Summary report on the second meeting of the structured expert dialogue Warsaw, Poland, 12 and 13 November 2013

Note by the co-facilitators

28 March 2014

I. Introduction

A. Mandate

1. The Conference of the Parties (COP), at COP 18, decided that the structured expert dialogue (SED) should consider on an ongoing basis, throughout the 2013–2015 review, the material from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) as it becomes available, through regular scientific workshops and expert meetings and with the participation of Parties and experts, particularly from the IPCC.[1]

2. The COP, at the same session, also decided that workshops will be open to all Parties and observers, held pre-sessionally, where possible, and organized by the secretariat.[2]

3. In response to these mandates, we sent a message to Parties, on 26 September 2013, indicating our intention to convene the second meeting of the SED (SED 2) to consider the contribution of Working Group I to the Fifth Assessment Report, *Climate Change 2013: The Physical Science* (AR5 WGI), and other information in conjunction with the thirty-ninth sessions of the subsidiary bodies, in Warsaw, Poland; the broad proposed approach to the meeting; and our intention to provide them with an information note outlining that approach.[3] In addition, we invited views on the further work of the SED. The secretariat received four submissions of views from Parties, which we took into account when preparing our approach for SED 2.

B. General objective and approach for the meeting

4. The objectives and goals of SED 2 were to discuss the latest findings, mostly on the basis of AR5 WGI, as they provide a foundation to assess the adequacy of the long-term global goal; to assess the overall progress made so far towards achieving the long-term global goal, as well as the projected progress, including the likelihood of limiting global warming below 2 °C; and to share lessons learned on the effectiveness of the support provided.

5. Accordingly, we organized SED 2 as a fact-finding exchange of views between experts and Parties. IPCC experts presented findings from AR5 WGI and their relevance to both themes of the 2013–2015 review. Representatives of Technology Executive Committee (TEC), Standing Committee on Finance (SCF) and the Global Environment Facility (GEF) presented lessons learned from providing support in technology, finance and capacity-building. A moderated discussion followed addressing guiding questions and questions from all participants.

II. Summary of the proceedings

6. The meeting was held on 12 and13 November 2013 (3–6 p.m. on both days) at the National Stadium in Warsaw, during the thirty-ninth sessions of the subsidiary bodies, and it was open to all Parties and observers.

7. The discussion at the meeting focused on the two themes of the review: the adequacy of the long-term global goal in the light of the ultimate objective of the Convention (theme 1), and overall progress made towards achieving the long-term global goal, including a consideration of the commitments under the Convention (theme 2). Theme 2 was considered in two parts: global greenhouse gas (GHG) emissions and concentrations; and

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[1] Decision 1/CP.18, paragraph 86(a).
[2] Decision 1/CP.18, paragraph 87(a).
[3] Available at <http://unfccc.int/7521.php>.

lessons learned from providing support in technology, finance, and capacity-building.

8. Each session consisted of three parts: (i) presentations by experts (outreach), (ii) group discussions between experts and Parties, and (iii) general discussion with all participants. [4]

9. The meeting was opened and facilitated by Mr. Andreas Fischlin and Mr. Zou Ji, the co-facilitators of the SED. We commenced with a scene-setting presentation made by an IPCC expert on the overarching findings and new approaches of AR5 WGI. The following questions were provided by the co-facilitator to guide the general discussion:

(a) What are the key messages from AR5 WGI relevant for the review?

(b) What does AR5 WGI tell us about the relationship between GHG emissions, atmospheric concentrations and change in the climate system?

(c) How reliable are the projections made using climate models (e.g. equilibrium/transient, timeline of 2100–2300)?

10. Under the first theme of the review, three experts from the IPCC and an expert from the Netherlands Environmental Assessment Agency (PBL), representing the Integrated Assessment Modeling Consortium (IAMC), made presentations. These experts, together with representatives of the European Union, New Zealand, South Africa, the Alliance of Small Island States (AOSIS) and the IPCC secretariat, reflected on the following questions:

(a) What changes has the world observed, and what changes are projected to be observed, that are related to anthropogenic climate change?

(b) Are there any limitations in working only towards a temperature target? Are there any risks associated with this (e.g. misunderstanding uncertainties in climate sensitivities)?

(c) What uncertainties remain? What is the importance of these? Are they significant enough to affect the global response at the policy level?

11. The general discussion was guided by following questions:

(a) What insights exist on the observed and projected changes in the climate system?

(b) What insights exist on the long-term aspects of climate change?

(c) What are the key findings contained in AR5 WGI on the stabilization level of GHG concentrations in the atmosphere that would prevent dangerous anthropogenic interference with the climate system, and what are the associated uncertainties?

(d) How do the above findings relate to the adequacy of the long-term global goal in the context of policymaking under the UNFCCC?

12. Under the first part of the second theme of the review, two experts from the IPCC made presentations. These experts, together with the other two experts from the IPCC, as well as representatives of Brazil, China, European Union, Switzerland and the IPCC secretariat, reflected on the following questions:

(a) What are the uncertainties and the risks associated with specific pathways and how to address them in the context of decision-making? How urgently is action required to move towards and follow emission pathways compatible with the long-term global goal?

(b) How to deal with issues, such as probabilities, overshooting, negative emissions, and irreversible changes?

(c) What information is most necessary to give an accurate picture of global emissions and progress towards the goal?

13. The general discussion under the first part of theme 2 was guided by the following questions:

(a) What does AR5 WGI tell us about the overall progress made so far and the projected progress towards achieving the long-term global goal?

(b) What is the relationship between global emissions and the global temperature rise and how can this be factored into policymaking under the UNFCCC?

[4] Additional information on SED 2, including the agenda for the meeting and copies of all presentations, is available at <http://unfccc.int/7521.php>.

14. Under the second part of the second theme of the review, representatives of the TEC, the SCF and the GEF made presentations. These experts, together with representatives of AOSIS, Mexico, Philippines and the Climate Technology Centre and Network (CTCN), reflected on the following questions:

(a) How effective have finance, technology transfer, and capacity-building been in supporting the delivery of mitigation and adaptation outcomes? Which supporting schemes have been successful? Are there some best practice examples of streamlining support to lead to effective mitigation?

(b) What are the best practices/lessons learnt in streamlining support that can lead to effective mitigation of and adaption to climate change? Globally, are there any sectors/gases/policies that are ‘low-hanging fruit’?

15. The general discussion under the second part of theme 2 was guided by the following questions:

(a) Which scheme of support has worked and for what reasons?

(b) How can best practices and lessons learned be factored into policymaking under the UNFCCC?

16. At the closing of the meeting, the co-facilitators thanked Parties and experts for their constructive and active participation and for their contribution.

