementation of commitments made by major developed countries and China. But overall, the chances of limiting global warming to 1.5°C are quickly declining, and the objective will only remain credible if COP27 and subsequent COPs, together with nationally agreed policies and actions, deliver both:

- Further acceleration of emissions reductions in major developed countries.
- Large financial flows and technical assistance to help middle and low-income countries peak and then reduce emissions as soon as possible.

This brief sets out our assessment in five sections:

1. Achievements at COP26: significant milestone but chances of keeping 1.5°C alive “hanging by a thread”.
2. Position going into COP27: some progress in renewables, EVs, and harder-to-abate sectors, but minimal on NDCs, coal phase-out and deforestation.
3. Facing reality at COP27: a dwindling climate budget and commitments inconsistent with 1.5°C.
4. Accelerating progress across multiple sectors and technologies.
5. Closing the “financing gap” critical to keep 1.5°C on the table.

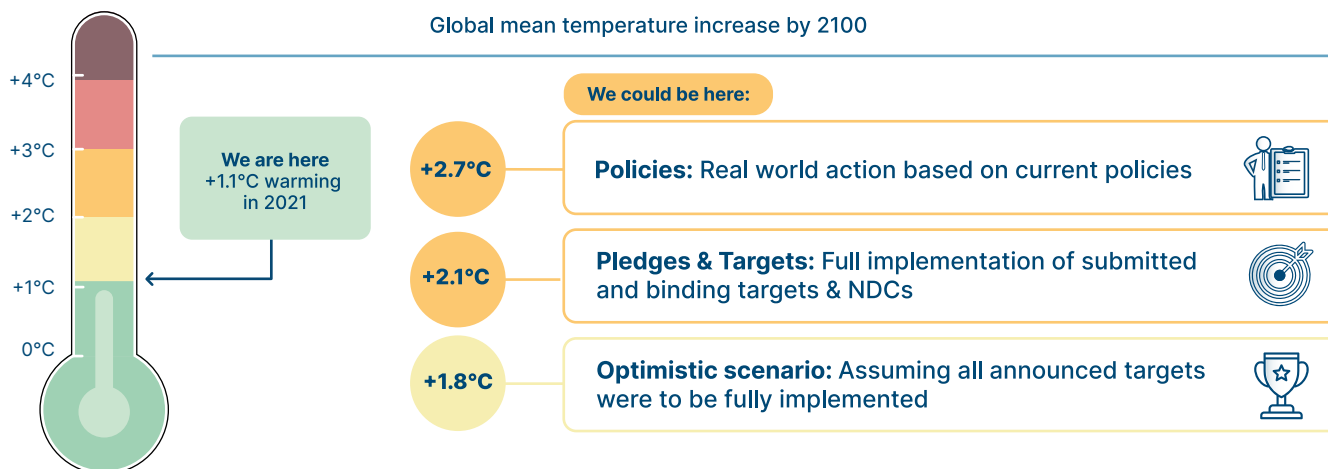


DEGREE OF URGENCY: ACCELERATING ACTION TO KEEP 1.5°C ON THE TABLE



SOME PROGRESS AT COP26, GAP TO 1.5°C REMAINS

Global mean temperature increase by 2100



PROGRESS MUST ACCELERATE ACROSS SECTORS:

CRITICAL SECTORS

PROGRESS SCORECARD

ACTIONS TO ACCELERATE

REDUCING METHANE EMISSIONS 40% BY 2030

MtCH₄

2030 Business-as-Usual ~380

Fossil extraction 71

Agriculture and waste 62

1.5°C compatible ~235

REDUCING CO₂ EMISSIONS 45% BY 2030

GtCO₂

2030 Business-as-Usual ~43

Nature 6.5

Power 3.5

Road 2

Industry & other 2

Energy efficiency 3

Other 2

1.5°C compatible ~21

Cost effective abatement potential exists, but lack of stringent monitoring and regulation.

POOR

Growing meat consumption per capita globally (except in Europe), continued poor waste management.

POOR



Tighter standards, monitoring, taxation



Behavioural change



Concessional/grant Payments



Policy

Forest loss persistently high with record losses in the Amazon in first half of 2022.

POOR

Record renewables (90% of new capacity additions) but little progress on coal phase down – finance required.

MIXED

Accelerating EV sales globally, 13% of all new light vehicle sales in 2022.

GOOD

Accelerating ambition (net zero targets) and action on the ground (investment in green steel plants, green ammonia, SAF, and rising heat pump sales).

GOOD

Reinforced commitments but lack of policy support. Some response to high energy prices, but likely behind required trajectory.

MIXED





Chapter 1

**Achievements at COP26:
significant milestone but
chances of keeping 1.5°C
alive “hanging by a thread”**

The UK presidency of COP26 defined its first goal as “to secure global net-zero by mid-century and keep 1.5°C within reach”.¹ Significant progress towards this objective was achieved through three approaches:

1. New or reinforced national targets and commitments for both long-term objectives (‘Net-zero’ targets) and shorter-term milestones (Nationally Determined Contributions (NDCs) for 2030), announced either in the year running up to COP26 or during the conference. On the NDC side, new commitments delivered only 3.5 GtCO₂ of additional emission reductions by 2030. However, by the end of COP26, 85% of global GHG emissions and 90% of global GDP were covered by a net-zero target.²
2. Sector specific commitments agreed by voluntary coalitions of countries. These commitments promised accelerated action along the six dimensions described earlier [Exhibit 2]. At the end of COP26, we estimated that these agreements could, if fully implemented, deliver 9.5 GtCO₂ reductions and just under a 15% cut in methane [Exhibit 3].³
3. Formal agreement in the final text that:
 - Countries should pursue efforts to limit the temperature increase to 1.5°C.⁴
 - Countries should bring forward reinforced NDCs before COP27, compatible with the Paris temperature goal; accelerating the five-year ratchet mechanism originally agreed in Paris in 2015.

Range of commitments on CO₂ reduction galvanised by COP26

NDC commitments	Improved commitments (examples): <ul style="list-style-type: none">• EU: Increase from “at least 40%” to 55% emissions reduction vs. 1990• USA: Increase from 26-28% by 2025 to 50-52% by 2030 emissions reduction vs. 2005• South Africa: Reduction of absolute emissions level from 398–614 to 350–420 MtCO₂e including LULUCF			
	Forest & Nature	Power	Other sectors	Finance
Other country commitments	<ul style="list-style-type: none">• Leaders’ Declaration on Forests and Land Use	<ul style="list-style-type: none">• Global Coal to Clean Transition Statement	<ul style="list-style-type: none">• Glasgow breakthroughs to accelerate clean tech deployment (incl. reporting on progress)• Product Efficiency Call to Action• Clydebank declaration for Green Shipping Corridors• New Mission Innovations on urban transitions, carbon dioxide removal, net zero industries	<ul style="list-style-type: none">• Statement on ending public fossil fuel financing
Joint commitments between both countries and non-state actors	<ul style="list-style-type: none">• Forest, agriculture and commodity trade (FACT) statement	<ul style="list-style-type: none">• Powering Past Coal Alliance	<ul style="list-style-type: none">• Declaration on zero emissions cars and vans	
Non-state actors: Corporates, finance, states, cities, etc.		<ul style="list-style-type: none">• Race to Zero ambitions agreed across 17 sectors (incl. cement, aviation, power, road)	<ul style="list-style-type: none">• Race to Zero ambitions agreed across 17 sectors (incl. cement, aviation, power, road)• First Movers Coalition for breakthrough technology developments	<ul style="list-style-type: none">• Glasgow Financial Alliance for Net Zero (GFANZ)

SOURCE: Energy Transitions Commission (ETC) research

¹ ‘COP26 Goals’, <https://ukcop26.org/cop26-goals/>

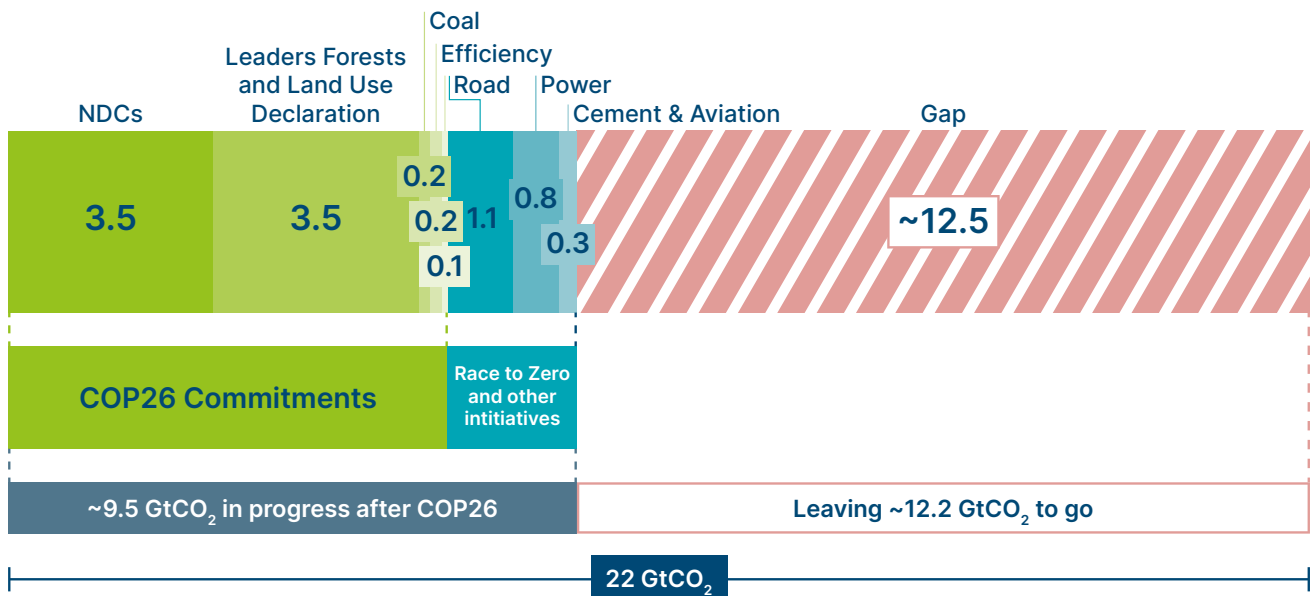
² Net Zero Tracker, <https://zerotracker.net/>

³ ETC (2021), ‘Assessing the commitments from COP26’.

⁴ UNFCCC, ‘Glasgow Climate Pact, Decision -/CP. 26, advance unedited version’ available at <https://unfccc.int/documents/310475> [1/CP. 26]. UNFCCC, Glasgow Climate Pact, Decision -/CMP.

To keep 1.5°C alive, annual CO₂ emissions in 2030 need to be 22 Gt lower than BAU

At the end of COP26, commitments (if delivered) would close that gap by 9.5 Gt



SOURCE: SYSTEMIQ analysis for the Energy Transitions Commission (2021)

Exhibit 3

Together, these results increased the probability that global warming could be limited to 1.5°C. But they are insufficient in themselves to deliver that objective – leaving a gap of approximately 12.5 GtCO₂ between pledges and a 1.5°C pathway.

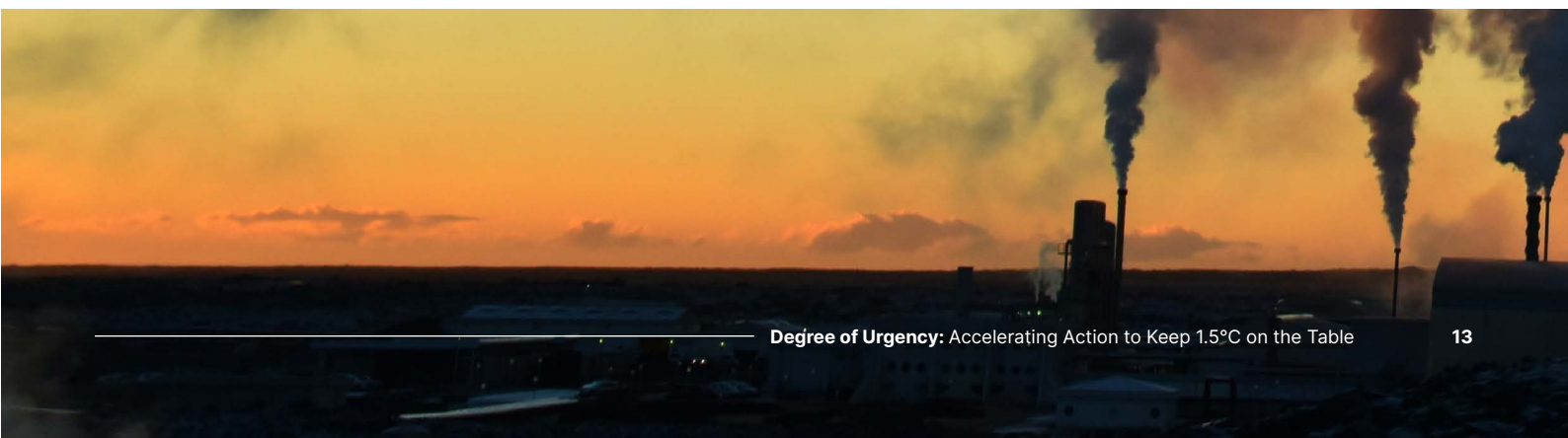
Assessments by the IEA and others in the aftermath of COP26 suggested that:

- Full implementation of formally submitted NDC targets, if not accompanied by further subsequent action, could result in 2.4°C warming.
- Adding the impact of long-term targets would put the world on a path to 2.1°C warming.

