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Emissions Gap Report 2020

Executive Summary

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Executive summary – Emissions Gap Report 2020

Introduction

This eleventh edition of the United Nations Environment Programme (UNEP) Emissions Gap Report has been produced in a year where the COVID-19 crisis has dominated the news and policymaking and has caused immense suffering and economic and social disruption worldwide. This economic disruption has briefly slowed – but far from eliminated – the historic and ever-increasing burden of human activity on the Earth's climate. This burden is observable in the continuing rise in extreme weather events, including wildfires and hurricanes, and in the melting of glaciers and ice at both poles. The year 2020 has set new records – they will not be the last.

As in previous years, this report assesses the gap between estimated future global greenhouse gas (GHG) emissions if countries implement their climate mitigation pledges and the global emission levels from least-cost pathways that are aligned with achieving the temperature goals of the Paris Agreement. This difference between "where we are likely to be and where we need to be" is known as the 'emissions gap'.

The report also examines two areas that are highly relevant for bridging the gap and which have become even more relevant in the wake of the COVID-19 pandemic: the shipping and aviation sectors, where international emissions are not covered by nationally determined contributions (NDCs), and lifestyle change.

Reflecting the unusual circumstances, the 2020 report deviates from its usual approach of exclusively considering consolidated data from previous years as the basis for assessment. To maximize its policy relevance, preliminary assessments of the implications of the pandemic and associated rescue and recovery measures are included throughout the report.

Are we on track to bridging the gap? Absolutely not.

Although 2020 emissions will be lower than in 2019 due to the COVID-19 crisis and associated responses, GHG concentrations in the atmosphere continue to rise, with the immediate reduction in emissions expected to have a negligible long-term impact on climate change. However, the unprecedented scale of COVID-19 economic recovery measures presents the opening for a low-carbon transition that creates the structural changes required for sustained emissions reductions. Seizing this opening will be critical to bridging the emissions gap.

The United Nations Secretary-General is calling on governments to use COVID-19 recovery as an opportunity to create more sustainable, resilient and inclusive societies. Aligned with this, the United Nations Framework Convention on Climate Change (UNFCCC) has stressed that governments could integrate and specify some of their post-COVID-19 recovery plans and policies in their new or updated NDCs and long-term mitigation strategies, both of which countries are requested to submit in 2020.

The most significant and encouraging development in terms of climate policy in 2020 is the growing number of countries that have committed to achieving net-zero emissions goals by around mid-century. These commitments are broadly consistent with the Paris Agreement temperature goal, provided they are achieved globally. The litmus test of these announcements will be the extent to which they are reflected in near-term policy action and in significantly more ambitious NDCs for the period to 2030.

As in previous years, the 2020 Emissions Gap Report has been guided by a distinguished steering committee and prepared by an international team of leading scientists, assessing all available information, including that published in the context of the Intergovernmental Panel on Climate Change (IPCC) reports, as well as in other recent scientific studies. The assessment process has been transparent and participatory. The assessment methodology and preliminary findings were made available to the governments of the countries specifically mentioned in the report to provide them with the opportunity to comment on the findings.

1. GHG emissions continued to increase in 2019.

- Global GHG emissions continued to grow for the third consecutive year in 2019, reaching a record high of 52.4 $GtCO_2e$ (range: ±5.2) without land-use change (LUC) emissions and 59.1 $GtCO_2e$ (range: ±5.9) when including LUC.
- Fossil carbon dioxide (CO_2) emissions (from fossil fuels and carbonates) dominate total GHG emissions including LUC (65 per cent) and consequently the growth in GHG emissions. Preliminary data suggest that fossil CO_2 emissions reached a record 38.0 $GtCO_2$ (range: ±1.9) in 2019.
- Since 2010, GHG emissions without LUC have grown at 1.3 per cent per year on average, with

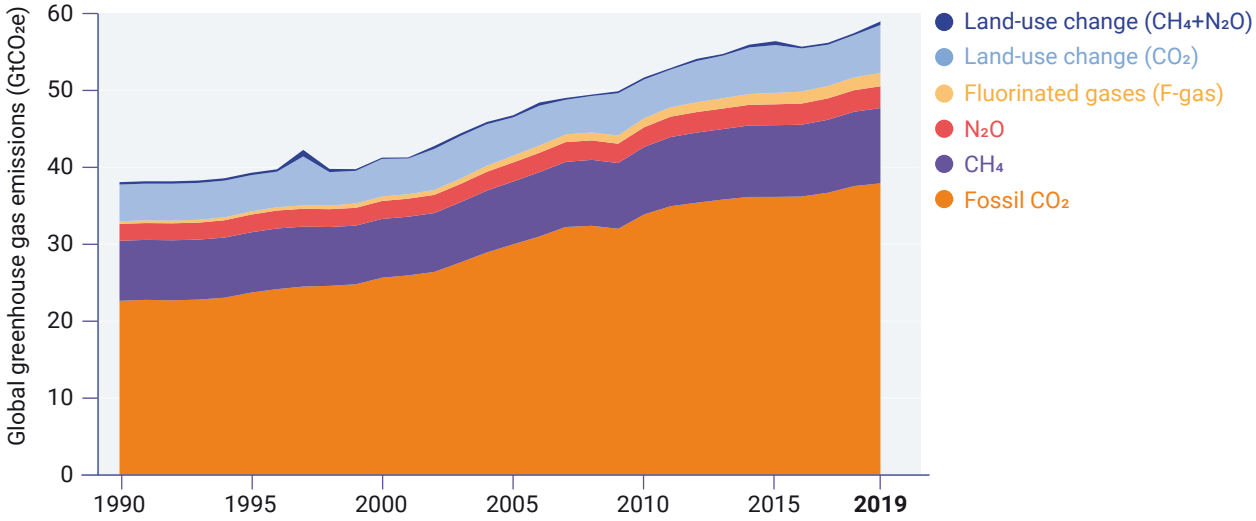
preliminary data suggesting a 1.1 per cent increase in 2019. When including the more uncertain and variable LUC emissions, global GHG emissions have grown 1.4 per cent per year since 2010 on average, with a more rapid increase of 2.6 per cent in 2019 due to a large increase in vegetation forest fires. LUC emissions account for around 11 per cent of the global total, with the bulk of the emissions occurring in relatively few countries.

- Over the last decade, the top four emitters (China, the United States of America, EU27+UK and India) have contributed to 55 per cent of the total GHG emissions without LUC. The top seven emitters (including the Russian Federation, Japan and international transport) have contributed to 65 per cent, with G20 members accounting for 78 per cent. The ranking of countries changes dramatically when considering per capita emissions (figure ES.2).