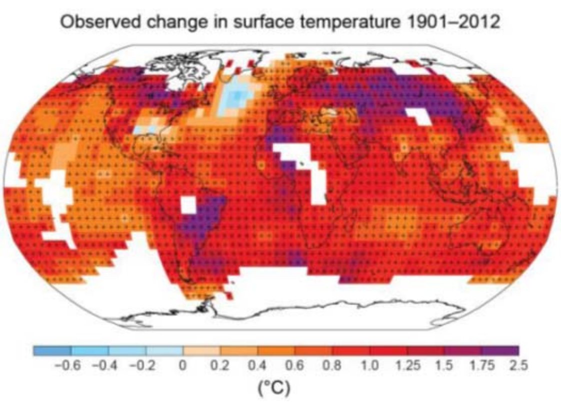
III. Summary of the discussion

A. Setting the scene

1. Presentations by experts

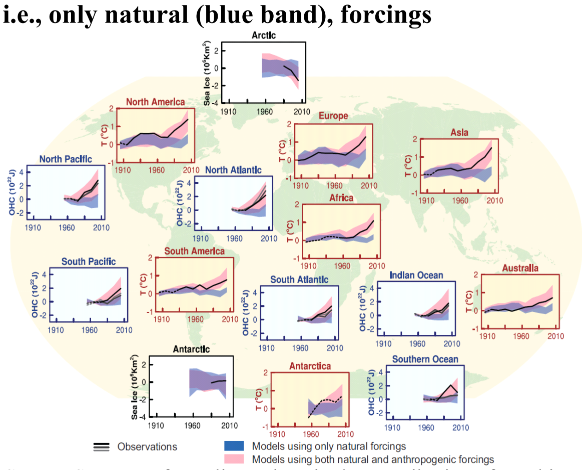
17. Mr. Thomas Stocker, a co-chair of Working Group I of the IPCC (WGI), presented the overarching findings and new approaches of AR5 WGI relevant for the review. He identified the following three key messages:[5] observed changes in the climate system, based on multiple lines of evidence, show that the **warming of the climate system is unequivocal** (figure 1); based on the understanding of the climate system and its recent changes, **human influence on the climate system is clear** (figure 2); and projections of future climate change indicate that **limiting climate change will require substantial and sustained reductions of GHG emissions** (figure 3).

Figure 1
Map of the observed surface temperature change from 1901 to 2012



Source: Summary for Policymakers in the contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, figure SPM.1(b).

Figure 2
Comparison of observed and simulated climate change in continental land surface air temperatures (yellow panels), Arctic and Antarctic September sea ice extent (white panels), and upper ocean heat content in the major ocean basins (blue panels) with all forcings (red band) or without anthropogenic, i.e., only natural (blue band), forcings



Source: Summary for Policymakers in the contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, figure SPM.6.

[5] See also the headline statements from the AR5 WGI Summary for Policymakers (SPM), which highlights the overarching conclusions from the SPM in AR5 WGI, at <http://www.ipcc.ch/news_and_events/docs/ar5/ar5_wg1_headlines.pdf>.

18. Regarding the first key message, he noted that the global average surface temperature[6] shows a **warming of 0.85** [0.65–1.06][7] °C over the period 1880–2012 and that the observed warming from 1850–1900 to the **reference period 1986–2005 is 0.61** [0.55–0.67] °C. On the last key message, he underlined that CO_2 emissions from fossil fuels released 375 gigatonnes of carbon (GtC) to the atmosphere from 1750 to 2011, while deforestation released 180 GtC, resulting in cumulative anthropogenic emissions of 555 [470–640] GtC. The period 1870–2011 alone accounts for the amount of 515 [445–585] GtC.

19. Regarding the relationship between GHG emissions, atmospheric concentrations and change in the climate system, Mr. Stocker noted that the increase in GHG concentrations in the atmosphere and the resulting changes in radiative forcing had an effect on the energy balance of the Earth. As **the total radiative forcing is positive**, it has led to an **uptake of energy in the climate system;** and more than 90 per cent of the energy accumulated between 1971 and 2010 has been **absorbed by the oceans, leading to their warming**. The **largest contribution** to the radiative forcing **is caused by the increase in the atmospheric concentration of CO_2** and these **changes are clearly due to the human influence on the climate system**.

20. Mr. Stocker illustrated how Earth system models were used to project changes in the climate system. These models, based on the changes in CO_2 and other drivers, estimate the resulting changes in radiative forcing and temperature, which can be quantified using the transient climate response and equilibrium climate sensitivity. Changes in temperature then create a climate response (e.g. sea level rise) and physical and biogeochemical feedbacks.

21. **Regarding the reliability of the projections** made with climate models, he concluded that, based on a comparison of results from simulations using climate models and observed data, **climate models can reproduce observed surface temperature patterns and trends over many decades not only on the global, but now also on a continental scale** and can therefore be used for projections into the future. He illustrated this with an example of projected changes in average surface temperature and precipitation for 2081–2100 compared to 1986–2005 in the case of the Representative Concentration Pathway (RCP) 2.6 (CO_2 eq concentration reaching 475 ppm by 2100). Changes are much larger for RCP8.5.[8]

22. He also noted **a new quantity** to characterize the climate system, the **transient climate response to cumulative carbon emissions** (TCRE), which is *likely*[9] in the range of 0.8 to 2.5 °C per 1,000 GtC or 3,666 $GtCO_2$.[10] This leads to the important finding that **cumulative emissions of CO_2 will largely determine global mean surface warming by the late twenty-first century and beyond**. WGI assessed that the **cumulative total emissions of CO_2 and global mean surface temperature response are approximately linearly related**. Therefore, cumulative emission amounts enable one to easily make a reasonable estimation of the corresponding future temperature response of the Earth for a given amount of carbon emitted to the atmosphere.[11]

2. Discussion

23. A Party asked whether AR5 WGI has provided **a value for the global average temperature change since 1750**.[12] Responding to this question, the expert answered that, due to absence of a data set, WGI could not estimate the warming for the period since 1750 as reliably as the temperature changes for the period 1880–2012.[13]

24. On the issue of climate models, another Party asked about the **reliability of near-term temperature projections**, considering the reduced rate of warming of the last 15 years. The expert answered that the current generation of climate models can and does simulate reduced warming over several years. However, on the decadal timescale it is difficult to predict the precise time point at which such reduced warming will start. He also said that the increase in global mean temperature for a 15-year period starting in 1996 would be almost three

[6] Calculated by a linear trend.
[7] Numbers in brackets give the 90% uncertainty intervals for the best estimate value stated. This interval is expected to have a 90% likelihood of covering the true value that is estimated. These intervals are not necessarily symmetric about the corresponding best estimate.
[8] See box SPM.1 on Representative Concentration Pathways (RCPs) and footnote 17 below.
[9] The same conventions for highlighting uncertainty language using italic fonts as adopted by IPCC AR5 (see AR5 WGI SPM, page 4, notably footnotes 1 and 2).
[10] See further explanations on this matter in paragraph 35 below.
[11] For further details, see paragraph 19 of this report and the Summary for Policymakers (SPM) in AR5 WGI, figure SPM.10.
[12] This somewhat arbitrarily chosen year was used by IPCC to define the pre-industrial period, before 1750, and the industrial period as after 1750.
[13] See paragraph 18 above.

times larger than for the one starting in 1998, which illustrates the sensitivity to the starting year of a trend spanning only such a short period.[14]

25. In response to a question on whether WGI focused on **specific temperature targets** in the course of the assessment, the expert clarified that WGI has not focused on any specific temperature targets or scenarios as the work of the IPCC is policy-relevant but not policy-prescriptive.

