Summary report on the first meeting of the structured expert dialogue on the second periodic review of the long-term global goal under the Convention and of overall progress towards achieving it

Report by the Co-facilitators

8 December 2021

Abbreviations and acronyms

AFOLU	agriculture, forestry and other land use
AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change
AR6	Sixth Assessment Report of the Intergovernmental Panel on Climate Change
CBD	Convention on Biological Diversity
CCS	carbon dioxide capture and storage
CDR	carbon-dioxide removal
CGE	Consultative Group of Experts
CO2	carbon dioxide
COP	Conference of the Parties
COVID-19	coronavirus disease 2019
EIT	economies in transition
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FWG	Facilitative Working Group
G20	Group of 20
G77 and China	Group of 77 and China
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	greenhouse gas
IEA	International Energy Agency
IMF	International Monetary Fund
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
KCI	Katowice Committee of Experts on the Impacts of the Implementation of Response Measures
LCIPP	Local Communities and Indigenous Peoples Platform
LDC	least developed country
LDCF	Least Developed Countries Fund
LEG	Least Developed Countries Expert Group
LTGG	Long-term global goal
MEA	multilateral environmental agreement
NAP	national adaptation plan
NDC	nationally determined contribution
NZE	net zero emissions
PCCB	Paris Committee on Capacity-building
PR2	second periodic review
RFC	Reasons for Concern framework
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCF	Standing Committee on Finance
SDG	Sustainable Development Goal
SED	structured expert dialogue
SIDS	small island developing State(s)
SLR	sea level rise
SSP	shared socioeconomic pathway
SR1.5	Intergovernmental Panel on Climate Change Special Report on Global Warming of 1.5 °C

SRCCL	Intergovernmental Panel on Climate Change Special Report on Climate Change and Land
SROCC	Intergovernmental Panel on Climate Change Special Report on the Ocean and Cryosphere
UNCCD	United Nations Convention to Combat Desertification
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
WGI	IPCC Working Group I
WMO	World Meteorological Organization

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I. Introduction

A. Mandate

1. COP 25 decided that the second periodic review of the LTGG under the Convention and of overall progress towards achieving it (PR2) shall start in the second half of 2020 and conclude in 2022, with the second structured expert dialogue (PR2-SED) held in conjunction with sessions of the subsidiary bodies, starting at their fifty-third sessions (November 2020) and being completed at their fifty-fifth sessions (November 2021).[1]

2. COP 25 agreed that the outcome of the PR2 will not result in an alteration or redefinition of the LTGG stated in decision 10/CP.21, and decided that the PR2 should, in accordance with the relevant principles and provisions of the Convention and on the basis of the best available science:

(a) Enhance Parties' understanding of:

(i) The LTGG and scenarios towards achieving it in the light of the ultimate objective of the Convention;

(ii) Progress made in relation to addressing information and knowledge gaps, including with regard to scenarios to achieve the LTGG and the range of associated impacts, since the completion of the 2013–2015 review;

(iii) Challenges and opportunities for achieving the LTGG with a view to ensuring the effective implementation of the Convention;

(b) Assess the overall aggregated effect of the steps taken by Parties in order to achieve the LTGG in the light of the ultimate objective of the Convention.[2]

B. Objective and general approach to the first meeting of the SED

3. As mandated by the COP, three meetings of the PR2-SED will be held and consider several sources of information as they become available on both themes of PR2. As a result, the final summary report of PR2-SED will consolidate all the aspects considered at individual SED meetings in a comprehensive way. Parties nominated Ms. Tara Shine (Ireland) and Mr. Xiang Gao (China) to co-facilitate PR2-SED.

4. The objective of PR2-SED is to make a contribution to: enhancing Parties' understanding of the LTGG and scenarios towards achieving it, progress made in relation to addressing information and knowledge gaps, and challenges and opportunities; and assessing the overall aggregated effect of the steps taken by Parties in order to achieve the LTGG. Information sources for PR2 include: the assessment and Special Reports, as well as the technical papers of the IPCC; Parties' submissions; information from Parties; other relevant reports of UN agencies and other international organizations; and information from regional and sub-regional agencies. The first periodic review[3] identified 'other processes' that would be relevant to the review, without prejudice to any further discussions that Parties might have on the identification of these processes.[4] The PR2-SED co-facilitators followed the precedent of the first periodic review, and added new processes established since 2015, such as the FWG and the KCI.[5]

5. The first meeting of PR2-SED contributed to the objective of PR2 by making use of the relevant findings of the three Special Reports of IPCC made available in 2018–2019, information from Parties, and information from other relevant reports from UN agencies and

[1] Decision 5/CP.25, para. 7.
[2] Decision 5/CP.25, para. 4.
[3] The first periodic review took place from 2013 to 2015, https://unfccc.int/topics/science/workstreams/periodic-review#eq-1
[4] FCCC/SB/2014/INF.3, para 6.
[5] See presentation by the PR2-SED co-facilitators https://unfccc.int/sites/default/files/resource/1.per cent20Overarchingper cent20presentationper cent20byper cent20theper cent20SEDper cent20CFsper cent20v02.pdf.

other international organizations. As mandated by decision 1/CP.25, para. 21, SED1 also considered the summary report of the round table among Parties and non-Party stakeholders on pre-2020 implementation and ambition. The round table was held virtually on 30 November and 1 December 2020, during the UNFCCC Climate Dialogues 2020.[6]

6. Building on the approach adopted at previous SED meetings, SED1 was organized as a fact-finding exchange of views between experts and Parties. Given the global lockdown due to the COVID-19 pandemic, the meeting was conducted in two virtual sessions. At each session, presentations by experts were followed by a discussion among Parties and experts to clarify possible interpretations of the findings presented and their possible policy implications. At the first session of SED1, the discussions were guided by the following questions:

(a) How does the additional information on the LTGG influence the action needed to achieve it?

(b) How are global scenarios compatible with the LTGG implemented in national scenarios/action? How are the new findings on the associated impacts of these scenarios shape adaptation action by, and support needs of Parties?

(c) What can we learn from the challenges and how can build on the opportunities identified for achieving the LTGG? What can we do to address the knowledge gaps?

(d) What new and additional information has become available on mitigation and what does it tell us on trends and drivers of global emissions and the effectiveness of mitigation policies?

(e) What new and additional information has become available and what does it tell us about the overall effect of the steps taken by Parties on ensuring an adequate adaptation and means of implementation and support response in the context of the LGTT?

7. At the second session of SED1, the discussions were guided by the following questions:

(a) What new knowledge has your organization/agency gathered regarding the scenarios towards achieving the LTGG in the light of the ultimate objective of the Convention?

(b) What progress has your organization/agency made in relation to addressing information and knowledge gaps, including with regard to scenarios to achieve the LTGG and the range of associated impacts, since the completion of the 2013–2015 review?

(c) What challenges and opportunities have your organization/agency identified for achieving the LTGG with a view to ensuring the effective implementation of the Convention?

C. Summary of proceedings

8. The first session of PR2-SED1 took place on 26–27 November 2020, during the UN Climate Change Dialogues 2020 (hereafter Climate Dialogues).[7] It was opened by Mr. Tosi Mpanu-Mpanu, Chair of the SBSTA and considered the three Special Reports of the IPCC published in 2018 and 2019 and information from Parties. On each of the two days, presentations by experts were followed by a question-and-answer session.

9. The second session took place from 3 to 5 June 2021 in conjunction with the May-June sessions of the subsidiary bodies and considered information available from other UN agencies and international organizations.[8] Each day, a two-hour session consisting of presentations by experts and discussions among Parties and experts clarified possible

[6] https://unfccc.int/event/roundtable-on-pre-2020-implementation-and-ambition.
[7] https://unfccc.int/event/first-meeting-of-the-structured-expert-dialogue.
[8] https://unfccc.int/event/first-meeting-of-the-structured-expert-dialogue-of-the-second-periodic-review-session-2.

interpretations of the findings presented and their possible policy implications. In addition, a poster session took place on 3 June to complement the discussions that took place in plenary.[9]

10. In between the two sessions, on 27 April 2021, the Chairs of the subsidiary bodies held informal consultations with Parties on matters related to the PR2. When organizing the second session, the PR2-SED co-facilitators took into account the feedback received on the organization of the first session of SED1, Parties' expectations for the second session of SED1, and views on when to consider the report of the pre-2020 round table on implementation and ambition held in November 2020. The PR2-SED co-facilitators also took into consideration views submitted by Parties.

11. The two sessions consisted of presentations from experts on findings relevant to the two themes of PR2. Based on the modalities of PR2, the co-facilitators strove to ensure a balance in terms of the gender of experts invited, as well as the regions of their origin. The balance in terms of the time allocated to the two themes of the PR will be maintained across the various PR2-SED meetings in aggregate, but not necessarily within a single meeting. In addition, organizations and agencies invited to present on one day were also invited to participate in the discussions on the other days of each session. This ensured a richer discussion and the participation of a wider number of experts on both themes. Some of the IPCC experts participated in all sessions of the SED, thereby ensuring the scientific integrity of the information discussed. After the presentations were delivered, a moderated discussion addressed guiding questions and questions from participants. Below is a summary of the presentations and discussions by topic.

12. This report is not meant to present an exhaustive assessment of the issues at hand, as it is confined to documenting the dialogue held in a thematic rather than chronological way. Furthermore, the views expressed by experts during the dialogue and captured here should not be seen as taking precedence over the findings of the IPCC Special Reports or the reports from other organizations considered in SED meetings. We, the co-facilitators, strove to ensure that this report is factual and reflects the scientific understanding of the issues addressed.

13. Finally, the report only covers findings shared until June 2021 and not the new information included in the WGI contribution to the IPCC's AR6 report, which will be considered at SED2.

II. Summary of discussions

A. The long-term global goal and scenarios towards achieving it

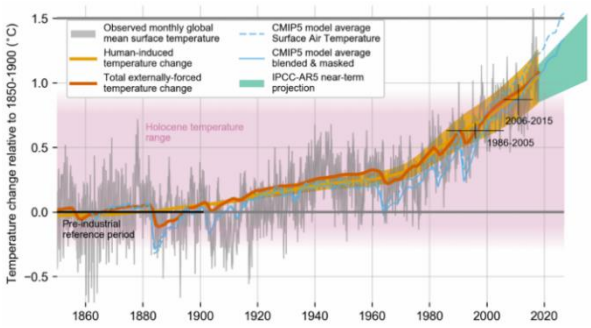
1. New knowledge on the long-term global goal

14. Piers Forster, IPCC, focused on global surface temperature change. To date, we have already reached between 1.1 and 1.2 ºC of global average warming compared to pre-industrial levels using SR1.5 methods. Global warming is assessed by the human-induced contribution, which is very close to the observed change (figure 1). However, it is not always the case, for example in periods where there are large volcanic eruptions, the observed temperature is often lower than the human-induced contribution.

15. Many parts of the world are already temporarily experiencing local temperature change that is larger than the LTGG temperature limits, even if the global average temperature has not reached that level yet (figure 2). Several billion people are already experiencing these high temperatures, some are living with temperatures over 2 ºC above pre-industrial levels. This is important because most climate impacts directly scale with the level of global warming. So, to reduce future impacts, we need to reduce the level of future global warming.

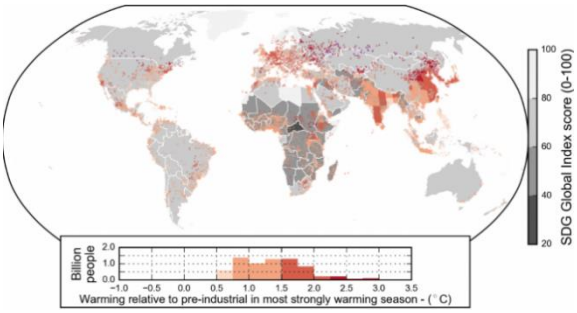
[9] Posters are available at https://unfccc.int/event/first-meeting-of-the-structured-expert-dialogue-of-the-second-periodic-review-session-2.

Figure 1: Evolution of global mean surface temperature over the period of instrumental observations



Source: Intergovernmental Panel on Climate Change (IPCC) SR1.5, figure 1.2. Grey shaded line shows monthly mean global mean surface temperature (GMST) (weighted average of near-surface air temperature over land and sea surface temperature over oceans). Human induced (yellow) and total (human- and naturally-forced, orange) contributions to these GMST changes are calculated. Thin blue lines show the modelled global mean surface air temperature (dashed) and blended surface air and sea surface temperature accounting for observational coverage (solid) from the CMIP5 historical ensemble average extended with RCP8.5 forcing. The pink shading indicates a range for temperature fluctuations over the Holocene. Light green plume shows the AR5 prediction for average GMST over 2016–2035. Abbreviations: IPCC-AR5 = Fifth Assessment report of the Intergovernmental Panel on Climate Change; CMIP5 = Coupled Model Intercomparison Project Phase 5.

Figure 2: Human experience of present-day warming



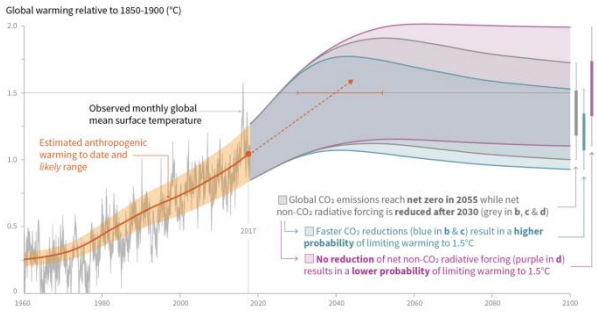
Source: Intergovernmental Panel on Climate Change (IPCC) SR1.5, figure 1.1. Different shades of pink to purple indicated by the inset histogram show estimated warming for the season that has warmed the most at a given location between the periods 1850–1900 and 2006–2015. The density of dots indicates the population (in 2010) in any 1° × 1° grid box. The underlay shows national SDG Global Index Scores indicating performance across the 17 SDGs. Hatching indicates missing SDG index data (e.g. Greenland). The histogram shows the population (in 2010) living in regions experiencing different levels of warming (at 0.25 °C increments). Abbreviation: SDG = Sustainable Development Goal.

16. The first graph in the summary for policy makers (figure SPM.1, here as figure 3) from the SR1.5 shows what we need to do to keep temperature within a certain limit. The first part of the graph, on the left-hand side, shows observed warming. Its right-hand side depicts different emission pathways in which global CO_2 emissions reach net zero in 2055 while net non-CO_2 emissions radiative forcing is reduced after 2030 (not to net zero). The three scenarios show that rapid CO_2 emission reductions result in a higher probability of limiting warming to 1.5 ºC, and that no reduction of net non-CO_2 radiative forcing results in a lower probability of limiting warming to 1.5 ºC.

17. Therefore, to keep within the long-term temperature limit, we must take urgent action to reduce CO_2 emissions to zero as fast as possible. Overall, the cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5 ºC.

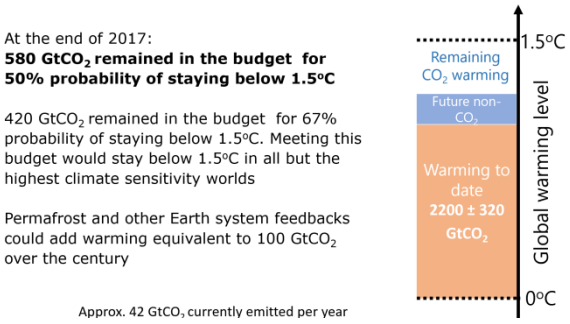
18. Responding to a question on the different measurements of global average temperature, Piers Forster, IPCC, explained that the findings presented at the previous PR1-SED were based on one way of measuring temperature, which combines surface temperature above land and above oceans. In the SR1.5, a different measurement led to a 0.1 ºC difference. These temperature measurements will be examined again in AR6.

Figure 3: Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5 °C



Source: Panel a of SR1.5, Figure SPM.1 Observed monthly global mean surface temperature (GMST), change and estimated anthropogenic global warming (solid orange line up to 2017, with orange shading indicating assessed likely range). Orange dashed arrow and horizontal orange error bar show respectively the central estimate and likely range of the time at which 1.5 °C is reached if the current rate of warming continues. The grey plume on the right shows the likely range of warming responses, computed with a simple climate model, to a stylized pathway in which net CO_2 emissions decline in a straight line from 2020 to reach net zero in 2055 and net non-CO_2 radiative forcing increases to 2030 and then declines. The blue plume shows the response to faster CO_2 emissions reductions, reaching net zero in 2040, reducing cumulative CO_2 emissions. The purple plume shows the response to net CO_2 emissions declining to zero in 2055, with net non- CO_2 forcing remaining constant after 2030. The vertical error bars on right show the likely ranges (thin lines) and central terciles of the estimated distribution of warming in 2100 under these three stylized pathways.

Figure 4: Remaining carbon budget to keep temperatures below a given warming level



Source: Slide 7 of the presentation by Mr. Piers Forster and Mrs. Kirsten Zickfeld (Intergovernmental Panel on Climate Change) at the first session of the SED1, available at <https://unfccc.int/documents/266660> based on IPCC SR1.5 Chapter 2, table 2.2 on the assessed remaining carbon budget and its uncertainties.

19. Kirsten Zickfeld, IPCC, illustrated the relationship between future global mean warming and cumulative CO_2 emissions. Temperature stabilization requires annual CO_2 emissions to reach net zero. If emission reductions are delayed, a given warming limit will be reached earlier and emission reductions must be steeper. Temperature overshoot scenarios are scenarios that, instead of holding warming below a specified warming limit, first exceed the warming limit in the hope to return warming below it at a later point in time. These temperature overshoot scenarios require net removal of CO_2 from the atmosphere. Approximately 220 $GtCO_2$ of net removal would be needed to reverse a temperature overshoot of 0.1 ºC.

20. On the timescale associated with impacts, she stated that: some impacts scale with global mean temperature; others scale with atmospheric CO_2 concentration (for example, ocean acidification); and time-integrated impacts continue even if temperature stabilizes, as shown for Sea Level Rise, and are irreversible after overshoot. So, following an overshoot scenario that first exceeds a specified level of global warming, while aiming to return global warming below it at a later point in time, could cause adverse impacts that take decades to many centuries to reverse, or might be irreversible altogether.

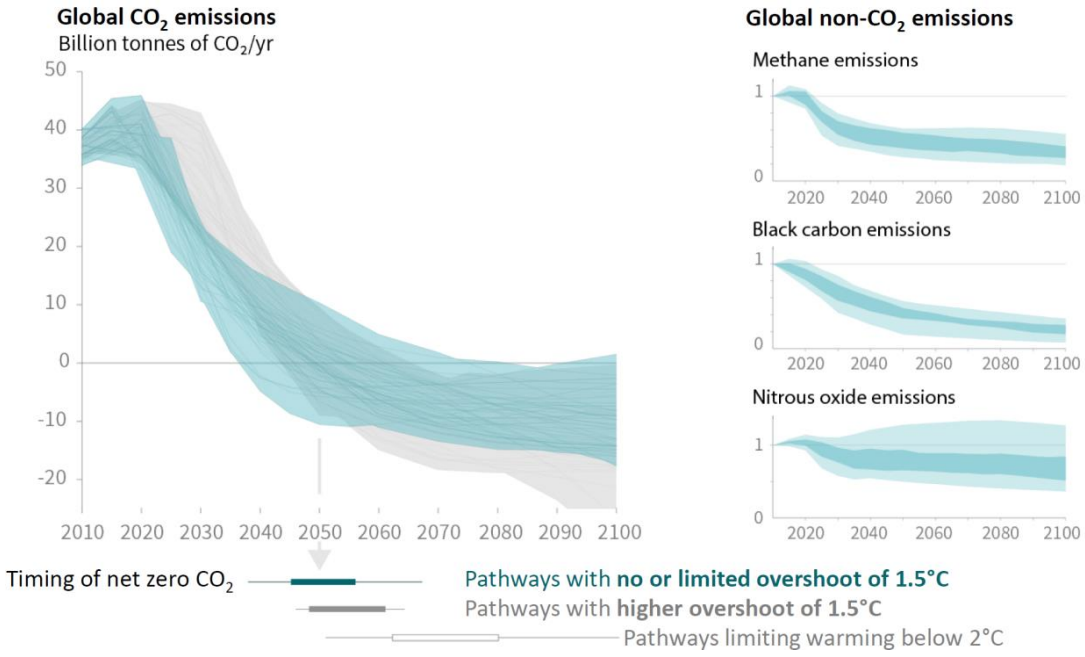
21. Because long-term warming is dependent on cumulative CO_2 emissions, there is only a finite amount of CO2 emissions that can be emitted in the atmosphere to keep temperature below a given warming level, this is referred to as the "carbon budget". At the end of 2017, 580 $GtCO_2$ remained in the budget for a 50 per cent probability of staying below 1.5 ºC. For a 67 per cent probability of staying below 1.5 ºC, 420 $GtCO_2$ remained in the budget (figure 4). Geophysical factors that make meeting the LTGG more challenging are the sensitivity of the climate system and future climate risk to land-based carbon dioxide removals. The carbon budget is also determined by Earth system feedbacks, such as the release of methane and CO_2 from the thawing of permafrost, which could add warming equivalent of 100 $GtCO_2$ over the century.

22. Joeri Rogelj, IPCC, focused on emissions and carbon dioxide removal aspects of scenarios compatible with the LTGG. He presented the global emissions pathways for limiting global warming to 1.5 ºC (figure 5). In pathways that limit warming to 1.5 ºC with no or limited overshoot: CO_2 emissions are roughly halved by 2030 compared to 2010 levels and reach net-zero levels around mid-century; and non-CO_2 emissions are also strongly reduced. In pathways that do not hold global warming to 1.5 ºC, emissions are not reduced sufficiently over the next decade. In scenarios with higher overshoot of 1.5 °C, net-zero CO_2 emissions are still reached around mid-century, but such scenarios rely heavily on CDR in the second half of the century to attempt to reverse warming back below 1.5 °C in 2100.

23. He highlighted the difference between CO_2 and aggregate GHG emissions in 1.5 ºC pathways (IPCC SR1.5, chapter 2, table 2.4, GHG aggregation with GWP 100). In scenarios compatible with a 1.5 ºC level of global warming, global net-zero CO_2 emissions are achieved before (around 2050) global net-zero GHG emissions (around 2067) (figure 6). Not only are the timing of CO_2 and GHG emissions different, they also achieve different outcomes in terms of global warming. Net-zero CO_2 emissions result in stabilizing global temperatures and coincide approximately with peaking temperatures, and net-zero GHG emissions imply that temperatures have peaked and are on a gradual declining path (figure 7).

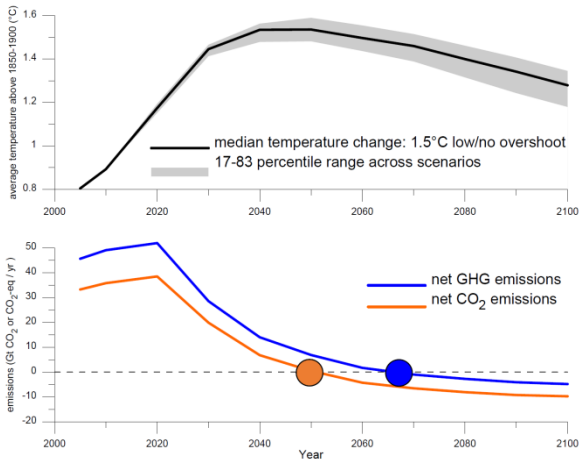
24. He explained why CDR is required for net-zero CO_2 emissions (IPCC SR1.5 Chapter 2, Table 2.4), since CO_2 would still be emitted from fossil fuels, from industrial activities, or even gross emissions in the land-use sector. Reductions in gross CO_2 emissions and CDR deployment play together to achieve net-zero CO_2 emissions. Deployment of CDR compensates residual CO_2 emissions and contributes to stabilizing global warming. CDR is also required to achieve net-negative CO_2 emissions and to achieve temperature decline after having peaked earlier.

Figure 5: Global emissions pathway characteristics



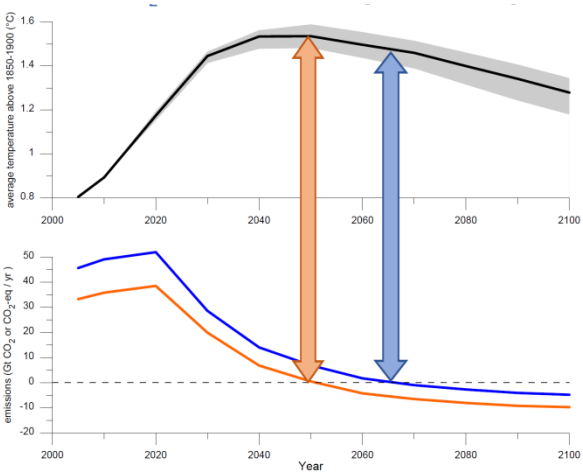
Source: adapted after SR1.5 SPM Figure SPM 3A, which shows global emissions pathways for limiting global warming to 1.5 ºC. The main panel shows global net anthropogenic CO_2 emissions in pathways limiting global warming to 1.5 °C with no or limited (less than 0.1 °C) overshoot and pathways with higher overshoot. The shaded area shows the full range for pathways analyzed in this Report. The panels on the right show non-CO_2 emissions ranges for three compounds with large historical forcing and a substantial portion of emissions coming from sources distinct from those central to CO_2 mitigation. Shaded areas in these panels show the 5–95per cent (light shading) and interquartile (dark shading) ranges of pathways limiting global warming to 1.5 °C with no or limited overshoot. Box and whiskers at the bottom of the figure show the timing of pathways reaching global net zero CO_2 emission levels, and a comparison with pathways limiting global warming to 2 °C with at least 66per cent probability.