- There is some indication that the growth in global GHG emissions is slowing. However, GHG emissions are declining in Organisation of Economic Co-operation and Development (OECD) economies and increasing in non-OECD economies. Many OECD economies have had a peak in GHG emissions, with efficiency improvements and growth in low-carbon energy sources more than offsetting the growth in economic activity. Despite improving energy efficiency and increasing low-carbon sources, emissions continue to rise in countries with strong growth in energy use to meet development needs.

- There is a general tendency that rich countries have higher consumption-based emissions (emissions allocated to the country where goods are purchased and consumed, rather than where they are produced) than territorial-based emissions, as they typically have cleaner production, relatively more services and more imports of primary and secondary products. In the 2000s, the gap between consumption and production was growing in rich countries but stabilized following the 2007–2008 global financial crisis. Even though rich countries have had higher consumption-based emissions than territorial-based emissions over the last decade, both emission types have declined at similar rates.

Figure ES.1. Global GHG emissions from all sources

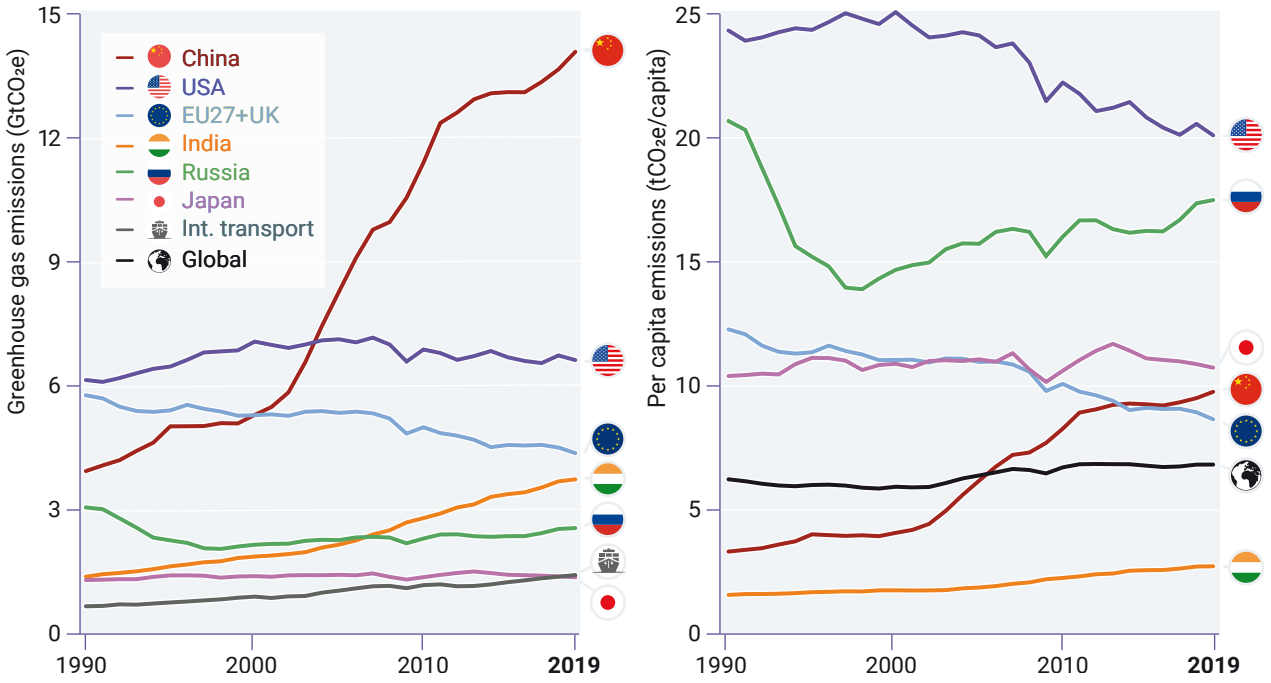


2. CO_2 emissions could decrease by about 7 per cent in 2020 (range: 2–12 per cent) compared with 2019 emission levels due to COVID-19, with a smaller drop expected in GHG emissions as non-CO_2 is likely to be less affected. However, atmospheric concentrations of GHGs continue to rise.

- The reduction in GHG emissions in 2020 due to COVID-19 is likely to be significantly larger than the 1.2 per cent reduction during the global financial crisis in the late 2000s. Studies indicate that the biggest changes have occurred in transport, as COVID-19 restrictions were targeted to limit mobility, though reductions have also occurred in other sectors (figure ES.3).

- Although CO_2 emissions will decrease in 2020, the resulting atmospheric concentrations of major GHGs (CO_2, methane (CH_4) and nitrous oxide (N_2O)) continued to increase in both 2019 and 2020. Sustained reductions in emissions to reach net-zero CO_2 are required to stabilize global warming, while achieving net-zero GHG emissions will result in a peak then decline in global warming.

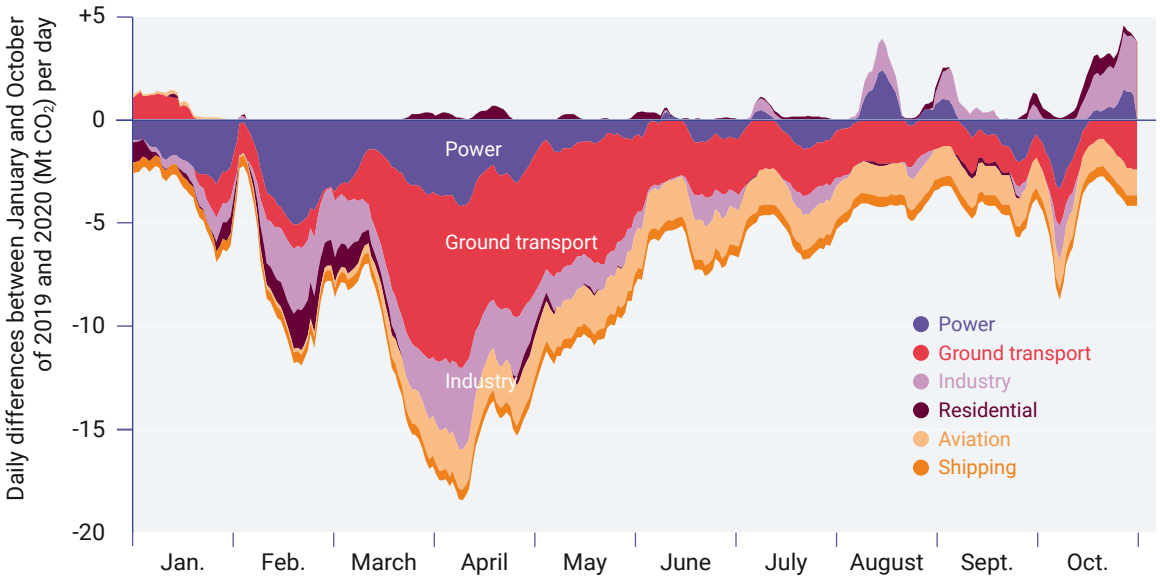
Figure ES.2. Absolute GHG emissions of the top six emitters (excluding LUC emissions) and international transport (left) and per capita emissions of the top six emitters and the global average (right)



3. The COVID-19 crisis offers only a short-term reduction in global emissions and will not contribute significantly to emissions reductions by 2030 unless countries pursue an economic recovery that incorporates strong decarbonization.