26. A Party asked for further clarification of the **relationship between increasing GHG emissions and changes in the climate system, especially in regard to the sea level rise corresponding to a TCRE value of 0.8 to 2.5 °C per 1,000 GtC**. The expert answered that it is difficult to capture the impact of sea level rise that is equivalent to a given TCRE, as the sea level responds in a more complex manner than temperature and more slowly (i.e. much delayed) to changes in the climate system.[15]

27. Responding to a question on whether there were **metrics** to support the review of the adequacy of the long-term global goal considering the time-horizon, the expert answered that no single metric can accurately compare all consequences of different emissions, and that the selection of the metric depends on the policy goals and the time horizon of that policy goal.[16]

28. A Party sought clarification on **uncertainties** and their implication for the policy-making process when a wide range of estimates are provided. For example, by 2050, Earth system models for scenarios compatible with RCP2.6 predict annual CO_2 emissions that are lower than 1990 emissions by 14 to 96 per cent.[17] Regarding this point, the expert advised that despite wide ranges the mean or other best estimate value of the model range can nevertheless often be used, in this case IPCC having estimated it to be 50 per cent. He added that all uncertainties in WGI should in general be treated the same way and on both ends of the range.

B. Theme 1: the adequacy of the long-term global goal in the light of the ultimate objective of the Convention

1. Presentations by experts

29. Mr. Detlef van Vuuren (IAMC/PBL), presented benefits and limitations of the RCPs[18] and compared these scenarios with those from the IPCC *Special Report on Emissions Scenarios* (SRES). He provided four reasons to develop new scenarios for climate assessment: (i) to cover a wider range of GHG concentrations, as SRES only includes scenarios without reference to climate policy and thus provides limited insight into twenty-first century warming and warming commitment; (ii) to widen the set of parameters, such as in reference to land use and pollutants, as climate models have become more complex; (iii) to include scenarios that cover both mitigation and adaptation, which requires collaboration between the IPCC working groups; and (iv) to use more recent insight into trends of scenario drivers.

30. He stressed that **RCPs are the cornerstone of the new process of scenario development**,[19] which was **applied in AR5 to shorten the time between the development of emissions scenarios and their use in impact research**, as well as to address the key information needs of users more effectively. He noted that RCPs nicely span the range of GHG emissions from scenarios in the literature. In terms of radiative forcing, RCP8.5 is comparable to SRES A2/A1FI, RCP6.0 to SRES B2/A1B, and RCP4.5 to SRES B1. There are no SRES scenarios that are comparable to RCP2.6.

31. Regarding scenarios corresponding to **RCP2.6**, he noted that the **decarbonization rate should be around 6 per cent per year after 2030, with an average of 4.5 per cent for 2010–2050**.[20] Assuming that global GHG emissions would peak around 2020, such scenarios would nevertheless require negative emissions by the end of the twenty-first century produced by using bioenergy and carbon dioxide capture and storage

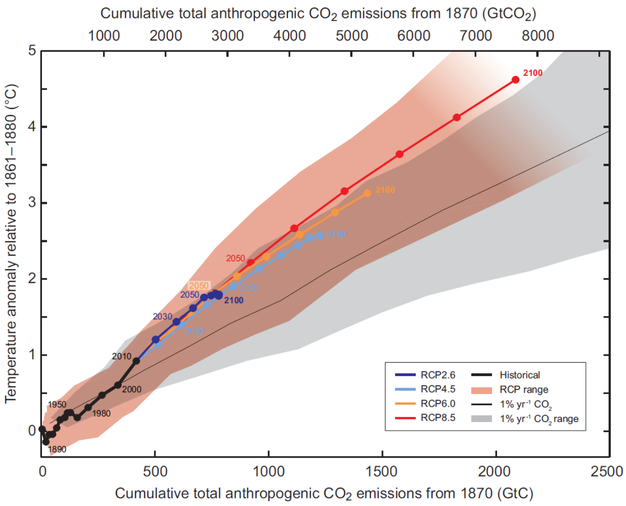
[14] See footnote 5 of SPM and paragraph 65.
[15] See further explanations on this matter in paragraph 38.
[16] WGI assessed that no single metric can accurately compare all consequences of different emission pathways. For further details on metrics, see chapter 8, section 8.7 for emission metrics.
[17] SPM, p. 27.
[18] RCP8.5: high-range emission scenario (possible development for high population numbers, high fossil/coal use); RCP6.0: medium-range emission scenario (low–medium baseline scenario or high mitigation scenario); RCP4.5: medium-range emission scenario (high mitigation scenario); RCP2.6: low-range mitigation scenario.
[19] See *Towards new scenarios for analysis of emissions, climate change, impacts, and response strategies* published in 2007 at <http://www.ipcc.ch/pdf/supporting-material/expert-meeting-ts-scenarios.pdf>.
[20] See figure on global decarbonization on slide 9 of the presentation by Mr. Van Vuuren, available at <http://unfccc.int/files/science/workstreams/the_2013-2015_review/application/pdf/2_vvuuren13sed2_amended.pdf>.

(BECCS). It would be **possible to delay the peaking time, although only with stronger emission reductions in the period 2030–2050** (e.g. –5 per cent reduction annually) **and with deeper negative emissions**,[21] to remain in line with RCP2.6. Alternatively, some models show that it is **possible** to be in line with RCP2.6 **without negative emissions, but such scenarios would require immediate and more stringent reductions in global emissions**.

32. Mr. van Vuuren concluded that **RCPs have supplied a strong link between the work of WGI and WGIII;**[22] have allowed for **a set of policy-relevant conclusions to be drawn by the WGI and, at the same time, for WGIII to use results from updated models**; this has allowed for a **strong research focus on the feasibility of the 2 °C goal**. He also said that further research is needed on climate impacts based on RCPs, such as in regard to the assessment of socioeconomic conditions.

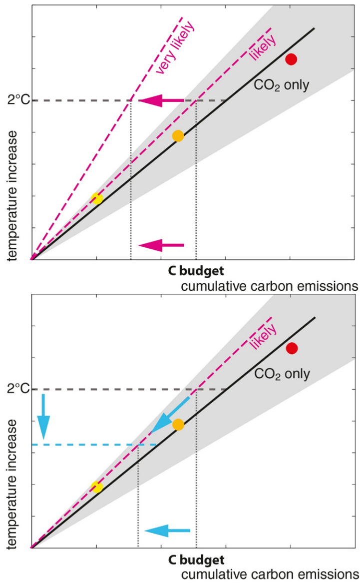
33. Mr. Stocker summarized the findings of WGI on the **past, current and future changes in the climate system** (e.g. in temperature, precipitation, ocean acidification, cryosphere, and sea level rise). These findings indicate that it **is *likely* that the global surface temperature will exceed 1.5 °C by the end of the twenty-first century relative to the average of the 1850–1900 period for all scenarios except RCP2.6.**[23] Warming will continue beyond 2100 under all RCP scenarios except RCP2.6, will continue to exhibit interannual-to-decadal variability and will not be regionally uniform. The Northern Hemisphere sea ice extent in September will decrease for all scenarios and a nearly ice-free Arctic Ocean in September is *likely* before the middle of this century for RCP8.5.