Figure 6: The timing and the temperature outcome for net zero CO_2 emissions



Source: Slide 4 of the presentation by Mr. Joeri Rogelj, (Intergovernmental Panel on Climate Change) at the first session of the SED1, available at <https://unfccc.int/sites/default/files/resource/2_Scenarios_LTGG_IPCC_2018_19_SR.pdf> based on SR1.5, Chapter 2, table 2.4. Abbreviations: GHG = greenhouse gas GtCO2 = gigatons of carbon dioxide.

Figure 7: The timing and the temperature outcome for net zero total greenhouse gas emissions



Source: Slide 5 of the presentation by Mr. Joeri Rogelj, (Intergovernmental Panel on Climate Change) at the first session of the SED1, available at <https://unfccc.int/sites/default/files/resource/2_Scenarios_LTGG_IPCC_2018_19_SR.pdf> based on SR1.5, Chapter 2, table 2.4. Abbreviation: GtCO2 = gigatons of carbon dioxide.

25. National GHG inventories and global pathways define the anthropogenic land flux differently, thus requiring special attention when setting targets. Global pathways take into account direct human induced effects on managed lands, while country GHG inventories take into account direct and indirect human induced effects, as well as natural effects on managed lands. So, for the same state of emissions and removal, national GHG emission inventories will report lower emission values. These differences are important when setting targets and when tracking progress towards national or global/aggregated targets.

26. A Party asked how to overcome the differences between GHG inventories and global pathways in defining anthropogenic land flux. Joeri Rogelj explained there is no solution yet and expressed the hope that these differences would be addressed in forthcoming studies.

2. Scenarios compatible with the long-term global goal

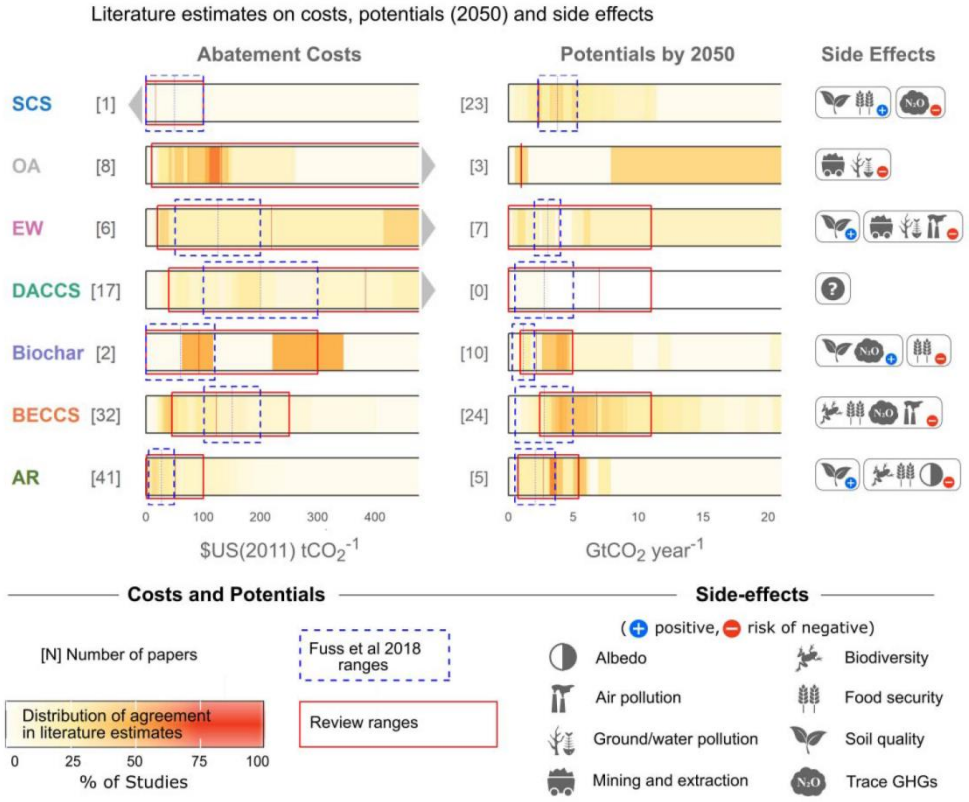
27. Roberto Schaeffer, IPCC, focused on CDR and the role it plays in achieving both net-zero CO_2 (compensate for residual CO_2 and stabilize warming; achieve temperature decline) and net zero-GHG emissions (compensate for residual CO_2 and hard to abate residual non-CO_2 emissions). He underlined that the timing and scale of CDR depend on the stringency of gross emission reductions over the near-term, the mitigation portfolio and strategy, including the desired mix of CDR technologies, and the desired rate of temperature decline after the peak.

28. He presented four illustrative model pathways (IPCC SR1.5 SPM.3B, SRCCL Chapter 6). The first pathway focuses on innovation and lower energy demand with economic development, and limited CDR based on AFOLU is required. The second pathway shows higher emissions, higher economic development, and more reliance of CDR that are based not only on AFOLU but also on BECCS. The third pathway, or "middle-of-the-road development," is based on historical patterns of development. Because of delayed actions and higher emissions, this pathway relies more heavily on CDR, with more BECCS than the others. The fourth pathway is a resource- and energy-intensive scenario with high reliance on fossil fuels, and therefore features a heavy use of BECCS.

29. The various CDR options vary in terms of costs, potential and side effects (figure 8). These options include soil carbon sequestration, ocean alkalinization, enhanced weathering, direct air carbon dioxide capture and storage, biochar, and BECCS and afforestation. Cost

potential and side effects are quite different according to the CDR options. In addition, there is also a variety of views in the literature on abatement costs and potential of these options.

Figure 8: Evidence on CO_2 removal abatement costs, 2050 deployment potentials, and key side effects



Source: Adapted from SR1.5, figure 4.2, which shows the percentage of papers at a given cost or potential estimate. Reference year for all potential estimates is 2050, while all cost estimates preceding 2050 have been included (as early as 2030, older estimates are excluded if they lack a base year and thus cannot be made comparable). Ranges have been trimmed to show detail. Costs refer only to abatement costs. Icons for side effects are allocated only if a critical mass of papers corroborates their occurrence.

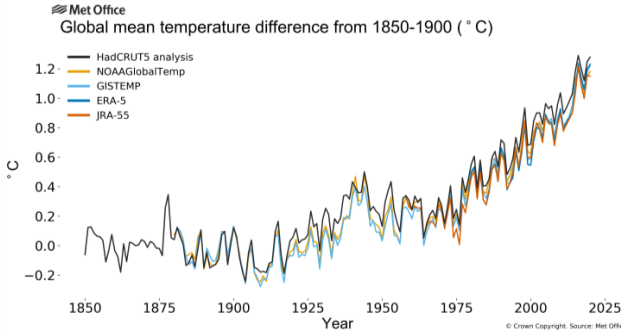
30. Adam Scaife, WMO, presented on the current state of the global climate and progress in providing climate services. His presentation focused on three recent WMO reports: the State of the Global Climate 2020, the WMO Global Annual to Decadal Climate Update, and the State of Climate Services.

31. The State of the Global Climate[10] is led by WMO with inputs from over 70 of its members and is produced in collaboration with other UN agencies. Key climate indicators in 2020 include: record high concentrations of CO_2, methane and nitrous oxide despite the COVID-19-related lockdown; one of three warmest years on record (figure 9); numerous regional temperature records; and the annual global mean temperature that was 1.2 ºC above the pre-industrial level.

32. For other indicators, it is a similar picture. For the oceans, there was record high ocean heat content (figure 10) and high sea level, both are accelerating; and near-record Arctic sea ice minimum. High impact events in 2020 included: a Siberian heatwave; extreme snowfall in parts of North America and East Asia; and widespread extreme rainfall and summer flooding across Asia. Scaife said in 2020, millions of people were doubly hit, by climate-related disasters and the COVID-19 pandemic. Over the last decade, close to 23 million people on average each year have been displaced from their homes because of climate-related events. He underlined that the risks and the impacts often arise from compound events.

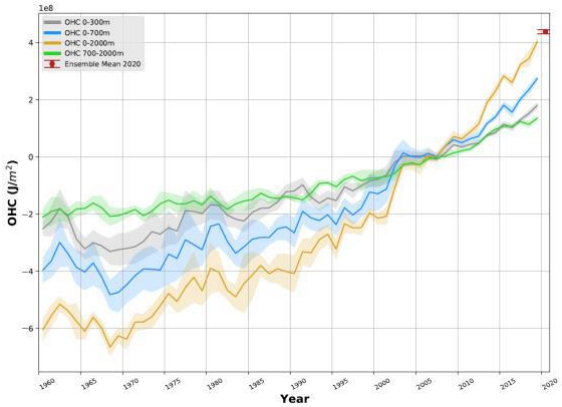
[10] https://public.wmo.int/en/our-mandate/climate/wmo-statement-state-of-global-climate.

Figure 9: Global annual mean temperature difference from pre-industrial conditions (1850–1900)



Source: Figure 1 of the World Meteorological Organization State of the Global Climate 2020, available at: https://library.wmo.int/doc_num.php?explnum_id=10618. The figure represents the global annual mean temperature difference from pre-industrial conditions (1850–1900) for five global temperature data sets, expressed relative to the 1850–1900 average. The global mean temperature is reported as the mean of the following five data sets: HadCRUT5, NOAAGlobalTemp, GISTEMP, ERA5 and JRA.

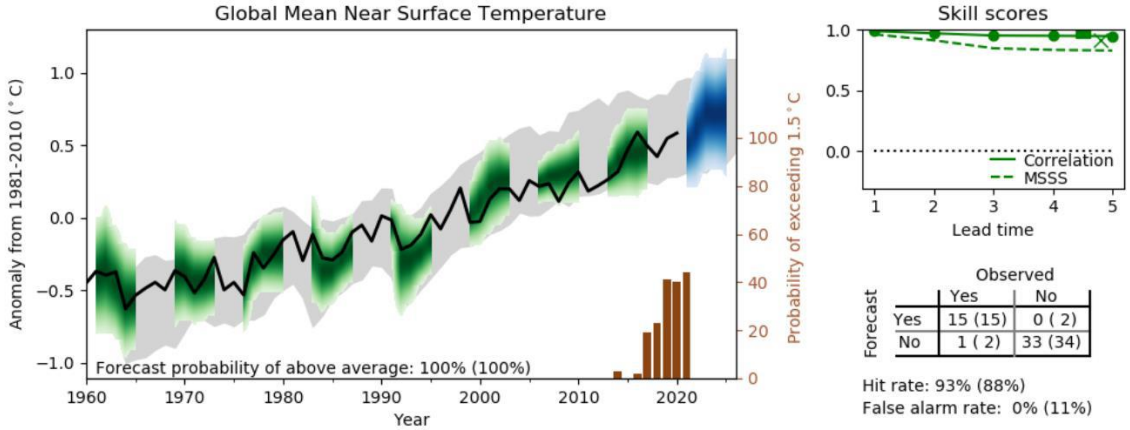
Figure 10: Ocean heat content



Source: Figure 5 of the World Meteorological Organization State of the Global Climate 2020, available at: https://library.wmo.int/doc_num.php?explnum_id=10618. The figure represents the 1960–2019 ensemble mean time series and ensemble standard deviation (2-sigma, shaded) of global ocean heat content anomalies relative to the 2005–2017 climatology. Values are given for the ocean surface area between 60°S–60°N and limited to the 300 m bathymetry of each product. The ensemble mean ocean heat content (0–2 000 m) anomaly (relative to the 1993–2020 climatology) has been added as a red point, together with its ensemble spread. *Abbreviation*: OHC = ocean heat content.

33. Turning to the WMO Global Annual to Decadal Climate Update,[11] Scaife said it is produced by WMO dedicated climate centres. Highlights from the Update include: in the coming five years, the annual global mean temperature is likely to be 0.9 °C – 1.8 °C warmer than the pre-industrial level; there is about a 40per cent chance of the annual average global temperature temporarily reaching 1.5° C above the pre-industrial level in at least one of the next five years – and these odds are increasing with time (figure 11). He underlined that this temporary exceedance is different from the Paris Agreement threshold (i.e. holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels).

Figure 11: Probability of temporary exceedance of 1.5 ºC



[11] https://hadleyserver.metoffice.gov.uk/wmolc/.

Source: World Meteorological Organization Global Annual to Decadal Climate Update, Figure 3, available at: https://hadleyserver.metoffice.gov.uk/wmolc/WMO_GADCU_2020.pdf. The figure represents multi-annual predictions of global mean near-surface temperature relative to 1981–2010. Annual global mean observations in black, forecast in blue, hindcasts in green and noninitialized simulations in grey. The shading indicates the 90per cent confidence range. The probability for above average in the five-year mean of the forecast is given at the bottom of the main panel. Hindcast skill scores are shown in the upper right panel, the square and the cross show the correlation skill and Mean Square Skill Score for five-year means, respectively. Significant correlation skill (at the 5per cent confidence level) is indicated by solid circles/square. The contingency table for the prediction of above average five-year means is shown in the bottom right panel (in brackets values for above average in the next year). Also inset in the main panel, referring to the right-hand axis, is the probability of global temperature exceeding 1.5 °C above pre-industrial levels for at least one year during the five years starting in the year indicated.
Abbreviation: MSSS = Mean Square Skill Score.

34. Scaife mentioned another highlight of the Update, that is, over the period 2021–2025, high-latitude regions and the Sahel are likely to be wetter than the recent past, and there is an increased chance of Atlantic storms compared to the recent past.

35. On the State of Climate Services 2020,[12] he reported that in the last 50 years, 79 per cent of disasters involved weather, water or climate-related hazards. Some of the report's highlights include that: since 1970, SIDS have lost USD 153 billion due to weather, climate and water related hazards; 70 per cent of deaths reported over 1970–2019 occurred in LDCs; and nearly 90 per cent of LDCs and SIDS have identified early warning systems for climate extremes as a top priority in their NDCs. He noted that across the board, the SDGs are highly sensitive to climatic indicators. Continuation of current and projected trends in these indicators will drive increasing demand for climate services. This demand is already seen in NDCs, with agriculture, water, disaster reduction and health being the top climate adaptation priorities. However, he underlined that climate services currently fall short of demand. In LDCs, for example, multi-hazard early warning systems addressing the top hazards are available in only a quarter of countries and less than half of people receive early warnings.

36. He cited the example of desert locust early warning systems, which are estimated by FAO to have contributed to saving 720,000 tons of cereal production from destruction during the outbreak in 2020 in the Greater Horn of Africa, illustrating that returns on investments in climate services can be substantial.

37. Scaife concluded with some key messages, namely that: climate continues to warm, and some aspects are accelerating; COVID-19 lockdowns had almost no impact on GHG concentrations and undetectable impact on global temperature; strong action needed to slow anthropogenic climate change; and operational predictions are available in real time for adaptation to impending extremes. He also formulated the following recommendations: climate actions should be prioritized based on the best available climate science; enhanced observing networks and international operational exchange of hydrometeorological data and products should continue to be financed; the "last mile" service delivery barrier should be addressed through stakeholder governance and partnerships; there is a need to focus on LDCs and SIDS; and data gaps can be filled by improvement in country reporting of climate information and early warning systems.

(a) Timing of reaching 1.5 ºC and temporary exceedance of 1.5 ºC target

38. A Party noted that after the publication of the SR1.5, articles in the media indicated that the world has 10 years left to reach the 1.5 ºC limit, although presentations indicated 2050 as the year when net-zero CO_2 emissions needs to be reached. Joeri Rogelj, IPCC, clarified that the SR1.5 shows that significant reductions will have to start by 2021, be achieved by 2030, and continue throughout the century and beyond. Mikiko Kainuma, IPCC, added that if current emission trends continue, we will be in a 1.5 ºC world between 2030 and 2052. Net-zero CO_2 emissions need to be reached in around 2050 to limit the temperature increase to 1.5 °C above pre-industrial levels by the end of the century.

39. A Party asked why a presentation mentioned that net-zero CO_2 emissions had to be achieved by 2055. Mikiko Kainuma, IPCC, explained that the timing of net zero CO_2 emissions in 1.5 °C pathways with no or limited overshoot typically lies in the 2046–2055 period, with a median estimate of 2050. She added that assumptions can vary and that solutions are not unique.

[12] https://library.wmo.int/index.php?lvl=notice_display&id=21777#.YLoCpvkzaux.

40. A Party asked, if current trends continue, whether it is correct that the 1.5 ºC limit will be reached between 2030 and 2050, and how does that relate to annual temperatures. Piers Forster, IPCC, explained that global warming is defined to a 30-year average, and within that period, for some particular years, the limit may be surpassed.

41. A Party noted that the IPCC tells us that the 1.5 ºC is still within reach, but the WMO indicates there is a high possibility that the annual average global temperature could reach 1.5 ºC over the next few years, so what are the implications for trajectories consistent with the LTGG? Other Parties also sought clarifications from WMO on new climate predictions to temporarily reaching 1.5 ºC within the next five years, stressing that the narrative should not confuse policy makers.

42. Scaife explained that it is important to consider both temporary exceedances and the Paris target, which are different. Temporary exceedance does not mean we have passed the Paris threshold, which was agreed as holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels. However, the global climate is subject to year-to-year variations, and this variability rides on top of the underlying climate change trend to which the Paris Agreement refers. In the next few years, we are inevitably going to face occurrences of temporary fluctuations reaching 1.5 ºC, yet we have not passed the Paris threshold. He stressed that as the probability of such events increases, it is marking the closer we are getting to the climatological level of the Paris Agreement. Although measuring this climatological level is not very clear, it is usually a 30-year mean average. In other words, when there is a 50 per cent chance each year of surpassing that level. Within the next decade, it is very likely that one or more of these temporary exceedances will occur, thus the importance of explaining the difference with the climatological threshold to the media. Maxx Dilley, WMO, explained that the global average temperature was above 1.2 ºC above the pre-industrial level in 2020. The probabilities are increasing that for some years, the temperatures will exceed the 1.5 ºC level. Noting a constant warming trend, he stated that unless GHG concentrations are reduced the trend will increase. The climatological standards look at a 30-year period, but if we are at an average of 1.5 ºC of warming for 30 years already, we would be locked in a higher level of warming because of the decades required for the climate system to respond to atmospheric forcing from the GHGs. Indications that we are approaching the 1.5 ºC threshold is an incentive to urgently reduce GHG concentrations.

43. A Party asked if WMO plans to use its decadal experiments to provide information on the possibility of exceeding 1.5 ºC over long-time scales. Scaife said WMO is not doing so at the moment but will raise this point with colleagues. A Party said there is statistical bias in the WMO model, since it does not take into account the dumping of waste in oceans that nuclear energy implies. Scaife recognized that non-GHG pollution does damage ecosystems, however, it is GHG emissions that are responsible for global climate change.

(b) Emission pathways to achieve the long-term global goal

44. Two Parties asked for elaboration on overshoot pathways resulting in not holding warming to below 1.5 ºC of warming. Joeri Rogelj, IPCC, said scenarios with high overshoots will exceed 1.5 ºC level of warming and have some probability of not holding warming to below 2 ºC.

45. In a related question, one Party noted that the 2013–2015 periodic review identified some knowledge gaps, including the 2030 GHG emissions level for pathways compatible with limiting warming to 1.5 ºC. He asked for clarification related to the new findings on low or no overshoot 1.5 ºC pathways in the IPCC SR1.5. Joeri Rogelj, IPCC, said that pathways with little or no overshoot still have a probability to exceed 1.5 ºC of warming, but a higher probability to stay below 2 ºC (SR1.5 Chapter 2, Figure 2.1, Table 2. SPM.12).

46. Another Party asked about the role of short-lived climate pollutants for achieving the LTGG. Joeri Rogelj stated that CO2 and non-CO2 gases interplay, and that all GHG are being reduced in pathways consistent with the LTGG temperature limits, but only CO2 reduced to zero. Long-lived climate forcers define long-term climate change the most.

47. Responding to which approaches, or sectors should be prioritized over the next 10 years, Joeri Rogelj, IPCC, said that action is needed in all sectors and on all GHGs. There is

unfortunately no "one or two things" that should be done. SR1.5 options and the way they are implemented is context-specific and will vary from country to country. Valérie Masson-Delmotte, IPCC, added that all three Special Reports had underscored the importance of climate literacy, education and training as key enabling conditions to achieve the LTGG. She also pointed to the need for transparency and information sharing.

(c) Ocean heat

48. A non-Party asked if the temperature target in the Paris Agreement takes into account ocean heat and the effects of short-lived climate pollutants. In response, IPCC WGI co-chair to noted that specific information on CO_2 and non-CO_2 emissions is important due to the cumulative effect of CO_2 on future global warming (based on IPCC WGI AR5 and IPCC SR1.5 reports). While many consequences are related to the level of global warming (such as regional climate trends and changes in extreme weather or climate events), it is not the case for the consequences of changes in components of the climate system such as the ocean, glaciers, ice sheets, which adjust slowly to the current perturbation and thus can continue to change (on timescales of decades, centuries or more) even if the level of global warming is stabilized (see IPCC SROCC report, chapter 6). The recent IPCC Special Reports (SR1.5 and SROCC) show that limiting the level of global warming leads to slower rates of changes for these slow components.

(d) Historical emissions

49. Two Parties asked about historical emissions and their impact on achieving the LTGG. Kirsten Zickfeld, IPCC, explained that observed warming to date is due to past human influence. She stated that if we were to reduce emissions to zero immediately today, warming would be less than 0.5 ºC over the next decade, and that future warming will largely be determined by both historical and future emissions.

3. Achieving the long-term global goal: implications for the energy and agricultural sectors

50. Mechthild Wörsdörfer, International Energy Agency (IEA), presented on net zero by 2050: a roadmap for the global energy sector.[13] She said this is the IEA first-ever global roadmap to achieve NZE by 2050. It was not envisaged when the IEA presented at the PR1-SED in 2014, illustrating how important it is to update analysis as challenges and opportunities change significantly overtime. The need to tackle climate change has only become more urgent. There have been important technology cost reductions, particularly when it comes to delivering clean electricity. She expressed the hope that the information in the roadmap will contribute to addressing knowledge gaps and encourage Parties to take steps towards the LTGG.

51. Wörsdörfer stressed that the IEA's new scenario shows "a" pathway to NZE by 2050, not "the" path. There are approximately 90 scenarios included in the IPCC's SR1.5, which were classified as having at least a 50 per cent chance of limiting warming in 2010 to 1.5 ºC. Only 18 of these scenarios have energy sector and energy process NZE in 2050. In addition, the NZE achieves universal energy access by 2030, a key SDG 7 target goal that is not included systematically in IPCC scenarios.

52. She compared the NZE pathway to the IPCC scenarios of comparable ambition, highlighting that it contains on average less than half of the amount of CO_2 capture as other scenarios, the lowest level of CO_2 removals from BECCS and direct air capture, and phases out the traditional use of biomass. Noting that this energy source is currently the cause of two million premature deaths, she said the NZE pathway relies on advanced bioenergy,[14] and ensures that there is no overall increase in crop land used for bioenergy production and that no bioenergy crops are developed on forested land.

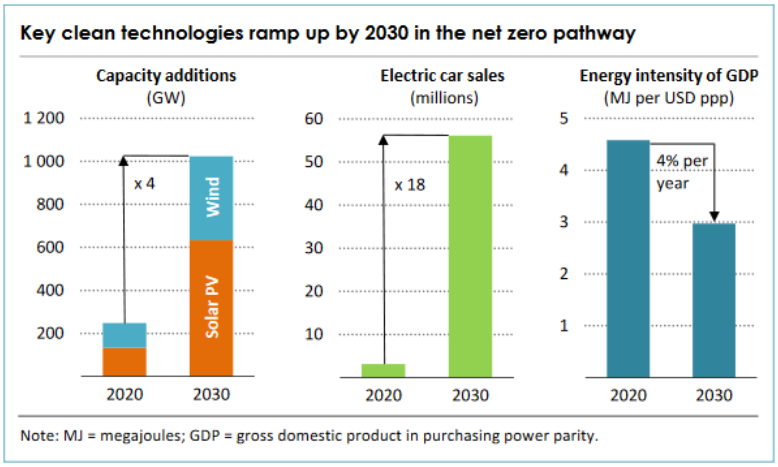
53. The NZE pathway also relies less on fossil fuels and more on hydrogen than the IPCC scenarios. She explained that higher hydrogen production in the NZE scenario is because many IPCC scenarios are older, and there has been significant progress on hydrogen in recent

[13] https://www.iea.org/reports/net-zero-by-2050.

[14] https://www.iea.org/fuels-and-technologies/bioenergy.

years. On renewables expansion, while annual capacity of solar PV and wind capacity expansion quadrupled over the last decade, it will need to quadruple again over the next decade, which is equivalent to building today's largest solar park every day. Wörsdörfer also said electric car sales must rise 18-fold and the NZE scenario envisages no new sales of the internal combustion engine globally. The scenario also "front-loads" energy efficiency, including with the retrofitting of buildings and increased efficiency of cooling appliances and transport, to decrease energy intensity of the global economy by 4 per cent per year (figure 12).