- Assessments of the implications of the COVID-19 pandemic and associated recovery measures on emissions by 2030 are still few and highly uncertain. However, this report provides explorative projections based on available studies (figure ES.4).
- The impact of the general slowdown of the economy due to the COVID-19 pandemic and associated rescue and recovery responses is expected to reduce global GHG emissions by about 2–4 $GtCO_2e$ by 2030 compared with the pre-COVID-19 current policies scenario (figure ES.4 – current trends scenario). This assumes a pronounced short-term dip in CO_2 emissions, after which emissions follow pre-2020 growth trends.
- If the initial short-term dip in CO_2 emissions is followed by growth trends with lower decarbonization rates due to countries' potential rollback of climate policies as part of COVID-19 responses, the decrease in global emissions by 2030 is projected to be significantly smaller at around 1.5 $GtCO_2e$ and may actually increase by around 1 $GtCO_2e$ (figure ES.4 – rebound to fossil fuels second-hit and single-hit scenarios, respectively) compared with the pre-COVID-19 current policies scenario.
- Global GHG emissions are only projected to be significantly reduced by 2030 if COVID-19 economic recovery is used as an opening to pursue strong decarbonization (figure ES.4 – IEA sustainable recovery scenario). This could result in global GHG emissions of 44 $GtCO_2e$ by 2030, a reduction of 15 $GtCO_2e$ (just over 25 per cent) by 2030 compared with the pre-COVID-19 current policies scenario.
- There is a significant opportunity for countries to integrate low-carbon development in their COVID-19 rescue and recovery measures, and to incorporate these into new or updated NDCs and long-term mitigation strategies that are scheduled to be available in time for the reconvened twenty-sixth session of the Conference of the Parties (COP 26) in 2021.

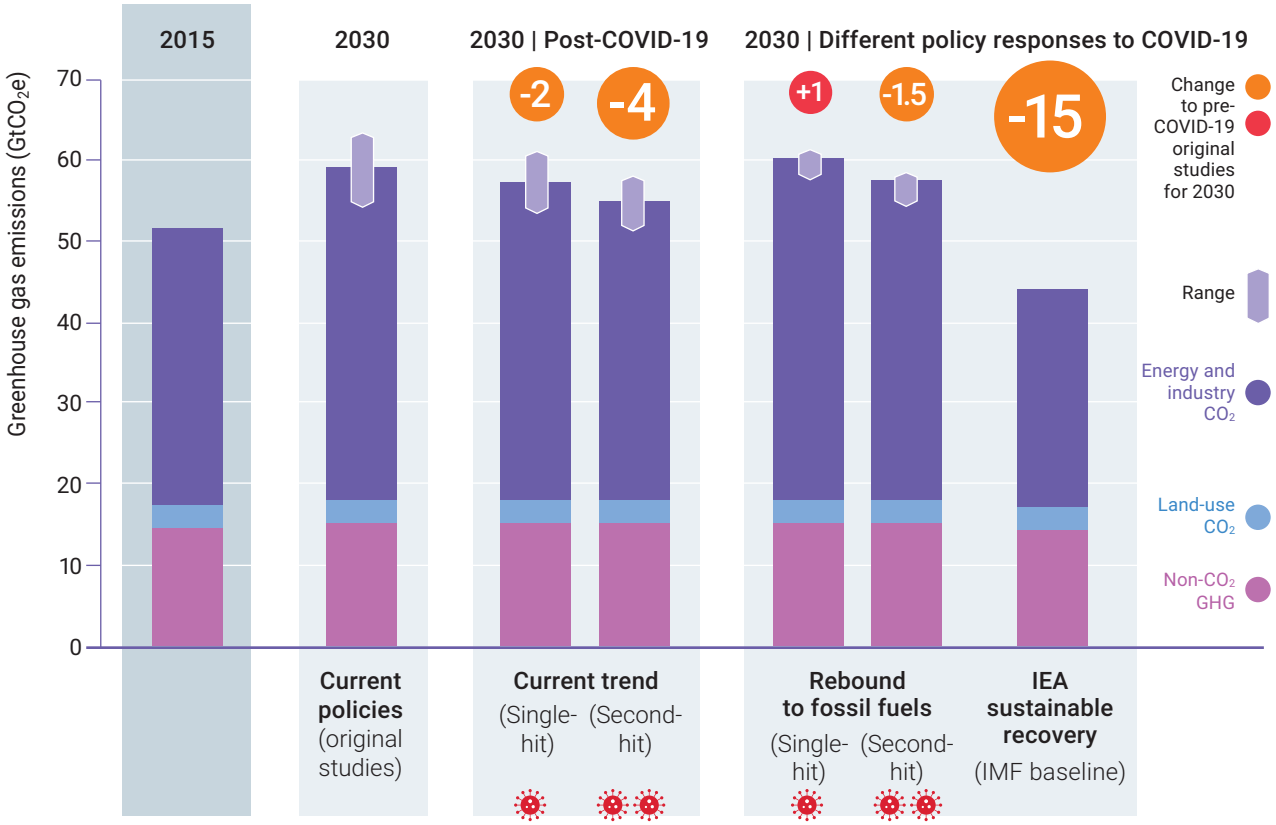
Figure ES.3. Reduction in emissions in 2020 relative to 2019 levels due to COVID-19 lockdowns



4. The growing number of countries that are committing to net-zero emissions goals by around mid-century is the most significant and encouraging climate policy development of 2020. To remain feasible and credible, it is imperative that these commitments are urgently translated into strong near-term policies and action, and are reflected in the NDCs.