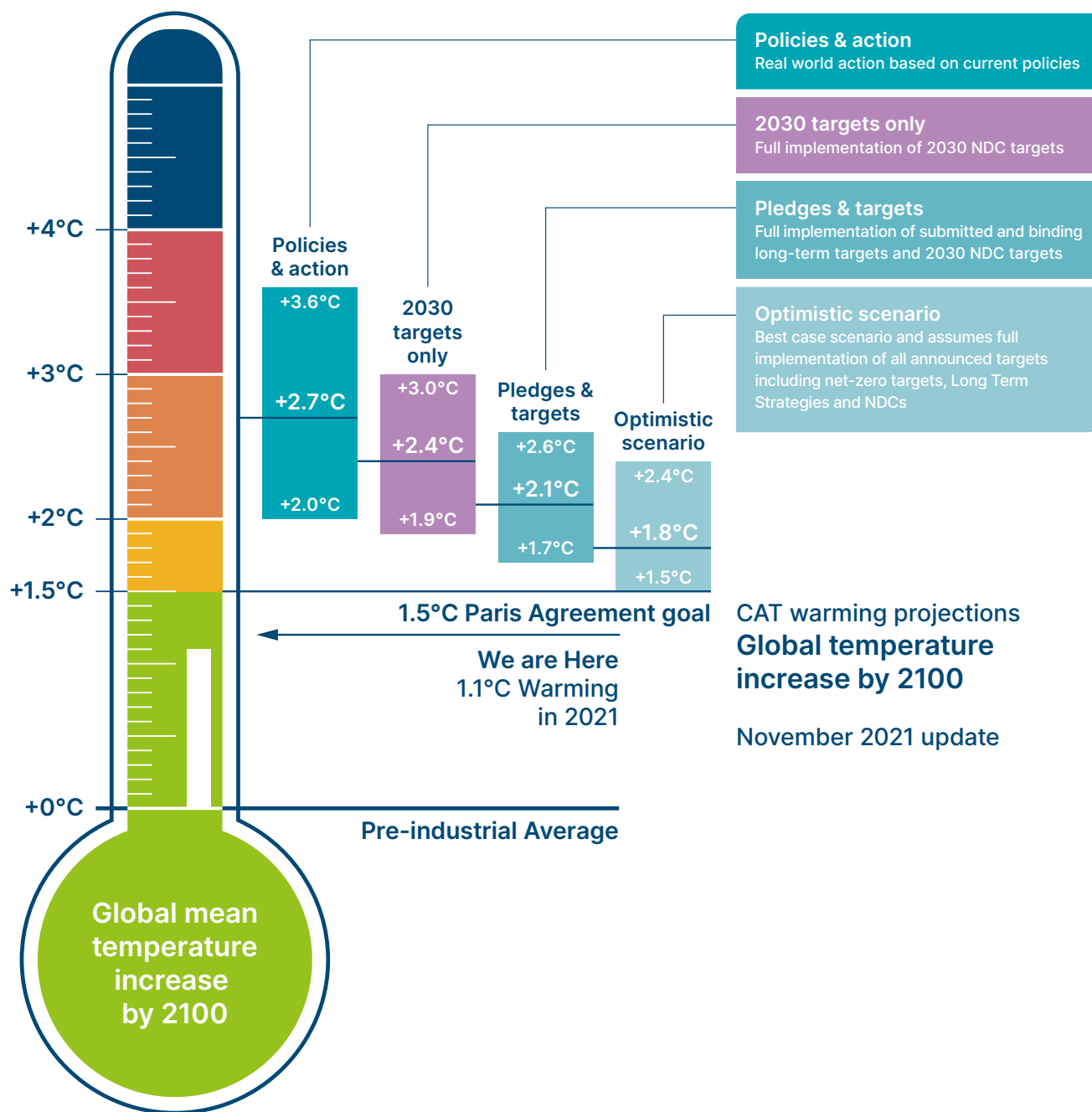
An optimistic assessment of the impact of all country targets and voluntary commitments, even when there are not yet clear policies to deliver them, could result in 1.8°C warming [Exhibit 4].

As COP26 President Alok Sharma said, the outcome of COP26 left the possibility of 1.5°C alive, but “hanging by a thread” and with a weak pulse.

In this environment, some voices are challenging whether a 1.5°C trajectory is even still available. However, each 0.1°C rise above 1.5°C will have hugely significant climate change impact. It is therefore essential to aim for this ideal target of 1.5°C, and to make sure that any overshoot of the target is as low as possible. Both full implementation of COP26 commitments and further progress at COP27 are therefore essential if the world is to have a 50-50 chance of limiting global warming to 1.5°C, and to limit any overshoot that may regrettably occur.



COP26 NDC commitments for 2030 lead to 2.4°C scenario under full implementation



SOURCE: Systemiq analysis; Climate Action Tracker.



Chapter 2

**Position going into COP27:
some progress in renewables,
EVs, and harder-to-abate
sectors, but minimal on
NDCs, coal phase-out
and deforestation**

The economic and political situation ahead of COP27 is highly challenging. In addition to lingering pressures resulting from the Covid-19 pandemic and supply chain disruptions, the world now faces record energy and high food prices in many regions resulting from the war in Ukraine. Together these are leading to high inflation, lower growth and risks of recession in many countries.

There is a danger that energy security and short-term economic pressures, together with geopolitical tensions, will divert national and international attention from climate change related issues. Yet, many of the actions needed to build greater energy security could also drive a faster transition to a low-carbon economy, as described in the ETC's paper *Energy Security through Accelerated Transition*.⁵ Despite the global geopolitical and macroeconomic headwinds, there is some evidence of progress on climate commitments.

This chapter therefore assesses the progress being made since COP26. Our summary findings are that:

- There has been very limited progress towards stronger country commitments either in the form of NDCs or mid-century net-zero targets.
- However, public policy developments in high-income countries and China have made it more likely that already existing targets for 2030 will be met. This is despite some short-term setbacks.
- Technological advancements continue to make zero-carbon technology increasingly competitive.
- Analysis along the six dimensions of action discussed earlier shows relatively strong progress in renewables, road transport, heavy industry, and aviation, unclear progress on energy efficiency, but limited progress on methane and coal phase-out, and adverse trends on deforestation.

2.1 Limited progress to increase commitments

Nationally determined contributions

The Paris Climate Agreement required countries to submit NDCs with a 5 year “ratchet mechanism”. COP26 was the first conference since Paris in 2015 where that “ratchet” applied, and updated NDCs were submitted by 151 parties (out of a total of 193 parties in the Paris Agreement).⁶ COP26 also urged countries to bring forward new NDCs ahead of COP27, accelerating the ratchet mechanism: it also urged that those new NDCs should be compatible with the 1.5°C climate objective.

As of 19th October 2022, 24 new NDC updates had been submitted, and in aggregate these make only a very limited contribution to closing the 2030 emissions gap.⁷

- The largest emitter to materially update their NDC is Australia, whose new 2030 target for a 43% cut in emissions on 2005 levels has lowered the 2030 emissions gap by around 0.1 Gt.⁸
- India has formally submitted an NDC based on pledges made by Prime Minister Modi at COP26. While the NDC is stronger on both emissions intensity and the share of clean electricity, it already aligns with India's climate action and is therefore not expected to drive emissions reductions beyond what was previously expected.⁹
- Brazil and Egypt submitted updates but failed to significantly increase ambition.¹⁰ Egypt's 2030 target would see emissions continuing to rise in absolute terms and even above what is expected with currently implemented policies.¹¹

In addition to these changes to NDC targets, at the time of writing six countries have published strategy documents providing more detail on how NDCs will be achieved.

5 ETC (2022) *Building Energy Security Through Accelerated Energy Transition*.

6 UNFCCC (2021) *COP26: Update to the NDC Synthesis Report*.

7 UNFCCC (2022) *Climate Action Tracker Climate Target Update Tracker*.

8 Climate Action Tracker (2022) *Country Assessments*. Note that South Korea also had a material improvement to its NDC, which halves the gap to becoming 2°C compatible, but it is still distant from being 1.5°C compatible. While this NDC update was formally submitted in December 2021, it was announced in October 2021 and therefore included in CAT's assessment of NDC progress at COP26.

9 Climate Action Tracker (2022) *Country Assessments*.

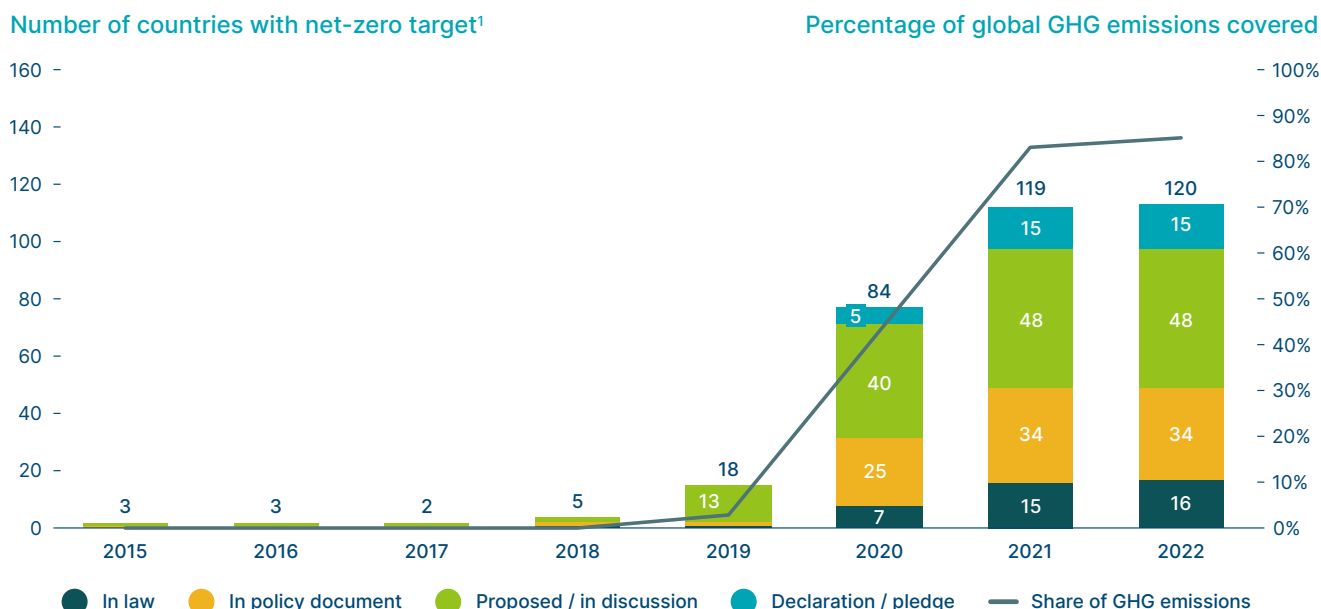
10 Brazil's March 2022 update is stronger than its 2020 update, but remains weaker than its original NDC submitted in 2016.

11 Climate Action Tracker (2022) *Country Assessments*.

Mid-Century Net-Zero Targets

Ahead of COP26 there was a large surge in the number of countries making a commitment to reach net-zero emissions by around mid-century (in most cases 2050 or 2060). Since COP26 only Australia has formalised its net-zero commitments in legislation [Exhibit 5].

Since COP26, progress of new net-zero commitments and transitioning them towards law has dramatically slowed down



NOTE: 1) Encompasses terms "carbon negative", "carbon neutral(ity)", "climate neutral", "climate positive", "GHG neutral(ity)", "Net zero". 2) GHG emissions baseline from 2019 is used. 3) Excludes countries that have unassigned years for their net zero target.