Figure 12: Key clean technologies ramp up by 2030 in the net zero pathway

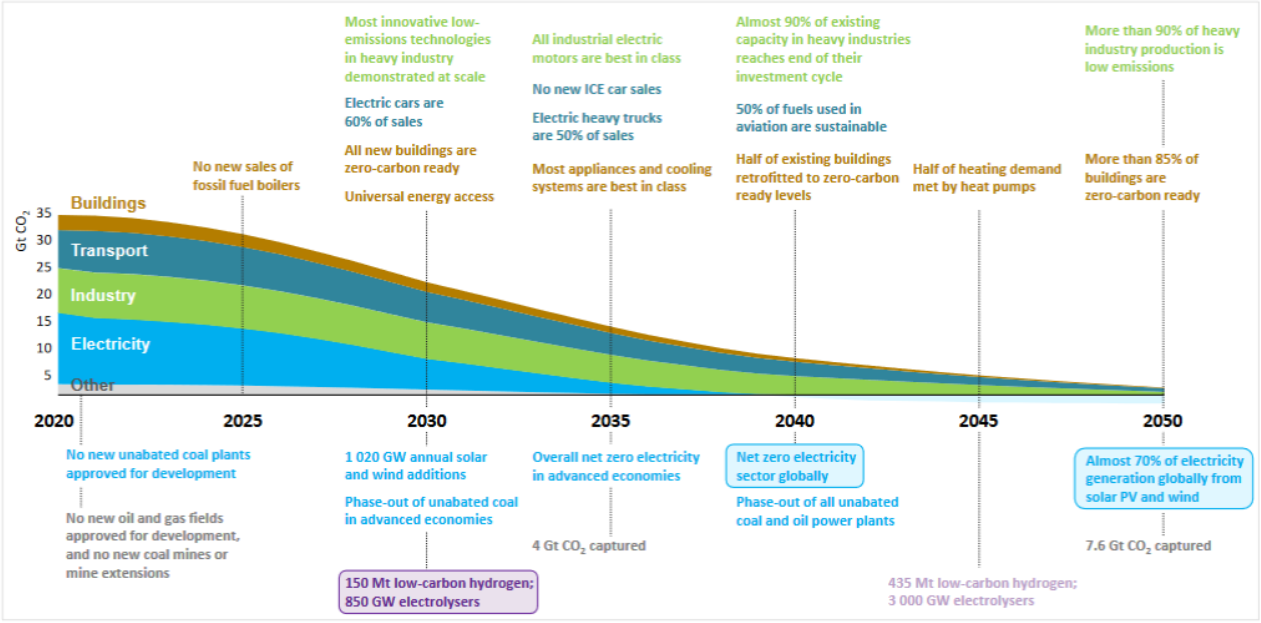


Source: IEA, May 2021, Net Zero by 2050 A Roadmap for the Global Energy Sector, p. 16, available at: https://www.iea.org/reports/net-zero-by-2050. The figure shows that the IEA pathway calls for scaling up solar and wind rapidly this decade, reaching annual additions of 630 gigawatts of solar photovoltaics (PV) and 390 GW of wind by 2030, four times the record levels set in 2020. Electric vehicles (EVs) go from around 5 per cent of global car sales to more than 60per cent by 2030. The figure also illustrates that major worldwide push to increase energy efficiency is an essential part of the IEA pathway, with an annual rate of energy intensity improvements averaging 4per cent to 2030 – about three-times the average rate achieved over the last two decades.
Abbreviations: GW = gigawatts MJ = megajoules GDP = gross domestic product.

54. She underlined that the NZE scenario envisages global economic growth, while noting that between 2020 and 2030, global population will increase by two billion. The scenario includes a surge in clean energy investment, which more than triples current levels by 2030. She stressed that some of the investments are by end users, namely consumers and businesses.

55. Financing the investments in the NZE scenario involves redirecting existing capitals towards clean energy and increase overall investments in energy. Most of these investments come from private sources, but with public incentives and direct government financing to boost the development of new infrastructure projects and accelerate innovation in technologies that are in early phases. Citing a joint IEA/IMF analysis, she said this spending could add a 0.4per cent per year to annual GDP growth in the 2020s.

Figure 13: Key milestones in the pathway to net zero



Source: Slide 7 of the presentation of Mechthild Wörsdörfer, IEA, available at: https://unfccc.int/sites/default/files/resource/NZE2050_Worsdorfer_IEA.pdf. The figure details some of the sectoral and technology milestones to guide the global journey to net zero by 2050 contained in the IEA pathway. The horizontal axis are the years from 2020 to 2050, and the vertical axis are the number of tons of CO_2 for each sector.

56. She underlined the need to set near-term milestones to achieve the net-zero emissions by 2050 target (figure 13). While recognizing that each country will develop their own plans depending on national priorities, she listed a few of these milestones: hydrogen needs to scale up from none today to 150 million tons by 2050; the electricity sector is the first to achieve NZE by 2040 and as early 2035 in advanced economies; and renewables become the dominant source of electricity generation by 2050, with almost 90 per cent of electricity generation.

57. Dolf Gielen, IRENA, presented a poster on the World Energy Transitions Outlook: 1.5 ºC Pathway, which was released in March 2021.[15] He informed that a future IRENA publication would focus on the social impacts and financing needs of this pathway. He underlined that the 1.5 ºC target is still feasible and affordable with existing technologies, and that renewable power, green hydrogen and modern bioenergy will dominate the future energy mix. He stressed the importance of urgently starting this energy transition.

58. A Party noted that the NZE pathway includes the 2021 milestone where there are no new coal plants, gas fields or coal mines, and asked what the central differences between this pathway and those are underlying the IPCC Special Report on 1.5 ºC. Tom Howes, IEA, said the scenarios of the IPCC reports have slightly aged and the data underlying the scenarios is even older. The IRENA and IEA pathways are based on more recent data. Since significant changes have happened in the energy sector in recent years, the projections are also different. In particular, there is a lower reliance on CCS and bioenergy in the IRENA and IEA scenarios. On the same milestone, a Party asked if new investments in fossil fuels would necessarily delay the projected date of net zero? Howes and Olhoff responded that if there are new such investments, it would increase the risk of stranded assets risk but not necessarily delay meeting the net zero target. They added that delaying action would increase risks, reliance on negative emissions technologies and costs.

59. A Party noted that the NZE scenario includes ambitious figures for hydrogen, and asked what are the key enabling policies that countries can put in place to boost its supply and demand. A Party asked what scientific information can be provided to guide Parties in identifying policies to achieve the required transition. On the supply side, Howes called for adapting existing infrastructure and developing industrial hubs to create economies of scale. On the demand side, there is a need to engage with different parts of industry and transport. Both supply and demand dimensions need to be addressed in policies. He also underlined

[15] https://www.irena.org/publications/2021/March/World-Energy-Transitions-Outlook.

that electrification and all increases in the renewables delivery of electricity is a win-win strategy, as green electricity together with electrolyzers can increase the supply of green hydrogen.

60. A Party asked if the reduced reliance in the NZE pathway on bioenergy and CCS is due to the fact that it is an energy pathway and whether the agricultural sector had been excluded, which would require BECCS and others to compensate. A Party asked if GHGs other than CO_2 had been included in the IEA's study. Howes said the low reliance on BECCS is related to the fact that it is an energy scenario, since more emissions reductions can be achieved in the energy sector than in agriculture, for example. He underlined that CO2 and methane are by far the most relevant gases for the energy sector.

61. A Party asked for guidance to countries in relation to investments in research and development and new technologies, and new investments in the industrial sector. Howes explained that IEA and IRENA stress the need for "massive investments" in research and development and industrial adaptation for cost-effective emission reductions. Today's close to two trillion energy investments per year need to be scaled up to five trillion by 2050. He pointed to a forthcoming book on investments in emerging economies. Howes also referred to work done with the IMF, which brings more clarity on the benefits of clean energy investments, including the creation of 30 million jobs.

62. Martial Bernoux, FAO, explained that FAO collaborates with other international organizations and efforts, and FAO data contributes to the work of the IPCC. Some key conclusions from IPCC Special Reports based on FAO data include that: human use directly affects more than 70 per cent of the global, ice-free land surface; decarbonization pathways to achieve net zero by 2050 are impossible without the land sector; and the land/AFOLU sector is different from the other sectors, as it is complex in many aspects and concerns billions of people. He underlined that commitments from States and non-state stakeholders already consider the land sector, which is mentioned in over 90 per cent of national climate plans. Bernoux noted that FAO presented a poster before this session on this issue. He added that numerous options exist and can be applied, including several "no-regrets" options.

63. The IPCC Special Report on Climate Change and Land shows that agriculture, forests and soils can mitigate a considerable amount of CO_2 per year, and the majority of these options can also provide adaptation benefits. In conclusion, he called for action in the near term based on the existing knowledge to address climate change through adaptation and mitigation, and to address desertification, land degradation and food insecurity. These actions can bring social, ecological, economic and development co-benefits that will contribute to poverty eradication. Delaying climate mitigation and adaptation responses across sectors would lead to increasingly negative impacts on land and reduce the prospect of sustainable development. He added that the current COVID-19 pandemic is compounding existing stress on food security and nutrition, and actions should take into consideration regional needs and circumstances.

64. A Party asked about the impacts of GHG emissions other than CO_2, in particular those from agriculture. Orr agreed that other GHGs from agriculture are significant. Although we have technologies for precision approaches, 50 per cent of nitrogen is not taken up by crops. He said these technologies could be scaled up.

B. Range of climate change impacts and risks

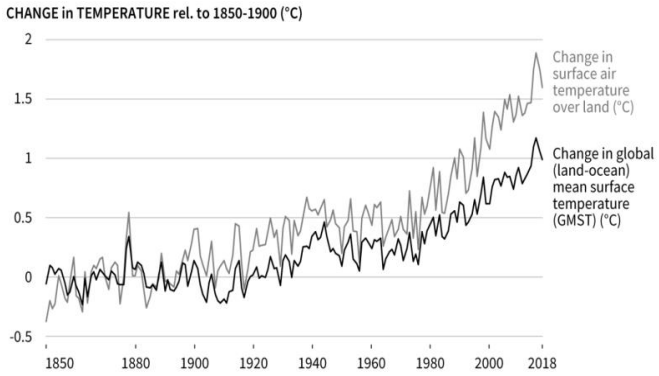
1. New knowledge on current and future climate change impacts and risks

(a) Information on impacts on land and oceans addressed in the IPCC 2018–19 Special Reports

65. Zinta Zommers, IPCC, and Michael Oppenheimer, IPCC, presented the current impacts of climate change, future risks and knowledge gaps. Zommers noted that there is increasing evidence that several climate-related physical changes to ocean and cryosphere have accelerated over recent decades, and that land is under increasing pressure. Climate change-related impacts are already detectable in many systems and in all regions.

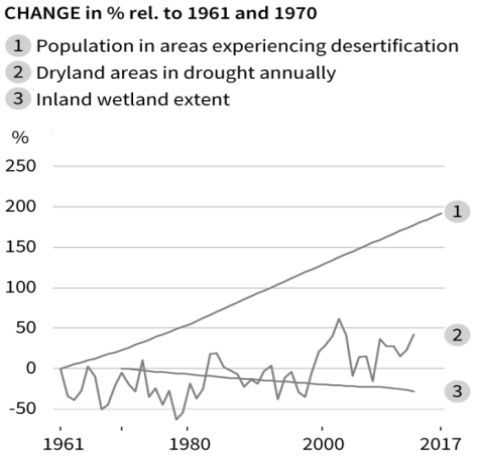
66. Since AR5, there is increased confidence that the loss of ice from the Greenland and Antarctic sheets and SLR are accelerating, and in high emissions scenarios, this acceleration is projected to continue throughout this century and beyond. Due to the long time it would take for ice sheets to regrow to their previous mass, the 21st-century contribution to SLR is effectively irreversible over multi-century timescales. There is low confidence on specific threshold temperatures for ice sheet instabilities that would greatly increase the rate of SLR, but such thresholds are likely to be exceeded under high emissions scenarios. For low emissions pathways consistent with less than 2 ºC warming, SLR during this century is markedly lower.

Figure 14: Observed temperature change relative to 1850–1900



Source: adapted from IPCC SRCCL, Figure SPM.1, Panel A, which shows that since the pre-industrial period (1850–1900) the observed mean land surface air temperature has risen considerably more than the global mean surface (land and ocean) temperature (GMST). The warming curves are averages of four datasets.

Figure 15: Desertification and land degradation



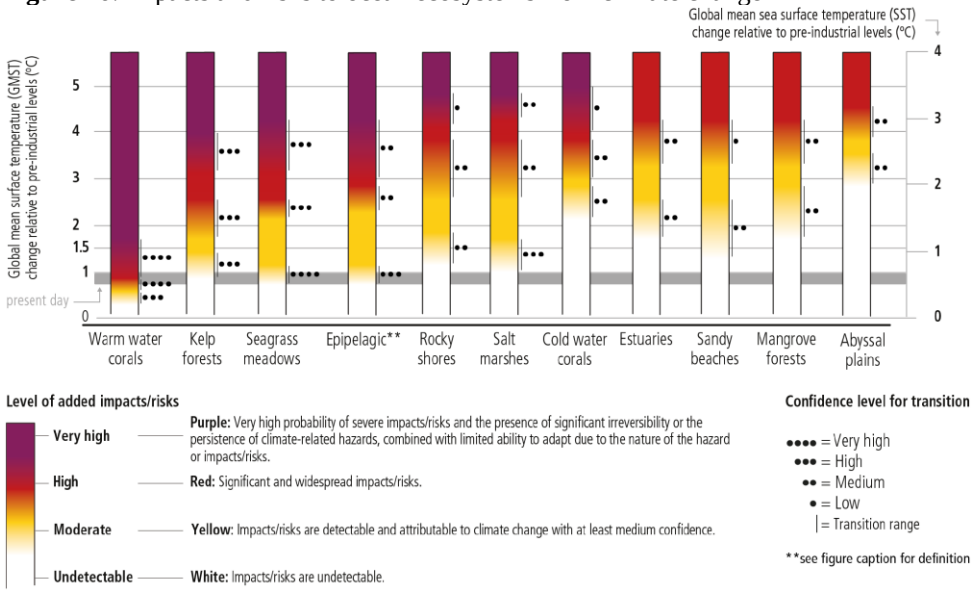
Source: adapted from IPCC SRCCL, Figure SPM.1, Panel F, which shows that land-use change, land-use intensification and climate change have contributed to desertification and land degradation. Dryland areas were estimated using TerraClimate precipitation and potential evapotranspiration (1980–2015) to identify areas where the Aridity Index is below 0.65. Population data are from the HYDE3.2 database. Areas in drought are based on the 12-month accumulation Global Precipitation Climatology Centre Drought Index. The inland wetland extent (including peatlands) is based on aggregated data from more than 2000 time series that report changes in local wetland area over time.

67. Land systems are also experiencing rapid change. Observed land surface temperature has risen nearly twice as much as the global average temperature (figure 14). Climate change has also exacerbated desertification and land degradation processes (figure 15). The percentage of dry land areas and drought annually, has increased. Climate change is also affecting food security, with documented declining yields in maize, wheat and barley in lower latitude regions. Declining animal growth rate and productivity have been documented in pastoral systems in Africa. Although yields of some crops in higher latitude regions have increased, overall, adaptation to current levels of warming lags behind the increased impacts.

68. As for the future, there are increased risks to biological and geophysical systems throughout the 21st century (figure 16). For warm water coral reefs, observed impacts and current risks from warming and acidification are already high. Since AR5, there is increased confidence that risks will become moderate or high for most other systems between 1.5 to 2 ºC. Since AR5, a new finding is that historically rare coastal high-water levels that cause widespread flooding and occurred once per century, are projected to become at least annual events at most locations in the 21st century due to SLR, assuming storm surge characteristics do not change. Low emissions pathways avoid this outcome for many but not most coastal locations by 2100. Since AR5, there is increased confidence that an increasing coastal human population and urbanization contribute to higher risk due to SLR. This is because of people's exposure to overlapping physical extremes and the increasing exposure of populations that

are already socio-economically vulnerable to these hazards. This combination challenges the attainment of the SDGs in coastal systems.

Figure 16: Impacts and risks to ocean ecosystems from climate change

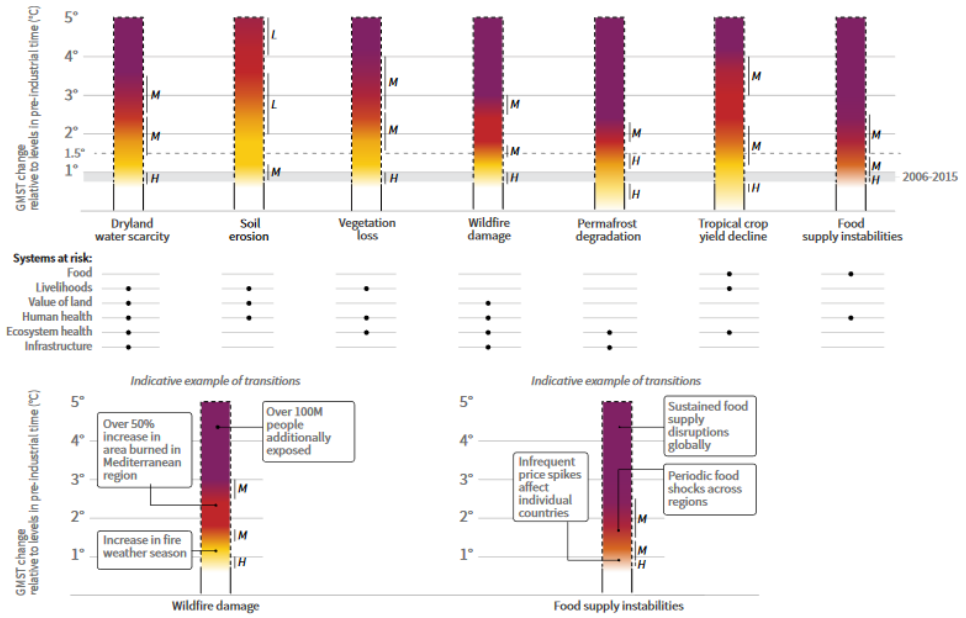


Source: IPCC SROCC Figure SPM.3, Panel D, which shows an assessment of risks for coastal and open ocean ecosystems based on observed and projected climate impacts on ecosystem structure, functioning and biodiversity. Impacts and risks are shown in relation to changes in Global Mean Surface Temperature (GMST) relative to pre-industrial level. Since assessments of risks and impacts are based on global mean Sea Surface Temperature (SST), the corresponding SST levels are shown. The figure indicates assessed risks at approximate warming levels and increasing climate-related hazards in the ocean: ocean warming, acidification, deoxygenation, increased density stratification, changes in carbon fluxes, sea level rise, and increased frequency and/or intensity of extreme events. The assessment considers the natural adaptive capacity of the ecosystems, their exposure and vulnerability. Impact and risk levels do not consider risk reduction strategies such as human interventions, or future changes in non-climatic drivers. Higher risks associated with compound effects of climate hazards include habitat and biodiversity loss, changes in species composition and distribution ranges, and impacts/risks on ecosystem structure and functioning, including changes in animal/plant biomass and density, productivity, carbon fluxes, and sediment transport.

69. On land, risks also increase from 1.5 to 2 ºC (figure 17). At around 1.5 ºC, risks from dry land water scarcity, wildfire damage, permafrost degradation, tropical crop yield decline and food supply instabilities, are projected to be high or transitioning to high. By 2 ºC, the risks from permafrost degradation and food supply instabilities are projected to be very high or transitioning to very high.

70. Future climate risks will not only depend on climate change, but also on socioeconomic pathways. At the same global mean temperature increase, there are lower risks in a world with lower population, high income, reduced inequalities, sustainable land management and consumption patterns, and low barriers to mitigation and adaptation (figure 18). However, across all scenarios, there are increases in demand for water and food in 2050. The Special reports of the AR6 cycle estimate the potential societal benefits of adaptation on risk reduction and highlights risks of certain response options.

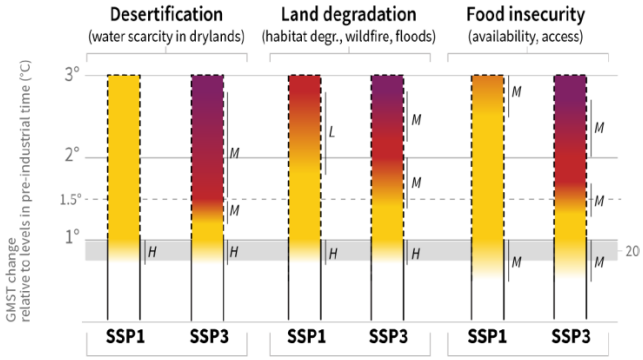
Figure 17: Risks to humans and ecosystems from changes in land-based processes as a result of climate change



Source: IPCC SRCCL SPM Figure 2, Panel A, which illustrates the level of risks to selected elements of the land system as a function of global mean surface temperature. Links to broader systems are illustrative and not intended to be comprehensive. The figure shows that increases in global mean surface temperature (GMST), relative to pre-industrial levels, affect processes involved in desertification (water scarcity), land degradation (soil erosion, vegetation loss, wildfire, permafrost thaw) and food security (crop yield and food supply instabilities). Changes in these processes drive risks to food systems, livelihoods, infrastructure, the value of land, and human and ecosystem health. Changes in one process (e.g. wildfire or water scarcity) may result in compound risks. Risks are location-specific and differ by region.

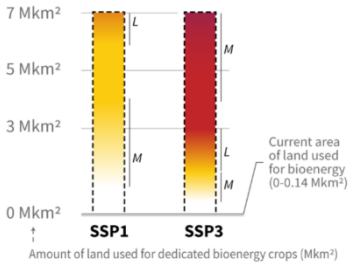
71. All assessed response pathways that limit warming to 1.5 ºC require land-based mitigation. But there are limits to the deployment of these measures. Widespread use of bioenergy crops increases risks to food systems, territorial ecosystems and water supply. These risks depend on socioeconomic factors, such as demand for land and food (figure 19).

Figure 18: Different socioeconomic pathways affect levels of climate-related risks



Source: adapted from IPCC SRCCL SPM Figure 2, Panel B, which shows that socioeconomic choices can reduce or exacerbate climate-related risks and influence the rate of temperature increase. The Shared Socioeconomic Pathway (SSP1) illustrates a world with low population growth, high income and reduced inequalities, food produced in low GHG emission systems, effective land-use regulation and high adaptive capacity. The SSP3 pathway has the opposite trends. Risks are lower in SSP1 compared with SSP3 given the same level of GMST increase. Purple: Very high probability of severe impacts/risks transition and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks. Red: Significant and widespread impacts/risks. Yellow: Impacts/risks are detectable and attributable to climate change with at least medium confidence. White: Impacts/risks are undetectable. The letters refer to the confidence level for transition: L: low; M: medium; and H: high.

Figure 19: Risks associated with bioenergy crop deployment as a land-based mitigation strategy under two Shared Socioeconomic Pathways (SSPs) (SSP1 and SSP3)



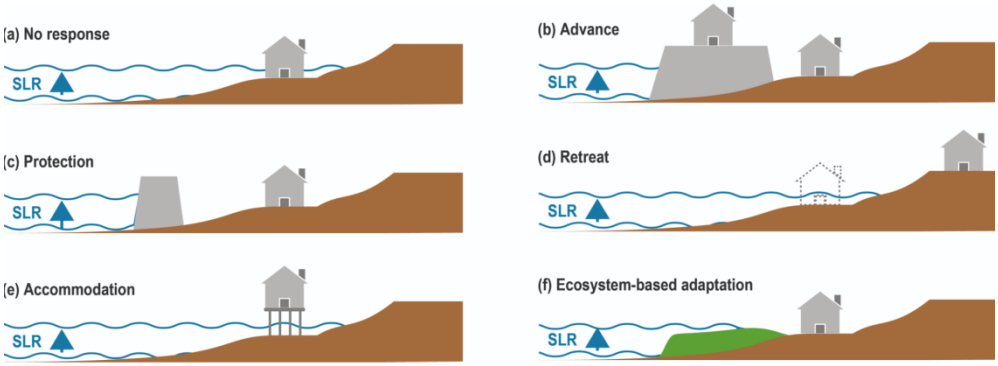
Source: adapted from IPCC SRCCL Chapter 7 Figure 7.3. The assessment is based on literature investigating the consequences of bioenergy expansion for food security, ecosystem loss and water scarcity. In this context, very high risk indicates that important adverse consequences are expected for all these indicators (more than 100 million people at risk of hunger, major ecosystem losses and severe water scarcity issues). Purple: Very high probability of severe impacts/risks transition and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks. Red: Significant and widespread impacts/risks. Yellow: Impacts/risks are detectable and attributable to climate change with at least medium confidence. White: Impacts/risks are undetectable. The letters refer to the confidence level for transition: L: low; M: medium; and H: high.

(b) Sea level rise: risks and responses

72. Robert DeConto, IPCC, presented a poster on SLR and implications for low-lying islands, coasts and communities. He highlighted the following key findings based on the SROCC: the pace of SLR is accelerating because of the pace of changes in the cryosphere and loss of sea ice; the stark difference between low and high scenarios increases dramatically beyond 2100; SLR will continue to rise regardless of the emissions scenarios; and the most favourable outcomes will come from early mitigation and adaptation action.

73. Zommers and Oppenheimer said that responses, such as accommodation to SLR (e.g., raising houses) managed retreat, coastal protection and advance (i.e., land gained by building seaward), significantly reduce risks to a range of coastal geographies (figure 20). For large tropical agricultural deltas, arctic communities and urban atoll islands, the risks remain high for high emissions pathways even with maximum potential response. Assuming the continuation of adaptation efforts, resource-rich coastal cities can maintain risks at moderate levels under a high emission pathway. For low emissions pathways, high-risk outcomes can be avoided by implementing maximum potential responses, including planned and local-scale relocation. For adaptation planning through 2050, uncertainty of SLR is relatively small, and thus more straight forward to plan for. Projections of locality-specific SLR beyond 2050 are characterized by greater uncertainty, in part reflecting uncertainty about emissions pathways. Adaptation pathways planning (i.e., a sequence of adaptation decisions that keep future options open) is compelling in the face of such uncertainty. An approach that is new since AR5, SROCC provides estimates of SLR that lie outside the likely range (i.e., estimates of ranges from methods other than from process-based models alone, such as expert elicitation) for consideration by decision makers with low risk tolerance.

