Framework Convention on Climate Change

Summary report on the third 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

26 August 2022

Contents

Abbreviations and acronyms

AFOLU	Agriculture, forestry, and other land use
AR5	Fifth Assessment Report of the IPCC
AR6	Sixth Assessment Report of the IPCC
CDR	Carbon dioxide removal
CO_2	Carbon dioxide
COP	Conference of the Parties
GDP	Gross domestic product
GHG	Greenhouse gases
Gt CO_2e	Gigatons of CO_2 equivalent
IPCC	Intergovernmental Panel on Climate Change
LDCs	Least Developed Countries
NDCs	Nationally Determined Contributions
PR2	Second Periodic Review
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SDGs	Sustainable Development Goals
SED2.1	First meeting of the Second Structured Expert Dialogue
SED2.2	Second meeting of the Second Structured Expert Dialogue
SED2.3	Third meeting of the Second Structured Expert Dialogue
SIDS	Small Island Developing States
SPM	Summary for Policymakers
WG I	Working Group I of the IPCC
WG II	Working Group II of the IPCC
WG III	Working Group III of the IPCC

I. Introduction

A. Mandate

1. COP 25 decided that the second periodic review (PR2) of the long-term global goal under the Convention and of overall progress towards achieving it shall start in the second half of 2020 and conclude in 2022, with the structured expert dialogue (SED2) held in conjunction with 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 second periodic review of the long-term global goal under the Convention and of overall progress towards achieving it will not lead to an alteration or redefinition of the long-term global goal stated in decision 10/CP.21, and decided that the review itself 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 long-term global goal 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 long-term global goal and the range of associated impacts, since the completion of the 2013–2015 review;

(iii) Challenges and opportunities for achieving the long-term global goal 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 long-term global goal in the light of the ultimate objective of the Convention.[2]

B. Objective of and general approach to the third meeting of the structured expert dialogue

3. As mandated by COP 25, three meetings of SED2 were to be held to consider a range of sources of information, as they became available, on both themes of the PR2. Parties nominated Tara Shine (Ireland) and Xiang Gao (China) to co-facilitate SED2.

4. Information sources for the PR2 of the long-term global goal under the Convention and of overall progress towards achieving it include the Assessment Reports (AR), special reports, and technical papers of the IPCC; submissions and information from Parties; other relevant reports of United Nations agencies and other international organizations; and information from regional and subregional 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 SED2 co-facilitators followed the precedent of the first periodic review and added processes that had been established after 2015, such as the Facilitative Working Group of the Local Communities and Indigenous Peoples Platform and the Katowice Committee of Experts on the Impacts of the Implementation of Response Measures.

5. The first meeting of SED2 (SED2.1) was held online in two sessions with the first held 26-27 November 2020 during the UN Climate Change Dialogues. The second session was held 3-5 June 2021 in conjunction with the May-June sessions of the subsidiary bodies. The second meeting of SED2 (SED2.2) took place 1-2 November 2021 during the UN Climate Change Conference in Glasgow.

[1] Decision 5/CP.25, para. 7.
[2] Decision 5/CP.25, paras. 4–5.
[3] The first periodic review took place from 2013 to 2015 and is available at https://unfccc.int/topics/science/workstreams/periodic-review#eq-1.
[4] FCCC/SB/2014/INF.3, para. 6.

6. In line with the periodic review modality to consider information as it becomes available, discussions at the third meeting of the SED2 (SED2.3) were primarily informed by the content of the Working Group II (WG II) and Working Group III (WG III) contributions to the IPCC's AR6.

7. Building on the approach adopted at previous SED meetings, SED2.3 was organized to facilitate the exchange of views between experts and Parties. Provisions were made to enable virtual participation for delegates unable to travel to Bonn owing to the COVID-19 pandemic.

8. The presentations and discussions at the meeting were guided by the following questions:

(a) What new knowledge has been gathered regarding the scenarios towards achieving the long-term global goal in the light of the ultimate objective of the Convention?

(b) What progress has been made in relation to addressing information and knowledge gaps, including with regard to scenarios to achieve the long-term global goal and the range of associated impacts, since the completion of the 2013–2015 review?

(c) What challenges and opportunities have been identified for achieving the long-term global goal with a view to ensuring the effective implementation of the Convention?

(d) What assessments have been made on the overall aggregated effect of the steps taken by Parties in order to achieve the long-term global goal in the light of the ultimate objective of the Convention?

C. Summary of proceedings

9. Based on the experiences from SED2.1 and SED2.2, the SBSTA and the SBI invited Parties and observers to submit via the submission portal by 4 March 2022 views on the third meeting of the SED2.[5] The co-facilitators held three informal exchange of view sessions with Parties on 11 February and 16 February 2022 (GMT) to accommodate different time zones and the schedules of delegates attending the IPCC plenary and WG II contribution to AR6 approval plenary. Valuable inputs from Parties on the organization of SED2.3, including on inputs and specific questions to be addressed, were received. These inputs, together with submissions from Parties and organizations, have guided the preparation for SED2.3.

10. The SED2.3 took place on 7 and 8 June 2022, during the United Nations Climate Change Conference in Bonn. The meeting was held in two sessions: session 1 from 4-7pm on 7 June 2022, focusing on adaptation issues with inputs from the WG II contributions to the IPCC's AR6, and session 2 from 4-7pm on 8 June 2022, focusing on mitigation issues with input from WG III. At each session, experts, including lead authors from each working group, presented on key findings. Presentations were followed by a facilitated dialogue with all participants and experts to clarify possible interpretations of the findings presented and their policy implications. All presentations delivered by invited experts at the meeting, as well as video recordings of each session, are available on the SED2.3 web page.[6] Participating experts from WG II included: Gueladio Cisse, Siri Eriksen, Andreas Fischlin, Matthias Garschagen, Elisabeth Anne Gilmore, Debora Ley, Johanna Nalau, Joy Pereira, Hans-Otto Pörtner, Roberto Sanchez Rodriguez, Lisa Schipper and Maarten van Aalst. Participating experts from WG III included: Amjad Abdullah, Heleen de Coninck, Dipak Dasgupta, Navroz Dubash, Michael Grubb, Alaa Al Khourdajie, Shonali Pachauri, Keywan Riahi, Jim Skea, and Raphael Slade. Quotations in this report are taken from these experts' collective contributions to the dialogue.

11. The two sessions consisted of presentations from lead authors from the IPCC AR6 WG II and WG III on findings relevant to both of the two themes of the PR2. Based on the modalities of the periodic review, the co-facilitators strove to ensure a balance in terms of gender of experts invited, as well as the regions of their origin. The co-facilitators made arrangements to ensure a balance of time allocated to each of the two themes of the periodic review. In response to requests

[5] Views are available on the submission platform https://www4.unfccc.int/sites/submissionsstaging/Pages/Home.aspx (in the search field, type in "second periodic review")

[6] See https://unfccc.int/event/third-meeting-of-the-structured-expert-dialogue-of-the-second-periodic-review-0

from Parties following the SED2.1 for more time dedicated to open discussion, two hours (of the total three hours) within each session were allocated for open dialogue among Parties and experts. In addition, lead authors invited to present on Day 1 were also invited to participate in the discussion under Day 2. This ensured a richer exchange and the participation of a wider range of experts on both themes.