Figure 3
Global mean surface temperature increase as a function of cumulative total anthropogenic emissions of CO_2 from various lines of evidence



Source: Summary for Policymakers in the contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, figure SPM.10.
Abbreviations: RCP = Representative Concentration Pathway.

Figure 4
Controls on the carbon budget



Source: Slides 6 and 7 of the presentation by Mr. Reto Knutti (IPCC), available at <https://unfccc.int/files/science/workstreams/the_2013-2015_review/application/pdf/7_knutti13sed2.pdf>.
The upper figure shows the reduction in the budget with increasing likelihood to keep warming below 2°C, and the lower the reduction in the budget with lowering the temperature target for the same likelihood for keep warming below 2°C.

34. Regarding global mean sea level rise (GMSLR), Mr. Stocker mentioned that for the first time, WGI was able to make a statement encompassing all the important components that contribute to sea level rise.[24]

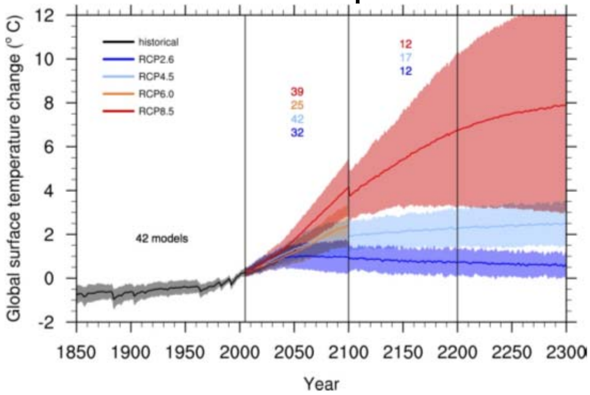
[21] If sustainable bioenergy is able to provide 150 EJ per year, and all bioenergy is used for BECCS, negative emissions of –10 Gt CO_2 per year are possible.
[22] IPCC Working Group III.
[23] See SPM, page 20 and figure SPM.7(a). Note that the temperature increase given in that figure is relative to the reference period 1986–2005, which is estimated to have an average that is 0.61°C above that of the period 1850–1900 (SPM, page 19 and note a to table SPM.2).
[24] See paragraphs 37–41 below for more information.

Regarding ocean acidification in the long term (2081–2100), RCP2.6 shows small changes in pH (from –0.06 to –0.07), while RCP8.5 shows a larger change (from –0.30 to –0.32 pH) by the end of the twenty-first century. Regarding extreme events, it is *very likely* that heatwaves will occur with higher frequency and duration; in case of RCP8.5, e.g. warm days[25] will be over six times more frequent by the end of twenty-first century than during the period 1961–1990.

35. He stated that **cumulative total emissions of CO_2 since 1870 and global mean surface temperature response are approximately linearly related** for all RCPs,[26] and that total cumulative CO_2 emissions since 1870 **must be limited to about 1,000 GtC in order to *likely* limit anthropogenic CO_2-induced warming to below 2 °C compared to the period 1861–1880** (figure 3). When accounting for non-CO_2 forcings, this budget is reduced to about 790 GtC; 515 [445–585] GtC have been emitted by 2011.

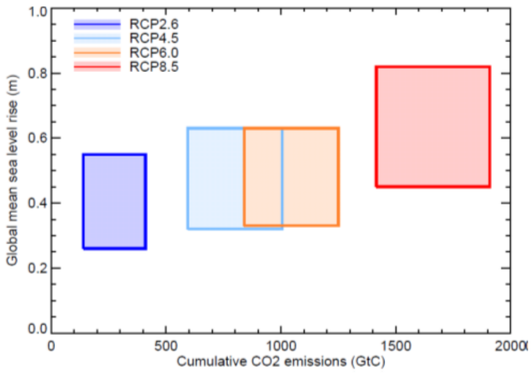
36. Regarding long-term aspects, he explained that global temperature will continue to rise by up to 8 °C beyond 2100 in RCP8.5, and that most aspects of climate change will persist for many centuries even if emissions were stopped at this moment (figure 5). He concluded that these results represent the **substantial multi-century climate change commitment created by past, present and future emissions of CO_2**.

Figure 5
Time series of global annual mean surface air temperature anomalies (relative to 1986–2005) from CMIP5 concentration-driven experiments



Source: Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, figure 12.5.
Abbreviations: CMIP5 = Coupled Model Intercomparison Project Phase 5, RCP = Representative Concentration Pathway.

Figure 6
Relationship between GMSLR, RCPs, and cumulative CO_2 emissions



Source: Slide 9 in the presentation by Mr. Jonathan Gregory (IPCC), available at http://unfccc.int/files/science/workstreams/the_2013-2015_review/application/pdf/4_gregory13sed2.pdf

Abbreviations: RCP = Representative Concentration Pathway.

See also Summary for Policymakers in the contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Table SPM.2.

37. Mr. Jonathan Gregory (IPCC) presented findings of WGI on GMSLR. He explained that GMSLR is a result of an increase in the volume of the global ocean as caused by the warming of the ocean (thermal expansion),[27] ice loss from glaciers[28] and ice sheets,[29] and the change of liquid water storage on land (groundwater and reservoirs). For example, the global glacier volume is projected to decrease by 15 to 55 per cent for RCP2.6, and by 35 to 85 per cent for RCP8.5 by the end of the twenty-first century. Regarding observed changes, the rate of GMSLR from 1901 to 1990 was 1.5 [1.3–1.7] mm per year, and 3.2 [2.8 to 3.6] mm per year from 1993 to 2010.

38. It is *very likely* that the average rate of the sea level rise during the twenty-first century will exceed that of the period 1971–2010 under all RCPs. A GMSLR of 0.40 [0.26–0.55] m for RCP2.6 and 0.63 [0.45–0.82] m for RCP8.5 was projected for the period 2081–2100 compared to 1986–2005 (medium confidence), and of 0.28−0.61 m for RCP2.6 and 0.52−0.98 m for RCP8.5 by 2100. The collapse of marine-based sectors of the Antarctic ice sheet, if initiated, would add no more than several tenths of a meter during the twenty-first century

25 Frequency of days above the 90th percentile of maximum temperature.
26 See paragraph 22 above.
27 *High confidence* in projections of thermal expansion and consistency of historical simulations with observations.
28 *Medium confidence* in projections of glacier mass loss and consistency of historical simulations with observations.
29 *High confidence* in projections of increasing Greenland surface mass loss and *medium confidence* in projections of increasing Antarctic snow accumulation.

(*medium confidence*). **Unlike global mean surface warming, the rate of GMSLR depends also on the pathway of CO_2 emissions, not only the total amount of CO_2 emitted, which means reducing emissions earlier rather than later will lead to a lower sea level rise** (figure 6).