Figure 20: Different types of response to coastal risk and sea level rise



Source: IPCC SROCC Box 4.3, Figure 1. (b) Advance creates new land by building seaward, reducing coastal risks for the hinterland and the newly elevated land. (c) Protection reduces coastal risk and impacts by blocking the inland propagation and other effects of mean or extreme sea levels. (d) Retreat reduces coastal risk by moving exposed people, assets and human activities out of the coastal hazard zone. (e) Accommodation includes diverse biophysical and institutional responses that mitigate coastal risk and impacts by reducing the vulnerability of coastal residents, human activities, ecosystems and the built environment, thus enabling the habitability of coastal zones despite increasing levels of hazard occurrence. (f) Ecosystem-based adaptation responses provide a combination of protect and advance benefits based on the sustainable management, conservation and restoration of ecosystems.

74. Responding to SLR poses a significant governance challenge. Notwithstanding widely varying responses around the world, five overarching challenges need to be addressed. First, account for the long-term commitment to curbing rising sea levels, and associated uncertainty beyond 2050. Second, improve coordination across jurisdictional levels and policy domains and sectors. Third, proactively address the compounding impacts of SLR on equity and social vulnerability – for the impacts and risks are disproportionately borne by those most exposed and vulnerable in both developing and developed countries. Fourth, put in place mechanisms to resolve difficult trade-offs and contestation that escalate as sea levels rise. Fifth, SLR introduces novel and complex problems at the coast that require integration of multiple knowledges, social learning, and governance capabilities to address complexity.

75. A Party asked WMO and IPCC if they can assess the impact of ice melt on the global climate system and sought clarification on the effect of cooling from melting ice and on the risk of domino effects of melting ice sheets of Greenland and Antarctica. Rob DeConto, IPCC, stated that a current knowledge gap is the interaction between the ice sheets, melt water and the global climate system. Modelling is carried out in this area and studies published in 2018 and 2020 have projected that when accounting for melt water from icebergs being released into the Southern Ocean in high emissions scenarios, there is a global cooling effect of approximately 1 ºC less of global warming by the end of the century, and an even bigger effect in the 22nd century. Scaife added that unlike the Arctic, Antarctic ice has been relatively stable, but this has been changing in recent years. He clarified that the WMO's decadal predictions include interactive sea ice and its impacts on the climate.

76. Rob DeConto further said that regardless of the emissions scenario, there will be ongoing SLR. But under high emission scenarios SLR is twice as high by 2100 as under low emissions scenarios. By 2300, SLR under the high emissions scenario is five times greater. He said current NDCs are insufficient to reduce the risk of rapid contribution to SLR by melting ice sheets in Greenland and Antarctica. He stressed that Antarctica contains eight times more locked ice than the Arctic and the Antarctic ice sheet is directly in contact with the oceans. There is increasing observational evidence that there is instability in Antarctica. He further added that exceeding global mean temperature rise above 2 ºC is capable of triggering these instabilities and ice loss. However, there is no confidence when the instability would be triggered, estimations are around 2060–2070. He underlined that once these instabilities start in Antarctica, they are unstoppable, even with rapid CO_2 removal. A temperature overshoot of a few decades could trigger SLR that would be ongoing and unstoppable.

(c) Risk assessment

77. Noting that some people already live at temperatures of 1.5 or 2 ºC above the pre-industrial level, Tara Shine, PR2-SED Co-facilitator asked how we can assess the level of risks they are exposed to now and how that helps assess future risks, Piers Forster indicated

that SR1.5 details some of the impacts experienced at 1.5 ºC level of warming compared to 2 ºC or to the current warming of approximately 1.1 ºC. Since parts of the world are already experiencing 1.5 ºC of warming, scientists can do a relative comparison. SR1.5 shows that impacts on ecosystems and temperature extremes are significantly different between 1.5 and 2 ºC.

78. Responding to a question on the differences in ice sheet loss between 1.5 and 2 ºC, Roderik van de Wal, IPCC, said the tipping point for the Arctic ice sheet is below 4 ºC, but scientists have not been able to differentiate between the 1.5 and 2 ºC levels of warming in this regard.

79. In response to a question on whether the levels of risks in the reasons for concern had been revised since the AR5, Hans-Otto Pörtner, IPCC, said SR1.5 found a tightening of risk transitions of the reasons for concern in relation to degrees of warming. Alexandre Magnan, IPCC, added that the Special Reports had made a lot of progress in disaggregating the reasons for concern, and that their revision will be further developed in Working Group II's contribution to the AR6.

80. A Party asked if progress had been made since the previous PR1-SED on quantifying the effect of adaptation. Zinta Zommers and Alexandre Magnan, IPCC, indicated that it is still a knowledge gap and that AR6 will continue to assess adaptation effectiveness in terms of reducing current and future climate risks.

81. A Party noted that as adaptation needs to deal with transboundary climate risks, many developing countries are requesting a mandate to set a global adaptation goal now. Without such a clear goal, she asked how progress on adaptation can be assessed. Hans-Otto Pörtner, Chair of IPCC Working Group II, explained that there are adaptation limits in several sectors. These include some adaptation limits of ecosystems and species that have already been surpassed. It also includes adaptation limits in crops and human performance outdoors. Against those limits, the contribution of adaptation to LTGGs can be assessed by providing clarity on future efforts towards LTGGs as defined in the Paris Agreement.

82. A Party noted that the effectiveness of adaptation depends on stringent mitigation, for example, adaptation to SLR impacts. He asked for a perspective on the linkages between mitigation and adaptation, and limits to adaptation. Pörtner responded that the temperature element of the LTGG will be the best orientation of adaptation needs. The issue of adaptation limits is one of the core questions addressed by IPCC Working Group II in its main assessment report, having coined the question of "how much mitigation we do need for adaptation to be successful". This concerns human adaptation to SLR, but also respecting adaptation limits in the natural world, for the conservation of biodiversity. He underlined that while the human species is part of this biodiversity, it has a specific physiology, and our adaptation limits are also challenged. One of the best pieces of knowledge concerning adaptation capacity and limits has been elaborated on in the SROCC (see SPM) where limits differ between places, and vulnerabilities are highest at low-lying islands and on the coast. Such limitations, for example for outdoor workers and agricultural productivity, should be considered by the Adaptation Committee and in discussions among governments.

83. Le-Anne Roper, ExCom, added that the science is very clear, that not meeting the LTGG will hamper efforts to adapt and importantly, to avert, minimize and address loss and damage. She expressed appreciation to the ongoing scientific work, which will enhance understanding of the actions needed to counter the impacts of climate change, especially loss and damage.

84. A Party asked UNEP for more information about how different countries and populations will experience 1.5 and 2 ºC of warming depending on their adaptive capacity, and how can social sciences better inform risk reductions policies. Olhoff said there is good knowledge on the impacts on populations and geographies at 1.5 and 2 ºC of warming, and that the IPCC SR 1.5 ºC has the best science. On how the impacts depend on adaptive capacity, the literature strongly underlines the correlation between development, and adaptative capacity and resilience. The most important factor to determine how people will be impacted is the development level.

85. A Party asked UNEP if there are quantified estimates of the damages caused by climate change and the savings that would occur through avoided impacts. Olhof explained

there is insufficient information for a detailed analysis of the damages at different levels of warming, although the UNEP reports provide as much information as possible. UNEP considers projected damages through adaptation costs estimates, however, these estimates are based on different underlying assumptions.

(d) Limits to adaptation and irreversible impacts

86. A Party asked about the irreversible impacts on biodiversity of overshoot scenarios and the classification of impacts in terms of irreversibility or reversibility. Zinta Zommers, IPCC, pointed to Table 6.1 "Cross-Chapter assessment of abrupt and irreversible phenomena related to the ocean and cryosphere" in Chapter 6 in the report on oceans (SROCC) on irreversibility of impacts.

87. Hans-Otto Pörtner, IPCC, stated that SLR in relation to melting ice sheets is irreversible and depends heavily on the degree of climate change and will be slow to respond. He added that climate change impacts on warm water coral reefs are irreversible, as 70–90per cent will disappear, together with the ecosystem services they provide, with a 1.5 ºC level of warming.

88. A Party asked about regional differences in terms of vulnerability to food shock and limits to adaptation. Katerine Calvin, IPCC, pointed to a map in SRCCL Chapter 6 (Figure 6.2) that shows areas currently experiencing food insecurity (estimated from chronic undernourishment). For future risks, SRCCL SPM Fig 2a shows the risks at different levels of warming for tropical yields. SROCC found that coastal communities particularly in low-latitude regions are vulnerable to decreases in seafood supply.

89. A Party noted that without stringent mitigation, SLR will be locked in. He asked about the role of adaptation in addressing SLR. Roderik van de Wal, IPCC, said adaptation will reduce risks, but its extent will depend on the location. In response to a related question by another Party, Alexandre Magnan, IPCC, added that local relocation was included as an adaptation strategy, but that international forced migration was not considered as adaptation compatible.

(e) Melting glaciers

90. Heidi Steltzer, IPCC, introduced a poster presenting a mountain perspective of the impacts of the changing cryosphere in a warming world. She underlined that the presence and persistence of snow and glaciers are decreasing around the world. This decline has altered the frequency, magnitude and location of most related natural hazards. In addition, changes in snow and glaciers have changed the amount and seasonality of runoff in related river basins, leading to local impacts on water resources and agriculture. She also pointed to marked changes in species composition and abundance in high mountain ecosystems, and underlined the critical importance of adaptation and urgent mitigation.

91. A Party asked what the latest science in relation to changes in water availability due to melting glaciers is. Rob DeConto, IPCC stated that there have not been any fundamental changes in this issue since the publication of the SROCC.

(f) Climate services for adaptation

92. A Party asked WMO how countries can identify the information they need to protect themselves from the climate impacts in the short and medium term. Scaife said information is available but "the devil is in the details in interpreting the data." He pointed to large databases of climate simulations that provide regional information and the seasonal and decadal climate predictions coordinated by WMO. Maxx Dilley, WMO, explained that a process for science-based adaptation action includes identifying the past, present and future behavior of climate indicators associated with impacts in priority sectors and non-climatic factors. On this basis, effective actions addressing those non-climatic factors can be identified, including the strengthening of climate information systems and services.

93. While the IPCC's Special Reports have filled various knowledge gaps since the first periodic review, remaining knowledge gaps relate to: uncertainty as to whether risk transitions are gradual or non-linear (physical thresholds) and the consequence of the rate of climate change on hazards and related risks (for example, future rate of loss from the

Antarctic and Greenland ice sheets is the major knowledge gap in SLR prediction, and little progress has been made since AR5 in quantifying differences in ice loss rates between 1.5 and 2 ºC). On adaptation, remaining knowledge gaps include information on risk tolerance; adaptation limits; effectiveness of adaptation measures/policies in terms of climate risk reduction; potential for maladaptation; quantified savings/avoided losses from timely action; and how to transition from practices that compound climate risk to transformative practices that reduce emissions and enable equitable and climate-resilient development.

2. Cross-cutting sectorial impacts

(a) Impacts on biodiversity

94. David Cooper, Convention on Biological Diversity (CBD), presented on "Biodiversity and Climate Change - Lessons from GBO-5." He reminded participants that the CBD had presented the key findings of the 4th edition of the Global Biodiversity Outlook during PR1-SED. Focusing on the 5th edition of this publication,[16] he underlined that it assesses progress in implementing Strategic Plan for Biodiversity 2011–2020 and achievement of Aichi Biodiversity Targets, provides scientific basis for the post-2020 Global biodiversity framework, and draws upon CBD national reports, indicators, assessment reports and scientific literature. Noting that the role of the IPBES in relation to the CBD is akin to that of the IPCC for the UNFCCC, Cooper stressed the importance of the IPBES reports. A 2018 workshop had brought IPCC and IPBES experts together; and more recently, the two bodies held a joint technical workshop, whose report is upcoming.[17] He said the key message is that climate change and biodiversity loss are inseparable threats to humankind and must be addressed together. Interconnections between biodiversity and climate change include that: biodiversity is affected by climate change; the conservation of biodiversity makes an indispensable contribution to addressing climate change; climate actions may impact biodiversity; and climate change and biodiversity loss share common and interlinked drivers.

95. The impacts of climate change on biodiversity are already apparent at current levels of warming and will increase with each temperature increment. Impacts on species at 2 ºC are at least twice as high as for a 1.5 ºC warmer world. Unabated climate change will likely be the largest driver of biodiversity loss in the second half of the century. Effective climate change action is a prerequisite to slowing and reversing biodiversity loss.

96. Cooper stressed that climate change is a direct driver of biodiversity loss, together with land-use change, overexploitation, pollution and invasive alien species. These drivers interact in many ways and reducing the multiple drivers of biodiversity loss can increase resilience and thereby contribute to climate mitigation and adaptation. He added that there are many common drivers, for example, land-use change leads to GHG emissions and habitat loss. The agriculture and food sectors are key and limiting food waste and reducing the over-consumption of meat can mitigate climate change and reduce biodiversity loss.

(b) Impacts on land

97. Barron Joseph Orr, UNCCD, addressed desertification and land degradation and their impact on natural ecosystems and food security. Noting that "we are days away" from the launch of the UN Decade on Ecosystem Restoration 2021–2030, he described what has been committed by countries so far.

98. He noted that the global total of country restoration commitments that are spatially delineated is very large, approaching one billion hectares. Such a large commitment from countries is needed because, as indicated by the IPBES Global Assessment (2019) and the IPCC Special Report on Climate Change and Land (2019), as much as 75 per cent of the land area in our natural ecosystems on land have been very significantly altered. The primary drivers of land transformations are: meeting the demand for food, feed, fiber and energy; and more food, energy and materials than ever before are now being supplied to people across distant regions. Countries report that one in five hectares of land are now degraded.

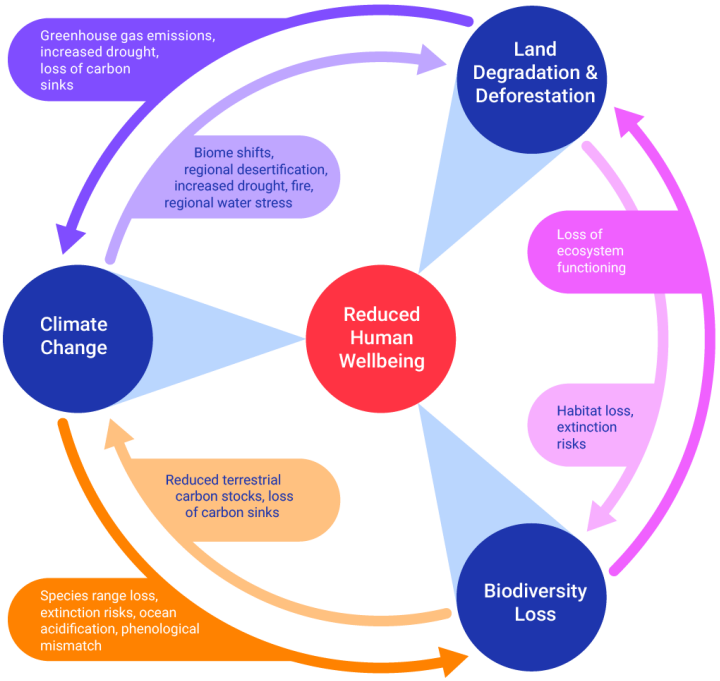
[16] CBD, Global Biodiversity Outlook 5, available at: https://www.cbd.int/gbo5.

[17] IPBES/IPCC co-sponsored workshop on biodiversity and climate change, held in December 2020, see: https://ipbes.net/events/ipbes-ipcc-workshop.

99. Orr pointed to the UNEP report "Making Peace with Nature", which brings home the interlinkages among biodiversity loss, climate change and land degradation (see figure 21). Citing the findings of the IPCC Climate Change and Land Special Report, he highlighted that: climate change exacerbates land degradation; land degradation is a driver of climate change through emissions of GHGs and reduced carbon uptake; and gross emissions from AFOLU make up one third of total global emissions.

100. He said the impacts of land degradation are "monumental", underlining that: the well-being of over 3.2 billion people is undermined by land degradation; biodiversity loss is expected to reach 38–46 per cent by 2050 and that the cost of ecosystem services lost through land degradation is estimated at more than 10per cent of the annual global gross product. Orr stated that "consumption eats land", as it is the indirect driver of agricultural expansion, natural resource and mineral extraction, and urbanization, leading to greater levels of land degradation. Among the current impacts of food production on nature, he highlighted deforestation, GHG emissions, and impacts on freshwater and biodiversity.

Figure 21: The interactions between climate change, land use and biodiversity



Source: UN Environment Making Peace with Nature, figure 3.9, available at: https://wedocs.unep.org/xmlui/bitstream/handle/20.500.11822/34948/MPN.pdf. The figure illustrates how climate change, land-use change, land degradation, and air and water pollution act synergistically to cause pervasive, extensive and systemic damage to biodiversity and ecosystem services on land and in the ocean.

101. Orr underlined that acute food security has soared to a five-year high in 2020, which was compounded by the COVID-19 pandemic, although this relentless rise dates back to 2017. The concern is that the underlying systemic issues are going to be maintained.

102. Turning to the footprint of cities, Orr said the accelerating rate of urban expansion also contributes to reducing the amount of land that can be dedicated to other uses. He stated that the world is getting drier where many people live –or will live in the next 20–30 years because of climate change, amounting to 70 per cent of the urban population being in drylands at that time. Simultaneously halting and reversing land degradation would successfully address all the SDGs.

(c) Impacts on health

103. Diarmid Campbell-Lendrum, WHO, discussed the health impacts associated with the LTGG. He said human health is inextricably linked to climate conditions and therefore to climate change. Increasing levels of CO_2 lead to increasing temperatures and weather extremes, which feeds into a range of socioeconomic and geographic determinants of health. Decreasing carbon emissions will help safeguard the conditions for human health and there are a range of available measures we can take to strengthen our health systems.

104. He noted significant advances on detection and attribution since PR1-SED. Recalling it has been challenging to directly attribute health impacts to climate change, within the last couple years, it has been possible to do this attribution, which is highly policy relevant. For example, a recent study showed that, mortality increase attributable to human-induced climate change is evident on every continent while burdens varying geographically. It estimated that 37 per cent of warm season heat-related deaths between 1991 and 2018 can be attributed to anthropogenic climate change.[18] This information has been used in legal cases to hold governments and companies to account for their lack of action on climate change.

105. He explained that the Working Group II contribution to the IPCC third assessment report introduced the RFC framework and the associated figure referred to as the "burning embers". The RFC were first applied to risks to unique and threatened systems, and recently to health. The RFC framework and figure facilitate communication of the magnitude of climate-related risks and how they could change over time. The RFC look at selected characteristics of health systems under three Shared Socioeconomic Pathways. It shows that different scenarios of what society will do have strong implications for health.

106. Campbell-Lendrum explained that across a range of health impacts, there is a consistent pattern that risks ramp-up as we move towards or exceed the temperature limits. In addition, the choice of development pathway has an influence of the risk levels, and scenarios where there is greater collaboration and coordination tend to result in lower health impacts.

(d) Methodological issues

107. A Party noted that the SSPs are used to produce the ember diagrams and asked what methodologies or scenarios the experts used. Cooper explained the IPBES report uses SSPs and other scenarios. Another Party noted that the fifth Global Biodiversity Outlook uses the AR5 and the IPCC Special Report on 1.5 ºC as main references. She said the latter has its shortcomings and context, and did not address the socioeconomic impact of achieving 1.5 ºC. While recognizing that land, biodiversity and climate have distinct processes and conventions, Cooper underlined the need to address the challenges together. He said the GBO5 is based on the IPCC Special Reports and IPBES reports, noting an increasing coherence between them. He indicated the CBD would welcome greater collaboration on developing models.

108. A Party asked for clarification on the study that attributed mortality to heat and if this study had significant gaps in some tropical countries, in particular in Sub-Saharan Africa. Campbell-Lendrum noted that there are significant data gaps on the overall impact of heat waves in lower income countries. Kristie Ebi, WHO, explained that data is unavailable for a large part of the world, especially LDCs. Data from other tropical countries suggests there is considerable, unmeasured heat-related mortality. While noting that the overall picture would probably significantly change with the missing data, Campbell-Lendrum noted a general challenge with data and surveillance systems in low-income countries.

C. Assessing the overall aggregated effect of the steps taken by Parties

1. Mitigation action

(a) Assessing and reporting on mitigation efforts

109. Anne Olhoff, UNEP, addressed new scenarios compatible with the LTGG and information on mitigation and adaptation gaps. She explained the emissions gap report has been produced since 2010 to inform the discussions under the UNFCCC. The 2020 edition of the Emissions Gap Report seeks to address questions relating to: the trend in global GHG emissions, whether countries are on track to meet their Cancun Pledges and NDC targets, if this be sufficient to stay well below 2° C and pursue 1.5 °C, what preliminary studies tell us about the implications of the COVID-19 pandemic and emerging responses, and whether and

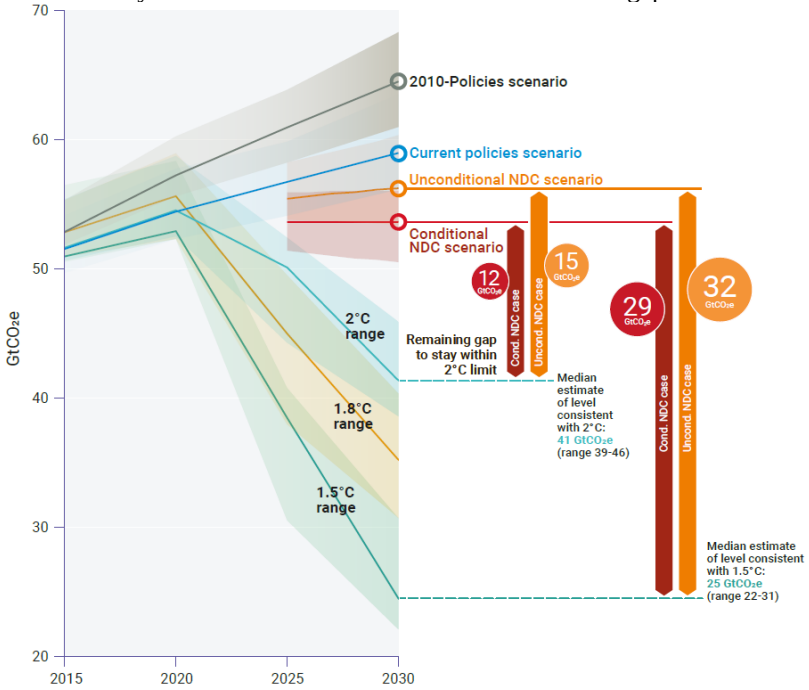
[18] Source: Vicedo-Cabrera, A.M., Scovronick, N., Sera, F. et al. The burden of heat-related mortality attributable to recent human induced climate change. Nat. Clim. Chang. 11, 492–500 (2021). https://doi.org/10.1038/s41558-021-01058-x.

how the 2030 gap can be bridged. The report also dove into the issue of lifestyles and behavioural changes.

110. Olhoff provided an overview of key findings from the 2020 Emissions Gap Report, including that global GHG emissions have risen 1.4 per cent per year in the last decade, reaching a record high of 59.1 Gt CO2e in 2019. In 2020, due to the COVID-19 pandemic, global CO_2 emissions decreased by 7per cent, but atmospheric concentrations of GHGs continued to rise. While the biggest changes occurred in the transport sector, power, industry and residential emissions remained comparable with pre-COVID-19 levels.

111. Looking at G20 pledges, she stated that, collectively, G20 members are projected to overachieve their 2020 Cancun Pledges, but these are insufficiently ambitious to establish a path that will get the world to 2030 emission levels consistent with the Paris Agreement. She added that, collectively, G20 members are not projected to achieve their NDCs for 2030 based on current policies, however these projections are based on pre-COVID studies. She said it is encouraging that 127 countries covering around 63per cent of global GHG emissions and including more than half the G20 members have net-zero goals by around mid-century that are formally adopted, announced or under consideration. However, she underlined a "huge discrepancy" between these pledges, and current emission trends and the inadequate level of ambition in the NDCs for 2030. She called for urgently translating the net-zero goals into strong near-term policies and action, and reflecting them in the NDCs.

Figure 22: Nationally determined contributions and the emissions gap in 2030



Source: Adapted from figure ES.5. of the 2020 UNEP Emissions Gap report, available at: https://www.unep.org/emissions-gap-report-2020. The figure illustrates 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).
Abbreviations: GtCO2e = gigatons of carbon dioxide equivalent NDC = nationally determined contribution.

112. Looking at the scenarios (see figure 23), the top level is where emissions are heading in 2030 with no new policies, what emissions are under current policies, and the effects of NDCs and conditional NDCs on emissions. She stressed that comparing emissions under current policies with the 2 ºC and 1.5 ºC pathways, there is a gap of 12–15 Gtons of CO_2 for limiting warming to below 2 ºC, and a gap of 29–32 Gtons of CO_2 for limiting warming to 1.5 ºC. Bridging the emissions gap requires that countries increase their NDC ambitions threefold to limit warming to 2 °C and more than fivefold for the 1.5 °C goal. If ambition action is postponed further, it will make it impossible to achieve the LTGG.