12. Structured around the key topics of the PR2, this report provides a summary of the presentations and discussions from the SED2.3. The report does not aim to present an exhaustive assessment of the issues pertinent to the second periodic review, as it documents 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 WG II and WG III contributions to AR6 or the reports from other organizations considered at the meeting.

II. Summary of discussions

13. Discussions at the SED2.3 are summarized below under the two themes of the PR2 of the long-term global goal under the Convention and of overall progress towards achieving it.

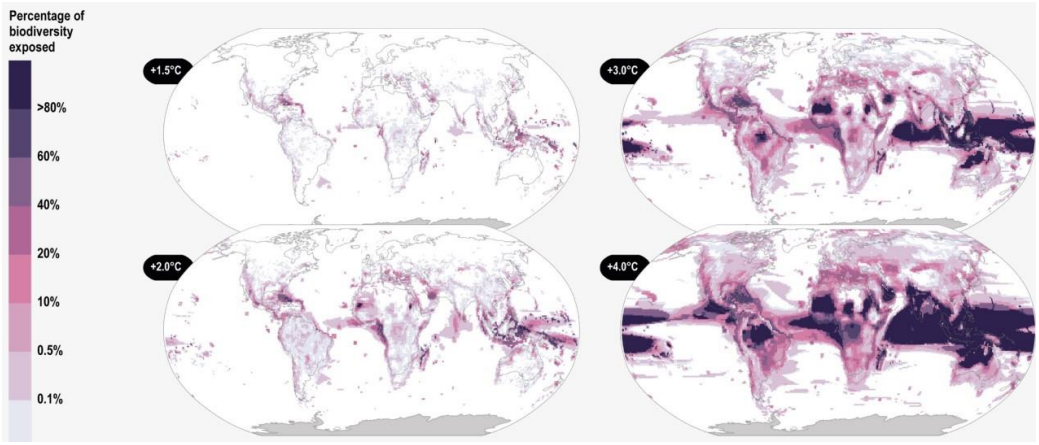
A. Long-term global goal and scenarios towards achieving it

1. Climate change impacts to human and natural systems are already happening and are projected to get worse.

14. The lead authors of IPCC Working Group II (WG II) and Working Group III (WG III) presented key findings from the Working Groups' contributions to AR6, focusing on new information since AR5. Published in 2022, the WG II contribution focuses on impacts, adaptation, and vulnerabilities. Published in 2022, the WG III contribution focuses on climate change mitigation progress and pledges.

15. The WG II contribution reinforces the findings from WG I in concluding that the scientific evidence is unequivocal: climate change is threat to human well-being. Impacts are cascading through natural and human systems, often compounding with the impacts of other human activities. With global warming of 1.5°C, many species will be exposed to potentially dangerous climate conditions, with an increasing fraction of the planet uninhabitable to key species (Figure 1); while with global warming of 2°C more severe impacts will be observed. An increasing proportion of the human population will live in areas exposed to intolerable temperature and humidity combinations, leading to a "respective loss of human habitat."

Figure 1.
Species exposed to potentially dangerous climate conditions under different warming scenarios



Source: IPCC WG II AR6 Report Figure AI.15

16. Future climate risks include: heat stress, as exposure to heat waves continues to increase with additional warming; water scarcity, with regions relying on snowmelt experiencing a 20 per cent decline in water availability for agriculture after 2050 under 2°C warming scenarios; food security, with food insecurity increasing; and flood risk, with approximately one billion people in low-lying cities and on small islands at risk from sea level rise by 2050. Multiple extreme risks have the potential to compound. For example, increasing heat and drought can reduce agricultural yields, the negative effects of which can be exacerbated by heat stress among agricultural workers.

17. Noting that deadly heat waves are becoming more frequent worldwide, a Party asked for further information on the frequency and severity of heat waves under scenarios limiting warming to 1.5°C and scenarios overshooting 1.5°C. The experts said that there is expected to be an increase in the frequency of hot days and hot nights with warming above 1.5°C. They also noted that extreme heat increases inequities because its impacts are unevenly distributed.

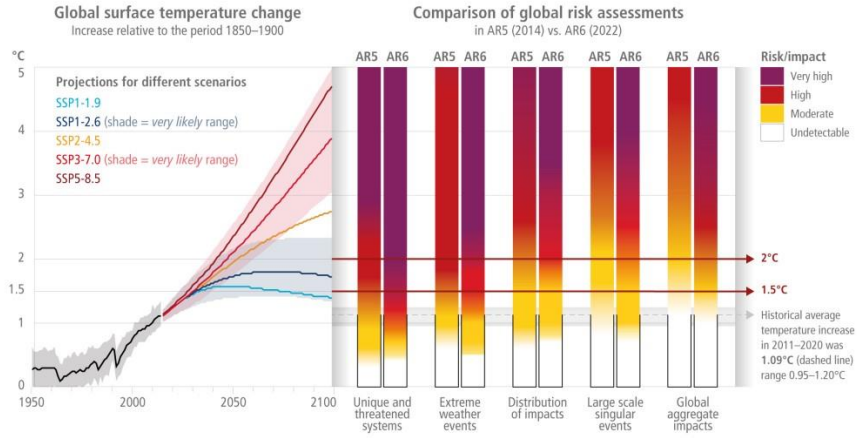
18. A Party enquired how climate impacts could differ by gender. The experts observed that women, especially pregnant women and their newly born children, are among the most vulnerable groups with regard to health outcomes. For example, an increase in extreme events is leading to more frequent outbreaks of waterborne and vector-borne diseases. They also noted that women are important sources of resilience, and that women's empowerment can reduce some of the most "pernicious risks" of climate change.

2. Since AR5, climate risks are appearing faster and are expected to get more severe, sooner.

19. The experts highlighted that one key insight of AR6 is that risks are developing sooner than assessed in AR5. They emphasized that the risk assessment of AR5 was "too conservative." The updated risk assessments in AR6 project that risks will transition from moderate to high at lower temperatures than assumed in AR5.

20. The experts stressed that "every small increase in warming will result in increased risks, escalating above 1.5°C." WG II's analysis in AR6 shows that most sectors (ranging from fisheries to biodiversity, coastal flooding to water quality) transition from moderate risk to high risk at 1.5°C (Figure 2). Other sectors (such as ocean systems) may have already surpassed a tipping point beyond which they cannot return to their previous state. For these sectors, warming beyond 1.5°C would exacerbate the "down slide."

Figure 2
Comparison of Global Risks in AR5 and AR6



Source: IPCC WG II SPM Figure 3and AR5 Assessment Box SPM Figure 1.

21. A group of Parties requested clarification as to how the assessment of risk at 1.5°C and 2°C has changed between the AR5 and AR6 reports. The experts replied that compared with AR5 and

the IPCC 1.5°C report, risks have now increased to high and very high levels at lower levels of global warming for all five major clusters of risks. In short, "all the risks are coming at us faster."