- At the time of completing this report, 126 countries covering 51 per cent of global GHG emissions have net-zero goals that are formally adopted, announced or under consideration. If the United States of America adopts a net-zero GHG target by 2050, as suggested in the Biden-Harris climate plan, the share would increase to 63 per cent.
- The following G20 members have net-zero emissions goals: **France** and the **United Kingdom**, which have legally enshrined their 2050 net-zero GHG emissions goals; the **European Union**, which aims to achieve net-zero GHG emissions by 2050; **China**, which announced plans to achieve carbon neutrality before 2060; **Japan**, which announced a goal of net-zero GHG emissions by 2050; the **Republic of Korea**, the president of which committed the country to becoming carbon neutral by 2050 in a speech to parliament; **Canada**, which has indicated its intention to legislate a goal of net-zero emissions (though it is unclear if this refers to just CO_2 or all GHGs) by 2050; **South Africa**, which aims to achieve net-zero carbon emissions by 2050; and **Argentina** and **Mexico**, which are both part of the UNFCCC Climate Ambition Alliance working towards net-zero emissions by 2050.
- There has been limited progress of G20 members in terms of providing formal submissions to the UNFCCC by 2020 of mid-century, long-term low GHG emission development strategies and new or updated NDCs. As at mid-November 2020, nine G20 members (Canada, the European Union, France, Germany, Japan, Mexico, South Africa, the United Kingdom and the United States of America) have submitted long-term low GHG development strategies to the UNFCCC, all of which were submitted before net-zero emissions goals were adopted. No G20 member has officially submitted a new or updated NDC target.
- Although the recent announcements of net-zero emissions goals are very encouraging, they highlight the vast discrepancy between the ambitiousness of these goals and the inadequate level of ambition in the NDCs for 2030. Furthermore, there is inconsistency between the emission levels implied by current policies and those projected under current NDCs by 2030, and, more importantly, those necessary for achieving net-zero emissions by 2050.
- To make significant progress towards achieving the long-term temperature goal of the Paris Agreement by 2030, two steps are urgently required. First, more countries need to develop long-term strategies that are consistent with the Paris Agreement, and second, new and updated NDCs need to become consistent with the net-zero emissions goals.

Figure ES.4. Global total GHG emissions by 2030 under the original current policies scenario based on pre-COVID-19 studies and various 'what if' scenarios using explorative calculations (post-COVID-19) (median and 10th to 90th percentile range)



5. Collectively, G20 members are projected to overachieve their modest 2020 Cancun Pledges, but they are not on track to achieve their NDC commitments. Nine G20 members are on track to achieve their 2030 NDC commitments, five members are not on track, and for two members there is a lack of sufficient information to determine this.

- In line with previous Emissions Gap Reports, this report pays close attention to G20 members, as they account for around 78 per cent of global GHG emissions and thereby largely determine global emission trends and the extent to which the 2030 emissions gap will be closed.
- Collectively, the G20 members are projected to overachieve their 2020 Cancun Pledges, even without considering the expected impact of COVID-19. According to the latest pre-COVID-19 scenario studies, South Africa is now projected to likely achieve its Cancun Pledge. The United States of America is also projected to achieve its Cancun Pledge, though only when the expected impact of COVID-19 is considered. It is still unlikely or uncertain whether Canada, Indonesia, Mexico and the Republic of Korea will achieve their Cancun Pledges, even when COVID-19 implications are considered.
- Collectively, the G20 members are not on track to achieve their unconditional NDC commitments based on pre-COVID-19 projections. Nine of the 16 G20 members (counting the EU27+UK as one), are on track (Argentina, China, EU27+UK, India, Japan, Mexico, the Russian Federation, South Africa and Turkey). Five G20 members are projected to fall short and therefore require further action (Australia, Brazil, Canada, the Republic of Korea and the United States of America). Projections for Indonesia and Saudi Arabia are inconclusive.
- The impacts of COVID-19 and economic recovery measures on 2030 emissions of individual G20 members may be significant, although estimates are still highly uncertain and vary across the few studies available.

6. The emissions gap has not been narrowed compared with 2019 and is, as yet, unaffected by COVID-19. By 2030, annual emissions need to be 15 $GtCO_2e$ (range: 12–19 $GtCO_2e$) lower than current unconditional NDCs imply for a 2°C goal, and 32 $GtCO_2e$ (range: 29–36 $GtCO_2e$) lower for the 1.5°C goal. Collectively, current policies fall short 3 $GtCO_2e$ of meeting the level associated with full implementation of the unconditional NDCs.

- The emissions gap for 2030 is defined as the difference between global total GHG emissions from least-cost scenarios that keep global warming to 2°C, 1.8°C or 1.5°C with varying levels of likelihood and the estimated global total GHG emissions resulting from a full implementation of the NDCs.
- The three temperature scenarios allow for various interpretations of 'well below 2°C', by covering the entire range of below 2°C to below 1.5°C (table ES.1). Each scenario considers a least-cost climate change mitigation pathway that starts long-term reductions from 2020. These are calculated from the scenarios that were compiled as part of the mitigation pathway assessment of the IPCC Special Report on Global Warming of 1.5°C.
- The NDC and current policies scenarios are based on updated data provided by 10 modelling groups. As at mid-November 2020, none of the major emitters have submitted new or updated NDCs with stronger targets for 2030. Overall, NDC target updates from 2019 are expected to reduce total emissions by less than 1 per cent by 2030.
- Collectively, 2030 emission levels fall short of what the NDCs imply: the deficit is about 3 $GtCO_2e$ under the unconditional NDC scenario, and about 5 $GtCO_2e$ under the conditional NDC scenario.
- The emissions gap between estimated global total emissions by 2030 under the NDC scenarios and under pathways limiting warming to below 2°C and

Table ES.1. Global total GHG emissions in 2030 under different scenarios (median and 10th to 90th percentile range), temperature implications, and the resulting emissions gap (based on the pre-COVID-19 current policies scenario)