113. Looking at temperature implications of the current policies and NDCs, she said current NDCs lead to a temperature increase of at least 3 ºC by 2100. Announced net-zero emissions goals could reduce this by about 0.5 ºC according to preliminary estimates. Noting that COVID-19 influenced CO_2 emissions in 2020, she underlined that the crisis will only

contribute significantly to 2030 emissions reductions if the economic recovery incorporates strong decarbonization.

114. Predictions of global GHG emissions in 2030 vary significantly, ranging from a slight increase compared to the current policies, to an emission level consistent with limiting global warming to below 2 °C. She stressed that so far, "we are not using this opportunity in the right way". Despite the unprecedented scale of fiscal responses, most countries bring forward measures and packages supporting a high-carbon status quo of their economies, or even fostering new high-carbon investments.

115. Katia Simeonova, UNFCCC secretariat, presented on steps taken by Parties on mitigation, based on compilation and synthesis reports, and on GHG data reported by developed countries. She noted that, the secretariat has no mandate to compile information from developing countries. However, developing countries are reporting this information and the secretariat includes in various reports it prepares, such as the 'Climate action and support trends, 2019' report, which provides some qualitative information on the general trends of mitigation actions in developing countries.[19]

116. She highlighted the challenges in compiling data on the aggregated efforts of mitigation action by developed and developing countries. These include: the use of different methodologies, including IPCC methodologies; and data gaps, in particular the lack of quantified effects of mitigation actions in terms of GHG reductions reported by Parties.

117. Simeonova highlighted key findings on mitigation efforts by developed countries, based on the information contained in the compilation and synthesis report prepared by the secretariat on their fourth BRs.[20] These include progress by developed countries towards their 2020 emission reduction targets (although gaps remain for some countries); 2,624 mitigation actions reported for the period 2017–2018, signalling increasing efforts to decarbonize their economies; and ongoing transformational change towards low or zero-emission economies.

118. Key findings on emission trends and policies and measures of Annex I Parties include: a 10 per cent projected decrease in emissions between 1990 and 2020 with the currently implemented and adopted climate actions; and a 3.4 per cent decrease in emissions between 2010 and 2018 (figure 24). Overall, despite some fluctuations over 1990 and 2030, there is a clear declining trend in emissions, reflecting the mitigation efforts, which by far offsets the impacts of some underlying drivers, such as economic and population drops. This is reflected in a clear decrease in carbon intensity or emission intensity of these countries' economies.

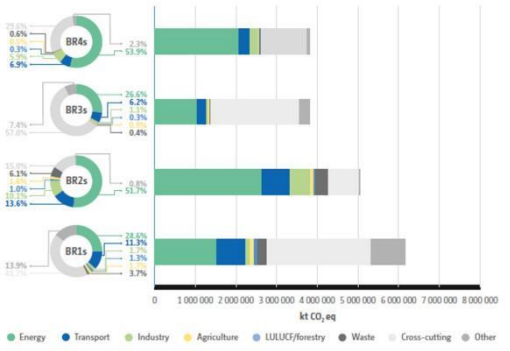
119. Looking ahead, developed country Parties' emissions are projected to increase slightly between 2017 and 2020, and then decrease by 2.2 per cent between 2020 and 2030, but without taking into account the impact of COVID-19. Compared to 1990, a 12.1 per cent decrease in emissions is projected between 1990 and 2030 (3.96 per cent in 2030 compared to 2010). Given that COVID-19-related reductions may be only temporary, the current emission trends suggest the need for much stronger policies and measures, possibly supported by legislative and institutional frameworks, to irreversibly change the trends in emissions in these countries.

[19] https://unfccc.int/sites/default/files/resource/Climate_Action_Support_Trends_2019.pdf.
[20] https://unfccc.int/sites/default/files/resource/sbi2020_inf10a01.pdf.

Figure 23: Historical and projected greenhouse gas emissions of Annex I Parties without land use, land-use change and forestry under the 'with measures' scenario

Source: Compilation and synthesis of fourth biennial reports of Parties included in Annex I to the Convention, FCCC/SBI/2020/INF.10, the figure presents historical and projected emissions under the scenario 'with measures' for Annex I economies in transition (EIT) and non-EIT Parties.

Figure 24: Total and sectoral impacts of policies and measures reported in biennial reports



Source: Compilation and synthesis of fourth biennial reports of Parties included in Annex I to the Convention, FCCC/SBI/2020/INF.10/Add.1, the figure presents the total and sectoral impacts of policies and measures across the four reporting cycles by developed countries, as reported in their first biennial report (BR1)-BR4.

120. On policies and measures, the compilation and synthesis report indicate that, capitalizing on years of experience, developed countries continue to expand and strengthen key policies that underlie their efforts towards their 2020 targets. Simultaneously, these countries are shifting the focus towards their post-2020 targets.

121. Key policies and measures reported by developed countries are aimed at (figure 25): increasing the share of renewable energy in total power generation; phasing-out coal; improving energy efficiency; and electrifying road transport. On the promotion of renewable energy, she noted that this source has quickly increased its share in the total energy mix, reflecting rapidly falling prices. Renewable energy has already contributed significantly to emission reductions and has even greater potential to further reduce emissions. Policies attaching a price to carbon can do so either through carbon taxes or levies, or emission trading systems. These policies include a sizable share of domestic emissions and have the potential of accelerating climate action as they provide a good price signal across all sectors of the economy.

122. Turning to developing countries, Simeonova said many are taking steps to slow the growth of GHG emissions and decouple economic growth from emissions. They do so through policies aiming at sustainable and low-carbon development, and by encouraging green growth, green economy and low-carbon transition. In addressing climate change, developing countries are increasingly moving away from individual projects towards wider scope policy interventions, often linked to sustainable development policies and goals.

123. The sectoral composition of actions varies across developing country Parties, reflecting diverse national priorities, capacities, aspirations and national circumstances. She underlined that mitigation portfolios of developing countries are becoming more comprehensive in sectors covered and more impactful. Prominent elements of such portfolios include national climate change and energy legislation; renewable energy promotion; and carbon pricing.

124. In conclusion, she stressed that, across developed and developing countries a continuous improvement of reporting has been observed, as well as of information and analysis that underpin it. Well-established and well-functioning national systems have been essential to enhance the transparency of action and support. This in turn has increased the quality of reporting to the UNFCCC, but also underpinned domestic policymaking in many cases.

125. However, there are still data and methodological gaps in Parties' reporting. This poses a challenge for the quantification and assessment of the effect of mitigation actions both at

the individual country level, and at international level when looking at the aggregated effect of climate actions.

126. Arif Goheer, Chair of the CGE, recalled the CGE's mandate, vision and mission, namely to provide targeted technical support and advice to developing countries that respond to their needs to implement the MRV arrangements under the Convention and the enhanced transparency framework under the Paris Agreement.

127. The CGE conducted a survey among developing country Parties in 2017 and 2019, to assess their capacity-building needs to fulfil their reporting requirements (an updated report was released in 2021).[21] The results of the survey are contained in a technical paper and a distilled version is available on the CGE website. Identified constraints, lessons learned, and capacity-building needs are associated with national GHG inventories, reporting on climate change impacts and adaptation, reporting on mitigation action and support needed and received, and preparing for the enhanced transparency framework. In relation to reporting on mitigation action, the constraints relate to institutional arrangements, methodological issues and tools, and data and information.

128. Goheer highlighted three lessons learned. The first is that building on the existing data collection processes in key sectors to incorporate progress on indicators for mitigation assessment has helped streamline data collection processes, and enabled more up-to-date and accurate data to be obtained. The second is that strengthening coordination with enforcement entities has facilitated data collection and use of policy instruments. The third is that clearly communicating to key stakeholders the purpose, process and strategy of data sharing has facilitated the participation of stakeholders, ensuring that relevant policies and measures are incorporated into the reporting process. This has allowed for more comprehensive outcomes from mitigation assessments.

129. Among the capacity-building needs identified by the CGE, he mentioned the provision of training and guidance to identify and use appropriate methodologies to track progress and quantify the effects of mitigation actions; making progress on indicators; maintaining or strengthening the extensive analytical work conducted for developing scenarios and projections and the creation of a solid analytical base for revising mitigation measures in the future; developing or strengthening a mechanism for tracking and verifying GHG emission reductions, across all sectors; developing further data management and archiving system; and developing or strengthening data collection processes by establishing data sharing protocols or developing standardized data sharing formats to ensure systematic collection of data, in line with IPCC guidelines.

130. Annela Angar-Kraavi, KCI Co-Chair, explained that after its first meeting in October 2020, the Committee started implementing two activities related to NDCs and long-term low GHG emission development strategies that maximize the positive impacts and minimize the negative impacts of response measures; and capacity building on economic diversification and transformation just transition. The KCI received inputs from experts but did not consider the overall aggregated effects of steps taken by Parties since 2015.

(b) Data and methodological gaps

131. A Party asked for clarifications regarding the data and methodological gaps in Parties' reporting and what Parties and/or the Secretariat could do to remedy them. Simeonova underlined the distinction between national and international data gaps. She stressed that the lack of a complete set of emissions information from developing countries is the biggest data gap at the international level. At the national level, the two main gaps are GHG inventories, and capacity to estimate the effects of policies and measures. While noting progress in the latter area, she recognized that it would take some time for developing countries to put in place robust arrangements, especially for data gathering. In the area of estimation of effects from policies and measures, progress is lagging, since Parties are using different methodologies, with different degrees of uncertainty. In addition, there is a lack of clarity regarding how synergies and overlaps are taken into account to calculate aggregate effects. As for solutions to GHG inventories, she referred to technical review and technical analysis for developed and developing countries, respectively. However, she stressed the need for

[21] https://unfccc.int/sites/default/files/resource/CGE%20TP%202020_published.pdf.

more capacity building and strengthening of institutional frameworks in developing countries. To better assess the impacts of policies and measures, she suggested reviving the process called 'Good practices in policies and measures', which used to exist under SBSTA, where all Parties could showcase their methodologies for assessing the impacts of their policies and measures.

132. Responding to a question by a Party on the priority areas to address data and methodological gaps in assessing mitigation action, Simeonova pointed to the need for robust GHG inventories of developing countries, stressing that they are not only critical for aggregation, but also to inform policy choices at the national level. She also stressed that only looking at aggregated emissions trends is not enough, as it may mask important developments relevant to policy making. To understand emission trends, one needs to understand how policies may impact them and how policies may evolve over time. Therefore, it is key to assess the impacts of policies and measures.

(c) Transparency reporting

133. A Party asked what the findings show about the importance of transparency in reporting and the need for capacity building to assist developing country Parties in improving their reporting on mitigation actions and their effects. Simeonova stated that while reporting of information on emissions on mitigation and adaptation is a critical obligation under the Convention and the Paris Agreement, it is not a box-ticking exercise. Simeonova therefore underlined that capacity building of developing countries is of paramount importance, to support the establishment of a robust reporting. Noting that many multilateral initiatives focus on this area, she suggested providing a comprehensive overview of all these capacity building initiatives, so that everyone could get assistance.

(d) Challenges in aggregating information from Parties

134. A Party asked if the secretariat had been able to compare Parties' efforts with the long-term emission pathways required to limit global warming to 1.5 °C. Simeonova explained that the Secretariat does not have the mandate to compare efforts by Parties to the long-term pathway. She added that the secretariat compiles and synthesizes data from developed countries. While information from developing countries is much more incomplete, she noted that issues of completeness and timeliness are improving, citing the MRV under the Cancun Agreement as an effective means to improve reporting of these countries. With sufficient information and a mandate, the secretariat could assess Parties' aggregate efforts in comparison to pathways consistent with the LTGG.

135. A Party suggested that the challenges involved in quantifying and aggregating the impacts of mitigation actions by developing countries could be addressed by using information from BURs, NCs, and international consultation and analysis. Simeonova noted that the present discussions are 'only the beginning' of identifying the challenges, and that the secretariat could engage more on this issue.

136. A Party asked how official UNFCCC data is considered by the scientific community and subsequently in recent IPCC reports. Simeonova stated that information on GHG emissions by developed countries is taken into consideration by the IPCC to present emission trends, and that information from developing countries comes from a variety of sources, including their own reporting, if complete. While underlining the difficulty of aggregating data from individual countries, Jim Skea, IPCC, indicated that the IPCC makes use of existing harmonized sources for emissions (such as the EU EDGAR database and the IEA), and the UNEP Emission Gap reports. AR5 attempted to aggregate Cancun pledges and the SR1.5 mentions UNFCCC sources themselves. SRCCL has already highlighted methodological issues regarding land emissions and sinks. In AR6, Working III AR6 will discuss methodological/coverage issues with different sources (Chapter 2 drivers and trends) and will aggregate current mitigation efforts (Chapter 4 mitigation and development pathways in the near-mid-term).

(e) Developed countries' emissions

137. In responding to a Party on the projected increase of aggregate emissions of non-EIT developed countries during the period 1990 to 2020, Simeonova underlined the differences

in trends in emissions in economies in transition (EIT) and non-EIT developed countries. In non-EIT developed countries, emissions are slightly above 1990 levels in 2020. Since 2000, their emissions have been on a downward trend, which will continue until 2030. She said emissions from EIT countries rapidly decreased in the early 1990s, but then increased steadily since 2000, albeit well below their 1990 levels. The aggregate effect of the emission trends of both EIT and non-EIT developed countries is a reduction of about 2 per cent between 2020 and 2030.

138. A Party asked why this decline is so small, despite the increased scope and expected strengthening of developed country mitigation actions beyond 2020. He also asked what policy improvements could be made to bring projected emission reductions in line with what is needed to limit warming to 1.5 °C, and where long-term targets and associated policies may take us. Simeonova explained that the level of emission reductions from developed countries is in part due to the continued slight increase in emissions from EIT countries. She also pointed out that the fourth BRs of these countries contain several new policies and measures, which have not been fully implemented and whose impacts have not been fully assessed, which may explain such a modest reduction in emissions from these countries. Nonetheless, she noted that these policies and measures will probably be insufficient to achieve the required dramatic emission reductions.

139. A Party commented that Annex I Parties' emissions have risen during the period 1990 to 2020 and that they lack real ambition. Simeonova said countries are now in the process of setting ambitious long-term goals, but they need to translate them into concrete and pragmatic measures now. As these policies are implemented, they should be adapted based on their assessment over time.

(f) Coal phase-out policies

140. Further to a question on coal phase-out policies and estimates of their contribution to emissions reduction, Simeonova said it is one of the pillars of mitigation strategies by developed countries. Noting that coal phase-out policies are relatively new, she stated that more time is required to assess the results and no robust estimates of its impact are available yet. However, she estimated that the impact of such measures is likely to be very high, because coal is part of the power generation mix of many countries. Many countries have mentioned coal phase-out goals or policies in their BRs.

(g) Near-term action

141. A Party noted that UNEP stressed the need to set ambitious near-term goals in 2030 and push for low carbon post-COVID recovery. She said increased ambition pre-2030 should be a key outcome of this SED. Olhoff agreed that there is a need for ambitious goals in 2030 and indicated it would be a focus of the 2021 Emissions Gap report.

142. A Party expressed concern about the focus on long-term goals and stressed the need to focus on immediate emissions reductions. Howes said both the long- and short-term visions are useful. The long-term goals give a sense of direction and shape investments and private sector's views. Policies and implementation in the short-term are also essential, which is why the IEA set the milestones to ensure immediate action. Gielen said immediate action is needed. He underlined that in all scenarios, there is a massive build-up of renewables, which is a no-regret strategy. The financing and enabling framework has to be put in place at global scale. Bernoux informed of the forthcoming publication on short-lived climate forcers by FAO and partners, stressing that any action today on methane can be very effective in the short-term. Olhof explained that the 2021 edition of UNEP's Emissions Gap report would include a chapter on methane.

2. Adaptation action

(a) Assessing progress on adaptation

143. Olhoff explained that since 2014, UNEP has produced a complementary report to the Emissions Gap report on the Adaptation Gap. She noted good progress in adaptation planning, with 72 per cent of countries have at least one national-level adaptation planning instrument in place, 125 developing countries having begun the process of formulating and

implementing NAPs, 20 of which have been completed, and 58 per cent of countries having established sectoral planning instruments and 21 per cent subnational planning instruments. She underlined, however, that it is difficult to assess the degree to which adaptation planning efforts are adequate or effective in achieving adaptation objectives, with less than half of countries meet criteria for implementation, monitoring and evaluation.

144. On adaptation finance, while noting that it is growing, Olhoff underlined it is still very low. Current annual adaptation costs in developing countries are estimated at USD 70 billion and are expected to rise to USD 140–300 billion by 2030 and to USD 280–500 billion by 2050. Total tracked adaptation finance is currently USD 30 billion and has remained around 5per cent of total climate finance since 2015. As a result, the adaptation finance gap does not seem to be closing. This gap is expected to increase unless things are significantly changed. She added that implementation of adaptation actions is growing, but there is limited evidence of climate risk reduction.

145. To sum up on adaptation, she outlined that there is robust evidence that progress has been made on greater engagement in national level adaptation worldwide over the last decade, but further ambition is needed. Despite encouraging trends, the scale of adaptation progress is insufficient and tracking progress remains a challenge: there is a real risk that adaptation costs will increase faster than adaptation finance, and there are limited indications of current and future levels of risk reduction in connection with trends in adaptation planning, finance and implementation.

146. Alessandra Sgobbi, Co-Chair of the Adaptation Committee, stated that since the conclusion of the first periodic review in 2015, the Adaptation Committee has continued its work on providing technical support and guidance to the Parties on all aspects of adaptation to enable them to achieve the objective of the Convention. While the Adaptation Committee's work plan does not have a specific focus on the LTGG, some of its activities are relevant to the work undertaken under the periodic review. These include the following deliverables: an information paper on linkages between adaptation and mitigation; a technical paper on long-term adaptation planning; a technical paper on data for adaptation on different temporal and spatial scales; and work on monitoring and evaluation and linkages with the SDGs and the Sendai Framework for Disaster Risk Reduction.

147. The objective of paper on linkages between adaptation and mitigation was to better understand how linkages, synergies and trade-offs are addressed. Insights gained show that Parties address the linkages between adaptation and mitigation primarily in the form of potential mitigation co-benefits resulting from adaptation actions and vice versa. Synergies are being sought across several sectors, including energy, agriculture and livestock, forestry, ecosystems, and urban development and infrastructure.

148. The paper on long-term adaptation planning illustrates that taking a long-term approach to adaptation is cost-effective and can reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience over time. It can also facilitate the integration of adaptation into development planning processes and strategies, within all relevant sectors and at different levels. In 2020, the Adaptation Committee prepared a technical report on data for adaptation at different spatial and temporal scales. The findings reveal that although the availability and accessibility of data for adaptation are improving, there are still some critical gaps at all scales, in particular in developing countries. This calls for stronger international cooperation, coordination and support to manage growing amounts of data and data products, ensure their quality, and match them to specific national and local adaptation needs.

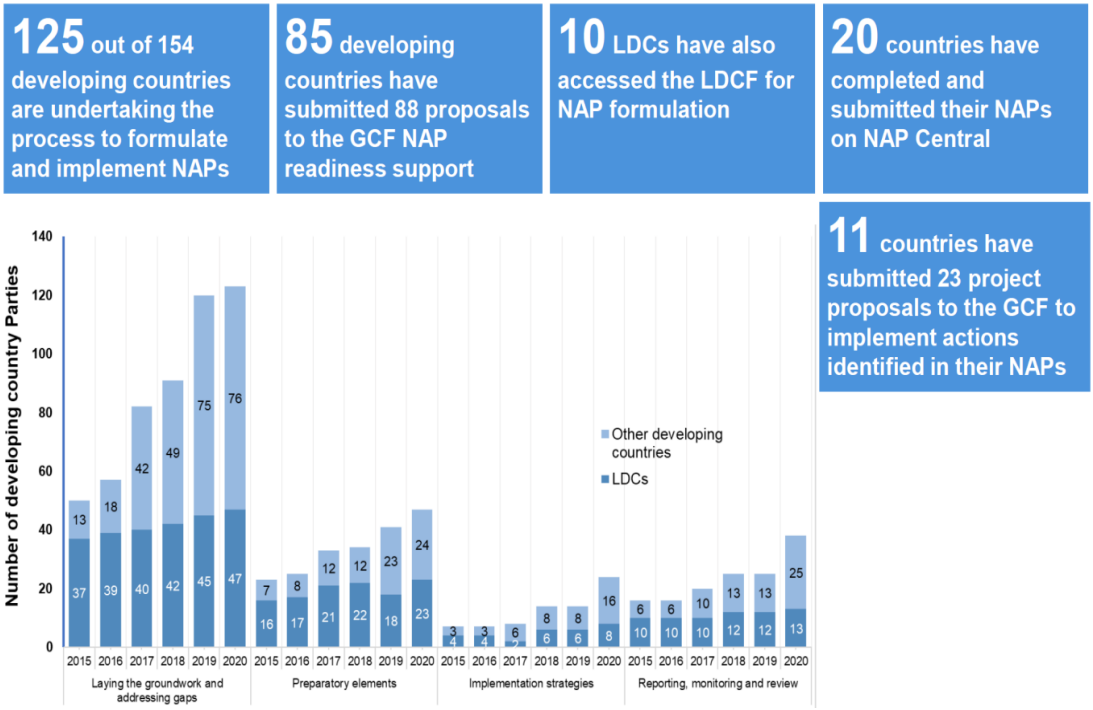
149. The work of the Committee on indicators reiterated that integrating adaptation with the SDGs and the Sendai Framework is critical for building long-term resilience across societies. Furthermore, coordination should be improved as it yields multiple benefits and enhances cost-effectiveness of measures that cut across the three agendas.

150. Ben Siddle, member of the LEG, said the process for developing NAPs was established in 2010. Progress has been gradual but is picking up. There is a positive trend in the last five years in NAP preparation, implementation and reporting. This progress enables a focus on the capacity gaps and needs to be addressed, especially in the LDCs. At present, 125 developing countries are taking action to formulate NAPs, which represents over 80 per

cent of developing countries. All 47 LDCs are formulating and/or implementing NAPs (figure 26). Support for NAPs in steadily growing, and 85 countries have submitted proposals to the GCF NAP readiness support. Eleven countries have submitted 23 project proposals to the GCF to implement actions identified in their NAPs. On the LEG support, good practices are being learned and shared. Learning is growing on the integration of adaptation into development, as well as on gender and measures to strengthen gender responsiveness in NAP formulation and implementation.

151. On learning on gaps and needs related to NAPs, the most relevant for the periodic review relate to: the challenges in accessing financial and other support, which requires improved capacity; the accessibility and availability of climate scenarios for good adaptation planning and implementation at all levels; and risk and vulnerability assessment and management to define baselines, and assess, manage and monitor risk and vulnerability at relevant scales.

Figure 25: Highlights of progress made in NAPs as of 31 October 2020



Source: Progress in the process to formulate and implement national adaptation plans (FCCC/SBI/2020/INF.13).
Abbreviations: LDCs= least developed countries, LDCF = Least Developed Countries Fund, NAPs = national adaptation plans, GCF: Green Climate Fund.

152. Le-Anne Roper, Co-chair of the ExCom, said not meeting the LTGG will have significant consequences, including loss and damage. She stressed that loss and damage associated with the adverse effects of climate change includes, and in some cases involves, more than that which can be reduced by adaptation. The ExCom has been working to enhance cooperation and facilitate implementation of approaches to avert, minimize and address loss and damage associated with climate change impacts, in particular in relation to slow onset events, non-economic losses, comprehensive risk management, human mobility, and action and support.

153. Work of the ExCom, including its technical expert groups, contributes to enhanced understanding of emerging climate-related risks. Currently, two groups are working on displacement and comprehensive risk management. The ExCom also recently adopted terms of references to relaunch the expert group on slow onset events, and to launch a group on non-economic losses and action and support. This work will continue to catalyze expertise and efforts to support countries' implementation on the ground.

154. She concluded by saying that the best available science should inform approaches to avert, minimize and address loss and damage associated with climate change impacts.

155. A Party noted that while many developed countries are reporting mitigation action as successfully achieving their objectives, globally we are not on track to achieve the LTGG. He also remarked that there are increases in adaptation processes and information, yet there is limited evidence of improved adaptive capacity. He asked why on so many targets we still fall short of what we need to achieve. On long-term adaptation planning, he asked how it is foreseen to enhance adaptation action.

156. Alessandra Sgobbi indicated that the Adaptation Committee is working on methodologies for reviewing the adequacy and effectiveness of adaptation and support. We will be able to gain a better understanding of adequacy and effectiveness in the course of this work. Additional insights may come from Parties' submissions and upcoming IPCC reports. She added that the Paris Agreement sets a global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2 of the Paris Agreement. The Adaptation Committee is considering approaches to review the overall progress made in achieving the global goal on adaptation.

(b) Mitigation co-benefits of adaptation

157. A Party asked how mitigation co-benefits resulting from adaptation activities contributed to achieving the LTGG, and how the synergies between adaptation and mitigation activities can be maximized. Alessandra Sgobbi explained that the reports that provided the basis for the Adaptation Committee's work on synergies do not include any quantitative assessment. However, more information may be available in the future as Parties start reporting on these co-benefits and their contribution to their NDC targets, including as part of the enhanced transparency framework and in their adaptation communications. On maximizing synergies, she stressed the importance of comprehensive planning and to promote the integration of both mitigation and adaptation in overall development plans. The SDGs should be taken into account and ensure sustainable development agendas are implemented jointly.

(c) Adaptation finance

158. A Party asked to what extent UNEP's recommendations on adaptation finance speak to integrated low-carbon development pathways, how to identify the required finance, and if there is an analysis of how adaptation finance is meeting adaptation needs. Olhoff explained that our knowledge of adaptation finance is very partial. In its Adaptation Gap Report, UNEP included only adaptation-related multilateral and bilateral flows to developing countries, which are not tracked comprehensively. National or private flows of adaptation finance are not included. It does not look at how finance is integrated into low-carbon resilient development pathways.