22. Several Parties called attention to the recent report "State of the Cryosphere," which summarizes worsening impacts on the global cryosphere, with corresponding impacts on societies and economies that threaten the survival of entire countries.[7]

3. Effective adaptation can save lives, help reduce risks, and yield multiple benefits.

23. Adaptation can help reduce risks, such as heat-related morbidity and mortality, ozone-related mortality, and diseases carried by mosquitos. But only "very intense adaptation efforts" will suffice and these efforts must be combined with other socioeconomic developments to reduce vulnerabilities and build resilience.

24. WG II uses a framework for systems transitions approach, which enables assessment of the synergies and trade-offs between adaptation and mitigation. The approach evaluates transitions in land, ocean, coastal, and freshwater ecosystems; urban, rural, and infrastructure systems; energy and industrial systems; and society. These transitions make possible the adaptation required for human health and well-being, economic and social resilience, and planetary health.

25. The systems transition approach illustrates that effective adaptation has many co-benefits. For example, for the more than 2.4 billion people living in rural areas, many of whom are vulnerable to climate change, resilience can be improved by providing social safety nets, improved roads, reliable energy, clean water, and improved food security, which also has benefits for poverty reduction, human security, and well-being.

26. A group of Parties asked if demand-side mitigation actions, e.g., reduced consumption, could benefit adaptation. Another group of Parties asked what ambition could mean in the context of demand-side measures. The experts replied that AR6 did not include a full assessment of demand-side effects on adaptation, noting that most adaptation to date remains behavioural and small-scale. To the second question, the experts said that the theoretical potential for emissions reductions from demand-side emissions reductions is in the range of 40-70 per cent by 2050. They said that because ambition is a "policy question," they were not in a position to answer it. Measures depend, however, not only on personal choices but also on how people are enabled to take such measures (e.g. infrastructure can enable people to make different choices about transportation).

27. A Party asked about linkages between adaptation and mitigation that could help in achieving the long-term global goal. The experts replied that the AR6 feasibility assessment shows that many adaptation options have significant synergies with mitigation, especially in forestry, green infrastructure, and energy systems.

4. There are limits to adaptation, especially over 1.5°C warming. The maintenance and recovery of human and natural systems therefore depends on achievement of mitigation targets.

28. The experts said that available evidence of projected climate risks indicates that opportunities for adaptation to many risks will likely become constrained and have reduced effectiveness should there be 1.5°C of warming. This includes overshoot scenarios (multi-decadal periods where global average temperature exceeds 1.5°C and then returns).[8] Some adaptation options are available at higher temperatures, but they are limited and do not address the system transitions needed to underpin effective adaptation.

29. Further, even effective adaptation cannot prevent all losses and damages. Above 1.5°C, some natural solutions (e.g., ecosystem-based adaptation) may no longer work. Lack of freshwater could mean that people living on small islands and those dependent on glaciers and snowmelt can no longer

[7] The state of the Cryosphere report is produced annually by the International Cryosphere Climate Initiative. The 2021 report details how a combination of melting polar ice sheets, vanishing glaciers, and thawing permafrost will have rapid, irreversible, and disastrous effects on the Earth's population. The report can be downloaded from: State of the Cryosphere Report – ICCI – International Cryosphere Climate Initiative (iccinet.org).

[8] Glossary — IPCC

adapt. Above 1.5°C, the feasibility of options for systems transitions will change. Above 2°C, it will be challenging to farm multiple staple crops in many current growing areas.

30. For many locations on earth, the capacity for adaptation has already been significantly limited. Climate change combines with unsustainable use of natural resources, habitat destruction, and growing urbanization and inequality to reduce capacity to adapt.

31. It is therefore essential to make rapid cuts in GHG emissions in order to keep the maximum number of adaptation options open.

32. A group of Parties requested clarification on the differences between nature-based solutions and ecosystem-based adaptation. The experts clarified that both refer to ecosystem services (the functioning of ecosystems to support livelihoods), but nature-based solutions include the mitigation capacity of ecosystems and therefore is more encompassing in its terminology.

33. A Party asked the experts to elaborate on the implications for vulnerability and resilience of overshooting 1.5°C, especially in terms of nature-based solutions. The experts replied that there are limits to ecosystem adaptation and that these limits constrain options for nature-based solutions. For example, there are indications that some natural systems (e.g. oceans) are reaching their capacity to absorb and store CO_2. They emphasized that the risks of irreversible impacts increase with every increment of warming. In overshoot scenarios, the less adverse consequences are to be expected from delayed impacts or risks (such as melt from ice sheets that cover a broad range of altitudes), while impacts will be more severe from immediate or instantaneous events (such as the disappearance of a small glacier that may take centuries to return). There is also the risk of crossing a "tipping point," at which point the climate system may prove unable to return to the temperature originally intended as the limit. Though it is difficult to quantify such effects, the higher and longer the overshoot, the higher the risk of crossing such tipping points. For this reason, WG II is clear that overshoot should be avoided.

34. A Party requested more information on the implications for smallholder farmers of overshooting 1.5°C. Another Party asked about future climate impacts on agriculture and livestock, specifically in African LDCs. The experts replied that vulnerability is higher in locations with high-levels of climate-sensitive livelihoods. Evidence shows that some smallholder farmers have been reaching soft adaptation limits. They emphasized that social safety nets may be an important means to reduce their vulnerability.

5. Halting climate change and global warming requires achieving net-zero CO_2 and GHG emissions. Different pathways are available to achieve net-zero emissions.

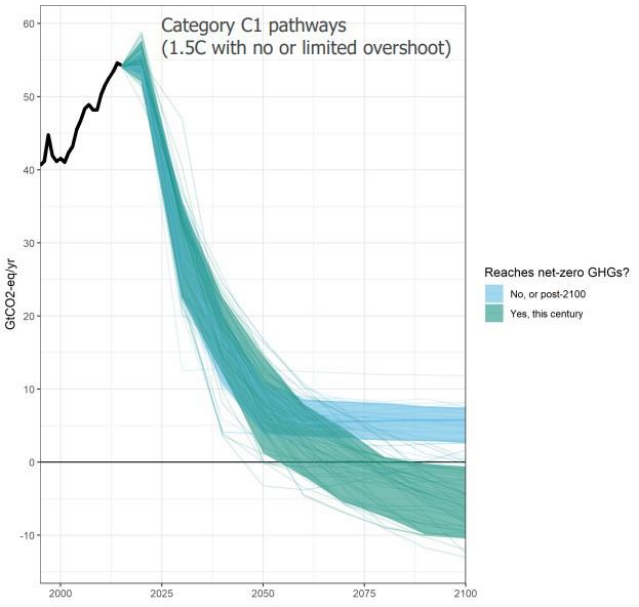
35. The WG III experts presented future emissions pathways that achieve net-zero CO_2 and limit warming to 1.5°C. They noted that achieving net-zero emissions requires the deployment of carbon dioxide removal (CDR) technologies, which could reduce long-term warming.