SOURCE: Data from Net Zero Tracker (zerotracker.net) retrieved on 03/09/2022

Country level sector pledges

At COP26, many countries signed up to non-NDC pledges which aim to drive action in specific sectors, and which might later be reflected in tightened NDCs. However, since COP26 there has been limited progress in expanding the number of countries signed up to these initiatives.

- The Global Methane Pledge announced in the run-up to COP26 now has over 122 endorsing countries. In the most notable step since COP26, Qatar – a major gas exporter – endorsed the Pledge in March 2022. However, the Pledge is still missing endorsements from significant players such as Russia and China.
- For deforestation, there have been no new notable country commitments to the efforts at COP26, though there has been progress in laying out key priorities since the launch of the FACT Roadmap at COP26.¹²
- For power, there have been no additional commitments to stopping new coal since COP26, with no additional signatories to the Powering Past Coal Alliance (PPCA), No New Coal Power Compact (NNCPC) or the COP26 Coal to Clean Power Transition Statement.
- The COP26 declaration on accelerating the transition to 100% zero-emissions cars and vans has seen 65 new country and company sector signatories since COP26, among which Greece is the latest to sign.

¹² While there have not been new signatories to the FACT Dialogue, there have been steps taken to define action priorities across the four thematic areas of: Trade and Markets; Transparency and Traceability; Smallholder Support; and Research, Development, and Innovation.

- The COP26 Clydebank Declaration for green shipping corridors now has 24 signatories, with 2 new joining since COP26, Palau – and most notably – Singapore, a key Asian shipping hub.
- The International Aviation Climate Ambition Coalition now has 54 current signatories, increasing from 23 at COP26.
- The Product Efficiency Call to action which aims to increase efficiency of four key appliances in mass markets has only seen one new signatory (Panama) taking the total to 15.
- On the Glasgow Breakthrough to accelerate clean tech deployments, the number of signatories has not changed. However, in 2022 the Agriculture Breakthrough has been formally launched.

Overall, country and private sector commitments to these sector actions suggest that there is additional potential for countries to strengthen their NDCs beyond what was pledged at the time of COP26. In particular, the pledge to end deforestation by 2030 is likely significantly under-reflected in both Brazil and Indonesia's NDCs. Similarly, ETC estimates suggest that China and India, amongst other countries, could materially increase NDC ambition based on accelerated progress in the power and road transport sectors if the above commitments were to be fully implemented.

Private sector Commitments

In addition to countries, private sector companies and financial institutions can make net-zero commitments and, in some cases, embrace "Science based targets" which commit them to a path of emissions reduction.

By the end of 2021 over 1000 companies across the world had SBT commitments, with the majority in Europe. In addition, more than 450 financial institutions representing \$130 trillion of capital were members of the GFANZ initiative.

Since then, the numbers of companies making commitments has steadily increased and the GFANZ initiative has developed a series of tools to support financial institutions' net-zero commitments,¹³ but there has not been major steps forward beyond what was anticipated at Glasgow. GFANZ currently has 550 member companies representing \$150 trillion of capital.

2.2 Public policy to deliver already existing commitments – significant progress in some developed countries and China, but also some setbacks

While national objectives have not been materially strengthened, new public policy actions have increased the likelihood that the commitments already made by major developed countries and China will be met:

- The US Inflation Reduction Act (IRA) commits \$369 billion in spending for the energy transition and climate change. It contains significant policy advancements for renewables scale-up, green hydrogen, Carbon Capture Utilisation and Storage (CCUS), infrastructure upgrades, electric vehicle support and more.¹⁴ The US NDC commitment to achieve a 50% reduction in emissions by 2030 (compared with 2005 levels) is now more likely to be achieved.
- The EU's REPowerEU package responded to the Russian invasion of Ukraine by increasing the 2030 ambition for renewables and hydrogen, and reinforcing policies on energy efficiency, significantly reducing projected EU gas consumption in 2030.¹⁵ A similar package has also been put forward in the UK. The ETC estimates that successful implementation of these packages could cut EU and UK emissions by an additional 0.2 Gt beyond their current NDCs in 2030.¹⁶
- China's 2022 14th Five-Year-Plan for Renewable Energy confirms the ambition made in its latest 2021 NDC to peak carbon emissions before 2030, and its 1+N framework is driving the translation of the national target into provincial and sectoral action. Current levels of renewable deployment – which could reach 55 GW for wind and almost 100 GW

¹³ GFANZ (2022) *Financial Institution Net-zero Transition Plan Framework and Guidance*.

¹⁴ *Inflation Reduction Act May Energize Utilities' Energy Transition*. In addition to the IRA, the Infrastructure Investment and Jobs Act (IIJA), and the CHIPS and Science Act could take federal spending on climate and clean energy to almost \$800 billion per annum between 2022-2027. See RMI (2022) *Congress's Climate Triple Whammy: Innovation, Investment, and Industrial Policy*.

¹⁵ EU members unanimously agreed to reduce gas demand by 15% from August 2022 to March 2023 in relation to their average consumption in the past five years Council Adopts Regulation on Reducing Gas Demand by 15% This Winter.

¹⁶ ETC 2022 analysis.

for solar in 2022 – would, if continued, result in a very large (over 500 GW) overshoot of the target of 1200 GW of solar and wind by 2030.¹⁷ On current trends China may therefore reach peak emissions a few years ahead of 2030.¹⁸

- In light of its G20 presidency, Indonesia aims to put its “New and Renewable Energy bill” into law before the G20 summit which aims for 31% renewables in energy by 2030.

But while the prospects for 2030 emissions have improved, short-term emissions have increased as a result of the energy crisis and other factors:

- In the EU, the need to live without Russian gas is seeing a switch away from gas to coal in the power sector¹⁹, as well as contracting new sources of fossil gas such as LNG, and including some financing of overseas gas projects.²⁰ Nonetheless EU CO₂ emissions are still expected to decline this year.²¹
- Despite record increases in renewable deployment, China also continues to deploy new coal power capacity to meet rapidly rising energy demand and to replace hydro power production which has been significantly depressed by a prolonged drought.²² As a result China has scaled back its ambition for renewables to provide 50% of additional electricity consumption through 2025, down from two-thirds.²³
- 2021 saw a 10% rise in investment in coal supply in 2021, led by emerging economies in Asia, with a similar increase likely in 2022.²⁴

2.3 Zero-carbon technologies increasingly competitive

Ahead of COP26 an increasing number of countries were willing to make net-zero mid-century commitments and to set stretching NDCs for 2030, because technological advances had dramatically improved the cost competitiveness of zero-carbon technologies.

Wind and solar are now cost-competitive against new and existing fossil for bulk electricity provision in countries representing 90% and 66% of global electricity generation.²⁵ And battery cost reductions of 85% over the last 10 years have made EVs and grid-based battery storage increasingly competitive.

As a result there is growing confidence that early power decarbonisation is possible, and that electrification will allow cost-effective decarbonisation in many sectors with a major supplementary role for hydrogen, and more limited roles for bioenergy and CCUS. Since 2018 there has also been rapid progress in identifying the technologies which will enable decarbonisation of the hard-to-abate industry and long distance transport.^{26,27,28,29,30}

17 BNEF (2022) *Global Installed Capacity*.

18 Reuters (2022) *China Says a Third of Electricity Will Come from Renewables by 2025*.

19 Though a long-term phase down of EU coal use is still expected this decade.

20 The initial EU objective was to reduce Russian gas use by 15% within a year and to entirely eliminate it by 2027: but latest Russian action to cut off gas supplies means that elimination must now be achieved immediately.

21 IEA (2022) *Defying expectations, CO₂ emissions from global fossil fuel combustion are set to grow in 2022 by only a fraction of last year's big increase*.

22 Girard (2022) *How China's Coal Commitment Went up in Smoke*.

23 Nikkei Asia (2022) *China curbs renewable energy target through 2025*.

24 IEA (2022) *Record clean energy spending is set to help global energy investment grow by 8% in 2022*.

25 BloombergNEF (2022) *1H2022 LCOE Update*.

26 Joule (2022), *Empirically grounded technology forecasts and the energy transition*.

27 ETC (2021), *Making Clean Electrification Possible: 30 Years to Electrify the Global Economy*.

28 ETC (2021), *Making the Hydrogen Economy Possible: Accelerating Clean Hydrogen in an Electrified Economy*.

29 ETC (2021), *Bioresources within a Net-Zero Emissions Economy: Making a Sustainable Approach Possible*.

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



Over the last year, increases in the price of energy (which is an important input to almost all production processes) plus widespread disruption to supply chains, has increased the cost of key zero-carbon technologies in many locations, including in particular wind turbines and solar panels outside China. EV battery costs have also increased for the first time in over 15 years. But the underlying cost competitiveness of zero-carbon technologies has continued to improve since:

- Increasing fossil fuel prices mean that even slightly higher cost renewables have become significantly cheaper than fossil fuels (in particular gas) in power generation.
- The underlying drivers of renewable technology cost decline – learning curve effects and economies of scale – are still in place and have for instance delivered significant reductions in wind turbine costs in China, where supply chain disruptions have been less significant.
- The increase in the price of polysilicon, which has driven increased solar PV panel prices, is likely to dramatically reverse within the next few years as very large new capacity increases come on stream.³¹
- Large investments in green hydrogen in multiple countries, supported in the US and EU by strong public policy actions, are likely to drive faster cost reductions than anticipated only two years ago, increasing the potential for green hydrogen's accelerated use in multiple sectors including steel, chemicals and shipping.
- In addition, the short-term economics of green hydrogen relative to grey or blue hydrogen, have been dramatically improved by current high gas prices.

2.4 Good progress in some sectors, but disappointing on methane, deforestation and coal

Technological progress, public policies, and growing company and industry sector commitments have helped drive progress as fast or even faster than expected in some sectors but in others progress has been disappointingly slow. Summary conclusions are:

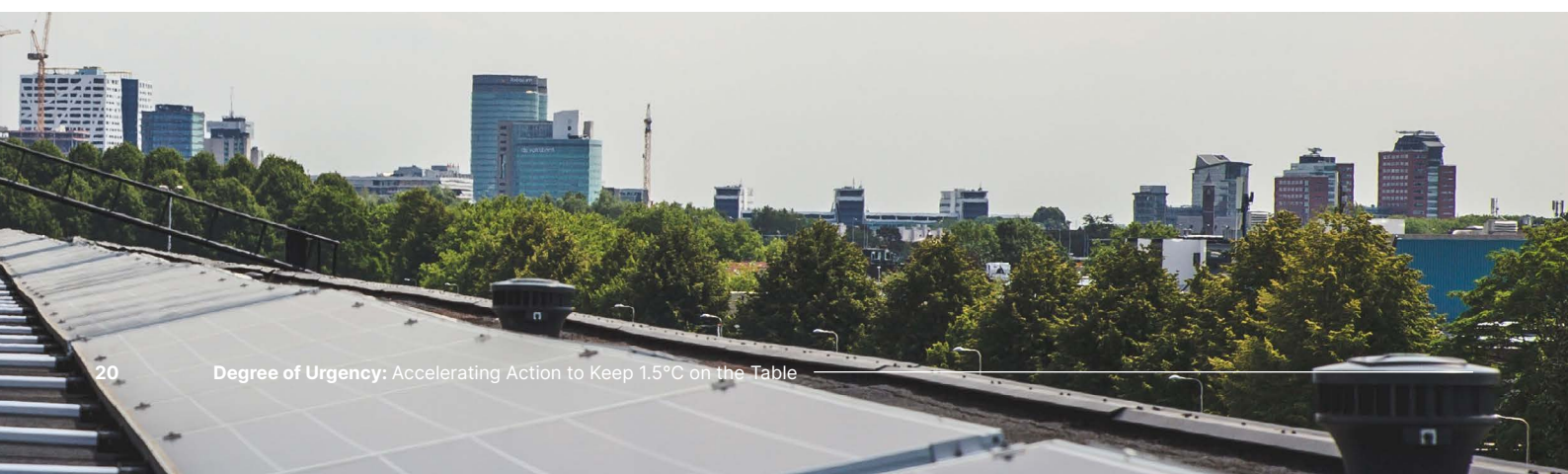
- **Methane:** While COP26 brought methane to the global stage and introduced the Global Methane Pledge, on-the-ground progress across the fossil, agriculture and waste sectors has been lacklustre. On the fossil fuel side, high gas prices should increase opportunities for cost effective action, and the United States and Europe have reinforced regulation and monitoring. But many major oil and gas producers (e.g. Russia) continue to impose little or no oversight over methane emissions. Furthermore, the IEA estimates that governments have been under-reporting emissions, with global methane emissions from the energy sector around 70% higher than officially reported figures from national governments.³² Methane emissions from ruminant animals continue to grow given increased meat consumption everywhere but Europe;³³ and there has been no sign of accelerated action to improve waste management techniques.
- **Nature-based solutions:** Nature-based solutions, including ending deforestation and large scale reforestation were identified before COP26 as providing the highest potential for emissions reductions by 2030. But latest information suggests that deforestation continues to outpace reforestation, with a decline in the rate of deforestation in Indonesia offset by developments in Brazil where forest loss has reached record levels.³⁴