39. Commitment to and irreversibility of sea level rise are important aspects, as **stabilizing the global mean surface temperature (**e.g. towards the end of this or during the next century) **will not stabilize the global mean sea level**.[30] It is virtually certain that GMSLR will continue for many centuries beyond 2100. Depending on future emissions, it could eventually reach several meters above pre-industrial levels and possibly include irreversible ice sheet mass loss.

40. **Regarding the projection for 2300**, there is *medium confidence* for a GMSLR lower than 1 m for radiative forcing corresponding to CO_2 concentrations below 500 ppm (about 3 W m^{-2}, similar to RCP2.6), and from 1 to more than 3 m for CO_2 at 700–1,500 ppm (about 5–9 W m^{-2}, as in RCP6.0 or RCP8.5). Sustained warming greater than a certain threshold above the pre-industrial level would lead to a near-complete loss of the Greenland ice sheet (*high confidence*). **That threshold for global mean warming is assessed to be greater than 1 °C (*low confidence*) but lower than 4 °C (*medium confidence*) with respect to pre-industrial levels**.

41. **Regarding regional changes** by the end of the twenty-first century, Mr. Gregory underlined that it is *very likely* that sea level will rise in more than about 95 per cent of the ocean area and that there will be a significant increase in the occurrence of extreme high sea level events. **About 70 per cent of the coastlines worldwide are projected to experience sea level change within 20 per cent of the global mean sea level change**.

42. Mr. Krishna Kumar Kanikicharla (IPCC) presented **regional changes** and their deviations from global means.[31] He explained that the IPCC was able to use more data sets for AR5 than for AR4,[32] which resulted in more precise data at the regional level, including changes in observed surface temperature and precipitation. He illustrated projected changes in temperature and precipitation for the period 2081–2100, which vary from region to region with various confidence levels. He stressed the **correlation between annual precipitation and changes in extreme events** (maximum five-day precipitation and consecutive dry days for 2081–2100 and RCP8.5), highlighting differences between regions in Latin America and Asia.

43. Mr. Kumar showed how features of regional climate change have been identified and assessed in AR5 WGI through important climate phenomena such as monsoons, El Niño/Southern Oscillation (ENSO) and tropical cyclones and noted that the report provides an Atlas of global and regional climate projections (temperature and precipitation for 3 time horizons and all RCPs) for 35 regions and based on results from 42 global models.

2. Discussions

44. During the **group discussion**, representatives of the European Union, New Zealand, South Arica and AOSIS asked questions and commented on the presentations. In response to a question regarding developments in the **current research on the threshold for critical and significant impacts in the climate system**, in particular regarding what types of **tipping points we should be aware of in order to assess the adequacy of the 2 °C limit**, an expert answered that the findings on the irreversibility of ice sheet mass loss and the time series of ocean acidification have improved.[33,34] Regarding the **predictability of critical thresholds**, another expert said that there has been some progress in identifying these points or whether such points exist for specific components, such as the Greenland ice sheet mass loss or ocean acidification.[35]

45. In response to a question on **scenario development**, in particular regarding consideration of scenarios that were published after 2007, an expert answered that some scenarios published by 2011 were considered in

[30] For example, while global surface temperature stabilizes between 2081 and 2100 for RCP2.6, GMSLR continues then still at a rate of 2–7 mm per year.
[31] See chapters 2, 12, 14 and annex I of WGI for regional information.
[32] Fourth Assessment Report of the Intergovernmental Panel on Climate Change.
[33] See paragraphs 34–41 above for details on sea level rise and AR5 WGI, chapter 12, section 12.5, for irreversible changes, chapter 13 for irreversibility of ice sheets and sea level rise.
[34] Impacts to marine ecosystems due to the ocean acidification will be mentioned in the contribution of Working Group II to the Fifth Assessment Report of the IPCC.
[35] For some components critical thresholds are clear from the nature of the process (e.g. melting point of ice in case of the melting of ice sheets, and transition to undersaturation in the case of ocean acidification). See also AR5 WGI Thematic Focus Element TFE.8 on “Climate Targets and Stabilization“ in the Technical Summary, notably page 105.

the process of updating and developing RCPs, while scenarios that were developed after 2012 have been considered by WGIII.

46. A question arose on the **improvement of models for regional precipitation**. The expert answered that models have been improved in this area, for example by increasing their spatial resolution and by improving how they report projections (e.g. hatching patterns show the multi-model mean is small compared to natural internal variability and stippling patterns show that the multi-model mean is large compared to natural internal variability and that at least 90% of the models agree on the sign of change).

47. In response to a question regarding possible limitations due to **working only with a temperature related goal,** an expert explained that such a goal **might not capture all impacts that follow from emissions** and may thus cause other changes in the climate system to be overlooked. For example, the sea level rise beyond 2100 is not scalable with cumulative carbon emissions and leads to a centuries-long commitment, which means that additional measures or stringent limitations on cumulative carbon emissions are necessary to prevent such impacts.[36] He added that meeting **multiple goals would require a more ambitious effort to reduce emissions**.

48. With regard to costs, a Party commented that for Africa, a 1 °C warmer world seems to imply costs within the realm of a 0 °C increase; whereas a 2 °C increase implies costs significantly higher than for a 1 °C increase; and a 3 °C increase is associated with a drastic shift in climate impact and adaptation-related costs, as exceeding critical thresholds results in high-impact climate events.

49. During the **general discussion**, several Parties requested clarification on **underlying assumptions for RCP2.6**[37] and on the consideration of **emissions of short-lived gases**, such as fluorinated gases, particularly hydrofluorocarbons (HFCs). An expert noted that these questions are related to the work of WGIII and elaborated on the technical feasibility[38] and cost estimates for RCP2.6.[39] Another expert said that WGIII is assessing the economic cost, as well as the social and environmental aspects, technology development, and energy profile trajectories. Yet another expert encouraged delegates to participate in the review process of WGII[40] and WGIII draft reports, as many questions were related to those two reports. In reference to the second question, an expert answered that HFCs are also considered in these scenarios.[41]

50. Two questions arose **regarding the 1.5 °C target**: (1) what are the **regional implications of the difference between impacts caused by temperature increases of 1.5 °C and 2 °C**; and (2) which chapters of AR5 WGI present information on impacts from a 1.5 °C increase. Responding to the first question, an expert answered that WGI compared global and regional changes by RCPs rather than in terms of a 1.5 °C versus 2 °C increase. He then said that the projected regional near-term impacts for RCP2.6 may be closest to impacts that could be associated with a 1.5 °C temperature rise. For the second question, the expert answered that the relevant information for the 1.5 °C increase can be found in chapter 11 (near-term projections), chapter 12 (long-term projections), chapter 13 (sea level rise), and chapter 14 (regional issues), as well as in contributions of WGII, WGIII and the Synthesis Report.