36. The WG III authors explained that there are three important dynamics to consider in net-zero scenarios: near term emissions reductions, timing of net-zero CO_2, and peak warming levels. The decisive factor in the peak warming level is the cumulative emissions until the time of net-zero CO_2. For this reason, scenarios with the same timing for achieving net-zero CO_2 have very different shapes in terms of how emissions are reduced. The different scenarios can thus also lead to different peaks in warming outcomes. Scenarios that reduce emissions more quickly will have lower peak warming levels for the same net-zero CO_2 timing.

37. The experts described two scenarios (known as Category C1 pathways) that limit warming to 1.5°C with no or limited overshoot (Figure 3). The scenarios differ in whether net-zero GHG is achieved or not. Under scenario C1a, warming is limited to 1.5°C and net-zero GHG is achieved. Under scenario C1b, warming is limited to 1.5°C but net-zero GHG is not achieved. The two scenarios have similar cumulative CO_2 emissions until time of net-zero and broadly the same peak warming level. The speed of emissions reductions is largely the same, with similar emissions declines in 2030, 2040, and 2050. The key difference between the two scenarios is that under C1a, net-zero GHG is achieved about 10-30 years after net-zero CO_2. This scenario relies heavily on net negative CO_2 emissions, allowing draw-down of temperature after peak to lower levels in the long-term.

38. A group of Parties requested information on options to rapidly phaseout fossil fuels and find inclusive pathways for rapid and intense energy transition. The experts replied that the illustrative pathways in AR6 show how different policy choices and emphasis on different components of the mitigation portfolio can lead to distinctly different emissions.

Figure 3
Pathways to reaching net-zero GHGs return warming to lower levels in the long-term



Source(s): WG III SPM C.2.4. Typical emissions pathways that reach and sustain global net-zero GHG emissions based on the 100 -year warming potential are projected to result in a gradual decline in warming. About half of the assessed pathways that limit warming to 1.5°C (>50%) with no or limited overshoot reach net-zero GHG emissions during the second half of the 21st century.

39. A group of Parties asked about the magnitude and scope of mitigation action needed by 2030. The experts said that the pathways indicate different time schedules for replacing fossil fuels. In scenarios consistent with 1.5°C with low or no overshoot, the phaseout of coal is complete by 2050. The use of oil is reduced 60 per cent and the use of gas 45 per cent. They noted that the extent to which fossil fuel use will decline depends strongly on the feasibility of carbon capture and storage.

40. A Party asked about progress in understanding the role of near-term mitigation (up to 2030) for impacts and risks, and the occurrence of loss and damage. The experts replied that though they recognize loss and damage is a critical issue for many countries, there continue to be many data gaps on the topic. They stressed, however, the importance of distinguishing between soft limits (where things can be adjusted) and hard limits (where nothing can be done). One of the hard limits, they noted, is a lack of freshwater in small island states at 1.5°C.

41. A Party asked the experts to elaborate on how Annex I Parties' achievement of net-zero by 2030 would impact efforts to meet the long-term global goal. The experts said that none of the scenarios in AR6 include achievement of net-zero GHG emissions by 2030, as this is "beyond the scope" of the scenarios.

42. A Party asked whether, in the context of the available carbon budget, it is equal for both developed and developing countries to achieve net-zero by 2050?[9] The experts said that a study has

[9] The term 'carbon budget' refers to the maximum amount of cumulative net global anthropogenic CO2 emissions that would result in limiting global warming to a given level with a given probability, taking into account the effect of other anthropogenic climate forcers. This is referred to as the total carbon budget when expressed starting from the pre-industrial period, and as the remaining carbon

compared efforts to achieve net-zero regionally and globally. It found that the cost of achieving net-zero differs widely from country to country. The illustrative pathways show that the potential for carbon removal technologies is also unevenly distributed across countries and regions. For this reason, it will be more difficult and costly for all countries to achieve net-zero than for countries to collectively achieve net-zero. Hence, collaboration on net-zero at a global level is crucial.

43. A Party asked whether AR6 contains information on pathways that have a high chance (greater than 90 per cent) of limiting warming to 2°C. The experts replied that secondary research would be needed to determine pathways with 90 per cent probability.

44. Noting that deployment of renewable energy in many future scenarios does not match historical growth rates of renewable technologies, a group of Parties enquired about assumptions for the transformation of energy systems and phaseout of fossil fuels. The experts emphasized that the scenarios had been through an "extensive vetting process" which excluded scenarios that were too far away from current trends in renewables deployment.

45. A Party enquired about the advantages of making planning decisions now and in the future that are aligned with low-emissions pathways, versus the challenge of having to retrofit infrastructure. The experts said that long-term GDP is higher under pathways that include immediate action compared to scenarios that include only modest mitigation by 2030. They stressed that delaying action locks economies into systems and infrastructure which will need to be replaced quickly in order to stay within the carbon budget.

46. A group of Parties asked if scenarios to limit warming to 1.5°C account for emissions related to thawing permafrost. The experts replied that integrated assessment scenarios do not necessarily cover this type of feedback from climate change. They do, however, use "emulators," which could include permafrost. They noted that the magnitude of this feedback is highly uncertain and remains an active area of research. They also recalled that WG I found that methane emissions from permafrost may be less important than carbon, but that methane may be more relevant for longer timescales beyond this century.

6. There is a rapidly narrowing window of opportunity to enable climate resilient development.

47. The WG II authors emphasized the need for Climate Resilient Development which integrates mitigation, adaptation, and the SDGs. Such an approach aims for a future where climate risks are reduced to moderate levels through adaptation and mitigation efforts, biodiversity is enhanced, and SDGs are achieved (e.g. no poverty, zero hunger, good health and well-being, access to clean water and sanitation).

48. Achieving climate resilient development will require transformative change, "a change in the fundamental attributes in human and natural systems, including deeper changes in underlying values, worldviews, ideologies, structures, and power relations." The experts underscored that this will also require making rights and justice the target of adaptation, acknowledging power relations, embracing knowledge pluralism, fostering bottom-up conditions to strengthen local sources of adaptation, and recognizing risks, trade-offs, and unexpected outcomes. Changes in current governance and practices are needed, as "development ideologies, structures, and power relations" maintain the current system.

49. The magnitude of observed impacts and projected climate risks indicate the scale of decision-making, funding, and investment needed over the next decade to achieve climate resilient development. The challenge is already significant at current global warming levels. The prospects of achieving climate resilient development will become further limited if warming exceeds 1.5°C and may not be possible at 2°C. Worldwide action is thus more urgent than previously assessed. Any further delay in action will miss a brief and rapidly closing window to secure a livable future.

budget when expressed from a recent specified date. Historical cumulative CO2 emissions determine to a large degree warming to date, while future emissions cause future additional warming. The remaining carbon budget indicates how much CO2 could still be emitted while keeping warming below a specific temperature level (Source: footnote 43 of the SPM, WG I contribution to AR6: www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf)

50. A Party asked how national and regional planning can aid in achieving climate resilient development. The experts said that planning can support four key ways. First, by avoiding unintegrated approaches. Second, by undertaking new forms of planning that involve the private sector, civil society, and government actors, as well as groups that are often marginalized in decision-making (such as youth, women, indigenous peoples, and persons with disabilities). Third, by adopting integrated and inclusive systems-oriented solutions, specifically to support systems transitions. Finally, by developing more equitable partnerships.