31 Bloomberg (September 2022) *The Supply Chain to Beat Climate Change Is Already Being Built*.

32 IEA (2022) *Press Release: Methane emissions from the energy sector are 70% higher than official figures*.

33 FAO (2020) *Meat and dairy production dataset*.

34 Global Forest Watch 2022.



- **Power:** The power sector has seen developments that both accelerate and decelerate decarbonisation:
 - Total global renewable deployment has accelerated to record levels, driven in particular by rapid growth in China.
 - But total global coal use has continued to rise due to high gas prices, restricted gas supply in Europe and low output from European hydro and nuclear plants and from Chinese hydro.
 - There is therefore no clear sign that coal phase-out is proceeding at the rate implied by even the modest commitments made at COP26.
- **Road transport:** The road transport sector has witnessed faster than expected progress from when the Paris agreement was signed, creating a possibility for earlier and more widespread internal combustion engine vehicle phase-outs. EV sales continue to rise, with BNEF forecasting 13 million EVs to be sold in 2022 (around 13% of all new light duty vehicles) – against 9 million in 2021 (>40% annual increase), complemented by an expansion in public charging infrastructure. New policy commitments in the EU, US and China also make it likely that EV deployment will be faster than we anticipated before COP26; the EU being the first of these major emitters to set a full ban on ICE vehicle sales from 2035.
- **Other sectors – Heavy Industry:** Reductions in the hard-to-abate sectors will inevitably be back-ended due to long lived capital assets. But in several sectors ambition level and action on the ground has accelerated: projects in sectors such as steel and green ammonia are ramping up due to falling prices of green hydrogen. In the steel sector, there is increasing cross industry support for the decarbonisation pathway described in the Mission Possible Partnership's Sector Transition Strategy, which could see emissions fall by over 30% by 2030: an increasing number of global steel companies have clear net-zero 2050 or 2045 targets: and targets are increasingly matched by announcements of specific decarbonisation investments. By 2030, there are projected to be as many as 45 green steel plants operating (vs. 8 plants in 2021), as well as 45 Mt of green ammonia capacity (vs. less than 5 Mt pre-2020).³⁵
- **Aviation and Shipping.** After significant commitments before and at COP26, there has been no further announced progress in the shipping sector, but leading shipping companies continue to progress with investments in methanol ships. In aviation, support for a 2050 net-zero target has grown significantly alongside a clearer consensus around the key technologies required – with Sustainable Aviation Fuels (SAF) (from both biofuels and e-fuels) playing the major role described in the MPP Sector Transition Strategy.³⁶ EU proposals outline that a steadily rising percentage of aviation fuel is SAF, rising to 5-6% in 2030 and 63-85% by 2050.
- **Energy efficiency:** According to the IEA, energy intensity has improved on average by 1.3% annually, down from to 2.3% annually between 2011 and 2016, and well below the 4% IEA Net Zero Emissions target for 2020-2030. This reflects weak energy efficiency support in many major economies, alongside strong growth in energy-intensive economies. High oil and gas prices will create increased incentives for energy efficiency in many countries. As part of its response to the energy crisis, the EU has reinforced energy efficiency targets and committed to achieve a reduction in gas use of 15% this winter.³⁷ However, policies in place are still on average insufficient to drive the 4% per annum reductions required.

Exhibit 3 presented our post COP26 estimates of potential progress made in closing the 2030 emissions gap. A reasonable current assessment suggests that the 2.2 GtCO₂ per year of emissions reductions to be delivered by the Race to Zero and other initiatives in road transport, industrial sectors, and aviation, are likely to be achieved and might be somewhat exceeded.

But our initial assessment of slow coal phase-out remains: and the 3.5 GtCO₂ per year of emissions reductions which was implied by country commitments to the Declaration on Forests and Land Use must be considered materially at risk given latest trends in deforestation and no further progress on international strategies to halt it.

³⁵ Green Steel Tracker, Mission Possible Partnership (2022) *Making Net Zero Ammonia Possible*.

³⁶ At COP26, the International Civil Aviation Organization (ICAO) adopted a long-term goal of net-zero carbon emissions by 2050. <https://news.un.org/story/2022/10/1129367>

³⁷ Euractive, "EU plan to cut gas use by 15% set to come into effect", August 8, 2022.





Chapter 3

Facing reality at COP27: a dwindling climate budget and commitments inconsistent with 1.5°C

The IPCC's assessment of climate models, published in 2021, suggest that if the world is to have a 50-50 chance of limiting global warming to 1.5°C, total CO₂ emissions from 2020 to 2050 must be limited to 500 GtCO₂. Previous reports from the ETC and other organisations have discussed how to stay within this 500 Gt budget, via a combination of gross emissions reductions and carbon removals. Broadly speaking, this requires not only reaching net-zero emissions by mid-century, but reducing net emissions by at least 40% during the 2020s.

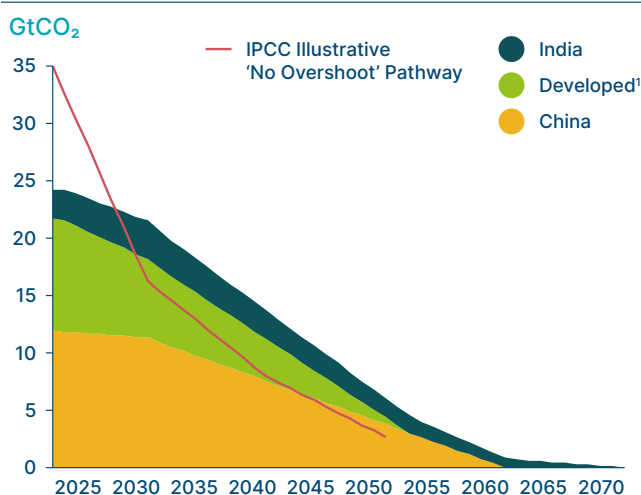
But we are now over two years into this first crucial decade, and global emissions reductions have not yet begun: indeed, after a COVID induced dip, emissions grew sharply in 2021. Emissions in 2022 also grew – though at a fraction of the annual increase than 2021 – and will be higher than in pre-COVID 2019.³⁸ From the start of 2022, around 80 Gt of the CO₂ of the 500 Gt budget will already have been used up, leaving only 420 Gt available.³⁹

Existing national commitments and targets imply that this budget will be significantly exceeded;

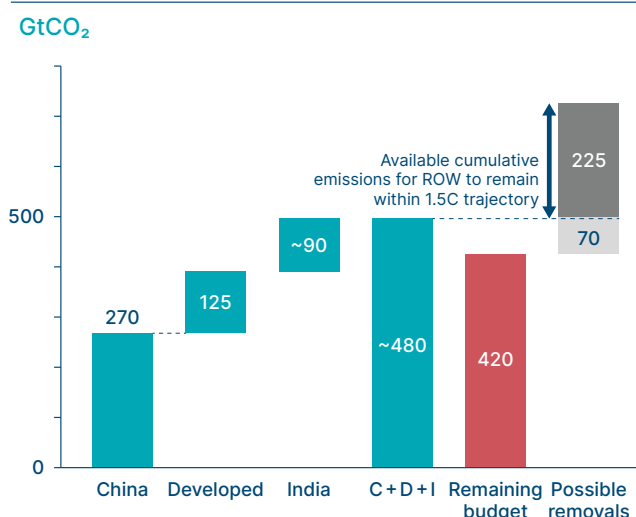
- Since the Paris climate agreement in 2015, all developed countries plus China have adopted net-zero targets for either 2050 or 60, and as Chapter 2 above described, 2022 saw implementation progress which makes it more likely that these targets and the shorter-term targets for 2030 will be achieved. But even if they are achieved, cumulative emissions by developed countries and China could use up ~390 Gt of the remaining 420 Gt of carbon budget, leaving limited space for any transitional emissions growth in emerging and developing countries [Exhibit 6].
- Many emerging and developing countries, however, believe that their fair contribution to achieving the global climate objective would entail significant transitional growth in emissions before eventual decline [Exhibit 7]. The largest emerging economy (EMDE), India, has set a 2070 rather than 2060 net-zero target and does not plan to peak emissions before the late 2030s. This might imply cumulative Indian emissions of about 90 GtCO₂ between now and 2070 [Exhibit 6].
- Carbon removals can help reconcile these apparently incompatible commitments and the ETC's *Mind the Gap* report suggested that removals of 70-225 GtCO₂ might need to be achieved, and in principle could be achieved, by 2050 [Exhibit 8].⁴⁰

Even with implementation progress, estimated emissions in the developed world, China and India under a Net Zero trajectory would overshoot the carbon budget

GHG emissions based on linear interpolation of 2030 and net-zero targets



Cumulative emissions 2022-2070



NOTE: 1) Developed country emissions are an estimate based on available IEA country data. Note: Emissions data from the IEA (2021). Data from 2021 to 2030 based on linear decrease to 2030 datapoint in the Announced Pledges case. From 2030, for key countries, interpolation of data based on net zero targets, for rest of the world based on linear decrease until 2055.

SOURCE: IEA (2021), Systemiq analysis for the Energy Transitions Commission (2022)

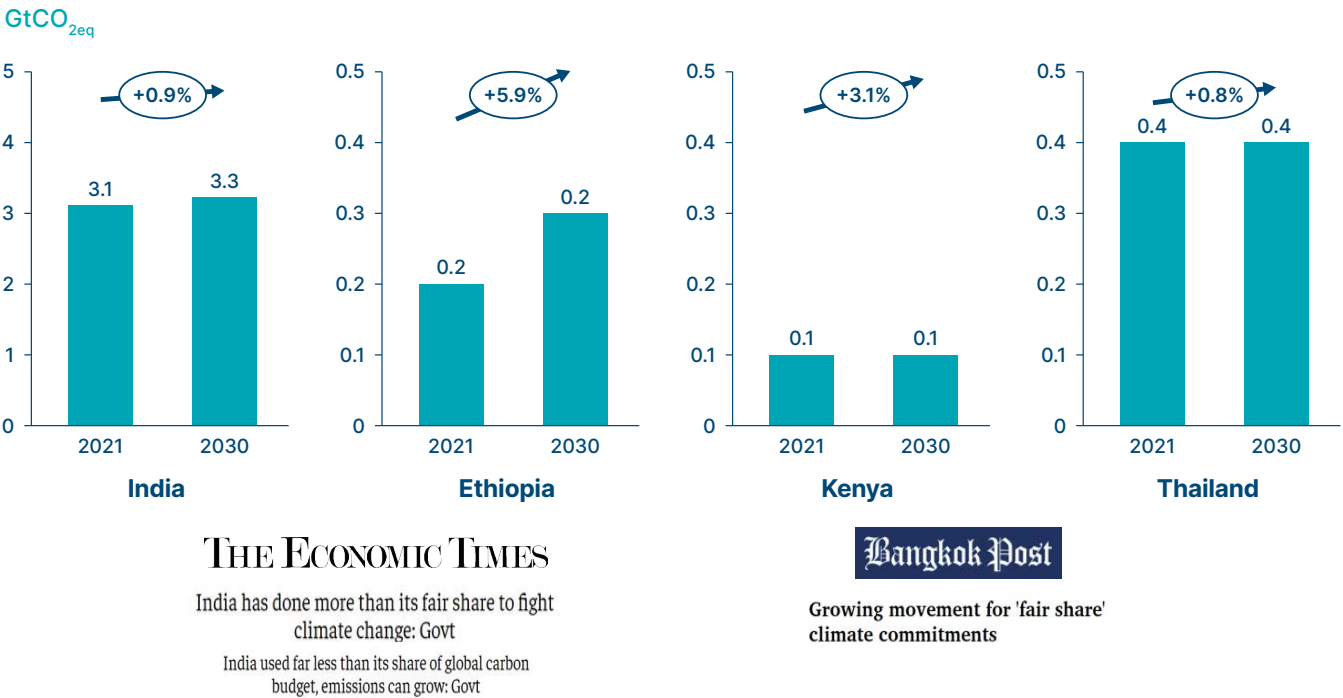
38 IEA (2022) *Defying expectations*, CO₂ emissions from global fossil fuel combustion are set to grow in 2022 by only a fraction of last year's big increase.