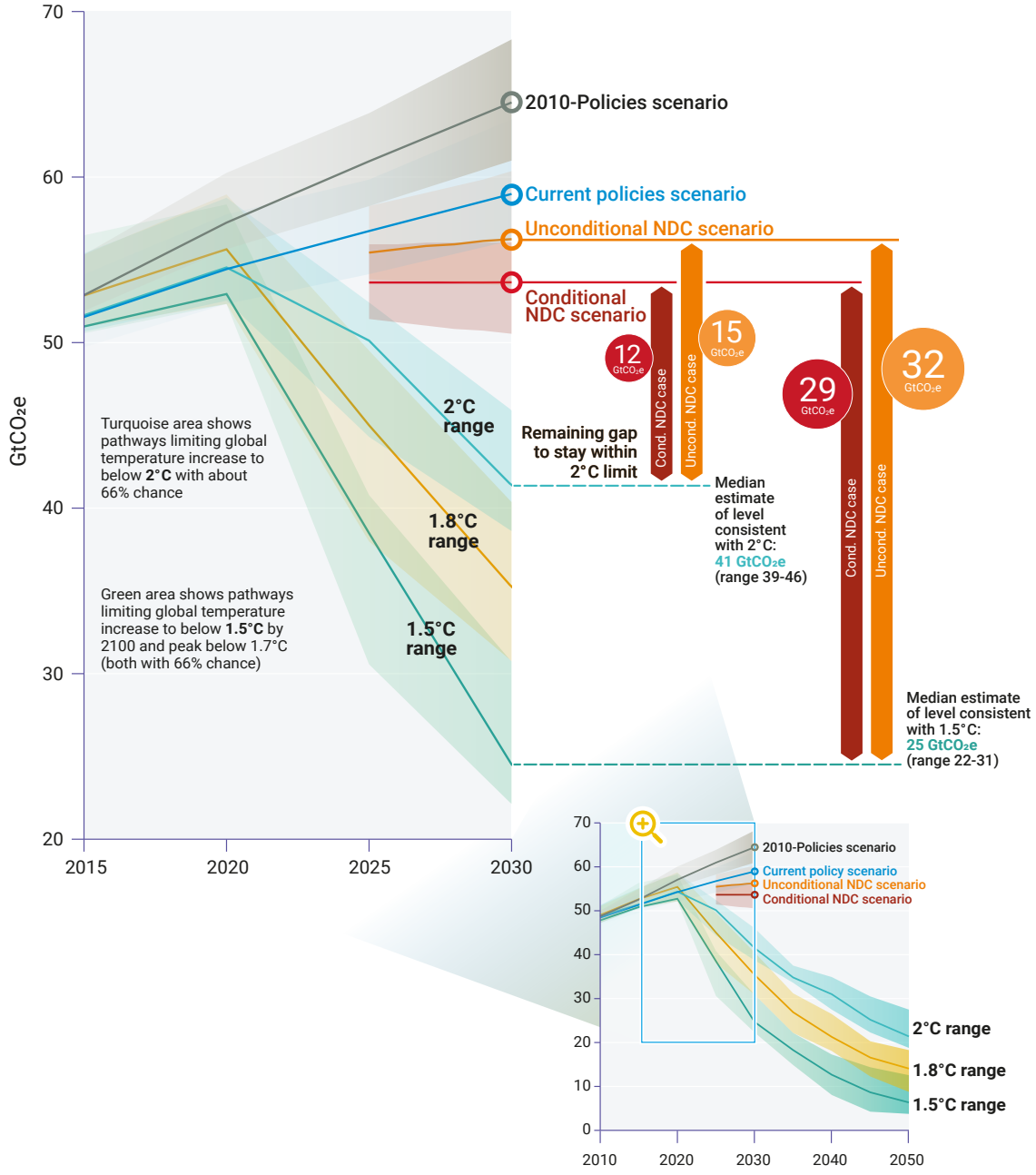
Scenario (rounded to the nearest gigaton)	Number of scenarios in set	Global total emissions in 2030 [$GtCO_2e$]	Estimated temperature outcomes			Closest corresponding IPCC SR1.5 scenario class	Emissions Gap in 2030 [$GtCO_2e$]		
			50% probability	66% probability	90% probability		Below 2.0°C	Below 1.8°C	Below 1.5°C in 2100
2010 policies	6	64 (60–68)							
Current policies	8	59 (56–65)					17 (15–22)	24 (21–28)	34 (31–39)
Unconditional NDCs	11	56 (54–60)					15 (12–19)	21 (18–25)	32 (29–36)
Conditional NDCs	12	53 (51–56)					12 (9–15)	18 (15–21)	29 (26–31)
Below 2.0°C (66% probability)	29	41 (39–46)	Peak: 1.7–1.8°C In 2100: 1.6–1.7°C	**Peak: 1.9–2.1°C In 2100: 1.8–1.9°C**	Peak: 2.4–2.6°C In 2100: 2.3–2.5°C	Higher 2°C pathways			
Below 1.8°C (66% probability)	43	35 (31–41)	Peak: 1.6–1.7°C In 2100: 1.3–1.6°C	**Peak: 1.7–1.8°C In 2100: 1.5–1.7°C**	Peak: 2.1–2.3°C In 2100: 1.9–2.2°C	Lower 2°C pathways			
Below 1.5°C in 2100 and peak below 1.7°C (both with 66% probability)	13	25 (22–31)	Peak: 1.5–1.6°C In 2100: 1.2–1.3°C	**Peak: 1.6–1.7°C In 2100: 1.4–1.5°C**	Peak: 2.0–2.1°C In 2100: 1.8–1.9°C	1.5°C with no or limited overshoot			

1.5°C is large (see figure ES.5). Full implementation of unconditional NDCs is estimated to still result in a gap of 15 $GtCO_2e$ (range: 12–19 $GtCO_2e$) by 2030 compared with the below 2°C scenario. The emissions gap between implementing the unconditional NDCs and the below 1.5°C pathway is about 32 $GtCO_2e$ (range: 29–36 $GtCO_2e$). Full implementation of both unconditional and conditional NDCs would reduce each of these gaps by around 3 $GtCO_2e$.

- Since there have been no updates to the temperature scenarios and only minor updates to the NDC scenarios, the estimated emissions gap remains unchanged from 2019. Similarly, the gap is as yet unaffected by COVID-19.

- However, the current policies scenario is likely to be affected by COVID-19. As shown in figure ES.4, current projections imply effects on 2030 emissions ranging from +1 $GtCO_2e$ to -15 $GtCO_2e$ compared with the pre-COVID-19 current policies scenario shown in figure ES.5. This could bring emissions by 2030 to below the levels associated with the NDC scenarios. A reduction in global GHG emissions of 15 $GtCO_2e$ would bring 2030 emissions within the range consistent with least-cost scenarios that keep global warming to below 2°C, but not in line with 1.5°C.

Figure ES.5. Global GHG emissions under different scenarios and the emissions gap in 2030 (median and 10th to 90th percentile range; based on the pre-COVID-19 current policies scenario)



7. Current NDCs remain seriously inadequate to achieve the climate goals of the Paris Agreement and would lead to a temperature increase of at least 3°C by the end of the century. Recently announced net-zero emissions goals could reduce this by about 0.5°C, provided that short-term NDCs and corresponding policies are made consistent with the net-zero goals.