51. A group of Parties asked about the parallels between the concepts of low GHG emissions pathways and climate resilient development pathways. The experts explained that WG III relies on an analogue concept to climate resilient development of "shifting development pathways towards sustainability," hence its focus on emissions pathways. WG II relies on climate resilient development as a concept because it encompasses adaptation and mitigation, as well as "other aspects that are supporting societal development." Though they are slightly different approaches, both concepts "encapsulate the same move towards systemic changes and transformations in order to reach adaptation, mitigation, and sustainable development."

52. Several Parties raised concerns about the lack of consideration of equity between nations in the WG II and WG III contributions to AR6. The experts replied that rights and justice are a part of the objective of adaptation, which also acknowledges power relations, the need to embrace knowledge pluralism, and the need to foster bottom-up coalitions to strengthen local sources of adaptation. They noted that the concept of "transboundary equity" is included in AR6.

7. Progress has been made in filling information and knowledge gaps since AR5, but important knowledge gaps remain.

53. WG III authors highlighted that the drivers and constraints of a low-carbon transition are better understood. The breadth and extent of the systemic change required to limit warming is clear, as is the need for transformational change across all sectors. Case studies have yielded insights into the successful deployment and transfer of technology across all sectors. Low-carbon electrification has emerged as highly feasible for transportation, industry, and buildings. Likewise, the effectiveness of low-carbon industrial processes has been widely demonstrated. Overall, there is an improved understanding of the key characteristics of scenarios that limit warming to 1.5°C and 2°C, as well as of the linkages and trade-offs between mitigation and adaptation.

54. The importance of social sciences and sustainable development are increasingly recognized. The key advances in AR6 include recognition of: how behavioral change motivates and contributes to mitigation; the role of justice, equity, and fairness in shifting development pathways towards sustainability and building consensus for transformational change; the importance of understanding local and regional context; and the lack of universal solutions that fit all locations, countries, and regions at the same time.

55. Important knowledge gaps include: the drivers for inequality of historical cumulative emissions; the feasibility of scenarios that embody prompt, ambitious mitigation action and the plausibility of CDR; how the global benefits of mitigation may change with warming levels, including economic repercussions; social and environmental limits on the pace and extent of change; how to motivate and enable diverse actors to take transformative steps; and the opportunities, limitations, and reversibility of ecosystem-based mitigation and adaptation.

56. Improved data and methodological advances could help to tackle many of these knowledge gaps. Low-income countries remain poorly represented in literature on mitigation and in studies on innovation and technology development and transfer. Overall, the accounting and transparency frameworks for GHG emissions and climate finance still need improvement. Data quality, frequency, and resolution of GHG estimates need to be improved, along with understandings of the causal mechanisms between individual, social, and structural drivers of change. Uncertainty in contemporary emissions and sinks within agriculture, forestry, and other land use (AFOLU) is still high, including inventories, accounting systems, and emissions factors. Finally, methodological challenges in understanding the effectiveness of international agreements and institutions remain.

57. A group of Parties requested clarification about whether research gaps outlined in AR6 include gaps in capacity building and technology transfer. The experts replied that AR6 highlights systematic gaps in the literature, noting that only 1 per cent of global research dollars go to African

institutions. They also noted that areas with the highest vulnerability are also those with the largest gaps in information and that international cooperation is important to extending knowledge. They stressed the need for new types of knowledge and new knowledge processes to support climate resilient development, particularly to support linkages between adaptation, development, and social justice.

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

1. Mitigation action

(a) Progress on mitigation to date is insufficient but not negligible.

58. The WG III authors said that in AR6 the IPCC offers for the first time an estimated range of the impact of mitigation policies on emissions. Multiple lines of evidence suggest that mitigation policies have led to avoided global emissions of several gigatons of CO_2 equivalent (hereinafter referred to as Gt CO_2e), at least 1.8 Gt CO_2e annually. Policies have enhanced energy efficiency, reduced rates of deforestation, and accelerated technology development.

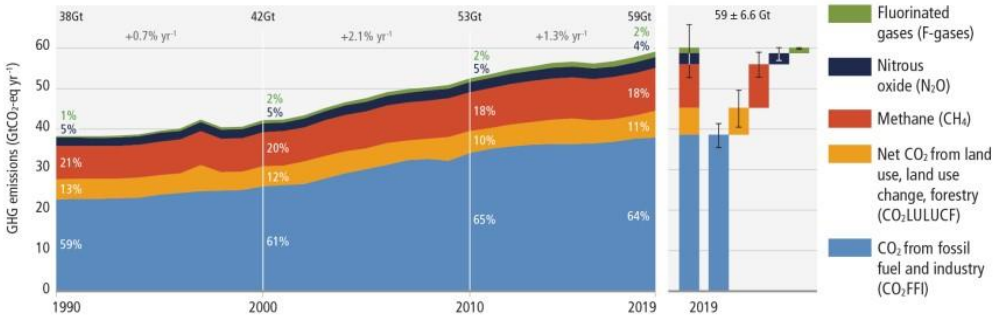
59. The experts underscored that large-scale transitions take time and require an evolving mix of policies. They stressed that "we are at an early phase in a dynamic process," in which initial efforts to help foster technologies will feed back into progress in markets. Market instruments will in turn lead to more extensive diffusion.

60. They noted that most progress to date is in the electricity sector and associated clean and efficient technologies. Electricity systems in some countries and regions are already predominantly powered by renewable energy. One of the key elements of change is the adoption of photovoltaics, onshore wind, and electric vehicles, which have grown exponentially over the last decade. Renewable energy now represents approximately 9 per cent of global electricity supplies.

(b) Global net anthropogenic GHG emissions continue to rise but annual growth has slowed.

61. From 2010-2019, average annual GHG emissions were at the highest levels in human history for each of the major groups of greenhouse gases (Figure 4). In 2019, emissions were 12 per cent higher than in 2010 and 54 per cent higher than in 1990. CO_2 emissions from net land use change and forestry have shown little long-term change, but with large uncertainties. Emissions growth slowed, however, from 2.1 per cent annually from 2000-2009, to 1.3 per cent annually from 2010-2019.

Figure 4
Global net anthropogenic GHG emissions 1990-2019



Source: IPCC AR6 WG III SPM.1.

62. Some regions are net exporters of emissions (they produce more emissions than they consume) and others are net importers (they consume more than they produce). Sources of emissions vary by region, with emissions from some regions dominated by fossil fuel and industry (e.g., North America, Europe, and East Asia) and emissions from other regions dominated by land use, land use

change, and forestry (e.g. Latin America and Caribbean, South East Asia and Pacific, and Africa). Historical emissions per capita also vary widely: they are highest in North America and lowest in Southern Asia. Other emissions metrics also vary across regions (such as emissions intensity, production-based emissions per capita, and consumption-based emissions per capita).