51. A Party asked for further clarification on the issue of **multiple goals**, referred in paragraph 47 above, in particular regarding a temperature related goal combined with an ocean acidification or sea level rise goal. The expert answered that, although the issue of multiple goals is relatively new to the scientific community, AR5 WGI provides information for each scenario on the degree of ocean acidification and sea level rise, which also covers relevant temperature related goals that UNFCCC is currently considering. Regarding the sea level rise, another expert reiterated that, in general terms, reducing emissions earlier rather than later would lead to a lower sea level rise.

52. In response to a question on **extreme events in mid-latitude regions**, an expert explained the existing complexity of and difficulties in making projections for such extreme events, including wildfire,[42] tornadoes, tropical storms and cyclones.

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[36] See paragraphs 39 and 40 above.

[37] For example, social and economic aspects such as technical feasibility, cost implications and discount rate, economic growth in developing and developed countries and barriers to technology transfer.

[38] Some models show pathways that are feasible without negative emissions but require immediate emission reductions. Options to reach negative emissions include BECCS, forestation and direct air capture. BECCS seems like a promising option compared to forestation, but requires a trade-off with food production.

[39] For example, costs are about 2 per cent of GDP, a discount rate of 5 per cent is used, and a higher growth rate is used for developing countries than for developed countries.

[40] Working Group II of the Intergovernmental Panel on Climate Change.

[41] See details in Annex II of AR5 WGI.

[42] Projection of wildfire or heatwaves need projections of the quantity of soil moisture, but the global models used for the former have not captured the latter.

53. Another Party underlined the importance of **adaptation costs** in policymaking in the context of the long-term global goal. Yet another Party mentioned a paper that analysed the attribution of climate change to human activities using statistical methods rather than models.

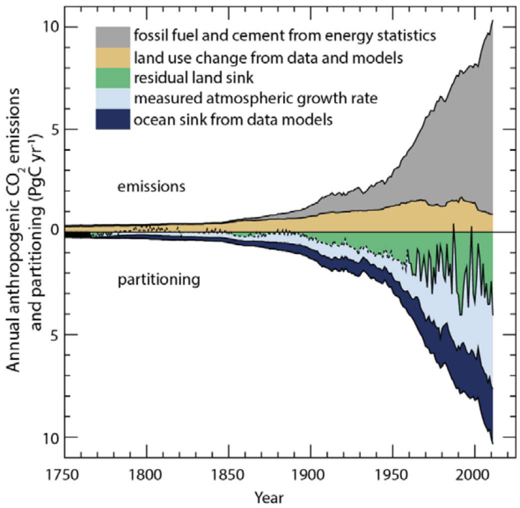
C. Theme 2: overall progress made towards achieving the long-term global goal, including a consideration of the implementation of the commitments under the Convention

1. Presentations by experts (part one)

54. The **first part of theme 2** focused on global GHG emissions and concentrations. Ms. Corinne Le Quéré (IPCC) presented past, current and projected changes of global GHG emissions and concentrations. In 2011, the concentrations of GHGs in the atmosphere reached 390.5 ppm for CO_2 (40 per cent increase compared to the pre-industrial period); 1,803 ppb for methane (CH_4) (150 per cent increase) and 324.2 ppb for N_2O (20 per cent increase). WGI concluded that **the largest contribution to total radiative forcing is caused by the increase in atmospheric CO_2**.

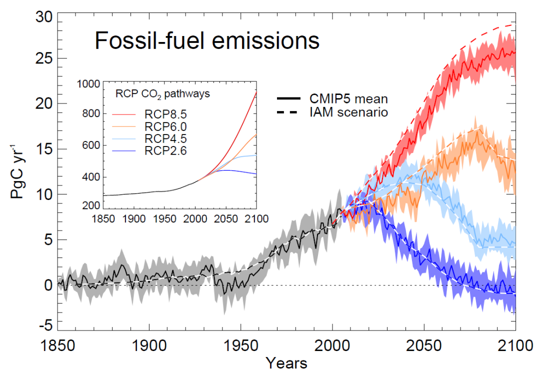
55. Regarding historical emissions from 1750 to 2011, **CO_2 emissions from fossil fuel combustion and cement production** have released 375 [345–405] GtC into the atmosphere (some 70 per cent of total cumulative emissions), while deforestation and other land-use change are estimated to have released 180 [100–260] GtC (some 30 per cent of total cumulative emissions).[43] Some 155 [125–185] GtC have been taken up by the ocean and 160 [70–250] GtC have accumulated in residual land sinks (figure 7). **Recently**, over the period 2002 to 2011, **emissions from fossil fuel combustion and cement production amounted to 90 per cent of total CO_2 emissions** while the remaining 10 per cent during that period were due to land-use change.

Figure 7
Annual anthropogenic CO_2 emissions and their partitioning among the atmosphere, land and ocean from 1750 to 2011



Source: Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change , Technical Summary, figure TS.4

Figure 8
Compatible fossil fuel emissions simulated by the CMIP5 ESM models for the 4 RCP scenarios



Source: Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, figure 6.25.
Abbreviations; CMIP5=Coupled Model Intercomparison Project Phase 5, IAM=Integrated Assessment Modeling, RCP = Representative Concentration Pathway.

56. She explained that Earth system models[44] showed that land and ocean CO_2 sinks continue to increase when the models simulated increasing atmospheric CO_2 only, while the opposite response was observed when the models simulated climate change only. The latter showed that **climate change affects the carbon cycle processes in a way that will exacerbate the increase of CO_2 in the atmosphere** (*high confidence*).

[43] Land-use change emissions are subject to large uncertainties and can be negative.
[44] Climate models that take into account carbon cycle processes. This includes uncertainties in carbon climate feedbacks, except feedbacks from frozen permafrost, from wetlands with a warmer climate and from marine hydrates.

57. After presenting the cumulative emissions for all RCP scenarios from 2012 to 2100, Ms. Le Quéré said that future emissions following RCP2.6 are on average 50 [14–96] per cent lower by 2050 than 1990 emissions (figure 8), and about half the models indicate emissions below zero by 2100. The **cumulative future CO_2 emissions that are compatible with RCP2.6** (270 [140–410] GtC from 2012 to 2100) **are less than half the historical emissions** (555 [470–640] GtC from 1750 to 2011).

58. Mr. Reto Knutti (IPCC) presented the relationship between global CO_2 emissions and the global temperature rise. He stressed that a substantial multi-century climate change commitment was created by past, present and future emissions of CO_2. **Stable CO_2 concentration will result in further warming over centuries, and even if CO_2 emissions reach zero,** about **15–40 per cent of the emitted carbon will remain in the atmosphere for longer than 1,000 years** depending on the scenario. However, most models show no or very little commitment to further surface warming from past CO_2 emissions once emissions should stop or become negative.

59. He further stated that cumulative emissions of CO_2 will largely determine global mean surface warming by the late twenty-first century and beyond. WGI found that warming is largely independent of the emission pathway and that only the total amount emitted matters. Hence, every ton of CO_2 causes about the same amount of warming, no matter when and where it is emitted. Therefore, **any temperature limit implies a maximum amount of cumulative CO_2 emissions compatible with that limit**. **Halting the global mean temperature rise at any level will require near zero carbon emissions at some point in the future**.