- A dramatic strengthening of ambition is needed if the Paris Agreement goals are to be achieved. In line with the findings of previous editions of the Emissions Gap Report, countries must collectively increase their NDC ambitions threefold to get on track to a 2°C goal and more than fivefold to get on track to the 1.5°C goal.
- The lack of sufficient mitigation action to date has added significantly to the challenge of meeting the Paris Agreement goals. Global average emissions reductions required per year to meet emission levels by 2030 that are consistent with the 2°C and 1.5°C scenarios have increased remarkably. By now, they are approximately more than double and four times what they would have been respectively had serious collective climate action started in 2010. Failure to significantly reduce global emissions by 2030 will make it impossible to keep global warming below 1.5°C.
- Unconditional NDCs are consistent with limiting warming to 3.2°C by the end of the century (66 per cent probability). If both conditional and unconditional NDCs are fully implemented, this estimate is 0.2°C lower. The pre-COVID-19 current policies scenario, on the other hand, results in higher emissions by 2030, which unless strengthened would result in an average global temperature rise of 3.5°C by 2100.
- COVID-19 containment measures have significantly reduced global GHG emissions in 2020. However, unless these are followed by economic rescue and recovery measures that support a low-carbon transition, this dip in global GHG emissions is estimated to result in no more than a 0.01°C reduction of global warming by 2050, which by then is expected to have exceeded 1.5°C.
- The temperature projections change when considering the potential effects of the recently announced net-zero emissions goals. Preliminary estimates suggest that, collectively, these goals could further lower the temperature projections consistent with unconditional NDCs by about half a degree Celsius to around 2.7°C. If the United States of America also adopts a net-zero GHG target by 2050, as suggested in the Biden-Harris climate plan, projections until the end of the century are estimated to be 0.6°C–0.7°C lower in aggregate compared with the global warming estimate for current unconditional NDCs, i.e. around 2.5–2.6°C.

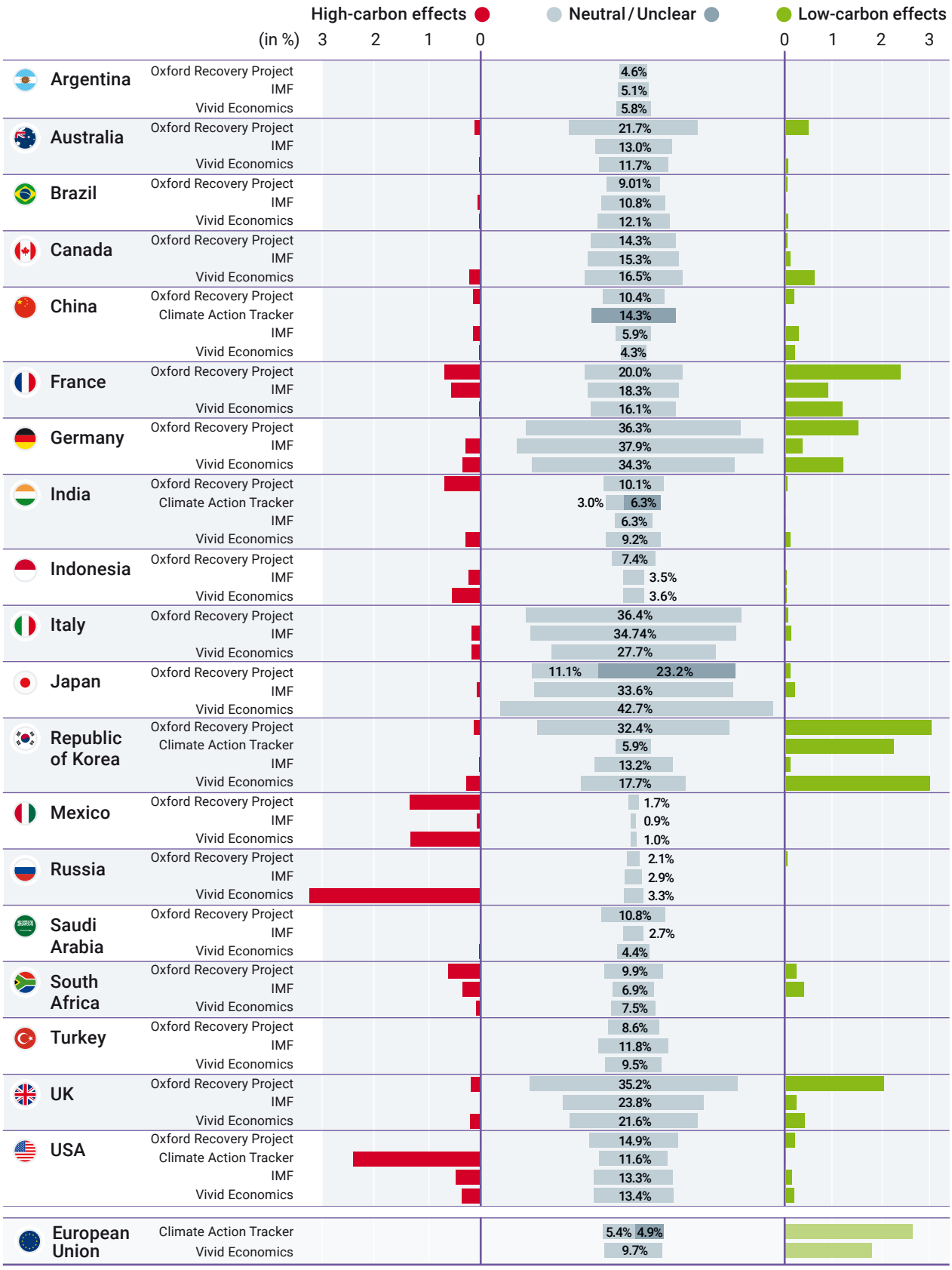
8. COVID-19-related fiscal spending by governments is of unprecedented scale, currently amounting to roughly US$12 trillion globally, or 12 per cent of global gross domestic product (GDP) in 2020. For G20 members, fiscal spending amounts to around 15 per cent of GDP on average for 2020.

- To date, most governments have focused on funding rescue measures to protect lives and businesses in their immediate economic response to COVID-19, with some including conditions that encourage businesses to decarbonize. Given the varied COVID-19 impacts and response timelines, some governments are also starting to fund recovery measures to reinvigorate their economies.
- There are large disparities in fiscal spending around the world. Average fiscal spending of G20 members currently hovers around 15 per cent, reaching as high as 40 per cent for some members. For middle-income and developing countries, however, this figure is much lower at less than 6 per cent of GDP.

9. So far, the opening for using fiscal rescue and recovery measures to stimulate the economy while simultaneously accelerating a low-carbon transition has largely been missed. It is not too late to seize future opportunities, without which achieving the Paris Agreement goals is likely to slip further out of reach.

- As at October 2020, COVID-19 fiscal spending has primarily supported the global status quo of high-carbon economic production or had neutral effects on GHG emissions. While it is understandable that immediate rescue measures were directed to incumbent industry, later rescue and recovery measures could have supported low-carbon development, without forsaking opportunities for economic gain.
- Based on four main trackers of COVID-19 fiscal investments, few G20 members have put words into action in terms of low-carbon rescue and recovery measures (i.e. those resulting in reduced GHG emissions). Around one-quarter of G20 members have dedicated shares of their spending (up to 3 per cent of GDP) explicitly to low-carbon measures. For most, spending has been predominantly high-carbon (implying net negative effects on GHG

Figure ES.6. Non-exhaustive overview of total fiscal rescue and recovery measures of G20 members with high-carbon, neutral and low-carbon effects as a share of 2019 GDP



emissions) or neutral (having no discernible effects on GHG emissions). In a number of cases, it is still unclear what effect countries' measures will have on GHG emissions (figure ES.6).