63. Historical contributions to cumulative net anthropogenic CO_2 emissions between 1850-2019 vary substantially across regions in terms of total magnitude, as well as in terms of CO_2 from fossil fuel industry (1650 +/- 73 Gt CO_2 eq.) and CO_2 from land use, land use change, and forestry (760 +/- 220 Gt CO_2 eq.). Between 1850 and 2019, developed countries contributed 57 per cent to cumulative CO_2 emissions from fossil fuel industry, followed by Asia and the Pacific (21 per cent), Eastern Europe and West-Central Asia (9 per cent), Latin America and the Caribbean (4 per cent), the Middle East (3 per cent), and Africa (3 per cent). Developed countries still have the highest share of historic cumulative emissions (45 per cent) when CO_2 from land use, land use change, and forestry are included. LDCs have contributed 0.4 per cent of emissions historically.

64. Only 24 countries have sustained emissions reductions to date. The scale of absolute reductions for these countries is small compared to overall global emissions growth. Six Western and Northern European countries began reducing emissions in the 1970s. Six former Eastern Bloc countries have consistently reduced emissions since the 1990s. Twelve other countries have seen reductions since the mid-2000s. A few countries have sustained CO_2 reduction rates of 4 per cent per year, which is consistent with the reduction rate needed to reach the 1.5°C target. These reductions have resulted from fuel shifts, and policy and economic changes.

65. A Party asked about the divergence in consumption-based emissions and production-based emissions, and the implications thereof for analysis of lifestyle consumption patterns and sustainable development. Noting that literature in this area has improved since AR5, the experts said the aggregate transfer of emissions from developing to developed countries has declined over the past fifteen years, due largely to greater production efficiency in the developing world. They observed that consumption-based emissions can also be analysed at sub-national scales, for example at the city-level and individual-level. They noted that some individual consumers have a "wholly disproportionate" carbon footprint.

66. Noting that WG III uses a different approach to grouping countries than WG I and WG II, a group of Parties asked the experts to explain the reasoning for using different categories. The experts explained that WG I and WG II are concerned with climatic systems and impacts and therefore use physical geography as the basis for classifying countries. WG III uses more political-economic geography to classify countries.

(c) There is a considerable gap between current pledges for emissions reductions and the reductions needed for optimal pathways that limit warming to 1.5°C and 2°C.

67. Current policies (implemented by the end of 2020) lead to an estimated 3.2°C of warming. Current GHG emissions pledges (i.e. NDCs submitted before COP 26) involve high temperature overshoot (an estimated 2.8°C of warming) and require rapid emissions reductions after 2030, as well as large negative emissions, to bring warming back below 1.5°C by 2100.

68. Limiting warming to 2°C would require reducing GHG emissions by about one-fifth by 2030 and reaching net-zero emissions by the early 2070s. Limiting warming to 1.5°C would require reducing GHG emissions by about half by 2030 and reaching net-zero emissions around 2050.

(d) There has been a steep rise in implementation of climate laws and institutions that enable mitigation action, but adoption lags in many countries.

69. Since AR5, governments have enacted more "direct" climate laws that cover more emissions. Laws in 56 countries covered 53 per cent of emissions in 2020, as compared to 20 per cent in 2010. "Indirect" climate strategies and policies have also proliferated, from 340 in 2010 to 690 in 2020. Taken together, these direct and indirect laws comprise an emerging "legal super-structure" for governing emissions. Adoption lags, however, in most developing countries, particularly LDCs, due in part to weaker enabling conditions.

70. National climate institutions (such as Climate Change Committees and Just Transition Committees) have spread and are helping to address challenges of coordination, strategy setting, and

consensus-building. Subnational entities have jurisdiction over key areas of climate action and are a source of experimentation.

71. Governments are implementing an increasing range of policies across sectors and instruments. Regulatory instruments have proven effective at the sector level. Over 20 per cent of global emissions are covered by carbon taxes or trading that incentivize low-cost reductions, though coverage and prices remain insufficient. Coverage remains limited for emissions from agriculture and production of industrial materials and feedstocks.

72. Policy packages tailored to national context and technological characteristics have been effective in supporting low-emission innovation and technology diffusion. Policy packages may prove more effective than single-instruments, particularly for enabling systems transitions, distributional outcomes, and shifts in development pathways.

73. A Party asked the experts to explain how, if the number of laws and policies governing emissions has increased, emissions continue to rise. The experts replied that emissions are lower than they otherwise would have been, had the policies not been in place.

74. A Party enquired about the role of technology transfer in enabling mitigation and how it is addressed in AR6. The experts said that AR6 addresses technology transfer, including in the SPM. They highlighted that the implementation of low-carbon technologies is lower in developing countries due to lower capabilities and the absence of technology transfer.

2. Progress in Adaptation

(a) Adaptation action has increased, but progress is uneven and not fast enough.

75. The WG II authors said that most adaptation action remains behavioral and small-scale. They noted growing public and political awareness of the need to adapt.

76. The experts also noted increased evidence of maladaptation (adaptation that results in unintended consequences) since AR5.[10] Much of this maladaptation is due to incremental and short-term thinking. It can be avoided through flexible, multi-sectoral, inclusive, and long-term planning processes. The experts also observed that the most disadvantaged groups are most impacted by maladaptation.

77. The experts also underscored the need to build capacity and increase access to finance, particularly for the most vulnerable countries. They noted that global financial flows are insufficient for near-term adaptation needs.

78. A Party enquired about the ability to measure progress towards adaptation, specifically whether quantitative vulnerability indices are suitable and sufficient for measuring progress. The experts replied that composite indicators are important for tracking progress but have significant flaws. The first flaw is that available data draws heavily on existing datasets, such as the SDGs and the Sendai Framework for Disaster Risk Reduction, which skews them towards human rather than natural systems. The second is that their reliance on aggregate information limits their utility at local levels. The third is that these indicators do not shed light on processes of adaptation, for example participation and empowerment. Finally, the indicators make it difficult to attribute outcomes specifically to adaptation. The experts concluded that because of these limitations, quantitative indicators should be complemented by qualitative information.

79. A Party asked how maladaptation can be avoided and for "good-practice" examples of effective long-term adaptation responses. The experts replied that it is difficult to assess and address maladaptation in real time. They emphasized, however, that adaptation planning should understand the "vulnerability" context, noting that the most vulnerable are often marginalized from decision-making processes. They recommended avoiding unintegrated approaches, which separate adaptation from other development activities, as well as mitigation. Among good-practice examples, they highlighted the operational framework for health system strengthening.

80. A group of Parties asked the experts to elaborate on short- and mid-term actions that could result in "lock-in" and how to prevent such lock-in. The experts said AR6 finds that some current

[10] Glossary — IPCC

actions and planned short-term actions have the potential to increase exposure and vulnerability. For example, some coastal urbanization and coastal infrastructure development is at high-risk in both high- and low-emissions pathways due to expected sea level rise and other hazards. In terms of how to prevent such lock-in, AR6 makes clear that adaptation planning requires a long-term view, which follows the precautionary principle and considers the lead times needed to implement adaptation action.

3. Progress in International Cooperation

(a) International cooperation is having positive and measurable results but can be strengthened.