159. A Party asked for more information of the required climate adaptation investments, stressing they did not figure in the IEA and IPCC presentations. Howes said the NZE pathway implicitly incorporates adaptation considerations, as the energy sector needs to be resilient for energy security.

3. Cross-cutting and sectoral mitigation and adaptation action

(a) Assessing action towards food security and against deforestation

160. Martial Bernoux, FAO, discussed agriculture, food security and the LTGG. He reminded participants that FAO leads international efforts to defeat hunger and aims to achieve food security for all and make sure that people have regular access to enough high-quality food to lead active, healthy lives. He identified assessing and managing climate change impacts on food systems as one of the greatest challenges for all countries. He stressed that the zero-hunger goal can only be achieved with better production, better nutrition, better environment and better life. He outlined FAO's core functions and explained his presentation focuses on FAO's role in improving access to data and information. Bernoux provided an overview of its flagship publications, which synthesize the best available knowledge on the

state of the world's food security and nutrition, fisheries, forests, agricultural commodities, and food and agriculture.

161. The 2020 edition of The State of Food Security and Nutrition in the World indicates that in 2019, nearly one in ten people in the world were exposed to severe levels of food insecurity and that the world is not on track to achieve zero-hunger by 2030. If recent trends continue, the number of people affected by hunger would surpass 840 million by 2030. A preliminary assessment suggests that the COVID-19 pandemic may add up to 132 million people to the total number of undernourished in the world in 2020. The 2016 State of Food and Agriculture, which focused on climate change, underlined that unless action is taken now to make agriculture more sustainable, productive and resilient, climate change impacts will seriously compromise food production in countries and regions that are already highly food insecure. He added that today, this conclusion is "more than ever valid."

162. Turning to the 2020 Global Forest Resources Assessment, he noted that while deforestation is going down, forest expansion is also decreasing, and forests in total are losing areas, which in turn affects regional climate (see figure 27).

Figure 26: Annual rate of forest expansion and deforestation 1990–2020

Source: FAO, Global Forest Resources Assessment 2020, p. 14, available at: http://www.fao.org/3/ca9825en/ca9825en.pdf. The figure shows that an estimated 420 million hectares of forest has been lost worldwide through deforestation since 1990, but the rate of forest loss has declined substantially. It also illustrates a decrease in forest expansion in 2010-2020 compared to 2000–2010.
Abbreviation: ha = hectare.

163. On data and statistics for food and agriculture. Some of this data is relevant to GHG emissions and climate, but most data can also be used for building scenarios for the future. For example, data since 1951 shows that for wheat and paddy rice, production and areas harvested were more or less decoupled over the last 20 years.

164. Bernoux then presented key messages from "The Future of Food and Agriculture", including that: climate change will incrementally affect all agriculture sectors; if left unaddressed, climate change will exacerbate poverty and inequalities; climate change impacts go well beyond crop yields; the agriculture sectors can only reduce GHG emissions through more investment; and efforts in agricultural sectors are insufficient, drastic economy-wide GHG reduction are needed.

(b) Tools and support for food transition

165. A Party asked what tools and what level of finance are available to help countries plan their food transition. Bernoux explained that his presentation only relates to one of FAO's seven core functions. The organization also holds policy dialogues, bringing together the line ministries in charge of agriculture, forests, land, environment, finance, to develop holistic approaches to eradicate poverty and hunger by avoiding competitions among policies. FAO also gathers countries to learn from each other. For example, it is hosting the thematic working group under the NDC Partnership on agriculture, food security and land use. He also pointed to FAO's support to countries in accessing finance, noting that ODA for agriculture is lagging behind and even decreasing, according to data from the DAC of the OECD.

(c) Stakeholders' and Indigenous Peoples' engagement

166. Clement Yow Mulalap, Co-Chair of FWG of the LCIPP, presented some of the findings of a mapping exercise undertaken by the FWG. The mapping related to policies, actions and communications on adaptation, with respect to whether and how they incorporate consideration and engagement of indigenous peoples and local communities. Many NAPAs and NAPs do not make specific references to Indigenous Peoples and local communities, because the predominant population in these Parties is indigenous or local, as in many Pacific States for example. Of the 16 NAPs submitted, more than half mention Indigenous Peoples and the majority refer to local communities. Ten out of 51 NAPAs mention Indigenous Peoples and 41 mention local communities. The references are not very specific to engagement or participation in planning and implementation. Rather, most are to Indigenous Peoples or local communities as vulnerable groups, rather than referring to their engagement in the NAP or NAPA.

167. Key takeaways from the mapping exercise include the importance of including those on the frontlines of climate change, e.g. Indigenous Peoples and local communities, when assessing the overall aggregated effect of the steps taken by Parties to achieve the LTGG, as well as in developing effective holistic responses. There is a need for greater consideration and engagement of Indigenous Peoples and local communities throughout adaptation planning, communication and implementation processes. There is also a need for a focus on capacity building for Indigenous Peoples and people from local communities, to enable them to better engage at the national and international levels for adaptation. In addition, government officials from Parties need improved capacity to better engage with Indigenous Peoples and peoples from local communities, as well as to integrate their inputs and active participation. The FWG will publish a technical paper on the mapping exercise including a gaps analysis in the coming months.

168. A Party noted that the contribution of the FWG to the PR2-SED is included under the heading 'adaptation,' while the LCIPP's mandate is broader. It also includes the exchange of experiences and sharing of best practices on adaptation and mitigation. She asked for more information on experiences and best practices with a clear mitigation component where local communities and Indigenous Peoples play an important role.

169. Yow Mulalap stated that indeed, the LCIPP's work is broader and includes mitigation. Its initial two-year work plan envisages several activities that will map, highlight and share the experiences and practices of Indigenous Peoples and local communities pertaining to mitigation and adaptation. These include regional gathering, thematic training workshops and submissions. Many of the written outputs for these activities will be considered by the FWG during its fourth formal and virtual meeting in December 2020. Preliminary findings, based on the feedback received, include that Indigenous Peoples protect 80per cent of remaining biodiversity in the lands they manage. The findings also show that they have sustainable land practices that guard against soil degradation, help sequester carbon and protect food security.

170. A Party asked what good practices the mapping exercise identified to strengthen Parties' engagement with Indigenous Peoples in adaptation and mitigation planning and climate action. Yow Mulalap indicated that the FWG is in the process of receiving and reviewing submissions pertaining in the participation of Indigenous Peoples and local communities in adaptation and mitigation planning actions.

4. Enhancing enabling environments

171. Richard Kozul-Wright, UNCTAD, underlined that, as most countries were already falling behind on the targets of the 2030 Development Agenda and Paris Agreement before COVID-19, they have been "blown further off course by the pandemic". He called for a coordinated investment programme on an unprecedented scale, across interconnected economic, social and environmental challenges. The required additional investments are estimated at minimum at 2 per cent of global GDP annually for the next few decades. He added that the COVID-19 crisis has illustrated that public financing mechanisms are "unmatched" in their power to mobilize resources, while noting that the climate crisis is considerably greater than the pandemic, which has also revealed a sharp difference between advanced and developing countries in mobilizing fiscal resources and accessing necessary technologies.

172. Kozul-Wright said our dominant economic model and its "misplaced faith" in market competition and the free movement of capital, has led to a destruction of the natural environment and an unhealthy investment climate. Instead, he called for an ambitious programme of financial and fiscal reform to shift investments from the short-term to the long-term and from speculative to productive investments to decarbonize economies. He urged abandoning austerity as the default macroeconomic adjustment policy, especially in many developing countries. Citing UNCTAD's 2020 Trade and Development Report, he said significant, well-planned and stable patterns of public expenditure can crowd in private investment and increase employment, wages and technological advances for a green transformation. He underlined the importance of an active public sector, stressing the role of public investment in infrastructure to decarbonize the global economy. While welcoming some recent programmes along these lines in some large emitters, he said their scale is still well below what is required for a 2 ºC target. Noting that output and population growth will be greatest in developing countries in coming years, he called for also increasing public investments in these countries. He described this globally coordinated investment strategy as a "Global Green New Deal."

173. Kozul-Wright underlined that the responsibility to "lead a big investment push" lies with the world's richest economies, including by supporting developing countries to decarbonize without compromising development efforts. Stressing that external debts constrain developing countries' resource mobilization, he urged: the creation of a multilateral mechanism for restructuring sovereign debt; increased international support to developing countries' central banks; tasking the IMF to guaranteeing sufficient liquidity to ensure the required investment push, including through the monitoring and elimination of illicit financial flows; and policy coordination to resolve trade-offs between growth targets, financial stability and environment protection.

174. He recommended learning from failed approaches and experience in public-private partnerships, noting that measures focusing on blending and maximizing finance by shoveling public money to private investors would not ensure the needed investment push to decarbonize economies. Instead, he said development banks provide more reliable sources of finance for sustainable infrastructure projects and support a just transition for workers and communities, pointing to suggestions to create a dedicated global climate bank.

175. He also underlined the need for sufficient policy space to adopt industrial policies and undertake programmes aimed at creating cleaner business and employment opportunities. He lamented that over the past decades, corporate monopolies have taken advantage of the restricting policy space to the detriment of the global commons. Pointing to the example of access to COVID-19 vaccines, he underlined that excessive protection of intellectual property will compromise effective responses to the climate crisis.

176. He said a Global Green New Deal will require a thorough audit of trade and investment rules and, where needed, rolling back free trade agreements and bilateral investment treaties.

(a) Circular economy

177. Stephan Sicars, UNIDO, presented on "Achieving the LTGG through circularity: the role of capacity building in the transition to a circular economy". He said the circular economy is a means to advance the achievement of the LTGG because over the last four decades, the volume of material extraction, processing and production has more than tripled while releasing 62 per cent of the global CO_2 emissions (see figure 28). For many countries, this economic growth is still a significant precondition for ensuring some societal goals, such as fighting poverty and hunger. He underlined that only 50 per cent of GHG emissions can be reduced by introducing renewable energy and planting forests. The rest has to come from reducing extraction and use of raw materials.

Figure 27: Circular Economy

Source: Circular Economy, 2017, p. 3, available at: https://www.unido.org/sites/default/files/2017-07/Circular_Economy_UNIDO_0.pdf.

178. The COVID-19 pandemic has highlighted the underlying vulnerabilities and limitations of existing linear supply chains. Instead, the circular economy is a regenerative system in which resource input and waste, emission, and energy leakage are minimized. He noted that although the circular economy agenda and low-carbon strategies are complementary and mutually supportive, at present, the world is only 9 per cent circular.

179. Turning to the NDCs, Sicars said they are not enough to ensure the long-term goal of decarbonization. He added that the over 500 environmental agreements in existence contain no reference to a circular economy. Nonetheless, there are successful cases of NDCs that consider the circular economy principle, including that of Chile, Saudi Arabia and Laos. As a multisectoral approach, circular economy can help countries achieve and boost NDC targets substantially.

180. On gaps and challenges facing developing countries in adopting circular economy, Sicars cited: the lack of international consensus on its definition and principles; weak national policies and insufficient coordination among stakeholders; inadequate access to finance, technologies and data; insufficient coherence, synergies and coordination within global initiatives; and a lack of awareness and overall knowledge on the synergy linking climate action and circular economy agendas. It is only developing now in some countries.

181. On the needs of developing countries to adopt a circular economy, he called for capacity building to: improve awareness and knowledge of businesses and policy makers on the benefits associated with circular economy; achieve a global consensus on the concept and a set of circular economy principles; build policy frameworks attractive for investors and the private sector that integrate circular economy and climate action holistically; incorporate circular economy into NDCs; build a global coalition for action; and develop standardized indicators of circular economy to track improvements.

182. Sicars provided examples of action on the ground, highlighting that UNIDO: promotes circular economy as a model towards sustainable development; builds capacity and fosters the creation of green expertise; advises policy makers to innovate in the regulatory environment, attract green investment and enable the expansion of circularity; and assists technology transfer.

183. He listed some successful examples, namely the Network for Resource Efficient and Cleaner Production, the Programme for Country Partnerships and Switchmed. He added that in collaboration with the EU and UNEP, UNIDO has co-launched the Global Alliance on Circular Economy and Resource Efficiency. In the past months, UNIDO convened and organized global consultations on circular economy. These consultations have shown that:

there is a common understanding that circular economy offers a promising solution to some of the most pressing global challenges; actions are required to build regulatory frameworks; and capacity building will be a key leverage to enhance shift into a circular economy. The consultations also formulated recommendations to promote capacity building. In concluding, he flagged that World Environment Day 2021 will serve as the formal launch of the United Nations Decade on Ecosystem Restoration, which is closely linked to reducing raw materials consumption, a challenge that can be supported by investing in circular economy.

184. A Party asked to what extent a circular economy approach helps achieving the LTGG. Sicars explained that circular economy is larger than circular carbon economy, which focuses on the energy sector only. Hammer said that the World Bank's work is country specific. Sector issues will be picked up in country diagnostics the Bank is currently developing.

185. A Party asked which studies supported the finding that only 9 per cent of the world is circular and what the potential for increasing this number is. Sicars said that the 9 per cent figure comes from the circularly gap report, published by the Dutch NGO "Circular Economy". In response to a question posed by two Parties about estimates of GHG emission reductions that could be achieved through a circular economy, Sicars said the estimated potential impact of GHGs savings by a circular economy until 2050 is 9.3 billion tons of CO2e. He added that this is only an estimate, since a lot of these savings would accrue in developing countries, where available data is rudimentary.

(b) Fiscal issues

186. A Party raised a question for UNCTAD, noting that the ongoing COVID pandemic has far-reaching impacts on the fiscal system of developing countries, on top of climate change impacts. She sought clarification on the role that proposed debt swaps for ambitious climate action could play in enabling SIDS to achieving ambitious mitigation and adaptation action. Kozul-Wright called for "freeing-up the fiscal space that developing countries will need", noting that the debt constraints in developing countries is profound and unless it is restructured and relieved on a large scale, these countries will not be able to meet the climate and development goals challenges.

187. A Party asked for clarification on how the global COVID-related stimulus packages is compared to investment needs for achieving the 1.5 ºC goal. Kozul-Wright expressed disappointment by the response to the COVID-19 shock, stressing that the Debt Service Suspension Initiative launched by the G20, consisting of a USD 5–10 billion debt suspension, is "utterly inadequate" compared to the pressure the public finances of these countries are facing. He welcomed a liquidity generating tool, namely the new issue and special drawing rights expected over the Northern summary of the order of USD 160 billion.

188. He stressed that freeing-up fiscal space is still a pending issue, which is why UNCTAD proposed more support to national central banks and MDBs. Underlining the detrimental impact of credit rating agencies, he noted the need for discussing alternatives to the current credit rating processes in the context of climate challenge.

189. A Party asked if UNCTAD has guidelines for developing and developed countries to carry out fiscal reforms in line with the Green New Deal and learn from each other. Kozul-Wright said the dominating forum is currently the G20, which has a legitimacy problem since most developing countries are not involved. Some UN fora, such as the ECOSOC, are more appropriate. He pointed to UNCTAD's promotion of guidelines on foreign direct investment with the G20. He also referred to UNCTAD work on responsible borrowing and lending, stressing these guidelines could be revised to include a stronger focus on climate.

190. A Party cited a 2020 UNCTAD report estimating illicit finance flows from Africa at USD 88.6 billion per year, noting this may increase. He asked what can developing countries do to address this issue, noting it is mainly a problem created by developed countries. Kozul-Wright said tax evasion is only one of the problems related to illicit financial flows. The loss for developing countries is huge and should be tackled on various fronts.

(c) Supporting enabling environments

191. A Party asked how public finance can support enabling environments to bring private capital at the scale required for achieving the 1.5 ºC goal. Another one asked what the critical

elements of an enabling environment for the transition are ahead of us. A third Party asked what the enabling policies to foster innovation and stimulate the commercialization of the technologies required to achieve the LTGG are.

192. Hoffmaister, GCF, said that the GCF places particular emphasis on de-risking, including by providing guarantees; enabling frameworks; and concessional finance. He also underscored the importance of strengthening the capacity of country focal points to engage with the private sector. Hammer explained that this work is done by the International Finance Corporation (IFC) through their engagement with the private sector, and by the World Bank, in its direct engagement with governments, where market reforms are discussed. The new country climate diagnostic reports will be co-led by IFC and the World Bank and will take a whole government approach and identify areas where strategies are aligned or not.

193. To improve enabling environments, another opportunity is for linking lending to institutional or policy reform, with flows released once intermediate steps are achieved along the way. He also pointed to World Bank's support to long-term strategies and their integration within the countries' policy frameworks. Sicars underlined that circular economy is not public spending and the enablers are key.

194. A Party asked what can be done to shift global financial flows to align them with pathways consistent with net-zero GHG emissions and climate-resilient development, and what the role of finance ministries and non-party stakeholders is in this endeavor. Hammer said 62 governments have banded together in a coalition of finance ministers, currently chaired by Indonesia and Finland, which work on six areas in the remit of finance ministers that has climate change links, including long-term development plans, NDCs, greener financial marketplace, government and fiscal policies, green budgeting. The coalition holds regular meetings and dialogues, all aimed to build capacity of finance ministries and ensure more engagement.

(d) Human rights dimensions

195. A non-Party underlined that health is a human right. He explained that at COP21 in Paris, a group of Parties came together to support the 1.5 ºC goal as a human rights imperative. He noted that since 2015, the Human Rights Council has mandated six studies on human rights and climate change through its annual resolution on human rights and climate change. They all find that the best way to achieve the objective of the Convention is a human rights-based approach to climate action. They emphasize that the most ambitious climate change mitigation action possible combined with effective adaptation measures that benefit persons most affected by climate change and effective measures to address loss and damage are human rights imperatives. He underlined the commitment in the preamble of the Paris Agreement to respect, promote and consider human rights obligations when taking climate action. He asked experts how human rights to health and human rights had informed their work.

196. Orr explained that one of the guiding principles in the Scientific Conceptual Framework for Land Degradation Neutrality focuses on human rights, as it states that "actions taken in pursuit of the LDN target should not compromise the rights of land users." He also pointed to land tenure, noting the guiding principles to "ensure that all stakeholders, public and private, pursue LDN responsibly […] ensuring that planning processes are transparent and participatory, providing spatial systems to record individual and collective tenure rights, and safeguarding against dispossession of legitimate tenure right holders, environmental damage, and other threats and infringements."

197. Cooper noted the increasing attention to human rights and rights-based approaches more generally, including in relation to the protection of biodiversity. Campbell-Lendrum explained human rights has informed the WHO's work.

5. Climate finance

(a) Provision of climate finance

198. Chizuru Aoki, the GEF, presented on supporting climate action with systemic impacts. She focused on how linkages can be drawn among actions to address climate change,

biodiversity loss and land degradation. She recalled that the GEF is part of the financial mechanism of the UNFCCC, but also supports implementation of four other MEAs. She noted that many of the MEA targets and goals depend on the success of others. Challenges and opportunities for the GEF are to identify entry points and drivers to deliver benefits for all themes and identify trade-offs.

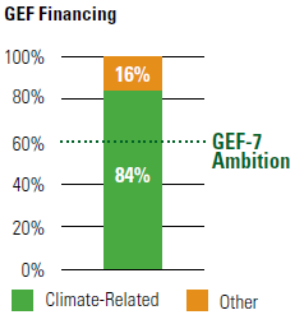
199. Aoki provided an overview of the systemic actions the GEF is supporting, noting that according to the Independent Evaluation Office, the ability of the GEF to address multiple conventions through a single integrated project or programme is seen as a significant comparative advantage for the GEF. For example, the GEF has been supporting a holistic approach across a range of countries through its Food Systems, Land Use and Restoration Impact Program, which promotes sustainable food systems, removes deforestation from commercial commodity supply chains and supports large-scale restoration of degraded landscapes. Expected results cut across all key conventions and include millions of hectares of land restored or under improved management, and millions of $GtCO_2e$ mitigated.

200. Aoki described the Sectoral Coverage of GEF-7 Climate Change Mitigation Projects and highlighted that 60 per cent of the climate change-relevant programming is supporting the AFOLU sector, showing alignment of support to those actions that generate systemic impacts across multiple conventions. Looking at LDCF projects under implementation, countries are also prioritizing agriculture and natural resources management.

201. On GEF climate-related financing, 84 per cent of GEF-7 financing, or USD 2.1 billion, have been tagged as climate-related and include significant mitigation-adaptation cross linkages (see figure 29). On enabling activities, she said they help address information, knowledge and capacity gaps, and they are used to inform implementation.

202. In closing, she called for systemic solutions to systemic problems, with multiple benefits across MEAs; and articulating national priorities and needs through enabling environments. She welcomed the emerging clarity and science-based information to support systemic interventions and highlighted that the GEF-8 replenishment and LDCF/SCCF programming strategy development have started, providing an opportunity to inform priorities for the next cycle.

Figure 28: GEF's climate-related finance



Climate-Related Financing in GEF-7 ($m)

	No Contribution to Adaptation	Adaptation a Significant Objective	Adaptation the Principal Objective
No Contribution to Mitigation	419	295	97
Mitigation a Significant Objective	634	578	25
Mitigation the Principal Objective	250	309	0

Source: Global Environment Facility, GEF-7 Corporate Scorecard 2020, p. 10, available at: https://www.thegef.org/sites/default/files/publications/GEFper cent20Scorecard_2020_December_CRA_bl2.pdf. The figure shows the share of climate-related financing in the Global Environment Facility's seventh replenishment (GEF-7). For this purpose, climate-related financing is defined as GEF financing that contributes towards climate change mitigation or adaptation as a principal or a significant objective, consistent with the Rio Marker methodology of the Development Co-operation Directorate of the Organisation for Economic Co-operation and Development.

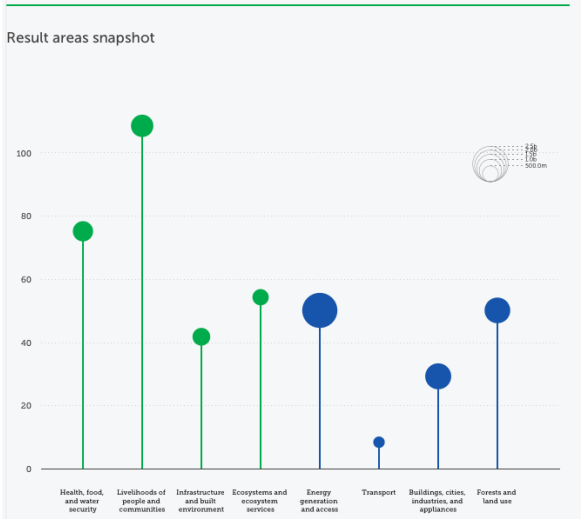
203. A Party asked if the amount spent by the GEF for AFOLU activities has been sufficient and if it matches the amount countries were requesting. Aoki explained that the needs are much greater than the resources available to the GEF for the AFOLU sector and countries need to identify what priorities they want to finance.

204. Juan Pablo Hoffmaister, GCF, discussed how the GCF is supporting climate action. He recalled that as an operating entity of the UNFCCC financial mechanism, the GCF aims to foster a paradigm shift to low-emission and climate-resilient development pathways in developing countries. The GCF is now the largest climate dedicated fund, with USD 7.2

billion received in 2014, which has entirely been programmed. In the first replenishment period, which covers 2020–2023, USD 10 billion have been pledged.

205. He underlined that engagement with the GCF is a 10-step programming process, starting with detailed country and entity programme setting, to evaluation, learning and project closure. He explained that the GCF makes investments within eight strategic result areas (four related to reducing emissions and four related to increasing resilience), in line with country priorities. He also underlined an increase in the number of projects cutting across areas. There is a concentration on energy in the mitigation side and on livelihoods in adaptation projects (see figure 30).

Figure 29: Green Climate Fund's result areas snapshot



Source: Green Climate Fund, result areas snapshot, available at: https://www.greenclimate.fund/results. The figure shows the size of investment by the Green Climate Fund (GCF) in eight mitigation and adaptation result areas. The vertical axis represents the size of investments in USD billions, and the horizontal axis lists the result areas. Adaptation areas are represented in green and mitigation areas in blue.

206. He provided an overview of the GCF's portfolio, highlighting that USD 8.3 billion have been programmed, with close to USD 330 million in readiness. With co-financing, this amounts to almost USD 30 billion, reaching half a billion people and aiming to reduce 1.8 billion tons of CO_2. Since 8.3 billion have been committed to the GCF but only 5 billion are under implementation, Hoffmaister noted there is a delay between projects approved and those under implementation, something the Fund is working to address.

207. Presenting the status of accredited entities, he said the GCF is a "partnership organization," with over 100 organizations accredited to channel resources, 80per cent of which are international entities, and 17 per cent are direct access. Of total GCF funding, 73 projects are for adaptation, 53 for mitigation and 44 are cross-cutting. He noted that maintaining the balance between mitigation and adaptation has been challenging. He also highlighted that: at least 50 per cent of resources are to be allocated to LDCs, SIDS and Africa; 33 per cent is directed to private sector operations; and blended finance has been paramount in the GCF's operations. Readiness programme and support for capacity building has been central, with USD 296 million under implementation or approved, targeting 140 countries. The structure of the outcome of the capacity building programmes consists of capacity building for climate finance coordination; strategic frameworks for low-emission investments; strengthening adaptation planning; building a pipeline of paradigm shifting projects; and project management.

208. He said the GCF-1 Strategic Plan for 2020–2023 aims to deliver greater impact for developing countries compared to the Fund's first programming period. He listed the GCF-1 2020–2023 portfolio targets, including to: ensure the 50:50 balance between adaptation and mitigation; increase finance to private sector and to direct financing entities; and increase speed, effectiveness and transparency.