- Policies with positive impacts on reducing GHG emissions have been slightly more prevalent in fiscal recovery measures than rescue measures. This is noteworthy, as the next stages of COVID-19 fiscal interventions are likely to shift a greater proportion of capital towards recovery measures, indicating that there is potential for increased implementation of low-carbon measures.

- It is still in the hands of policymakers whether global economic rescue and recovery responses to the COVID-19 pandemic will lead to decreased or increased global GHG emissions in the longer term. The future can still be shaped through decisions yet to be made on the composition and implementation of announced recovery packages and future recovery actions.

10. Early COVID-19 fiscal rescue and recovery measures provide valuable insight for policymakers designing measures for the immediate future.

- Many fiscal rescue and recovery measures can simultaneously support rapid, employment-intensive and cost-effective economic recovery and a low-carbon transition. Broad categories include:
  - support for zero-emissions technologies and infrastructure, for example, low-carbon and renewable energy, low-carbon transport, zero-energy buildings and low-carbon industry
  - support for research and development of zero-emissions technologies
  - fossil fuel subsidies through fiscal reform
  - nature-based solutions, including large-scale landscape restoration and reforestation.

- Conversely, some fiscal rescue and recovery measures are likely to perpetuate high-carbon and environmentally damaging development. These include:
  - fossil fuel-based infrastructure investments or fiscal incentives for high-carbon technologies and projects
  - waivers or rollbacks of environmental regulations
  - bailouts of fossil fuel-intensive companies without conditions for low-carbon transition or environmental sustainability (such as airlines, internal combustion automotive companies, industrial industries and fossil energy companies).

11. Domestic and international shipping and aviation currently account for around 5 per cent of global CO_2 emissions and are projected to increase significantly. International emissions from shipping and aviation are not covered under the NDCs and, based on current trends, are projected to consume between 60 and 220 per cent of allowable CO_2 emissions by 2050 under IPCC illustrative 1.5°C scenarios (figure ES.7).

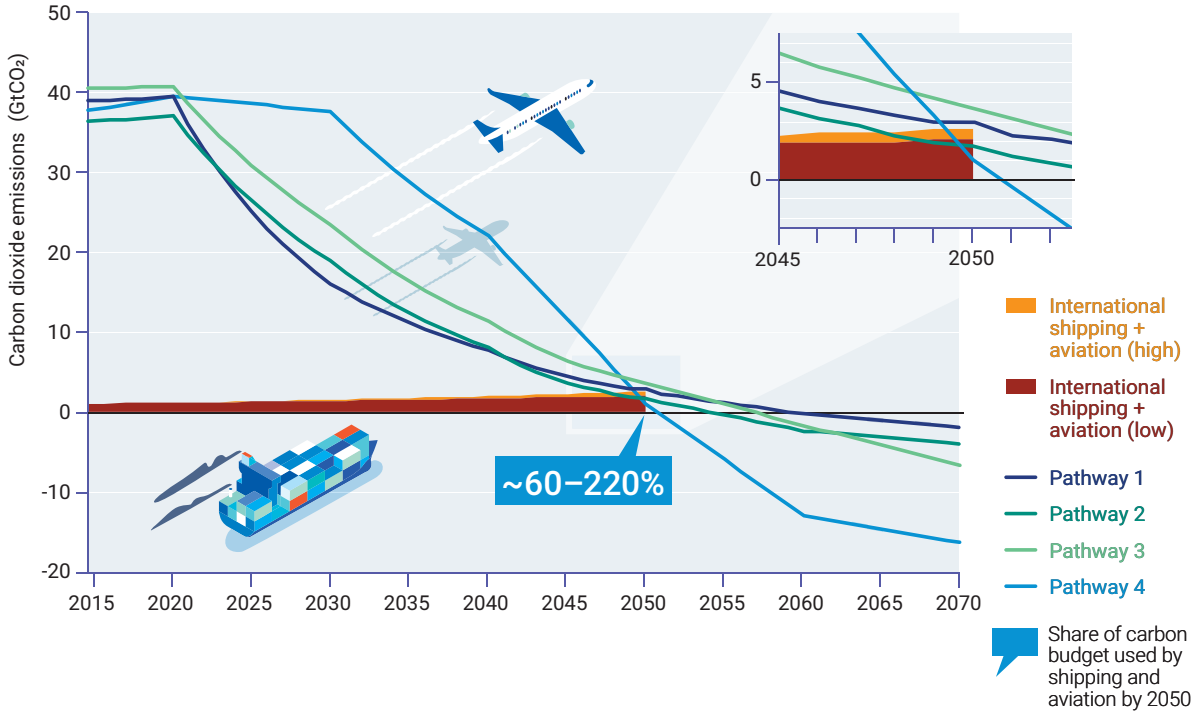
- Combined, the shipping and aviation sectors currently account for approximately 2 $GtCO_2$ per year (distributed evenly across the two sectors) and emissions have increased in the past decades. About 71 per cent of the CO_2 emissions from shipping and 65 per cent of emissions from aviation are international and are not included in national totals reported to the UNFCCC but are instead added as memo items. International emissions are not covered under the NDCs of most signatories to the Paris Agreement. However, because ships and aircraft are often active on both domestic and international routes, there are synergies in addressing domestic and international shipping and aviation emissions.

12. Current policy frameworks to address emissions are weak and additional policies are required to bridge the gap between the current trajectories of shipping and aviation and GHG emissions pathways consistent with the Paris Agreement temperature goals. Changes in technology, operations, fuel use and demand all need to be driven by new policies.

- International aviation currently intends to meet its International Civil Aviation Organization (ICAO) goals through heavily relying on carbon offsets, which do not represent absolute reductions, but at best provide time to transition to low-carbon fuels and implement energy efficiency improvements. At worst, offsets create a disincentive for investment in sector decarbonization and delay the necessary transition. Current carbon offsetting is therefore not a long-term solution and its role should only be temporary.

- Improvements in technology and operations can improve the fuel efficiency of transport if policies incentivize them, but projected increases in demand (even considering potential impacts of

Figure ES.7. Global CO_2 emissions pathways limiting global warming to 1.5°C and CO_2 emissions from international shipping and aviation



the current global COVID-19 pandemic) mean that the improvements will not result in decarbonization and absolute reductions of CO_2 for either the aviation or shipping sectors.