81. The WG II authors said that the global mitigation challenge is framed both as a global commons problem and one of accelerating socio-technical transitions and shifting development pathways. International cooperation is aimed at both objectives.

82. The Kyoto Protocol led to measurable and substantial avoided emissions, including in 20 countries with Kyoto first commitment period targets. The Paris Agreement marks a shift to facilitating national-level mitigation towards a shared goal, but "the jury is out on whether it will succeed."

83. They highlighted ways that international cooperation can be strengthened, including through support for NDCs; more ambitious goals for bunker fuels; ensuring that trade, energy, and investment agreements do not hinder mitigation; and enhancing cooperation on solar radiation management and CDR.

84. A group of Parties sought to clarify the importance of decreasing emissions from bunker fuels. The experts clarified that bunker fuels are a sector where measures have increased fuel efficiency, but technological change that drastically reduces emissions is still lacking.

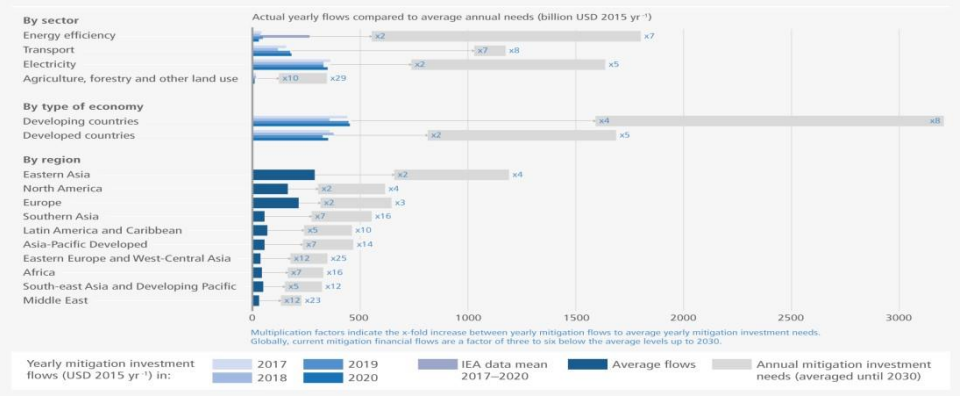
85. A group of Parties asked about the plausibility of extensive carbon removal, specifically whether current understandings of plausibility rely on existing methods of removal or anticipate the development of new methods. Parties also asked the experts to elaborate on the core benefits of carbon removal. The experts replied that the benefits depend on the method. Some methods (such as enhancing soil organic carbon storage or restoration of degraded ecosystems) have clear co-benefits (improved soil function and increased resilience). Other methods (such as monoculture reforestation) can have detrimental impacts (for example, leading to biodiversity loss).

4. Progress in Climate Finance

(a) Climate finance is falling short of commitments. Progress is insufficient to enable a low-carbon transition and climate resilient development.

86. AR6 shows that tracked financial flows fall short of the levels needed to achieve mitigation goals. To meet these goals, annual flows would need to be 3-6 times larger for the 2020-2030 period (Figure 5).

Figure 5
Tracked financial flows fall short of levels needed to achieve mitigation goals



Source: Slide 17 of WG III Part 2.

87. Finance flows have increased significantly since AR5. Public and private sources of finance combined to reach USD 685 billion in 2018, compared to USD 359 billion in 2012. The increased flows are uneven, however, across regions and sectors. Finance also stagnated between 2018-2021.

88. There is a significant gap between the investments required to achieve the low-carbon transition and current finance flows. AR6 found the gap to be in the range of USD 3-5 trillion annually, compared to USD 1.2 trillion in AR5. The gap is largest in developing countries. The gap is also significant in financing adaptation.

89. The experts highlighted a number of barriers to increasing climate finance flows. Among these are: crises and "macroeconomic headwinds," including the COVID-19 pandemic, debt, and climate effects; "very weak" progress towards the USD 100 billion goal to developing countries; "weak" progress in aligning the overall financial system with the Paris Agreement; continuing high fossil fuel investments, which exceed low-carbon investments; high costs of financing in developing countries; and weak flows to low-income and vulnerable countries.

90. A number of Parties asked about gaps in adaptation finance and sought recommendations on how to close them. The experts replied that the WG II contribution recognizes financial constraints as one of the limits to adaptation in many parts of the world, especially the most vulnerable parts. The report also recognizes that the effects of climate change are increasing financial constraints, mainly through the effects on economic performance.

91. A group of Parties asked the experts to elaborate on challenges and opportunities with regard to financial flows to achieve the long-term global goal, particularly for SIDS and the most vulnerable. The experts highlighted the need to invest in climate resilient infrastructure and replace fossil fuels with cost-effective renewables in SIDS.

92. A group of Parties asked about knowledge gaps in robust tracking of mitigation investment in LDCs. The experts replied that there continues to be a large gap in knowledge on tracking climate finance flows to where the deficits are largest, but AR6 does not make specific recommendations on how to improve tracking in developing countries.

(b) Immediate and actionable options are available to increase climate finance.

93. The experts stressed that accelerated financial support from developed to developing countries is a critical enabler of a low-emission and just transition. To accelerate support, countries need to address high costs, terms, and conditions of finance, as well as vulnerability to climate change.

94. They underscored that scaled-up public grants for mitigation and adaptation in vulnerable countries, especially in Sub-Saharan Africa, can be both cost-effective and have high social returns in access to basic energy and related SDGs.

95. Among other actionable steps, they highlighted: increased levels of public and publicly mobilized finance to meet the USD 100 billion goal; using public guarantees to reduce risks, lower budgetary costs, and leverage private flows at lower cost; supporting local capital markets development; building trust in international cooperation processes; and coordinated post-pandemic recovery.

96. A Party asked the experts to elaborate on the role of private sector finance and to provide examples of how these financial flows are contributing towards achievement of the long-term global goal. An observer constituency asked for an explanation of the failure to mobilize a large volume of private finance. The experts replied that private finance has proven particularly critical in developing and deploying renewable energy technology, with initial government support giving the private sector confidence to invest. Similarly, private finance is beginning to play a similar role in the transport sector, contributing to de-risking and public signaling. They also noted, however, that private finance has stagnated since 2018.

(c) Progress in aligning the financial system with the Paris Agreement is also insufficient.

97. AR6 finds that finance flows for fossil fuels are still greater than those for climate adaptation and mitigation. Green bonds, environmental and social governance strategies, and sustainable finance products have expanded since AR5, but finance flows remain below needs in all sectors and regions. Overall, there is a need to restructure the financial system, set incentives, and improve transparency.

98. The financial system has sufficient global capital and liquidity to close investment gaps, but deep barriers impede the redirection of capital to climate actions both within and outside of the global financial sector.

99. Aligning the financial system with the Paris Agreement will require more than "climate risk disclosure." It also requires clear signalling by governments, especially central banks and financial regulators who have thus far remained "on the side-lines." A stronger alignment of public finance and policy is essential to reduce risk and uncertainty for investors. Policy signalling can create incentives to reallocate capital towards climate-aligned investment decision-makers.