39 Global Carbon Project (2021).

40 ETC (2022), *Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive*.

Most EMDE plans assume increases in emissions for at least another decade

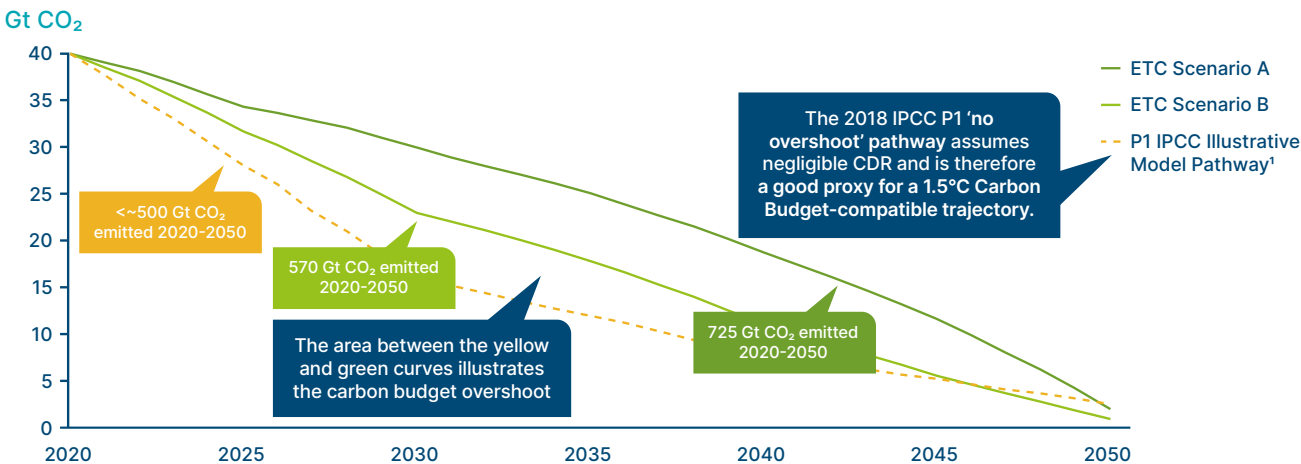
Annual CO_{2eq} emissions



SOURCE: Climate Action Tracker

ETC decarbonisation scenarios compared to a 'no-overshoot' 1.5°C pathway

ETC decarbonisation reduction scenarios versus IPCC 'no overshoot' 1.5°C pathway for net-zero emissions



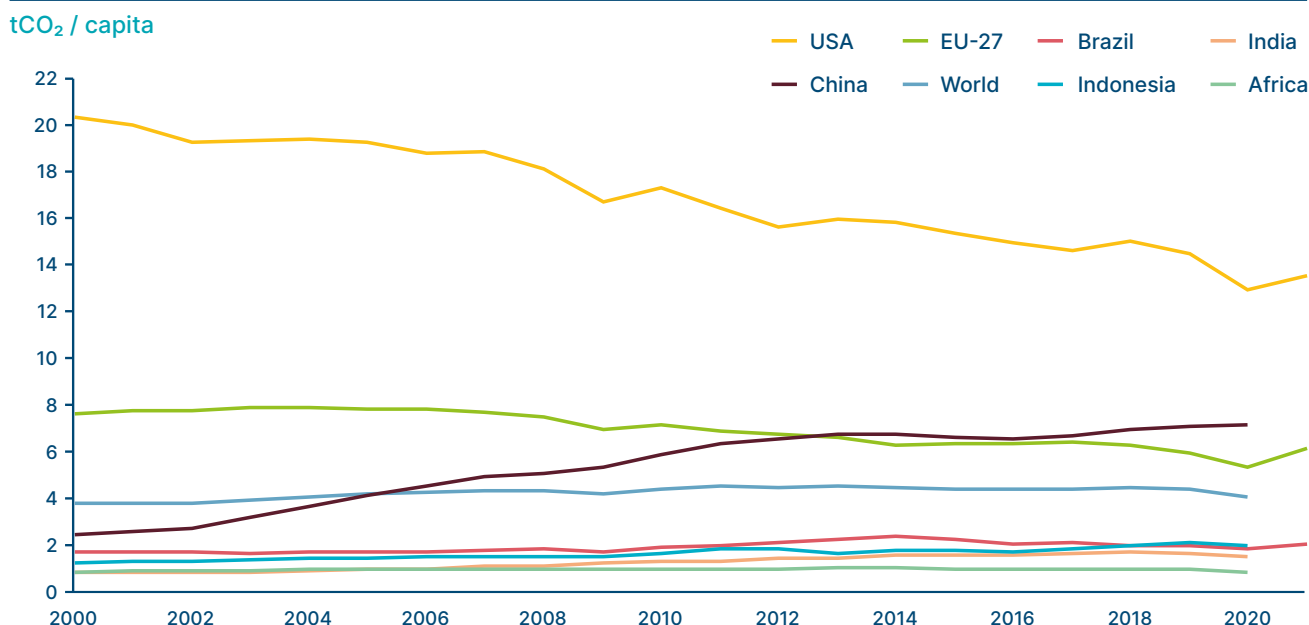
NOTE: (1) P1= an ambitious scenario which assumes social and technical innovation drive rapid decarbonization through low energy demand assumptions and investment in afforestation, cited in the IPCC (2018) Special Report. IPCC (2021) AR6 did not include a no-overshoot scenario in its illustrative pathways.

SOURCE: SYSTEMIQ analysis for the ETC based on: IEA (2017), Energy Technology Perspectives; IEA (2020), Energy Technology Perspectives; IPCC (2018), Global Warming of 1.5°C; IIASA SSP Public Database, Version 2.0 (Accessed 2021)

Annual emissions per capita vary greatly by country and country group, with China and the EU emitting 4-5 times as much per capita as India, and 8-10 times as much as some low-income developing economies [Exhibit 9]. On a per capita cumulative basis, the developed economies, and to an increasing extent China,⁴¹ have contributed disproportionately to the greenhouse gas concentrations which are producing global warming [Exhibit 10].

On a per capita basis China is now overtaking average advanced economy levels, but India and other EMDEs are still far lower

CO₂ from EBIT sectors per capita by region

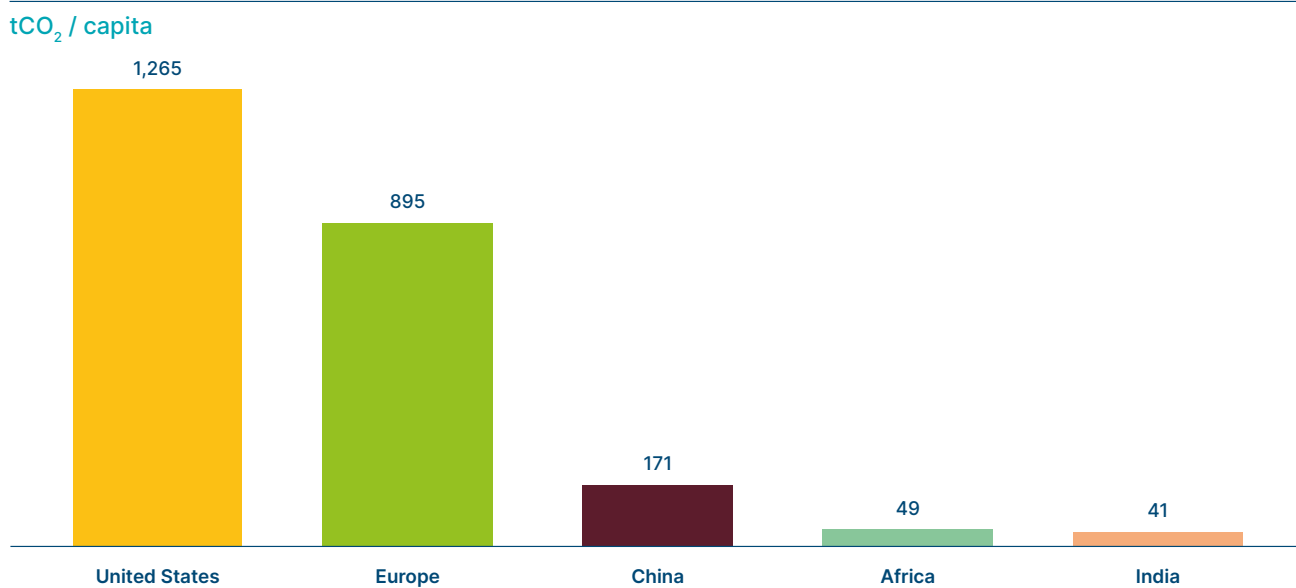


NOTE: Data was unavailable for some geographies for 2021.

SOURCE: IEA (September 2022)

Per capita cumulative emissions range from ~1250 tCO₂/capita in the US to ~40 in lower income countries, with China now at an intermediate ~170

Cumulative per capita CO₂ emissions until 2021



NOTE: Data based on earliest availability.

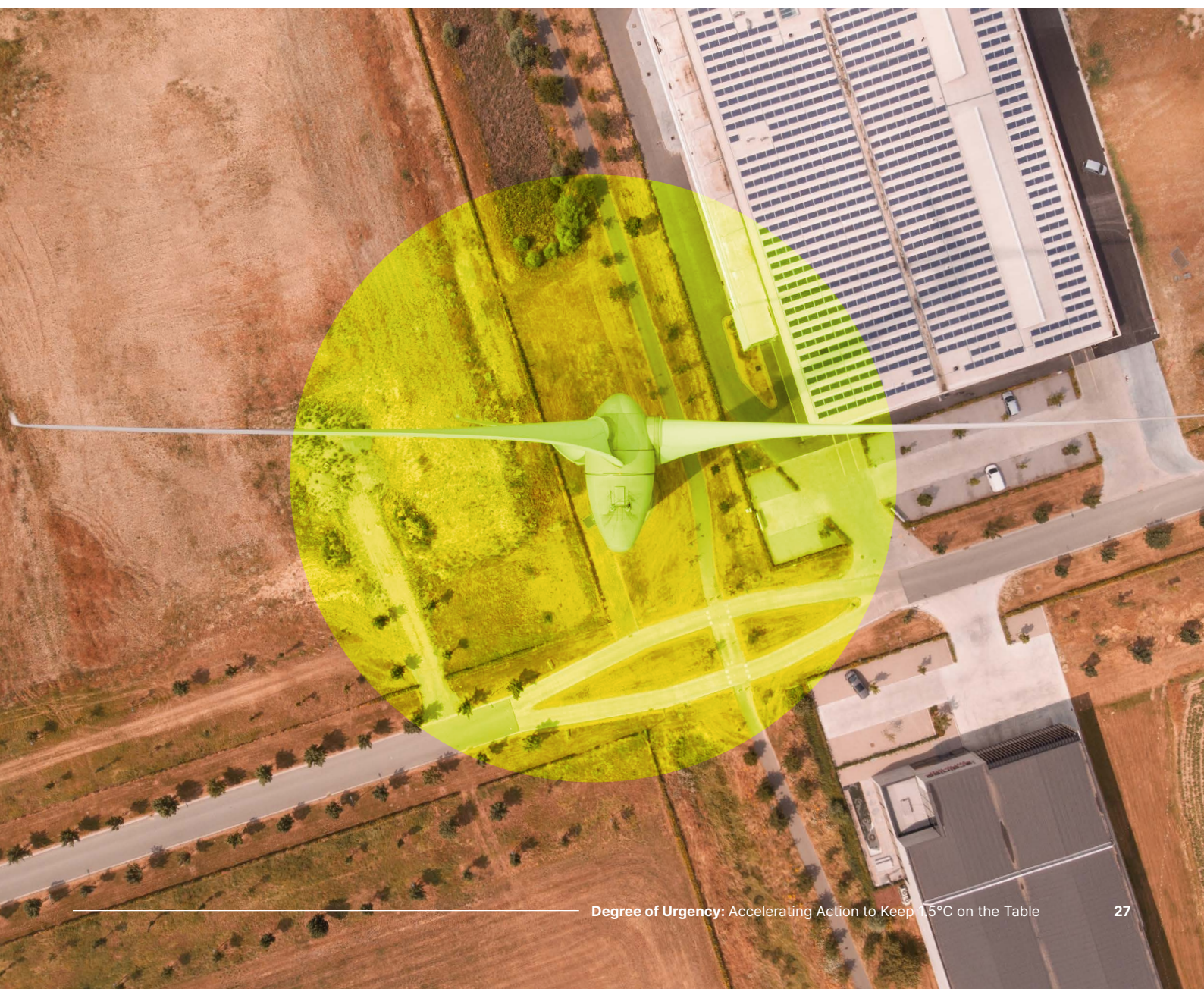
SOURCE: Global Carbon Project

⁴¹ Though some consider China's historical emissions, so-called 'consumption emissions' which could be attributed to Western economies.