209. In concluding, Hoffmaister noted that since the PR1-SED, the GCF has learned that: providing predictability and confidence requires a long-term engagement; national institutions are key, hence the emphasis on direct access; scaling up financing for adaptation

remains a challenge; supporting capacity building is essential; and the GCF's resources are not enough and addressing the climate challenge will require collaboration private sector and blended finance.

210. Stephen Hammer, World Bank, explained that his presentation at the pre-2020 roundtable in November focused on pre-COVID information, and that since then, the Bank has outlined the basic parameters of its new Climate Change Action Plan covering the period 2021–2025, whose publication is forthcoming. The Plan builds on the Bank's strong record on climate, further mainstreams climate change into its operations, refines its policy priorities, and deepens the focus on the work's impact. He underlined that between 2015–2020, the World Bank Group's support for climate action averaged 26per cent of total lending, and that for the period 2021–2025, the Bank is committing to increase this share to 35per cent, with at least half devoted to adaptation finance. Considering the fact that the Bank's total financing has increased over this period, this new target is even more ambitious in absolute terms.

211. Hammer outlined other elements of the Plan, including: the commitment to align the World Bank Group's financing flows with the objectives of the Paris Agreement by July 2025; the preparation of Country Climate Diagnostic Reports, to deepen understanding of how climate change will affect the development of a country over the long term, and that will be updated every five years; and policy priorities in the support provided to the Bank's clients, such as moving away from coal use, expanding reliance on clean energy, decarbonizing industry, agriculture, cities and transportation, and greening countries' finance sector.

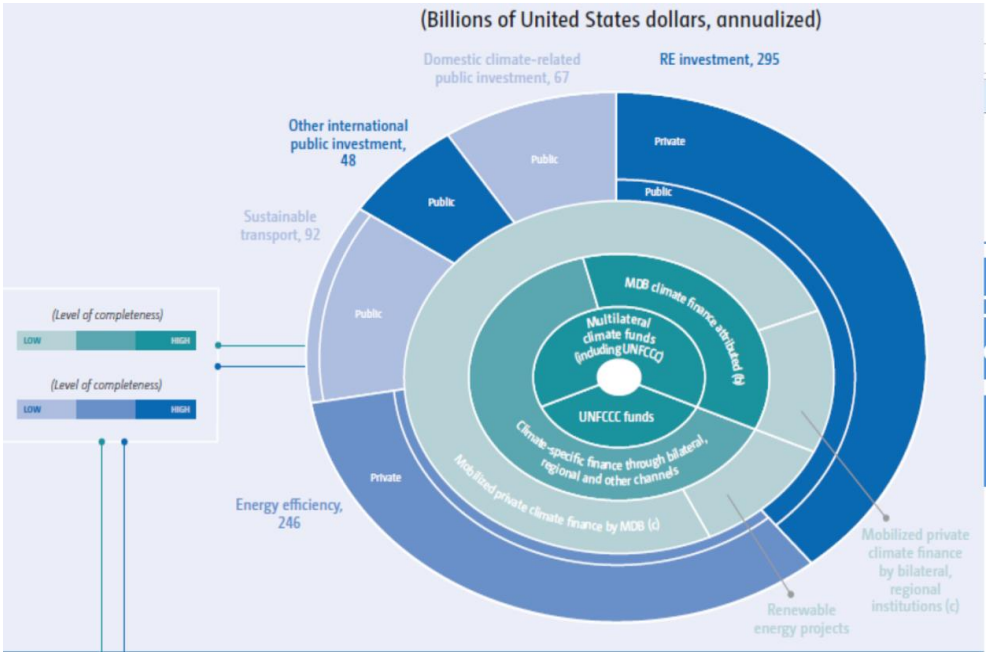
212. He then described how over the past year, the Bank has helped clients recover from the COVID-19 pandemic while retaining its green recovery focus. Takeaways from these efforts are that: the pandemic has dramatically increased debt levels in many countries; impacts of this debt crisis on future climate investments is uncertain; and not every government is ready to address linking climate action to the COVID response. In those countries better positioned to address long-term transformation, the ministries of economy or finance are those involved in discussions over building back better. He stressed that in these ministries, "nature-based solutions or energy system transformation are not exactly front-of-mind topics." Hammer therefore underlined the importance of building on the knowledge government official have in hand and the tools at their disposal. The Bank's strategic approach has involved drafting comprehensive policy notes aimed at making the case for green investments or policy changes. He mentioned the April 2020 publication of a COVID recovery sustainability checklist that aims to promote a comprehensive approach and assesses interventions on economic, environmental and social metrics. Hammer said government still decide which actions to move forward, but with a more consistent understanding of the implications. However, this approach is predicated upon access to data, which is challenging in many countries. Available estimates from advanced economies are often not compelling in developing countries' local context. He indicated the Bank is currently working on studies to provide better data, which should be released by COP 26.

213. Hammer underlined that it is often easier for governments to return to a business-as-usual approach in their recovery from the pandemic because of the information vacuum linked to other pathways. He cited the application of an abbreviated version of the Bank's sustainability checklist to a climate vulnerability assessment of a small island State. In light of limited resources, the assessment also identified priority actions that could be pursued depending on the amount of recovery funding available. He said this analysis has made resilient support more actionable and able to compete against a simple return to business approach.

(b) Assessment of climate finance flows

214. Ismo Ulvilla, Co-Chair of the SCF, provided an overview of the SCF's biannual assessments and of climate finance flows (figure 31). The biannual assessments compile all relevant climate finance data since its initial mandate, which was adopted in Cancun at COP17. He stressed that these assessments are key communication tools used by the SCF when serving the Convention and the Paris Agreement.

Figure 30: 2018 Biennial Assessments key findings: Climate finance flows in the period 2015–2016



Source: Adapted from 2018 BA summary and recommendations, available at: https://unfccc.int/sites/default/files/resource/51904per cent20-per cent20UNFCCCper cent20BAper cent202018per cent20-per cent20Summaryper cent20Final.pdf. Abbreviations: MDB = multilateral development bank, RE = renewable energy. The figure shows that climate finance flows increased by 17per cent in the period 2015–2016 compared with the period 2013–2014. High-bound climate finance estimates increased from USD 584 billion in 2014 to USD 680 billion in 2015 and to USD 681 billion in 2016.

215. He noted that his presentation covers up to the 2018 biennial assessment, because the 2020 assessment will only be published mid-2021. He also stressed that the SCF only uses data based on the best available science. For the 2020 biennial assessment, the SCF has the mandate of mapping information relevant to article 2.1.c of the Paris Agreement (on finance flows consistent with a pathway towards low GHG emissions and climate-resilient development), including reference to Article 9 thereof. He noted that the SCF has the additional mandate of looking at the definition of climate finance.

216. Biennial assessments are structured along four chapters covering: methodological issues; the overview of climate finance flows; an assessment of climate finance; and mapping of information relevant to Article 2.1c. The key findings from the 2018 biennial assessment are presented in the 'onion diagram' representing climate finance flows in 2015–2016. Ulvilla explained that the different sectors indicate areas of climate finance and that the darker the colour, the more granular the data is. The different UNFCCC funds are represented in green at the centre, while the other funds are represented in blue.

217. The biennial assessment's findings are also summarized in a table, which distinguishes among different sources of climate finance. Describing the context of climate finance, he noted that while the total of climate finance for the period 2015–2016 amounted to USD 621 billion, this is less than the fossil-fuel subsidies over the same period, which amounted to USD 742 billion.

218. In conclusion, he underlined that there has been a continuous increasing trend in climate finance, which has been documented in all the biennial assessments submitted by the SCF. He also noted a significant increase in finance to multilateral development banks. Ulvilla underlined that the 2018 biennial assessment shows a rapid increase in South-South financial flows.

219. He pointed out that the SCF does not yet investigate in depth the integration of climate flows in decision making. In concluding, he stressed that not only financial flows are increasing, but the climate finance resilience sector has also received increased finance.

220. Three Parties asked how a meaningful assessment of progress towards to the USD 100 billion pledge by developed countries can be made. Ulvilla responded that the SCF does

not have the mandate to assess progress by developed countries towards this pledge. Given the lag in reporting by many developed countries, the 2020 figures will not be available before the 2022 biennial assessment. He added that the numbers will be assessed by Parties and that the SCF has no mandate to determine formally whether the USD 100 billion pledge has been met.

221. Noting that they are "clearly incompatible" with Article 2.1.c of the Paris Agreement, a Party asked for more information on fossil fuel subsidies and Parties' efforts to phasing them out. She also asked about perspectives on a "climate-positive" recovery, opportunities and risks in response to the COVID crisis. Ulvilla indicated that the SCF does not have enough resources to "dig that deep" and obtain more information on fossil fuel subsidies. He noted that the reference to these subsidies is just a proxy indicator. On the response to the COVID crisis, he explained that it is not going to be central to the 2020 biennial assessment, but that the topic will have to be examined in more details in the future.

(c) Climate finance and health

222. Noting that multilateral finance is not adequate to support countries' health adaptation plans and the impact of the pandemic on the developing countries' health systems, a Party asked if climate finance should not include zoonotic diseases. Campbell-Lendrum underlined that the origins of the problems usually lie outside the health sector. He pointed to a WHO manifesto titled "Prescriptions for a healthy and green recovery from COVID-19" published in May 2020, which calls for: protecting and preserving nature; investing in essential services, from water and sanitation to clean energy in healthcare facilities; ensuring a quick healthy energy transition; and promoting sustainable food systems; and building healthy cities. He added that although the problems are multiple, the solutions are shared. He said WHO backs sustainable land-use planning, underlining that although there are trade-offs, broadly speaking "what is better for climate is better for health." Campbell-Lendrum noted that most of the pandemics have come out of the natural environment and that these tend to be associated with habitat destruction. Kirstie Ebi stated that in addition to the very low investment in health adaptation, there is also very limited investment in research on health risks of climate change and on effective adaptation. She stressed that investments in health systems, including surveillance and monitoring, are critical for effective decision making.

223. A Party asked if there are any finance estimates of what is required to support the whole range of projects presented by WHO. Campbell-Lendrum explained that he showed a graph representing the amount of finance going to health as a stated aim. The MDBs do not refuse health projects, but the mechanisms are not properly set up for them to receive such projects. He also indicated that it is conservatively estimated that treatment costs of climate change impacts on health amount to 2–4 billion per year, stressing that there is a significant financing gap. Aoki underlined that the GEF has supported some health-related activities, particularly those related to wildlife trade that could pose health risks.

(d) Climate finance and SIDS

224. Noting that only 2per cent of global finance and only 12 per cent of GCF funds go to SIDS, a Party asked what percentage of GCF funding is for individual countries vs. regional or global projects. He also asked how much of this funding is delivered through direct access. Hoffmaister recognized that reporting is an issue and that the 12per cent reported for SIDS includes some multi-country programmes. He underscored the importance of strengthening the capacity of SIDS, pointing to ongoing GCF efforts and continuous engagement with countries. He added that direct access is already a priority in the GCF's current strategy and expressed the hope progress can be achieved over the next five years. Hoffmaister further indicated that the GCF Board is addressing the simplification of approval process, with the aim to improve it by end of 2021, including by increasing risk appetite.

(e) Aligning finance with the Paris Agreement

225. A Party asked if the World Bank and the GCF had made public the criteria used to align their operations with the Paris Agreement. He also asked what barriers these institutions face, what developing countries can learn from this process, and what structural changes are the most urgent for the financial system. Hammer explained that the Bank is working to align

its activities to the Paris Agreement as soon as possible and has worked with other MDBs on what alignment implies. He pointed to progress made in aligning project lending to the Paris Agreement's objectives but noted that more work is still required on other financial instruments. On the criteria for aligning the MDB's activities with the Paris Agreement, Hammer said the framework should be rolled out in the next several months. Hoffmaister noted the need to align the different instruments, NDCs, NAPs and TNAs, to ensure they provide a clear signal to the private sector.

226. A Party to the GCF asked how the GCF coordinates its interventions with the GEF to ensure complementarity and maximize climate action. Hoffmaister said coordination with the GEF, the Adaptation Fund and other funds is crucial. They hold numerous conservations, identifying opportunities for harmonizing and scaling up. He added that coordination should also happen at the national level.

6. Technology development and transfer

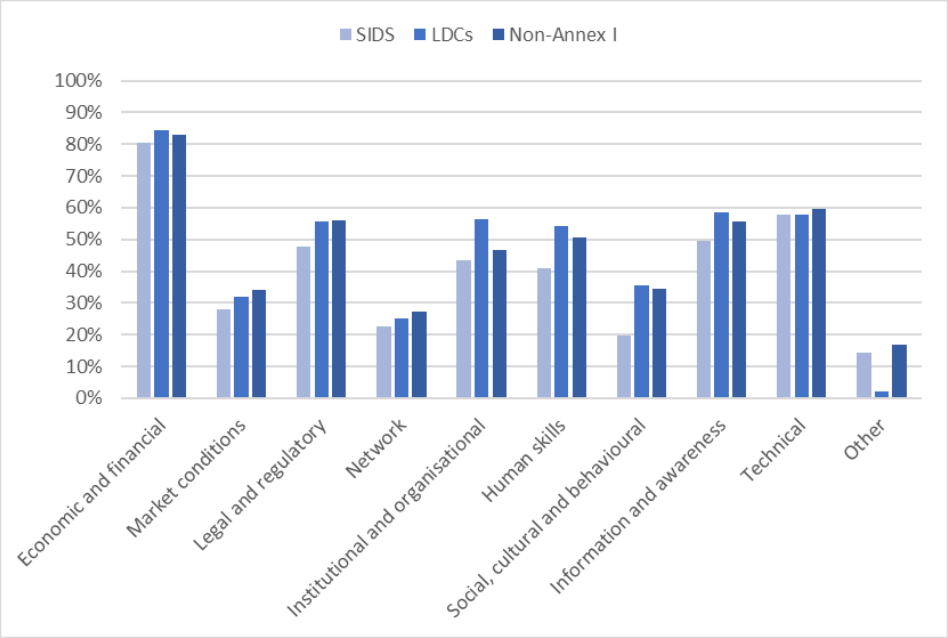
227. Sara Trærup, UNEP DTU, presented on TNAs and action plans to achieve the Paris Agreement. She explained that TNAs are a set of activities that identify and analyze mitigation and adaptation technology priorities of developing countries. They are country driven, implemented by national TNA teams, involve stakeholders, build capacity, align with national development objectives, and explore synergies with other national processes, striving towards NDCs implementation.

228. She explained that priority TNA sectors for mitigation are energy, transport and waste management; and water, agriculture and coastal zones for adaptation. As for priority technologies, she highlighted: water storage, harvesting, monitoring and management, crop diversification, drip irrigation, and water catchment and harvesting for adaptation; and solar, hydropower, bioenergy, electrification of vehicles, traffic management and public transportation for mitigation.

229. Trærup underlined that these technologies have different maturity characteristics, for example, conservation agriculture is a traditional technology, compared to the modern drip irrigation technology. She indicated that in mitigation, countries prioritized modern technologies, with the highest share of traditional technologies in the forestry and agriculture sectors. In adaptation, modern technologies also have the highest share among the three key sectors.

230. To address challenges to technology transfer and development reported in TNAs (see figure 32), NDCs and CTCN Technical Assistance, UNEP/DTU identify the key enabling environments, namely the set of resources and conditions within which the technology and the target beneficiaries operate. She underlined that by far, most of the enablers reported by countries are required in the economic and financial category. She added that this is the case whether the information is broken down by SIDS, LDCs and non-Annex I countries as a whole.

Figure 31: Challenges to technology development and transfer



Source: Technology Executive Committee, Draft paper on enabling environments and challenges to technology development and transfer identified in TNAs, NDCs and CTCN technical assistance, and relevant TEC Briefs, 27 October 2020 (TEC/2020/21/9) Figure 6, available at: https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/tn_meetings/b424150e4b9a4a3ab26df459d94c0d20/17d0f4143d9e4b9faa55bf6490c28c85.pdf. The graph illustrates the percentage of challenge types to technology transfer and development as reported by non-Annex I Parties in technology needs assessments (TNAs), nationally determined contributions (NDCs) and Technical Assistance of the Climate Technology Centre and Network (CTCN). It shows that among the 4421 challenges to technology transfer and development reported in TNAs, NDCs and CTCN Technical Assistance, economic and financial challenges stand out as the most significant. *Abbreviations*: SIDS = small island developing States; LDCs = least developed countries

231. Turning to implementation, she stressed that economic and financial challenges are the most frequently reported challenge for technology transfer and diffusion across all adaptation and mitigation technologies. However, she also stressed the need for education and training, assisting countries in making early-stage decisions on financing, matching country technology priorities with funding sources, and in general establishing a bridge between the policy and finance communities. She cited the example of Mongolia, which used the results of the TNA process to develop three GCF proposals, which are now all under implementation.

232. In concluding, she mentioned UNEP/DTU's main international partners in this field, noting that the GEF has funded the TNAs and that countries use their GCF readiness funds to update their TNAs and action plans.

233. Stephen Minas, Co-Chair of the TEC, identified elements of the work of the TEC, including support to the preparation and implementation of TNAs; support to technology development and transfer; and sharing of good practices, experiences and lessons learned. The TEC's specific contributions cover innovation, implementation, enabling environments and capacity building, and support. For example, he cited a compilation of good practices and lessons learned on countries' research and development; a policy brief on enhancing implementation of the results of the TNAs; a paper examining enabling environments and challenges based on TNAs, NDCs, CTCN technical assistance and relevant TEC briefs; and an upcoming technical paper on experiences and lessons learned from support for climate technologies.

234. On the TEC policy brief on enhancing implementation of the results of TNAs, he mentioned that it describes gaps, challenges and good practices in the TNA process. Recommendations from the brief include encouraging developing countries to engage well-selected project development teams and relevant decision makers for successful TNA preparation and implementation of results; further engagement of the public and private sectors with TNA implementation plans and in project preparation teams; and international cooperation and support on meeting technology needs to enhance implementation of TNA results.

235. A Party asked what efforts are underway to update TNAs and align them with the Paris Agreement targets. He also asked if there is a significant risk that existing TNAs may lead to technology lock-ins that would make the LTGG more difficult to achieve. Sara Traerup said that the development of TNAs is a continuous process, with frequent updates of the guidelines. She noted that countries are increasingly requesting to update their TNAs and the GCF readiness support can help countries in this endeavour.

236. A Party raised concerns about the lack of focus on the steps taken by Parties and asked what the new sources of funding are, what the status of adaptation funding is, and how technology transfer will be undertaken. Hammer said the Bank always tries to promote learning from one client to another, including in terms of technology transfer knowledge exchange and social support mechanism and other 'softer' issues that can facilitate this transfer. Kozul-Wright stated that, in the 1980s and 1990s, UNCTAD developed a code of conduct on technology transfer, which could be revived in the context of climate technologies.

237. A Party noting that to achieve the LTGG, ambition is required not only in mitigation action, but also in terms of means of implementation, sought more clarification about the maturity of renewable energy technologies in developing countries and how to get access to investments to deploy them. Howes noted that the Paris Agreement is broad with different levels of ambition, although many countries are signing up to a net zero ambition by 2050. This overall vision focuses the mind of governments to introduce the required policies. On the maturity of renewables, he noted the costs of solar and wind have decreased dramatically and are often competitive compared to traditional fuels, calling for a focus on their roll-out, according to each country's circumstances. Each country has its specific barriers to this deployment.

7. Capacity-building

238. Yongxiang Zhang, Co-chair of the PCCB, said the Committee was established in 2015 to address gaps and needs, both current and emerging, in implementing capacity building in developing country Parties and further enhance capacity-building efforts, including with regard to coherence and coordination in capacity-building activities under the Convention. Although the PCCB does not have the mandate to assess the overall effects of steps taken by Parties towards the LTGG, some of the Committee's activities could provide relevant information. These include the development of a toolkit to assess capacity-building needs and gaps at national level; and the activities of the PCCB's working group on enhancing coherence and coordination of capacity-building activities under the Convention and the Paris Agreement. The PCCB uses as reference the synthesis reports prepared by the secretariat on capacity-building needs and gaps reported by developing country Parties in their national reports; and on the capacity-building work of bodies established under the Convention and its Kyoto Protocol.

239. A Party asked which capacity-building activities have contributed to the LTGG. Yongxiang Zhang explained that several of its activities could help assess progress towards the LTGG. The PCCB's key mandate is to identify capacity gaps and needs and propose solutions, including by enhancing coherence and coordination. To fulfil its mandate, the Committee organizes the knowledge action days and workshops at regional level, and holds the Capacity-Building Hub at every COP. It will also launch the informal coordination group to coordinate and avoid duplication among all the bodies carrying capacity-building work. The Committee is also developing a toolkit to assess national capacity-building needs and gaps.

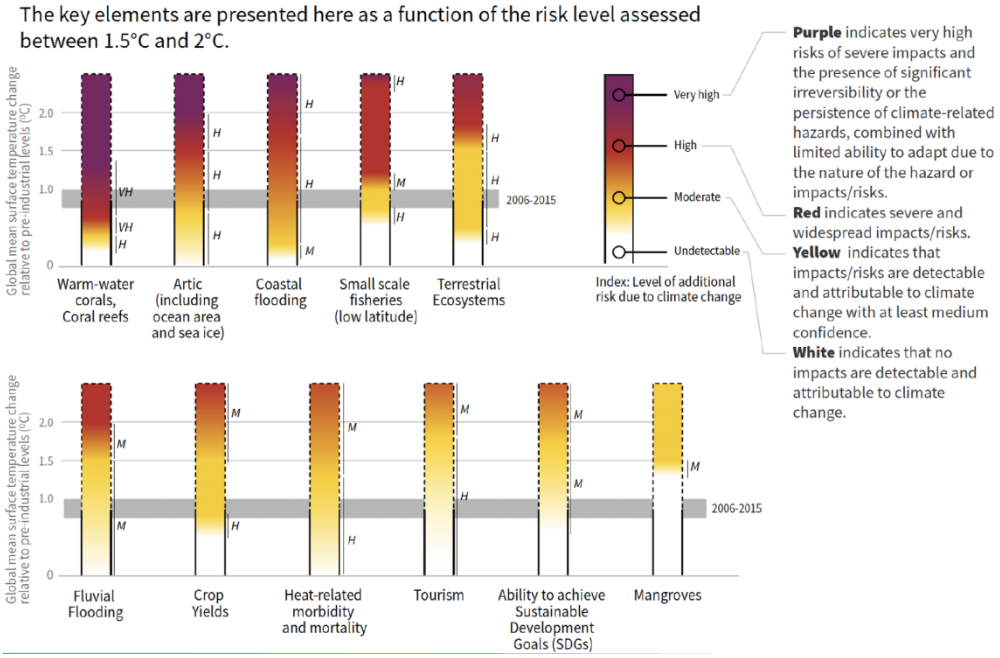
D. Challenges and opportunities

1. Challenges

240. Debora Ley and Pamela McElwee, IPCC, focused on three key challenges: i) timing of climate action due to increasing risks; ii) the need for adaptation; and iii) sustainable development challenges.

241. The first key challenge relates to the benefits of early action, given increasing risks overtime (see figure 33). This includes paying attention to the irreversibility of some impacts to ecosystems, such as those to coral reefs, and ice sheet and glacier mass loss, as well as the potential for impacts on some ecosystems to lead in the longer term to substantial additional GHG emissions. This challenge also relates to decreasing options overtime, as some response options such as that to increase soil organic carbon become less efficacious as climate change intensifies. Delayed action also increases costs and the risks of overshoot, which requires more use of CDR. Delayed action increases risks across social and ecological systems (figure 26), in particular for warm water coral reefs and the Arctic. The longer humanity waits to act, the more constrained the options available will be. There have been decreasing opportunities and increasing risks even since the PR1-SED held in 2013 to 2015.

Figure 32: Risks and/or impacts for specific natural, managed and human systems



Source: SR1.5 Chapter 3 Figure 3.20. Confidence level for transition: L=Low, M=Medium, H=High and VH=Very high. The figure shows the dependence of risks and/or impacts associated with selected elements of human and natural systems on the level of climate change. The nature of this dependence is shown between 0 °C and 2 °C warming above pre-industrial levels. The selection of impacts and risks to natural, managed and human systems is illustrative and is not intended to be fully comprehensive. Literature was used to make expert judgements to assess the levels of global warming at which levels of impact and/or risk are undetectable (white), moderate (yellow), high (red) or very high (purple). The color scheme thus indicates the additional risks due to climate change. The transition from red to purple is defined by a very high risk of severe impacts and the presence of significant irreversibility or persistence of climate-related hazards combined with limited ability to adapt due to the nature of the hazard or impact. This assessment takes autonomous adaptation into account, as well as limits to adaptation independently of development pathway. The grey bar represents the range of GMST for the most recent decade: 2006–2015.

242. The second key challenge relates to the strong need for risk reduction and adaptation measures in the immediate and near-term. At present, there are already significant impacts and risks and, these include compound problems, limits to adaptation and maladaptation. Regarding limits to adaptation that already exist at 1.5 ºC (see SR1.5 SPM B.6.3), hard limits mean that no adaptation action exists to avoid intolerable risks, as in the case of coral reefs that face irreversible damage at 1.5 ºC. Soft limits, on the other hand, are adaptation measures that do not currently exist but might be available in the future, for example, poverty eradication. Maladaptation is another risk, as some adaptation options can become maladaptive due to their environmental impacts (e.g., irrigation causing soil salinization or over extraction leading to ground water depletion).