100. Early-stage risk reduction in capital markets is critical. The experts noted the highest risks of climate finance and climate investment are in initial stages. Grants and technology support can de-risk early project preparation; concessional finance, grants, and guarantees can de-risk the second stage; institutional investors can enter at the final stage, when there is a "sound project pipeline" and mature financing.

101. The experts emphasized that a "disorderly financial transition" risks stranding assets. Avoiding such a transition requires strengthening the role of multilateral and national climate funds, lowering financial costs for underserved groups, and enhancing international cooperation.

III. Reflections

102. The SED2.3 has contributed to bridging science and policy through extensive exchange of information, views, and insights among Parties and IPCC experts. It has helped to deepen understanding of current impacts on the Earth's natural and human systems, progress in mitigation and adaptation, and pathways to limit warming to the temperature goal of the Paris Agreement and enable climate resilient development.

103. Regarding procedural issues, Parties expressed appreciation for the in-depth knowledge and expertise of the WG II and WG III teams who provided comprehensive updates on their contributions to AR6 and responded to numerous comments, questions, and queries from Parties and observers.

104. The SED2.3 contributed substantively to enhancing Parties' understanding of the long-term global goal and scenarios towards achieving it in the light of the ultimate objective of the Convention by highlighting the following:

(a) Climate change impacts are already happening and are projected to get worse. These impacts are cascading through human and natural systems, often compounding with the impacts of

other human activities. At 1.5°C, humans and other species in some regions will be exposed to intolerable conditions, with a potential "loss of human habitat."

(b) A key insight of AR6 is that every small increase in warming will result in increased risks. Most sectors transition from moderate to high risk at 1.5°C, though some (such as oceans) may have already passed "tipping points" from which they cannot return to the previous state. Available evidence of projected climate risks indicates that opportunities for adaptation to many risks will likely become constrained and have reduced effectiveness when warming exceeds 1.5°C.

(c) Limiting warming to 2°C would require reducing GHG emissions by about one-fifth by 2030 and reaching net-zero emissions by the early 2070s. Limiting warming to 1.5°C would require reducing GHG emissions by about half by 2030 and reaching net-zero emissions around 2050.

105. Presentations and discussions during the SED2.3 also shed light on the overall aggregated effects of the steps taken by Parties in order to achieve the long-term global goal:

(a) Progress on mitigation to date is insufficient but not negligible. Multiple lines of evidence suggest that mitigation policies have led to avoided global emissions at least 1.8 Gt CO_2e annually. Global GHG emissions continue to rise, though annual growth in emissions has slowed. From 2010-2019, average annual GHG emissions were at the highest levels in human history for each of the major groups of greenhouse gases. In 2019, emissions were 12 per cent higher than in 2010 and 54 per cent higher than in 1990.

(b) Adaptation action had increased, but progress is uneven and not fast enough. Most adaptation action remains behavioral and small-scale. Current financial flows are insufficient to meet near-term adaptation needs.

(c) International cooperation is having positive and measurable results. The Paris Agreement marked a shift to facilitating national-level mitigation towards a shared goal, but "the jury is out on whether it will succeed."

(d) Climate finance is falling short of commitments. Progress is insufficient to enable a low-carbon transition and climate resilient development. AR6 shows finance flows have increased significantly since AR5, but continue to fall short of the levels needed to achieve mitigation goals. Annual financial flows would need to be 3-6 times larger for the 2020-2030 period to meet these goals. Finance has stagnated between 2018-2021. Finance flows for fossil fuels remain greater than those for climate adaptation and mitigation.

106. Experts and Parties also discussed progress made in relation to addressing information and knowledge gaps, including with regard to scenarios to achieve the long-term global goal and a range of associated impacts:

(a) The drivers and constraints of a low-carbon transition are better understood. The breadth and extent of the systemic change required to limit warming is clear, as is the need for transformational change across all sectors.

(b) There is an improved understanding of the key characteristics of scenarios that limit warming to 1.5°C and 2°C, as well as the linkages between adaptation and mitigation.

(c) The importance of social sciences and sustainable development are increasingly recognized. Key advances in AR6 include recognition of: how behavioral change motivates and contributes to mitigation; the role of justice, equity, and fairness in shifting development pathways towards sustainability and building consensus for transformational change; the importance of understanding local and regional context; and the lack of universal solutions that fit all locations, countries, and regions at the same time.

107. The dialogue between Parties and experts at the SED2.3 highlighted a range of challenges and opportunities related to both themes of the PR2 of the long-term global goal under the Convention and of overall progress towards achieving it:

(a) There is a considerable gap between current pledges for emissions reductions and the reductions needed for optimal pathways that limit warming to 1.5°C and 2°C. Current policies (implemented by the end of 2020) lead to an estimated 3.2°C of warming. Current GHG emissions pledges (i.e., NDCs submitted before COP 26) involve high temperature overshoot (an estimated

2.8°C of warming) and require rapid emissions reductions after 2030, as well as large negative emissions, to bring warming back below 1.5°C by 2100.

(b) Pathways to reach net-zero CO_2 and GHG emissions and limit warming to 1.5°C remain available. Achieving net-zero emissions requires the deployment of CDR technologies, which could allow draw-down of temperature after peak warming to lower levels in the long-term. The feasibility of CDR is not well understood. The illustrative pathways in AR6 demonstrate how different policy choices can lead to distinctly different emissions.

(c) There is a rapidly narrowing window of opportunity to enable climate resilient development, which integrates mitigation, adaptation, and sustainable development goals. The prospects for achieving climate resilient development will be limited at 1.5°C and may not be possible at 2°C. Making rapid cuts in emissions helps to keep the maximum number of adaptation options open.

(d) AR6 found increased evidence of maladaptation (adaptation that results in unintended consequences), disproportionately impacting the most disadvantaged groups. To minimize the risk of maladaptation, planning should understand the "vulnerability" context and avoid unintegrated approaches that separate adaptation from other development activities, as well as mitigation.

(e) International cooperation can be strengthened to help achieve the long-term global goal, including through: support for NDCs; more ambitious goals for bunker fuels; ensuring that trade, energy, and investment agreements do not hinder mitigation; and enhancing cooperation on solar radiation management and CDR.

(f) Immediate options are available to increase climate finance and align the financial system with the Paris Agreement. Accelerating financial support from developed to developing countries requires addressing high costs of finance but can be cost-effective in yielding social returns beyond climate resilience. There is sufficient global capital and liquidity to close investment gaps, but this requires restructuring the financial system, setting incentives, and improving transparency.

108. While there have been notable advances in information and knowledge as highlighted in the WG II and WG III reports and by experts at the SED2.3, knowledge gaps remain. They include, among others:

(a) The feasibility of scenarios that embody prompt, ambitious mitigation action and the plausibility of CDR.

(b) Low-income countries remain poorly represented in literature on mitigation and in studies on innovation and technology development and transfer.

(c) The GHG and climate finance transparency and accounting framework requires improvement, including in data quality, frequency, and resolution of GHG estimates. Uncertainty in contemporary emissions and sinks within AFOLU is still high, including inventories, accounting systems, and emissions factors.

(d) Methodological challenges in understanding the effectiveness of international agreements and institutions remain.