- Both sectors, will therefore need to maximize their energy efficiency while rapidly transitioning away from fossil fuels. Although there are technologically mature production processes for non-fossil fuels, rapid scale-up of new production and supply chains is required and hinges on policies to mandate the use of these fuels, as their costs are much higher.
- Biofuels and synthetic kerosene from biomass or CO_2 and hydrogen have lower carbon footprints than fossil hydrocarbon fuels, provided the biomass is sourced sustainably. These are probably the most realistic fuel alternatives for aviation and shipping in the short to medium term, but will compete with other uses, such as road transport.
- For ships, CO_2-free ammonia is an option, given that a ship's design is less constrained than that of a plane in terms of volume, fuel mass and safety.
- The hydrogen feedstock used in ammonia and synthetic hydrocarbon fuel will only present net benefits if the production is powered by renewable electricity, CO_2 is produced from non-fossil sources, or CO_2 is removed from the atmosphere.
- Long-term fuel alternatives, such as electricity or (CO_2-free) hydrogen will require different aircraft and ship designs and will likely only be applicable for certain purposes.
- Regardless of the feedstock and process, the cost of fuel will increase severalfold, raising the overall cost of both aviation and shipping. This will likely supress demand, especially for aviation, which may ultimately be the most effective means to manage the sector's emissions.

13. Lifestyle changes are a prerequisite for sustaining reductions in GHG emissions and for bridging the emissions gap. Around two thirds of global emissions are linked to the private household activities according to consumption-based accounting. Reducing emissions through lifestyle changes requires changing both broader systemic conditions and individual actions.

- Lifestyle emissions are influenced by social and cultural conventions, the built environment and financial and policy frameworks. Governments have a major role in setting the conditions under which lifestyle changes can occur, through shaping policy, regulations and infrastructure investments. At the same time, it is necessary for citizens to be active participants in changing their lifestyles through taking steps to reduce personal emissions

and fostering societal change as consumers, citizens, owners of assets and members of communities. The participation of civil society is necessary to bring about wider changes in the social, cultural, political and economic systems in which people live.

- Lifestyle emissions are linked to many sources and sectors. Foremost among these are mobility, residential and food, each of which contributes close to 20 per cent of lifestyle emissions, thus implying strong mitigation potential in these areas. For example, foregoing one long-haul return flight has the potential to reduce annual personal emissions by 1.9 tCO_2e per capita on average. Home energy emissions can be tackled through improving existing and new housing stock. The use of renewable electricity by households could also reduce emissions by approximately 1.5 tCO_2e per capita per year for those on higher incomes. In terms of food, shifting consumption towards low-carbon diets has strong emissions reduction potential. Moving to a vegetarian diet, for example, could reduce emissions by an average of 0.5 tCO_2e per capita per year.

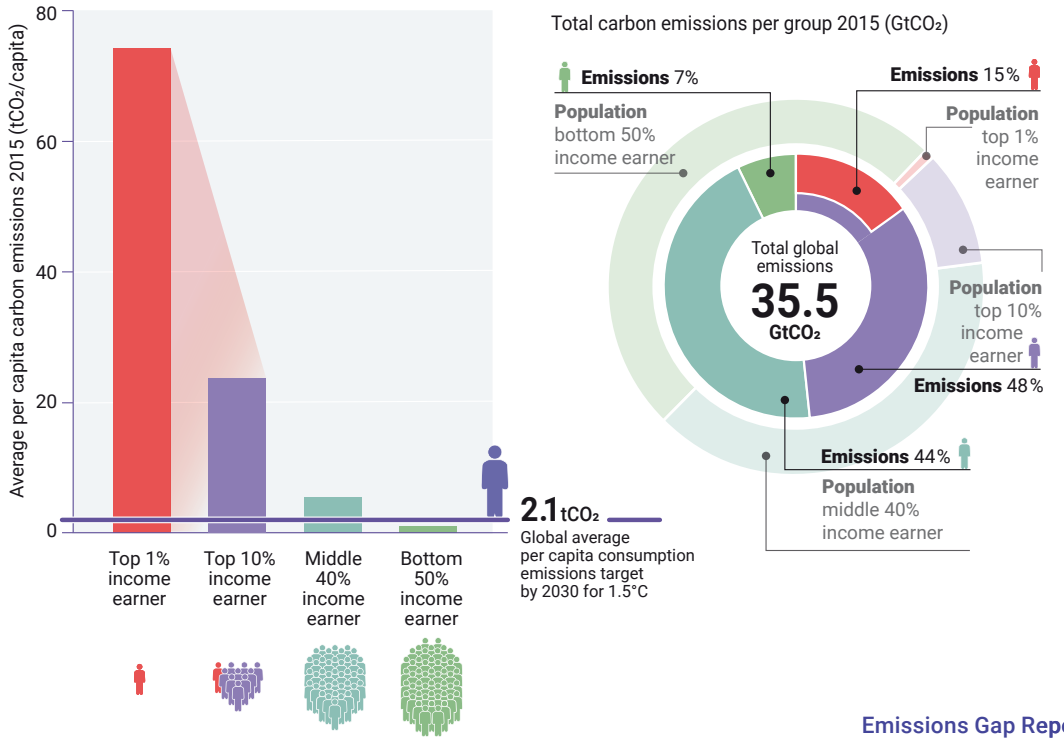
- There are numerous examples of good practices in both the developing and developed world that show it is possible to lead more sustainable lifestyles. Such examples include: replacing domestic short-haul flights with rail journeys and providing incentives and the infrastructure necessary for cycling and car-sharing, while restricting petrol cars; improving the energy efficiency of housing and renewable energy defaults from grid providers; ensuring the provision of low-carbon food in the public sector and developing policies to reduce food waste.

14. Equity is central to addressing lifestyles. The emissions of the richest 1 per cent of the global population account for more than twice the combined share of the poorest 50 per cent.

- Compliance with the 1.5°C goal of the Paris Agreement will require reducing consumption emissions to a per capita lifestyle footprint of around 2–2.5 tCO_2e by 2030. This means that the richest 1 per cent would need to reduce their current emissions by at least a factor of 30, while per capita emissions of the poorest 50 per cent could increase by around three times their current levels on average (figure ES.8).

- COVID-19 has provided insight into how rapid lifestyle changes can be brought about by governments (who must create conditions that make lifestyle changes possible), civil society actors (who must encourage positive social norms and a sense of collective agency for lifestyle changes) and infrastructure (which must support behaviour changes). The lockdown period in many countries may be long enough to establish new, lasting routines if supported by longer-term measures. In planning the recovery from COVID-19, governments have an opportunity to catalyse low-carbon lifestyle changes by disrupting entrenched practices.

Figure ES.8. Per capita and absolute CO_2 consumption emissions by four global income groups for 2015



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