Developed economies and China should therefore reduce emissions faster than middle- and lower-income countries and this is recognised in the principle of common but differentiated commitments, which are reflected in NDCs and the Paris Agreement. But we must face the reality that the combination of unilateral national commitments made so far do not add up and we are running out of time.

To achieve the 1.5°C objective which the world agreed to in Glasgow will therefore require both:

- Ensuring that all countries – but in particular the developed economies and China – at very least achieve, and ideally overachieve or increase, emissions reduction commitments. In so doing, driving the technological progress which will reduce mitigation costs across the world.
- Ensuring significant financial flows and technical assistance to enable middle- and lower-income countries to reduce emissions faster than they could achieve alone, via a combination of:
 - Financial flows which help middle and low income countries grasp the opportunity of cost-effective investment in new technologies.
 - Financial concessional/grant payments which help achieve emissions reduction which still entail a significant economic cost.
 - Financial flows which support nature based carbon removals, many of which will have to occur within middle- and low-income countries.







Chapter 4

Accelerating progress across multiple sectors and technologies

These two priorities are discussed in the next two sections.

This chapter considers the actions required to make progress at country level, and across six key sectors of critical importance to emissions reductions.

Country level

A combination of more ambitious targets from all countries to close the emissions gap going forward is required:

- While high-income economies often have relatively ambitious near-term (e.g. around 50% by 2030) reduction targets, they can potentially move even faster.
- Though China's official target is to peak emissions before 2030, some expect emissions to peak as soon as 2025,⁴² driven principally by faster-than-expected deployment of renewables.
- The link between emissions and economic growth has been broken, and lower-income and emerging economies are now able to move faster towards a renewable-dominated energy system. This is likely to see reductions in emissions that are more ambitious than many of their current targets imply. This acceleration should be reflected by tightening non-conditional NDC commitments.

Additionally, NDCs and long-term commitments can be improved by:

- Making them absolute emissions targets and not based on vague terms such as “GDP intensity”.
- Overall, more clarity is required with regards to the mid-term target of major economies (e.g. emissions trajectories by 2040) to provide a clearer overview of the future carbon budget take-up. The subsequent introduction of NDCs for 2035 should help provide clarity.

Whilst both high-income and developing countries can do more to accelerate their own emissions reductions, two further options exist that can accelerate progress:

- Flows of private and public funding to enable lower income countries to move faster than technology and policy sharing alone would enable. More details on this topic are described in chapter 5.
- Faster scaling and increased contribution of negative emissions solutions as discussed in the ETC report on Carbon Dioxide Removals.⁴³

In both of these cases, high-income countries will need to take the lead in providing both funding and knowledge transfer to enable this acceleration. There are several underlying arguments as to why high-income economies should do this:

- The cost of inaction outweighs the cost of action both on a global level, and domestically.
 - Globally the worst impacts of climate change are likely to be felt in emerging markets and developing economies (EMDE) countries (e.g. such as the recent floods in Pakistan), but impacts will also be material in high-income countries. Compelling analyses have shown that the costs of avoiding climate change are far lower than the damage that climate change will create; in addition, mitigating the impact of climate change will deliver significant co-benefits – for instance greater biodiversity, local environmental conditions and health.
 - Domestically, assessments which only consider the costs of climate action put it at a small percentage of overall GDP.⁴⁴ However, assessments which consider even a subset of the co-benefits of climate action – such as increased jobs, avoided air pollution – place climate action as a net benefit to society.⁴⁵
- Historic responsibility: high-income countries including China have emitted over 70% of total cumulative energy-related CO₂ emissions.
- Consumption emissions: While emissions have been falling in high-income economies, some of it is associated with export of production of goods to lower cost and higher emissions nations.

⁴² Carbon Brief (2022) *Why China is set to significantly overachieve its 2030 climate goals*.

⁴³ ETC (2022) *Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive*.

⁴⁴ CCC (2020) *Sixth Carbon Budget*

⁴⁵ Stern Review: The Economics of Climate Change (2006); UK Treasury Net Zero Review Final Report (2021).

Investment into infrastructure developments in developing countries can also be attractive with the right risk-return profile, including because relative growth in clean energy is likely to be higher in emerging markets than in high-income markets.

We therefore believe there is scope for all countries to move faster, backed by continuing improvements in technology and strong evidence of policies that can enable the low-carbon transition. Additionally, flows of funding from developed to developing economies can help to accelerate the transition.

Sector level

The six key action areas that the ETC highlighted in 2021 remain the key areas where to focus attention today. Across all highlighted areas, impactful policy and/or business action can significantly accelerate progress. In this section we highlight the key actions that are necessary to overcome these. Further detail and additional actions are presented in our 2021 report.⁴⁶

- **Methane:** Methane emissions from fossil fuels can be reduced to zero at very low-cost. Actions to enable these reductions include ensuring the correct monitoring and detection of methane leaks, and certification and regulation around strict fossil methane limits. Reductions in agricultural methane are more dependent on behaviour change, and therefore harder to implement, with a high level of uncertainty around the extent to which they can be reduced this decade. Low-cost opportunities include behaviour shifts (e.g. towards plant-based diets), waste reduction through better supply chain management, and improved agricultural and waste management practices.⁴⁷
- **Nature-based solutions:** Overcoming slow progress on deforestation will require an alignment of strategies at different levels, including clear national commitments to halt deforestation (esp. in Brazil, Indonesia, DRC), supported by financial support from developed countries (see chapter 5). These pledges should be complemented by corporate commitments to develop deforestation-free supply chains, building on existing initiatives (e.g. FACT Dialogue), and supported by due diligence standards, technology, individual action and public campaigns.
- **Power:** While encouraging progress is being made on targets for renewables and on deployment, action to phase-out coal power has seen major headwinds in the past year. Strong commitments to no new coal and to coal phase-out dates remain critical, alongside appropriate climate finance to support the transition in developing economies. To support growth of renewables, country strategies should aim to reduce bottlenecks surrounding planning and permitting and grid capacity, ensure appropriate power market design, and consider how the necessary supply chain investments can be unlocked to match ambitious policy targets.

⁴⁶ ETC (2021) *Keeping 1.5°C Alive: Closing the Gap in the 2020s*

⁴⁷ Key technology developments – including the application of digital technology to supply chain monitoring and management, and synthetic/plant-based meat alternatives – are steadily increasing the potential for emissions savings.



- **Road transport:** Progress has been facilitated by a supportive policy environment, most critically bans on the sale of new internal combustion engine (ICE) vehicles by 2030-35, where countries and sub-national jurisdictions should continue to make commitments. Bans should furthermore be backed by the complementary rollout of charging infrastructure, and restrictions for light-duty ICE use in major cities ahead of sale ban dates. Clear dates for the phase-out of ICE should be reinforced by corporate commitments (e.g. manufacturers to produce 100% zero-emission vehicles by 2035, corporate commitments for purchasing 100% EVs by 2030). Medium and heavy duty trucking should be subjected to stringent fuel economy regulation. Overall, progress should also be supported by financial incentives, such as ending subsidies to petrol and diesel or increase taxation rate to incentivise the heavy duty vehicle transition, as well as the introduction and extension of carbon pricing for the transport sector.
- **Industry, buildings, aviation and shipping:** There has been growing momentum for progress in the harder-to-abate sectors, backed by clear industry-supported roadmaps for 2030 and 2050. Critical actions to implement these visions include policy support to overcome “green cost premiums” (such as carbon pricing, quantitative fuel mandates and contracts for difference, public procurement of decarbonised materials, and regulated product standards), as well as strengthening of industry body targets for decarbonisation e.g. International Maritime Organization (IMO), International Civil Aviation Organization (ICAO), and national and regional commitments from public and private stakeholders to develop capacity for green hydrogen. Development of circular supply chains can also significantly reduce the amount of materials required from heavy industry. Lastly, the growing heat pump market in some regions should be supported by financial incentives, and retraining and new skills to ensure the necessary volumes of installation.
- **Energy efficiency:** Improving energy efficiency can be driven by reinforced by global commitments to adopt best-in-class building and appliance efficiency, support for building and heating systems retrofits, targeted taxation (e.g. business class and short-haul flights), and commitments to improve separate waste collection and collection/recycling targets, incentivising repair, light-weighting, reuse mechanisms and supply chain transparency.

Across all of these areas significant progress can be made through ambitious action. Three key cross-cutting themes stand out:

- Overall, forceful policy and regulation can and should underpin transformation across all sectors, to guide and accelerate private sector action.
- A global behavioural shift towards more plant-based diets is a major transformation that can and must unlock significant impact, both in reducing methane emissions as well as limiting the need for deforestation.
- Finally, in two of the areas that are most critical to limiting global warming to 1.5°C – phasing out existing coal power, and ending deforestation – significant acceleration of progress is likely to require greater overall volume and targeting of funding this decade. We turn to this in the next chapter.





Chapter 5

Closing the “financing gap” critical to keep 1.5°C on the table

Reaching the world's 1.5°C objectives will require two key types of financial flow:

- **Capital investment** in the technologies and assets required to create a zero-carbon economy.
- And **concessional/grant payments**, including from voluntary carbon markets, philanthropy and where needed additional government finance, to accelerate decarbonisation which would not occur fast enough unless economic actors are compensated in some way – these will be required to end deforestation, to phase out coal early (i.e. where it remains competitive with renewables), and to fund carbon dioxide removals.⁴⁸

The ETC will shortly release a detailed report on the scale of finance required for net-zero, and how it can be mobilised. Its key conclusions relevant to scaling finance in the next decade are detailed here.

5.1 The scale of capital investment for net-zero

The transition to net-zero will be capital intensive, requiring significant investment, around 70% of which will go into low-carbon electricity generation. On average, around \$3.6 trillion a year of capital investment is required to 2050. By 2030, annual investment needs reach \$3 trillion, tripling from around \$0.8-1.2 trillion today.⁴⁹

This will largely be driven by high income countries and China (~70% of global investment), as they accelerate progress in decarbonising their power systems, conduct buildings retrofits, and take the lead in getting early stage technologies off the ground. But the scale up in investment in middle and lower income countries is also going to be huge, and needs to reach around \$0.9 trillion per year by 2030.

There is no shortage of global capital available to finance the investment needed: and many of the investments already lead to positive returns, but it will only be mobilised with:

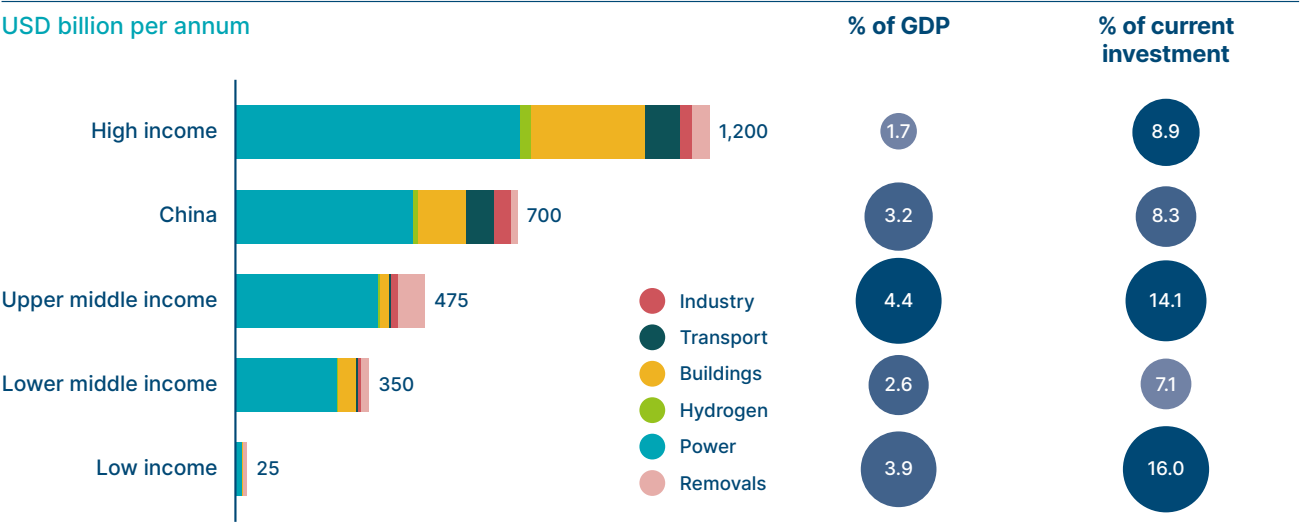
1. Forceful and well-designed real economy policy which leads the way in directing action and creates incentives for the non-financial sector to invest, achieved by:
 - **Establishing a clear strategic vision** to offer certainty to investors – clear medium-term targets, ambitious standards and regulations (e.g., a ban on the sales of ICE vehicles by 2035).
 - **Shaping markets to incentivise low-carbon investments** by addressing the green premium challenge through carbon pricing, contracts for difference, quantitative mandates, direct consumer subsidies, and public procurement which creates demand for low-carbon alternatives.
 - **Reducing downside risks** by de-risking investment in early stage technologies, implementing credible and consistent policymaking, and strategic planning.
 - **Removing supply side bottlenecks** to the pace of transition – streamlining planning and permitting, prioritising infrastructure development (e.g., EV charging, hydrogen and CO₂ networks), supporting supply chain development.
2. Targeted roles for public finance, including to accelerate the scale up of new low-carbon technologies and enable large-scale investment in residential buildings retrofits.
3. Supporting roles from financial regulation and net-zero commitments of financial institutions which can accelerate capital reallocation.
4. Additional policy support, knowledge transfer, investment capacity building and financial support in middle and low income countries from development finance institutions, including multilateral development banks (MDBs).