243. The third key challenge consists in the fact that a warming of 1.5 ºC is not considered safe and can make the SDGs less obtainable. For example, half as many people will be subject to water stress at 1.5 ºC of warming compared to 2 ºC, and 40per cent more people will be exposed to heat waves at 2 ºC compared to 1.5 ºC. Table 1 below summaries this new

knowledge on impacts on access to water, ecosystems, coastal cities, food systems and health. The table illustrates the significant difference of these impacts at 1.5 ºC and 2 ºC.

Table 1: Sustainable development implications of avoided impacts between 1.5 °C and 2 °C global warming

Impacts	*1.5 °C*	*2 °C*	*SDGs More Easily Achieved when Limiting Warming to 1.5 °C*
Water scarcity	4% more people exposed to water stress	8% more people exposed to water stress, with 184–270 million people more exposed	SDG 6 water availability for all
	496 (range 103–1159) million people exposed and vulnerable to water stress	586 (range 115–1347) million people exposed and vulnerable to water stress	
Ecosystems	Around 7% of land area experiences biome shifts	Around 13% (range 8–20%) of land area experiences biome shifts	SDG 15 to protect terrestrial ecosystems and halt biodiversity loss
	70–90% of coral reefs at risk from bleaching	99% of coral reefs at risk from bleaching	
Coastal cities	31–69 million people exposed to coastal flooding	32–79 million exposed to coastal flooding	SDG 11 to make cities and human settlements safe and resilient
	Fewer cities and coasts exposed to sea level rise and extreme events	More people and cities exposed to flooding	
Food systems	Significant declines in crop yields avoided, some yields may increase	Average crop yields decline	SDG 2 to end hunger and achieve food security
	32–36 million people exposed to lower yields	330–396 million people exposed to lower yields	
Health	Lower risk of temperature-related morbidity and smaller mosquito range	Higher risks of temperature-related morbidity and mortality and larger geographic range of mosquitoes	SDG 3 to ensure healthy lives for all
	3546–4508 million people exposed to heat waves	5417–6710 million people exposed to heat waves	

Source: SR1.5 Chapter 5 Table 5.1, which shows that the avoided climate change impacts on sustainable development, eradication of poverty and reducing inequalities would be greater if global warming were limited to 1.5 °C rather than 2 °C.

2. Opportunities

(a) Achieving climate-resilient pathways

244. Debora Ley and Pamela McElwee, IPCC, said that a key opportunity lies in climate-resilient development pathways that can help balance challenges and opportunities. Pathways to 1.5 ºC include ambitious emission reductions and strategies for adaptation that are transformational, as well as complex interactions with sustainable development, poverty eradication and reducing inequalities. The AR5 Working Group II introduced the climate-resilient development pathway concept, which combines climate change mitigation and adaptation to reduce climate change and its impacts, and emphasizes the importance of

addressing structural intersecting inequalities, marginalization and multidimensional poverty. The aim is to transform the development pathways themselves towards greater social and environmental sustainability, equity, resilience and justice. Achieving a climate-resilient development pathway involves implementing not only adaptation, but also transformational adaptation, which encompasses systemic changes that require reconfiguration of social and ecological systems.

245. A Party remarked that some conclusions presented do not take into account the high costs of mitigation, which become an expensive burden on development.

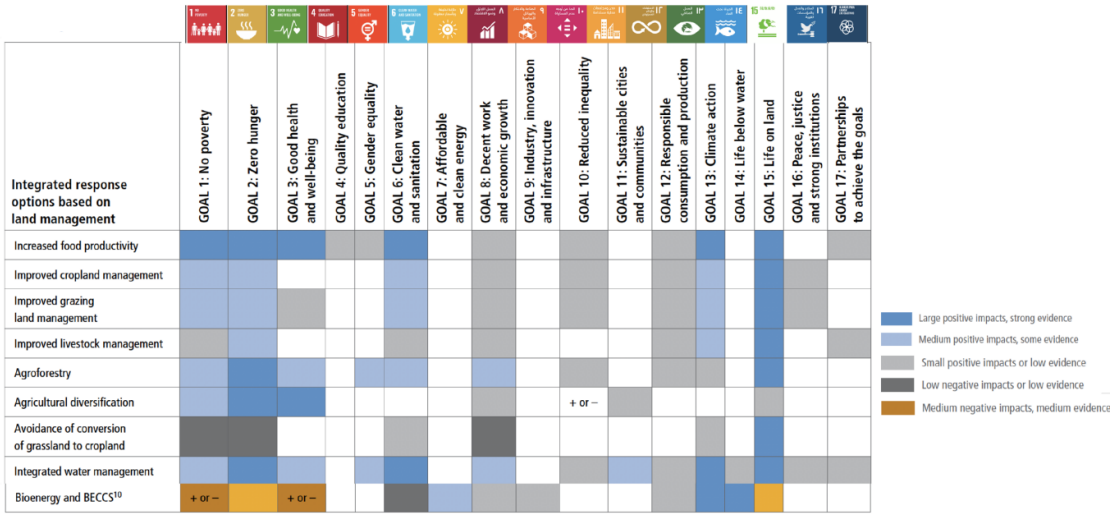
246. Regarding a question on how fast we need to take action on CDR to be in line with sustainable pathways, Katherine Calvin, IPCC, explained that pathways with lower levels of land-based CDR are more sustainable, stressing the importance of scale and degree of implementation. Joeri Rogelj, IPCC, underlined that immediate rapid reduction in fossil fuel-based emissions is a prerequisite to climate-resilient development pathways, although there are variations according to the types of fossil fuels.

247. A Party asked how we can achieve the LTGG in an equitable way, while taking into account common but differentiated responsibilities, national circumstances and sustainable development. Howes said inclusiveness and equity are critical, underlining that energy access is part of the IEA's NZE pathway, which looks at affordability and ensures energy security. He also pointed to the IEA's Global Commission on People-Centred Clean Energy Transitions, which looks at distributional aspects.

(b) Pursuing co-benefits of adaptation and mitigation

248. Debora Ley and Pamela McElwee said another key opportunity relates to the maximizing of co-benefits and the management of trade-offs between mitigation and adaptation options. Since the first periodic review, more knowledge is available on these co-benefits and trade-offs. Figure 34 below summaries these co-benefits and trade-offs for the following integrated response options based on land management that were evaluated by the SRCCL report: increased food productivity, improved management of cropland, grazing land, livestock and water, agroforestry, agricultural diversification, avoidance of conversion of grassland to cropland and bioenergy with BECCS.

Figure 33: Impacts of integrated response options based on land management on the Sustainable Development Goals



Source: SRCCL Chapter 6, Table 6.73

249. Campbell-Lendrum pointed to opportunities in the lead up to COP 26, noting that the United Kingdom has made health a priority and encouraged countries to strengthen their health systems and reduce emissions from the health sector. He underlined that meeting the Paris Agreement targets brings very large health co-benefits. The value of the health co-benefits of climate change mitigation, from air quality alone, is approximately twice as large as the costs. The co-benefits of healthy diets would be five times their costs.

250. A Party sought clarity on the presented health co-benefits, in particular, which impacts are considered in the cost-benefit analysis, and which are not. Another Party asked if the figure reported by WHO that the health benefits of clean air are at minimum twice the costs of climate change mitigation is a conservative estimate.

251. Campbell-Lendrum explained that the figures he reported were a conservative estimate of the health gains specific to air quality. WHO estimates that there are over seven million deaths per year from indoor and outdoor air pollution. Of the deaths caused by outdoor air pollution, two-thirds are from fossil fuels consumption. Any solution to transition to cleaner energy will lead to health gains. He added that as soon as there is cleaner air, lives will start to be saved. Campbell-Lendrum recognized that the figures presented are incomplete since they focus only on air pollution, where the causal chain it relatively clear.

252. A Party asked for more information on key opportunities that can support climate action and maximize synergies, for example, how health systems and healthy lifestyles can contribute to climate change mitigation. Campbell-Lendrum explained that the potential health gains from sustainable food systems are potentially higher than that of clean air, but the causal chain is longer and underpinned by more variability. A 2020 Lancet Countdown report identified large potential gains of healthier diets are about five times as large as those brought by clean air.[22]

(c) Enhancing enabling conditions and support

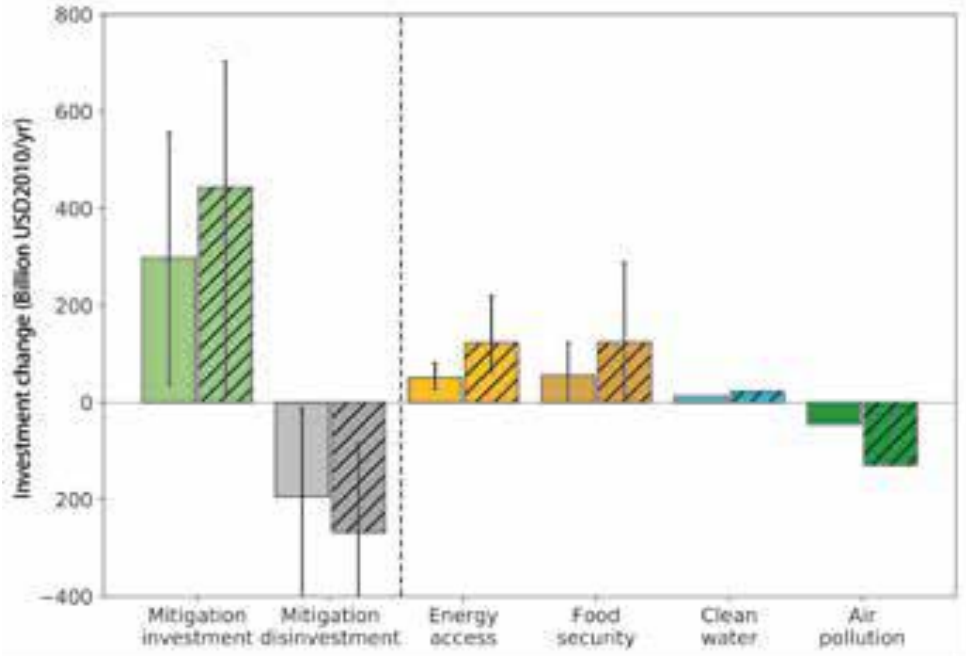
253. Debora Ley and Pamela McElwee said another key opportunity relates to the enabling conditions that can help realize opportunities and overcome challenges, including through attention to feasibility. The enabling conditions that need to be considered are strengthening policy instruments, and enabling multilevel governance, institutional capacities, lifestyle and behavioral change, technological innovation, and climate finance (SR1.5, Chapter 4, FAQs).

254. Finance is one of the enabling conditions. Figure 35 illustrates the investment into mitigation needed up until 2030. The difference in investment between the 1.5 and 2 ºC pathways was identified as a gap in the previous PR1-SED. This gap can be partially closed

[22] The 2020 report of The Lancet Countdown on health and climate change: responding to converging crises https://www.lancetcountdown.org/2020-report.

by looking at the investment needed for different pathways. Overall, there will be a need for a mix of investments and divestments. While the investment needs are around USD 2.38 trillion between 2016–2035 (SR1.5, 4.4.5, Box 4.8), there are also cost savings from adaptation investments. For example, coastal protection can reduce flood risk by 2–3 orders of magnitude and is cost-efficient for densely populated urban areas (SROCC SMP B.9.3). Similarly, land investments in restoration can have a benefit-cost ratio between 3 to 6 (SRCCL SPM D.2.2).

Figure 34: Investment into mitigation up until 2030 and implications for investments for four sustainable development dimensions



Source: IPCC SR1.5, Chapter 5, Figure 5.4. Cross-hatched bars show the median investment in 1.5 °C pathways across results from different models, and solid bars for 2 °C pathways, respectively. Whiskers on bars represent minima and maxima across estimates from the models considered. Mitigation investments show the change in investments across mitigation options compared to the baseline. Negative mitigation investments (grey bars) denote disinvestment (reduced investment needs) into fossil fuel sectors compared to the baseline. Investments for different sustainable development dimensions denote the investment needs for complementary measures in order to avoid trade-offs (negative impacts) of mitigation. Negative sustainable development investments for air pollution indicate cost savings, and thus synergies of mitigation for air pollution control costs. The values compare to about 2 trillion USD 2010 (range of 1.4 to 3 trillion) of total energy-related investments in the 1.5 °C pathways.

255. Campbell-Lendrum said that to protect health from escalating risks, WHO provides guidance and processes for assessing health impacts of climate change, supports health planning and implementation of climate and health interventions, and systematically monitors progress made by countries in protecting health from climate change. He added that countries have made significant progress in developing their health adaptation strategies or plans, but funding is missing and not supported by multilateral climate funds. Most countries do not have enough finance to implement their health climate plans.

256. A Party asked if the IPCC has carried out a cost-effectiveness assessment or feasibility assessment of different CDR options and scenarios compatible with LTGG. Aromar Revi, IPCC, stated that since there is very limited literature on the costs of achieving the LTGG, it was not included in the summary for policy makers of the SR1.5. Pamela McElwee, IPCC, cited OECD estimates indicating that USD 6.9 trillion per year is needed from 2016–2030 for new infrastructure investments to be made compatible to remain below the 2 ºC limit, and that the additional cost for ensuring clean and resilient infrastructure is only 10per cent above BAU needs.

257. A Party asked for examples of savings brought about with early action. Pamela McElwee, IPCC, explained that while avoided damages of early action are difficult to assess, some cost estimates of existing impacts that we can associate with delayed action are available, such as the direct impacts of extreme events, estimated at over USD 200 billion per year in some years (SREX, Chapter 4). Estimates of costs of slower onset events are not

available. She noted that the cost estimates can depend on the specific systems impacted, and that some significant impacts are not accounted for economic estimates, for example, the loss of cultural heritage.

258. A party asked for more information on the role of behavioural changes, including diet-related changes, and potential co-benefits in terms of GHG emissions and land degradation. Orr underlined that behavioural change at the level of the individual is intrinsically linked to policies and financial realities that can encourage or discourage the behaviour change. Policy changes, at least in part, are driven by consumer demand. The bridge between these realities is information. He thus reiterated that information should be made available about the sustainability of all products at each node of each value chain, including at the point of purchase. He added that the application of blockchain technology makes this possible and is already being implemented by some major retailers in some countries.

259. Cooper said behavioural changes will be a key component of transformative changes. The COVID pandemic has illustrated that the behaviours of individuals and governments can change rapidly. He added that there are not only biophysical tipping points, there are also human tipping points. IPBES looked at levers that can help move societies and support these behavioural changes.

260. Aoki cited successful policies that have led to behavioural changes, such as the promotion of public transport and public transit, although she noted the need to scale up. Campbell-Lendrum also pointed to the health benefits of increased cycling and walking in cities during the COVID pandemic, noting that they should be underpinned by the correct policies and information on consumer choices.

(d) Embracing integrated approaches to land, biodiversity and climate

261. David Cooper, CBD, said that actions to conserve biodiversity to manage and restore ecosystems are essential to climate action. Such ecosystem-based approaches could provide one third of the emissions reductions required for reaching the 1.5 ºC target. With appropriate safeguards, these approaches could also provide many ecosystem services, contributing to many of the SDGs.

262. Cooper listed four caveats to the use of such nature-based solutions: the climate change problem cannot be solved without drastic reductions in emissions; they must consider distributional impacts, and involve indigenous peoples and communities; careful assessments of synergies and trade-offs is required; climate change risks degrading the potential contribution of these solutions.

263. Cooper underlined the role of species and genetic diversity in ecosystem-based approaches, including that they enhance productivity and carbon storage by terrestrial ecosystems; animals make substantive contributions to ecosystem carbon sequestration; whales play an important role in supporting phytoplankton production through fertilization and in carbon sequestration; and the conservation and preservation of biodiversity in crops, livestock and trees can make major contributions to climate adaptation strategies.

264. He noted that the development of renewable energy and some adaptation measures can have negative impacts on biodiversity that should be minimized. To ensure that climate change action is biodiversity-friendly, he called for deploying biomass crops only at appropriate scales and with appropriate zoning and safeguards; ensuring hydropower and wind power projects are sited, designed and managed to minimize ecological impacts; promoting recycling of materials to reduce mined metals required for large-scale battery storage and energy transmission.

265. An integrated approach to addressing climate action and protecting biodiversity will allow moving away from a vicious cycle to a virtuous one where nature-based solutions alongside strong actions to reduce GHG emissions contribute to efforts to keeping warming to 1.5 ºC, thereby also ensuring a long-term resilience of ecosystems.

266. On how to build back better, Barron Joseph Orr, called for a positive transformation, a positive change in the fundamental attributes of natural and human systems. Land-degradation neutrality provides the framework for the required balanced approach that anticipates new degradation even as we plan to reverse past degradation, and considers trade-

offs among competing interests across the landscape. According to the definition of LDN adopted by the UNCCD COP, it is a resilience-based framework that is ideal for collaboration with those working towards the goals of the UNFCCC and CBD.

267. Orr explained that LDN seeks to maintain land-based natural capital and the ecosystem services that flow from it, keeping land in balance through a no net loss approach. It is a multiple benefits approach and is synergistic across the multilateral environmental agreements. Underlining that we have solved "the how of conservation, the how of sustainable land management and the how of restoration," he noted we not fully engaged in the planning processes. Integrated land-use planning should be strongly emphasized, stressing that LDN is about doing the right things in the right places at the right scale. In land degradation neutrality, there is a response hierarchy that emphasizes that "prevention is better than cure" – it is easier and less expensive to avoid degradation.

268. Turning to LDN targets, he said that since 2017, 127 countries have set targets, and 70 have put them into legislation. On how LDN and land restoration can boost nature-positive food production, he stressed the need for a systematic approach by countries and that there are multiple restoration pathways for a green recovery.

269. A Party asked if there are systematic frameworks countries can use to ensure climate action takes into account biodiversity and minimize trade-offs. Noting the connection between biodiversity, land, health and climate change, another Party asked how we can ensure our strategies and plans to be integrated to tackle all these challenges; how critical the next ten years are for the most concerning impacts mentioned in the presentations; what tools can guide countries in developing these integrated approaches, and how far we are from adopting guidance for integrated sustainable development.

270. Cooper said the challenges can seem overwhelming, as "we have to do everything at once and it is all urgent." However, he stressed that one of GBO 5's conclusions is that addressing these challenges together is easier than addressing them singly. For example, investing in biodiversity conservation through conservation of protected areas and restoration is only possible if we also invest in agricultural productivity, to make space for those conservation activities. This is also easier if we change consumption patterns that can help reduce demand that lead to land-use changes, and these in turn will also have health benefits. Orr (1:48:30) praised the efforts done by Saudi Arabia to update all its socioeconomic and environmental policies to work in a common way. On the tools available to governments, he referred to the Framework on Ecosystem Restoration Monitoring led by FAO, which provides to people, communities and countries, under one common umbrella, access to methodological guidance and tools to monitor ecosystem restoration, using priority and existing ecosystem restoration-related indicators.

271. Considering the land sector can contribute around 30per cent of the reductions needed but that we need to produce food, a Party asked what actions we can focus on to maximize emissions reductions. Orr explained that they vary regionally. For example, in Africa, the Great Green Wall initiative adopts a mosaic approach, bringing a more harmonized approach to the entire Sahel. In Europe, soil sealing should be addressed in land-use planning. He said the large post-COVID investment in infrastructure is the biggest opportunity in connecting human development to land and biodiversity. He cited the example of Northern Brazil, where the approach to tackle widespread land degradation fundamentally links social, environmental and economic projects. Cooper added that the global prescription to do "the right things at the right time in the right place and at the right scale" is relatively easy, but the difficulty lies in implementation in the local context. We can make use of increasing tools and information we have from science and remote sensing, local and traditional knowledge.

272. Cooper called for more investment in spatial planning, noting it is one of the tools to help "doing things in the right place at the right time." He also underscored the need for analyzing incentive structures, as we are still incentivizing harmful agricultural practices, unhealthy diets the destruction of biodiversity and fossil fuels. Orr) also stressed the need for a greater focus on spatial planning, noting it is specific to local circumstances and it is "where governance becomes operational."

273. Orr underlined that consumption and production are measured in flows, whereas the other elements assessed are on land areas, and we rarely link these two. Pointing to private

sector's investment in blockchain technology for supply chain innovations, he argued that "we can change the game" if consumers have access to that data, thereby systematically linking behavior with information on sustainability.

274. A Party asked what progress has been achieved in developing decision-making frameworks for implementing effective nature-based solutions and what we can learn from this experience for the next decade. Another asked which policy measures would help scale-up nature-based solutions. Another Party asked how much we can rely on nature-based solutions. And another Party sought clarification on the role of biodiversity protection and decisive emission reductions.

275. On the contribution of nature-based solutions, Cooper noted that the actual size of this contribution will depend on many factors, including the local context, but various estimates converge on around one third of the emissions reductions required to achieve the 1.5 ºC.

276. A Party asked about the implications of biofuels on biodiversity. Cooper said they will play a relatively small role in most of the roadmaps, but probably smaller than what was envisaged in AR5, because of the recognition of their impact on biodiversity, food production and GHG emissions from direct and indirect land-use change. Orr stressed there are implications for all the interventions on the landscape.

III. Reflections

277. PR2-SED1 has contributed to bridging science and policy by hearing from a range of experts and deepening our understanding of what it will take to achieve the LTGG and of overall progress towards achieving it. The discussions revealed some substantive and procedural issues that we will take into account when preparing for the next meetings of the SED.

278. Regarding procedural issues, most Parties stressed the need for significant time for discussions and welcomed the opportunity provided by the poster session to dig deeper into some of the issues presented. A majority also called for presentations to focus more narrowly on the themes of the PR2 as per decision 5/CP.25, paragraph 4. In preparing for PR2-SED2 and SED3, we will build on the good practices from SED1, seek to avoid duplication with the Global Stocktake and other processes under the Convention and the Paris Agreement, and take into account the views of Parties expressed in the informal Joint Contact Group.

279. We plan for the second and third meeting of PR2-SED to consider information from regional and sub-regional agencies and the working group contributions to the IPCC's AR6, as they become available. We will publish an information note for SED2 ahead of COP 26.

280. Based on new information available since PR1, and particularly that shared during the PR2, SED1 contributed to **enhancing Parties understanding of**:

(a) The **long-term global goal and scenarios towards achieving it** in the light of the ultimate objective of the Convention:

(i) Temperatures have continued to increase on land and oceans, with many parts of the world already temporarily experiencing local temperature change that is larger than the LTGG temperature limits. Despite the COVID-19-related lockdown, record-high CO_2 concentrations have been observed;

(ii) Climate change is affecting land and ocean ecosystems with consequences on sustainable development;

(iii) The likelihood of temporarily reaching and exceeding1.5 ºC above the pre-industrial level has increased to 40per cent and is increasing with time;

(iv) Global emissions pathways that seek to limit warming to 1.5 ºC with no or limited overshoot foresee roughly halving CO_2 emissions by 2030 compared to 2010 levels and reaching net-zero levels around mid-century with a concurrent strong reduction of non-CO_2 emissions. Pathways that do not hold global warming to 1.5 ºC, entail an insufficient reduction of emissions over the next decade. In scenarios with higher overshoot of 1.5 ºC, net-zero CO_2 emissions are still reached around mid-

century, but such scenarios rely heavily on CDR in the second half of the century to attempt to reverse warming back below 1.5 °C in 2100;

(b) **Progress made in relation to addressing information and knowledge gaps:**

(i) Since PR1-SED, increasing scientific evidence shows that a 2 ºC temperature rise may result in dangerous impacts of climate change, and even a 1.5 ºC temperature rise may result in dangerous impacts but with lower level compared to a 2 ºC temperature rise;

(ii) While various knowledge gaps have been filled since the PR1, gaps remain in relation to uncertainty as to risk transitions and the consequence of the rate of climate change on hazards and related risks; risk tolerance and adaptation limits; effectiveness of adaptation; potential impacts of maladaptation; and quantified savings/avoided losses from timely action; the needs, matching status and result of climate finance support; the needs for and expectation on the readiness and transfer of low/zero carbon and climate resilient technologies; feasibility of rapid large-scale energy transition etc.

(c) **Challenges and opportunities**:

(i) Delaying action to reduce GHG emissions could lead to adverse impacts that take decades to many centuries to reverse, or might be irreversible altogether. Opportunities to cost-effectively address climate change have been decreasing and risks have increased since PR1-SED. The next decade is essential to take concrete actions to keep the LTGG within reach;

(ii) Achieving the LTGG implies taking action on mitigation, adaptation and means of implementation. Developing countries require support from developed countries for both mitigation action and to tackle the present and future impacts of climate change;

(iii) Because every action matters, it is important to take advantage of opportunities to reduce emissions and adapt to climate change now and move quickly, particularly for those options which are time-limited. Managing response options for co-benefits and trade-offs and assessing the impacts of policies and measures can help achieve climate-resilient development pathways, bearing in mind national and local contexts and differences between developed and developing countries.

281. Based on new information available since PR1, and particularly that shared during the PR2, presentations and discussions have also shed light on the **overall aggregated effects of the steps taken by Parties in order to achieve the LTGG**:

(a) The pre-2020 pledges of Parties and their subsequent implementation, in terms of action and support for developing countries, have been insufficient to put the world on track to limiting temperature rise to well below 2 ºC, let alone to 1.5 ºC;

(b) Comparing emissions under current policies with the 2 ºC and 1.5 ºC pathways, there is a gap of 12–15 Gtons for limiting warming to below 2 ºC, and a gap of 29–32 Gtons of CO_2 for limiting warming to 1.5 ºC. Bridging the emissions gap requires that countries increase their NDC ambitions threefold to limit warming to 2 °C and more than fivefold for the 1.5 °C goal. If action is postponed further, it will make it impossible to achieve the LTGG.