60. The total cumulative carbon budget (CO_2 only) corresponding to the likelihood of 90, 66, 50, 33 and 10 per cent of the temperature increase since 1861–1880 staying under 2 °C are 730, 1,000, 1,212, 1,567 and 3,567 GtC, respectively[45]. In the case of a 1.5 °C increase, this budget is estimated at 548, 750, 909, 1,176, and 2,675 GtC, respectively (figure 4). Consideration of non-CO_2 forcing implies a lower budget. For example, the **upper amount is reduced from 1,000 GtC to about 790 GtC when accounting for non-CO_2 forcing as in RCP2.6** (probability greater than 66 per cent of staying under 2 °C); 515 GtC have already been emitted from this budget by 2011. He said **the long-term global goal could be seen as a threshold that must not be exceeded or as an eventual target after overshooting** and noted that some temperature related goals are very difficult to reach if defined as a threshold, but can be reached eventually after overshooting.

2. Discussions (part one)

61. During the **group discussion**, Brazil, China, the European Union and Switzerland asked questions and commented on the presentations. Some questions arose on **emissions from fossil fuels and land-use change**, including on their geographic distribution, the means to secure land sinks so as to continue the absorption of carbon, and the **relationship between emissions and the capacity of land and ocean sinks**. The experts explained that there is solid data for the geographical distribution of emissions from fossil fuel, but that for land use there was no agreement among experts regarding the distribution by region, even for recent decades. They also explained that, if sink capacity is to be secured, deforestation and changes in the climate should be limited. There is a relatively linear trend between emissions and the response of land and ocean sinks except for cases of higher emissions. The experts further said that, **while the quantification of changes in land and ocean sinks for high emission scenarios is difficult, the direction is clear: such scenarios will weaken the capacity of sinks**.

62. A Party asked about the **relationship between emissions and impacts such as ocean acidification, sea level rise or food production**. The experts answered that this relationship is not linear, and that different goals may require different carbon budgets. He also explained that a goal linked to food production may require the assessment of additional components that go beyond physical changes in the climate system.

63. Responding to Mr. Knutti's presentation, a Party pointed out the importance of the **emission pathway and the rate of changes in the climate system**, as different pathways may show different types and rates of impacts. Therefore, an important message is that **global emissions have to peak and decline in the near future to reach a low-emission pathway and limit warming**. The expert responded that the rate of climate change and the exact emission pathway, in contrast to global mean temperature, may indeed matter for some impacts such as sea level rise.[46]

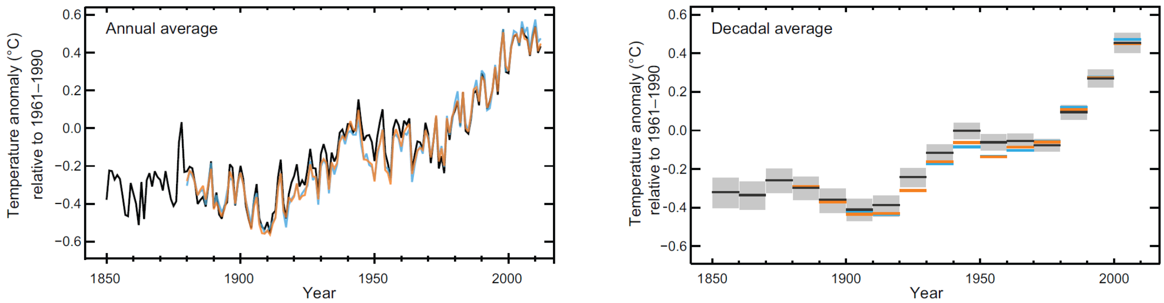
64. A Party asked a question about the **uncertainty ranges** and how they would impact policymaking, in particular in regard to the fact that such ranges translate into differences in future budgets equivalent to historical cumulative emissions. The Party noted that the practical meaning of such ranges is important and that further

[45] All numbers given here are estimates derived using the same method as described in AR5 WGI, Chapter 12, page 1113.
[46] See figure 3 and 6 above.

efforts are needed to reduce the uncertainties.[47] A different Party asked about the uncertainty range associated with the 50 per cent reduction by 2050 required by RCP2.6. He noted that the uncertainty comes in at different timescale, for example for concentrations and temperatures, and there is much less uncertainty for concentrations than for temperature profiles in going forward. It stressed that **uncertainty should be considered in risk management and that higher uncertainties will mean a lower carbon budget**, for example. The expert answered that the range of values represents the minimum to maximum values provided by all the models and that it is not very large if standard deviation is considered. He reiterated the need to focus on the total budget rather than total emissions at a given point in time, agreed that higher uncertainties will mean a lower carbon budget[48] and noted that the question of choosing a specific probability of keeping temperature below a given limit is not a scientific question nor a scientific uncertainty but is to be addressed as part of a value judgment.

65. Another Party was of the view that the **progress towards the long-term global goal** should be assessed **in terms of temperature**. He suggested that the goal should be broken down into partial targets that would be assessed every 10 years,[49] and asked about the feasibility of developing a methodology for this purpose. In response, an expert noted that adopting such an approach would be difficult, owing to the difficulties associated with the decadal predictability of temperatures. He stressed that there are periods with less warming (figure 9), and that short-term trends could lead to wrong conclusions when compared with long-term trends.[50] Instead, he pointed out, the goal should be revised based on emissions, which are well documented and for which we have a clear understanding of what they mean in terms of long-term commitments.

Figure 9
Observed global mean combined land and ocean surface temperature from 1850 to 2012, from three data sets



Source: Summary for Policymakers in the contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, figure SPM.1(a).

66. During the **general discussion**, a Party asked about the assessment of **risk of carbon cycle feedbacks** associated with different degrees of warming, especially **regarding whether overshooting scenarios would increase the risk of these feedbacks**; about which is a safer global warming limit for reducing these risks (1.5 °C or 2 °C); and about whether high probability emission pathways to limit warming to 1.5 °C would reduce the risk of overshoots and carbon cycle feedbacks. An expert answered that higher emission scenarios have broader feedbacks. She also mentioned that keeping the temperature rise below 1.5 °C could also help control carbon cycle feedbacks, and that smaller temperature changes will lead to smaller feedbacks.

67. A different Party asked two questions regarding the **relationship between the timescale and impacts**: (1) at what point do the impacts of a 2 °C rise matter; (2) is the timescale the same for various physical changes in the climate system, such as precipitation, ocean acidification or sea level rise? An expert answered the first question by saying that the timescale of the impacts will depend on the type of impacts. For example, warming will immediately impact precipitation or extreme weather, whereas changes in the Greenland ice sheet melting would take considerably much longer to occur and a few years would not matter.[51] In general, the timescales for emitting carbon might also apply to those for taking carbon out of the atmosphere (e.g., if we overshoot for 50 years we might stay above the target for 50 years).