⁴⁸ The ETC's numbers represent a plausible upper bound for payments that might be required for accelerating coal phase-out, ending deforestation and scaling carbon dioxide removals where there is no short-term economic incentive to do so. Within each of these areas a series of policies, regulations, additional actions and investment-type instruments can also be used to reduce emissions.

⁴⁹ BNEF (2022) *Energy Transition Investment Trends*; IEA (2022) *World Energy Investment 2022*.

Annual capital investment in middle and low income countries needs to average around \$850bn p.a. in the latter half of this decade

Estimated annual investment by income group and sector, 2026-30



NOTE: Income groups are based on the World Bank's classifications, with China called out separately from upper middle income. GDP is market exchange rate based.
 SOURCES: SYSTEMIQ analysis for the ETC (2022), SYSTEMIQ - Investments for green recovery and transformational growth 2020-30: Technical Note (2021), IMF World Economic Outlook October 2022

Using finance to accelerate progress in middle and low income countries

Middle and low income countries⁵⁰ are far from homogeneous, but typically face more acute challenges to scaling up low-carbon investments. Whilst the current macroeconomic environment is already posing a challenge to investment in these countries, a persistent barrier has been the high cost of capital, which has implications for financing investments given the capital-intensive nature of low-carbon technologies. This reflects factors including:

- Weaker policy environment for low-carbon investments in some countries, for example, due to institutional weakness, competing priorities for policymakers, or political instability.
- Geography-specific financing barriers, for example, due to high actual or perceived macroeconomic risks, the small size of some economies, and underdeveloped financial systems.
- Today's macroeconomic climate of increasing interest rates, exacerbating high costs of borrowing.

There are significant opportunities for private capital in middle and low income countries. But unlocking these investment opportunities crucially depends on lowering the cost of capital. Doing so requires:

- The private sector to do more to realise investment opportunities in middle and low income countries, including developing capabilities to identify opportunities (e.g., green hydrogen for export in coastal African countries) and assess and absorb risks in these markets, closing the gap between perceived and actual risks.

⁵⁰ Note that we exclude China from this analysis, as China's financing the transition challenges will be more similar to high income countries, as opposed to middle income countries, given the vast availability of domestic savings and low-cost capital which can drive investment (if enabled by well-designed real economy policy).



- Development finance institutions, including Multilateral Development Banks (MDBs), to do more to build capacity for the private sector to invest, as well as provide more financing.

Scaling up this support is critical given middle and lower income countries (excluding China) account for ~35% of global emissions.

MDBs are particularly important as they have access to low cost capital (e.g., due to their AAA credit rating) and can absorb greater risks (e.g., political risks) than the private sector. While their mandates and strategies vary, in general they are uniquely positioned to:

- Support the development of well-designed real economy policies through policy advice and investment capacity building.
- Unlock private capital at scale by mitigating risks that can't be managed commercially (e.g., through guarantees).
- Significantly scale up finance for the transition.

In 2020, MDBs provided \$25bn of climate mitigation finance in low and middle income countries. This in turn mobilised \$10bn of private capital; a low aggregate mobilisation ratio of less than \$1 for each \$1 of MDB finance. Analysis of various reports which have estimated the potential capital headroom in MDB balance sheets and the potential for more mobilisation of private capital suggests that:⁵¹

- MDBs have the potential to provide around \$140bn a year of finance.
- MDBs should aim to mobilise at least two or three times this amount (i.e. a minimum of \$280bn) from the private sector through de-risking and capacity building.
- This total of at least \$420bn could go a long way to meeting the financing needs of middle and low income countries by 2030 [Exhibit 12].

Specific recommendations to modernise the development finance system – especially to unlock additional private capital – have been developed by many organisations over the past decades.⁵² In 2022, MDB reform has become a public priority for the US⁵³ (which is critical as it is the largest shareholder in the MDBs), the private sector,⁵⁴ and for the G20, which published a comprehensive paper on how to boost MDBs' investing capacity.⁵⁵

Government stakeholders (e.g., Finance Ministers) who set the mandate of MDBs, are key to driving reform. The ETC joins these growing calls for MDBs to devise new approaches to help close the “financing gap” critical to keep 1.5°C on the table.⁵⁶

51 For example, Blended Finance Taskforce (2018) *Better Finance, Better World*; An Independent Review of Multilateral Development Banks' Capital Adequacy Frameworks (2022) *Boosting MDB's Investing Capacity*; Grantham Research Institute on Climate Change and the Environment and Brookings Institution (2022) *Financing a Big Investment Push in Emerging Markets and Developing Countries for Sustainable, Resilient and Inclusive Recovery and Growth*.

52 This includes the OECD, the Blended Finance Taskforce, the Centre for Global Development, the Overseas Development Institute, Convergence, the IMF, and various COP and UN High Level Expert Advisory Groups. For example, see [ODI \(2021\) Development Finance Institutions: the need for bold action to invest better](#); Report of the G20 Eminent Persons Group on Global Financial Governance (2018) *Making the Global Financial System Work for All*; Centre for Global Development (2022) *Reforming the World Bank and MDBs to Meet Shared Global Challenges*.

53 See Remarks by Secretary of the Treasury Janet L. Yellen at the Centre for Global Development – October 6 2022.

54 For example, see Larry Fink (2021) *Moving from Ambition to Action*.

55 An Independent Review of Multilateral Development Banks' Capital Adequacy Frameworks (2022) *Boosting MDB's Investing Capacity*.

56 It is important to note that MDBs will also have an important role to play in delivering finance for adaptation.

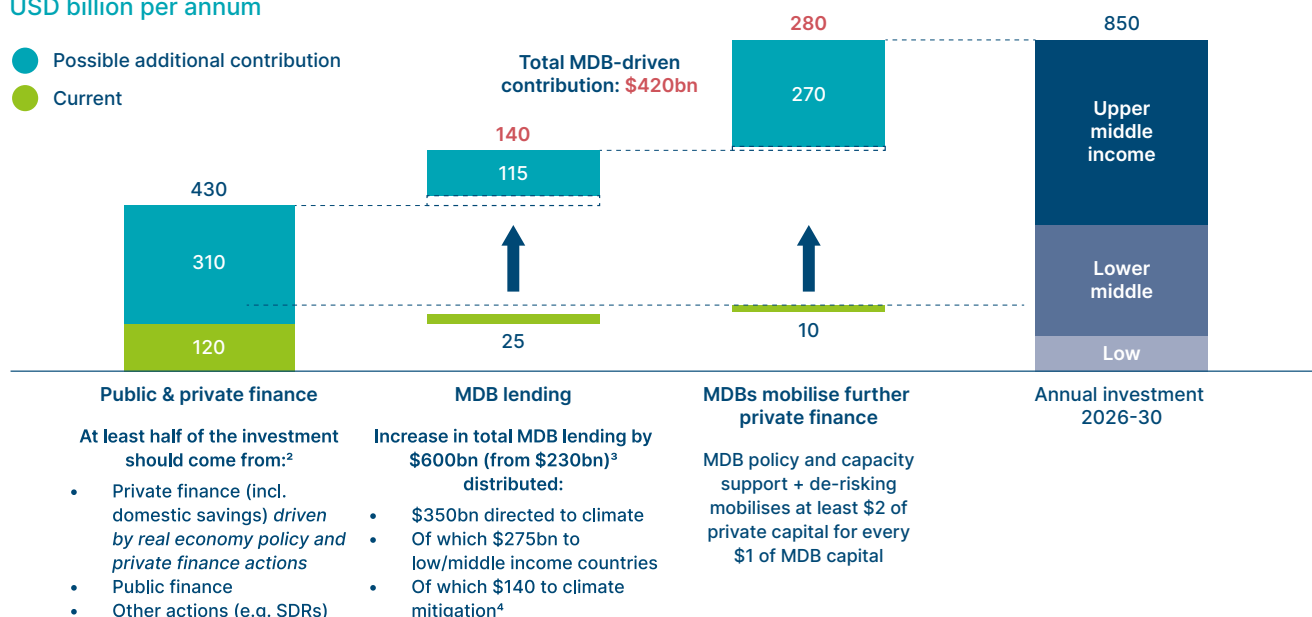


MDBs could realise half of the investment need through scaling up lending, policy and capacity building, and de-risking of private capital

Illustrative scenario for financing climate mitigation in middle and low income countries by 2030¹

USD billion per annum

- Possible additional contribution
- Current



NOTE: (1) Excludes China; (2) Estimates of current public and private investment cover regions dominated by middle and low income countries but likely overstate the true current amount invested as they do include some high income countries, but exclude China; (3) Literature review of estimates of feasible increases in MDB lending while maintaining a AAA rating; (4) Of total MDB finance, 50% used for climate, 2/3 directed to middle and low income countries, 50% used for mitigation (50% for adaptation)

SOURCES: SYSTEMIQ analysis for the ETC (2022), Climate Policy Initiative (2021) Global Landscape of Climate Finance 2021.

Exhibit 12

5.2 Financial transfers to phase out coal generation, halt deforestation and scale carbon removals

Beyond investment, payments to stop the most harmful activities – such as deforestation and burning coal for power – are likely to be essential to keep 1.5°C alive. Together, action in these sectors represents around 50% of the gap towards a 1.5°C pathway in 2030.⁵⁷

As outlined in this report, policymakers and industry need to take concerted action to tackle deforestation and decrease the relative competitiveness of fossil fuels compared to renewables. These policies are not being implemented fast enough and, even with accelerated action, it is likely that these crucially important emissions reductions will only occur if supported by concessional/grant payments to induce economic actors to do something for which they would otherwise have no economic incentive.

If policy is unsuccessful in curbing these harmful activities, additional concessional/grant payments could total around \$300-500bn a year in middle and low income countries (excluding China):

- \$25-50bn to phase out coal early, sustained for around 10-15 years, but declining over time.
- At least \$150-300bn over the next eight years to end deforestation by 2030.
- \$100bn to fund carbon dioxide removals from natural climate solutions.

The size of these payments underscores the critical importance of policy and regulatory action to ban the most harmful activities, increase the competitiveness of renewables and reduce demand for deforested land. If successfully implemented, these actions could reduce the need for such payments as a backstop solution.

⁵⁷ ETC (2021) *Keeping 1.5°C Alive: Actions for the 2020s*.

Early phase-out of coal

By 2025, estimates published in 2020 suggest that only 25% of the world's coal fleet could still be competitive with renewables on a marginal cost basis.^{58,59} But this cost competitive fleet could still produce around 2 Gt per year of emissions. It is therefore essential to develop mechanisms to encourage the early phase out of existing coal plants even where renewables cannot yet compete on a marginal basis.

Some of this early phase out will occur without concessional finance or grants:

- Various mechanisms are being developed which seek to incentivise existing owners to phase out coal operations in return for finance to develop replacement low carbon capacity;
- And voluntary net-zero commitments, whether made by existing coal operators or by the investors and financial institutions which finance them, can motivate early action.

The different forms which such private initiatives can take (and of various private/public partnership models) will be discussed in the ETC's upcoming *Financing the Transition* report.

But it is still clear that earlier than economic coal phase-out will not occur at the pace and scale required without some form of concessional/grant payment.

Estimating the size of these payments is inherently complex given the range of phase-out options (e.g., complete closure, running at reduced capacity, fitting carbon capture and storage) and the need to account for Power Purchase Agreements which cannot be renegotiated under other arrangements. Results from detailed analysis of the South African power system,⁶⁰ if simply scaled up in line with South Africa's share of coal power generation, implies a total figure of around \$25bn per annum of concessional/grant payments in middle and low income countries (excluding China⁶¹), but other recent global estimates are higher still at around \$50bn per annum.⁶²

The IEA is now looking in detail at this issue, and the ETC will address it in detail in our forthcoming workstream on *Fossil fuels in transition*.

Ahead of that more detailed analysis, a current assessment concludes that early coal phase-out could require concessional/grant payments of \$25-50bn per annum, reducing gradually over a 10-15 year time period as some plants reach end of planned life and as the relative economics between fossil fuels and renewables increasingly favours the latter.

Ending deforestation

As set out in Section 4, overcoming slow progress on deforestation will require an alignment of strategies at different levels, including clear national commitments, supported by financial support from developed countries. The need for such concessional/grant payments can be significantly reduced with concerted policy action which:

- Reduces demand for products produced on deforested land, most importantly through a shift towards plant-rich diets and advancing new technologies such as synthetic meat.
- Increasing the value of forested land as a revenue stream in other ways (i.e. without requiring concessional/grant payments), such as through ecotourism, wild forest harvesting, and sustainable commercial forestry.

It will take time for policy to have a material impact on either of these two objectives. This means governments in high income countries must scale up finance, supported by jurisdictional approaches, as one of the most effective short-term levers to end deforestation by 2030.

Concessional/grant payments to end deforestation must therefore be frontloaded this decade in order to:

- Halt deforestation by 2030.

58 Where the marginal operating costs of coal lower than the levelized cost to build and operate onshore wind or solar.

59 Rocky Mountain Institute, *How to retire coal early*. Based on RMI's analysis of almost 2,500 coal plants, and represents the difference in cost between running coal plants and building new renewable energy capacity.

60 *Blended Finance Taskforce (2022) Making Climate Capital Work* – analysis of the incremental cost, relative to the least-cost scenario, of early closure.

61 In China, significant costs of phasing out coal will be incurred, but these will be compensated for by public or private finance within the country.

62 ETC (2022), *Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive*.

- Lower the overall financial costs of ending deforestation, as costs are likely to increase materially over time.

Our estimates suggest that if an end to deforestation could be achieved through financial mechanisms alone, it might cost at least \$1.3-2.6 trillion to end deforestation by 2030, or \$150-300bn a year between now and the end of the decade. These costs reflect the protection of 85-170 Gt of carbon in the trees and soil of forest most at risk from deforestation.⁶³

These costs are significantly higher than the \$19.2bn that has currently been pledged by developed countries to end deforestation. The ETC's upcoming finance report will set out our approach to estimating these payments in more detail.

These payments would only be successful if they cover all forest at high risk of being deforested and are implemented alongside jurisdictional approaches;⁶⁴ otherwise, there is a risk that deforestation will be displaced to another area of forest. Jurisdictional approaches which take an aggregate view of land protection can protect forest at scale whilst also helping overcome the practical challenges of protecting forest through individual project-level finance.

Scaling carbon dioxide removals

The ETC, in a report earlier this year,⁶⁵ noted the important role of scaling carbon dioxide removals alongside deep and rapid emissions reductions if the world is to reach its agreed climate objectives. By 2030, around 3 Gt per year of carbon dioxide removals could be achieved, by scaling finance of around \$440bn per year – of which \$100bn per year would be required to scale natural climate solutions such as reforestation, mostly in middle and low income economies in the tropical belt.

Paying for concessional/grant payments - illustrative scenario of 4 key actions

If these critical emission reductions and removals were to be achieved through financial mechanisms alone, financing at least \$300bn of concessional/grant payments in middle and low income countries would require action from corporates, philanthropy, and governments [Exhibit 13]:

1. The participation of **corporates in voluntary carbon markets** should be maximised. Estimates suggest this could reach 1 – 1.7 Gt of emissions by 2030.⁶⁶ At an average cost of \$45-50/tCO₂, this could raise \$45-80bn for these payments. Other estimates suggest participation could be even higher, raising up to \$190bn per year by 2030.⁶⁷
2. More action from **philanthropists** within climate should be mobilised. If 10% (up from 2% currently) of philanthropic capital could be devoted to climate mitigation, around \$75bn could be raised.⁶⁸
3. **In coal close-down in particular, there is an opportunity for hybrid payment and investment instruments** which seek simultaneously to close down high carbon assets and investing in new lower-carbon assets.⁶⁹
4. **However despite these, intergovernmental transfers of climate related funding** must be significantly scaled up to fill any gap in funding, in particular to finance avoided deforestation and carbon dioxide removals. As an example, if high income countries met the UN's target of international aid at 0.7% of GNI and devoted half of this to climate-focused areas, this could realise around \$200bn of finance for these payments.
 - Provisions for intergovernmental transfers of funding towards emissions reductions have been established via Article 6 of the Paris Agreement, however, given that nearly all countries now have an ambition to reduce emissions to net-zero, any crediting of concessional/grant payments should be in addition to the purchasing countries' NDCs.

The challenges of maximising each of these contributions - especially of intergovernmental transfers in today's current economic and political climate - further underscores the critical importance of policy and regulatory action to ensure that financial mechanisms are a backstop solution.

⁶³ Around 85 Gt of carbon is estimated to reside in the tropical forest frontier (i.e. trees at the edge of the forest most at risk from deforestation) – see Food and Land Use Coalition (2019) *Prosperous Forests*. Estimates suggest an additional 85 Gt of intact forest could also be at high risk of being cut down due to increasing pressures to deforest.

⁶⁴ Jurisdictional approaches aim to ensure that efforts to end deforestation, including payments, are implemented over landscapes defined by political boundaries, as opposed to being delivered at the individual project level.

⁶⁵ ETC (2022), *Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive*.

⁶⁶ BNEF (2022), *Long-term Carbon Offsets Outlook*.

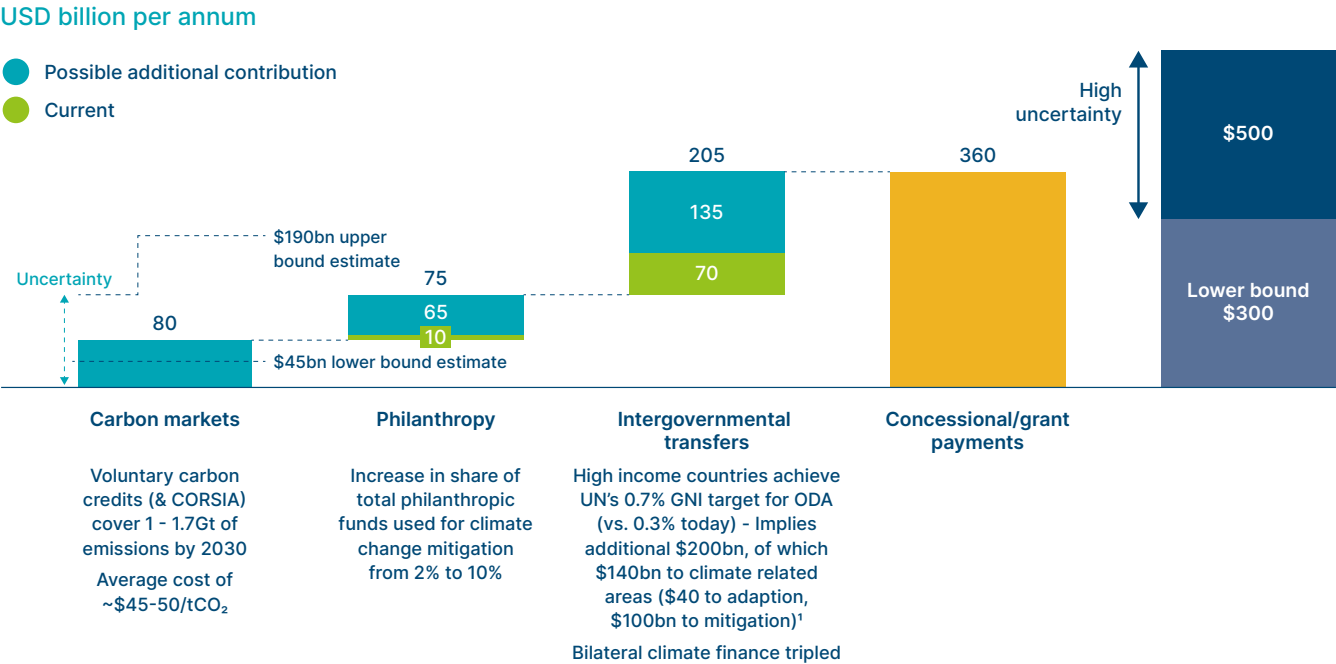
⁶⁷ FOLU (2022), *Prosperous land, prosperous people: a story of scaling finance for nature-based solutions in Kenya*.

⁶⁸ Climate Works Foundation (2021), *Funding Trends 2021: Climate Change Mitigation Philanthropy*.

⁶⁹ See, for example, Asian Development Bank (2021) *Energy Transition Mechanism*.

Three key sources of finance to scale concessional/grant payments to end deforestation, phase out coal power early, and scale carbon removals

Illustrative scenario for financing concessional/grant payments in middle and low income countries by 2030



NOTE: (1) 50% of total Official Development Assistance to climate related projects, and 75% to climate mitigation; (2) Current voluntary carbon market funding is estimated at ~\$200 million.

SOURCES: SYSTEMIQ analysis for the ETC (2022), ETC (2022) *Mind the Gap*, Nick Stern Beyond the \$100bn (2021), OECD ODA Data and Trends 2021, Climateworks Global Intelligence, Climate change mitigation philanthropy 2021, Bloomberg NEF Long-term Carbon Offsets Outlook 2022, FOLU (2022) *Prosperous land, prosperous people: a story of scaling finance for nature-based solutions in Kenya*.



Acknowledgements

The team that developed this report comprised:

Lord Adair Turner (Chair), Faustine Delasalle (Vice-Chair), Ita Kettleborough (Director), Mike Hemsley (Deputy Director), Elena Pravettoni, Manuel Schrenk, Andreas Wagner (Lead authors), Laurene Aubert, Hannah Audino, Leonardo Buizza, Philip Lake, Elizabeth Lam, Hugo Liabeuf, Chelsea Maffia, Tommaso Mazzanti, Shane O'Connor, Caroline Randle, Carolien van Marwijk Kooy (SYSTEMIQ).

The team would also like to thank the ETC members and experts for their active participation:

Clive Turton (ACWA Power); Elke Pfeiffer (Allianz); Nicola Davidson (ArcelorMittal); Abyd Karmali (Bank of America); Paul Bodnar, Julie Ansidei and Michelle Bolten (Blackrock); Jorge Blazquez (BP); Brendon Joe (CLP); Anupam Badola (Dalmia Cement (Bharat) Limited); Justin Bin Lyu, Yi Zhou (Development Research Center of the State Council); Tanisha Beebee (DRAX); Sarah Adair (Duke Energy); Adil Hanif (EBRD); Olivia Sang, George Wang (Envision); Rebecca Collyer (European Climate Foundation); Eleonore Soubeyran (Grantham Institute, London School of Economics); Matt Gorman (Heathrow Airport); Abhishek Joseph (HSBC); Francisco Laveron (Iberdrola); Chris Dodwell (Impax Asset Management); Yanan Fu (Institute of Climate Change and Sustainable Development, Tsinghua University); Ben Murphy (IP Group); Simon Gadd (L&G); Khangzhen Leow (Lombard Odier); Vincenzo Cao (LONGi); Jazib Hasan (Modern Energy); Tim Jarratt (National Grid); Emil Damgaard Gann (Ørsted); Vivien Cai, Summer Xia (Primavera Capital); Many Ranjan (Renew Power); Jonathan Grant (Rio Tinto); Cate Hight, Greg Hopkins (RMI); Daniel Wegen (Royal Dutch Shell); Emmanuel Normant (Saint Gobain); Vincent Petit (Schneider Electric); Brian Dean (SE4All); Camilla Palladino (SNAM); Martin Pei (SSAB); Alistair McGirr (SSE); Abhishek Goyal (Tata Group); Somesh Biswas (Tata Steel); A K Saxena (TERI); Reid Detchon (United Nations Foundation); Mikael Nordlander (Vattenfall); Niklas Gustafsson (Volvo Group); Rasmus Valanko (We Mean Business); Rowan Douglas (Willis Towers Watson); Jennifer Layke (World Resources Institute); Paul Ebert (Worley).

The team would also like to thank the ETC's broader network of experts for their input:

James Foster (NZSI - International Net Zero), Sam Karslake (UK Cabinet Office), Charles Ogilvie, Charlotte Weston, and Virginia Sentence (UK COP26 team).