[47] See paragraph 28 above.
[48] See figure 3 and 4 above.
[49] The scientific community would assess the temperature targets, while policymakers would assess mitigation actions that combat temperature increases.
[50] See paragraph 24 above.
[51] According to IPCC AR5 a global warming higher than a certain threshold value above preindustrial levels sustained over a millennium or more would lead to the near-complete loss of the Greenland ice sheet, causing a global mean sea level rise of up to 7 m. See AR5 WGI SPM page 29 and Executive Summary of chapter 13.

68. In response to the second question, the expert said that there is no linear feedback in the case of ocean acidification, as the upper and deeper ocean have different acidification profiles. Regarding changes in extreme events in terms of early versus late reduction, the expert answered that both global and local temperature matter for extreme events, and that thus the timing of reductions does not affect the timing of the events. Regarding the relationship between timescale and impacts he said that the reduction of emissions short-lived GHGs will show an effect immediately (e.g., the effect of reducing emissions of a short lived GHG in 2050 is seen in 2050 not in 2100). However, another expert added that reductions of short-lived GHGs emissions ought to be seen in addition to those of long-lived GHGs (particularly CO_2) to effectively manage a long-term goal.

69. Regarding a question on a **committed temperature rise** for RCP2.6, an expert answered that the temperature rise that is projected under RCP2.6 is *likely* below 2 °C in 2100 relative to the 1850 level (the mean response of models is about 1.6 °C). As regards commitments, he said that there is no warming commitment from past emissions in the physical climate system[52] that will cause further warming and that if we stop emissions today entirely, there will be no further warming. Essentially, the commitment to future warming is in future emissions. A stable concentration, however, will result in further warming.

70. Another Party asked whether there is coordination between WGI and WGII on reflecting the impact of a committed temperature rise on the cost of adaptation, which will be assessed by WGII. The expert answered that impacts and adaptation will be discussed in the WGII report for the same scenarios using the projections from the climate models from AR5 WGI.

71. Responding to a question regarding the **recent increase of CH_4 emissions from natural wetlands**, an expert said that while natural variability has caused a slowdown in recent warming, there are limited data available to support attributing the increase in CH_4 to a particular process. Only the results from one model linked this increase to changes in rainfall (not a systematic change) and to changes in fossil fuel emissions.

72. With regard to the **commitment from carbon infrastructure** that has already been built, an expert explained that this matter is addressed mainly by WGIII and that the question is if that infrastructure will be phased out at the end of its lifecycle or earlier.

73. In response to a question regarding the **potential of land sinks** in RCPs by 2050, an expert explained that the RCPs have clear pre-defined emission pathways for the twenty-first century. On the other hand, in the context of the discussion on uncertainty, the earth system models used by WGI show changes in sources of terrestrial biosphere sinks based on assumptions about vegetation and the climate change, in particular in precipitation.

3. Presentations by experts (part two)

74. **Second part of theme 2** focused on lessons learned from support in technology, finance and capacity-building. Mr. Antonio Pflüger, the Chair of the TEC, outlined the **key milestones in the technology process under the Convention**, culminating with the establishment in 2010 of the Technology Mechanism comprising the TEC, which provides policy recommendations and briefs to the COP and to stakeholders, and the CTCN, which aims to enhance the effectiveness of support for delivering mitigation and adaptation action and responds to developing country Parties' requests. An important component of the technology transfer framework is the technology needs assessments (TNA), a country-driven process aiming to identify priorities for mitigation and adaptation technologies. The second generation of TNA reports[53] provides information on prioritized sectors and technologies, barriers to and enablers for technology development and transfer, technology action plans, project ideas, estimated budgets for the short and the long term and possible linkages with other processes under the Convention, such as nationally appropriate mitigation actions (NAMAs) and national allocation plans (NAPs). However, the issue of measuring and monitoring the effectiveness of technology development and transfer may need to be further considered.

75. The TEC produced two briefs related to TNAs in 2013 that summarized the **lessons learned from TNAs**,[54] including the following: TNAs are rich sources of information on the technology needs of developing countries; financial and economic barriers are critical and they should be referred to by all financial entities under and outside the Convention; high-level governmental support and coordination of the TNA process is essential; TNAs should evaluate prioritized technologies that may be considered in NAPs and NAMAs; Parties,

[52] Which is only true for global mean temperature but not for other responses of the climate system such as sea level rise. See also paragraphs 39, 58, and 63 above.

[53] See the third synthesis report on technology needs identified by Parties not included in Annex I to the Convention at <http://unfccc.int/resource/docs/2013/sbsta/eng/inf07.pdf>.

[54] Available at < http://unfccc.int/ttclear/pages/tec_home.html>.

when preparing NAMAs and NAPs, should ensure coherence with the TNA findings; and the TNA process effectively helps Parties and relevant stakeholders to implement mitigation and adaptation projects.

76. Ms. Diann Black-Layne, the Chair of the SCF, introduced the general mandates of the **SCF** and provided **information relevant to the review**. She said that the questions are how much funding has been provided to place us on track for a 2 °C world and if this support can be further strengthened to meet a more ambitious target. In response to the first question, she said that the amount of funds being currently allocated to climate finance is inadequate to meet the 2 °C target and that some projections indicate that the current level of spending on "brown" technologies will continue to grow faster than that on renewable technologies.

77. Regarding the second question, she stressed that the **SCF will** be in a position to **assess the overall global financial needs for meeting the goals** agreed upon by the Convention and can present this information at a future SED meeting, in 2015 or beyond. Regarding adaptation, she emphasized that although spending on adaptation has increased, the current focus remains on mitigation despite efforts to place more weight on adaptation.

78. Mr. Robert Dixon (GEF) outlined the role of the **GEF** in financing clean energy and technology investments, adaptation and enabling activities. In terms of **lessons learned**, he highlighted the importance of **mainstreaming private sector engagement** in climate financing, **market transformation** through risk reduction in capital-intensive investing, more efforts to enhance **enabling environments** through capacity-building and technical assistance; and strengthening efforts to build the necessary **support infrastructure and policy frameworks** to further scale-up technology investment and archive transformational impact. He also stressed that **capacity-building** activities should be integrated with adaptation efforts, not be stand-alone activities.

79. In the future, the GEF will continue to invest in financing mechanisms and incentives to bring in the private sector; developing local know-how and intellectual capital through technical assistance and capacity-building; supporting countries in their transition to long-term adaptation, in addition to continuing support for urgent and immediate adaptation needs; encouraging a more strategic approach to multifocal area projects and programmes; and accelerating the demonstration and deployment of innovative adaptation and mitigation technologies and associated business models.

4. Discussions (part two)

80. During the **group discussion**, representatives of AOSIS, Mexico and Philippines asked questions and provided comments. **On technology**, their questions included whether technology transfer is shifting the industrial or technology infrastructure in developing countries towards low emission pathways, how the CTCN would evaluate the technology process of the last 20 years, what the timeline for moving from planning technology transfer to starting to measure its achievements and impacts is, and when we will know the technology needs for supporting mitigation and adaptation action.

81. A Party commented that WGI findings are clearly assuming that increased funding, technology transfer and capacity development are required to meet the 2 °C or 1.5 °C goal. On the subject of low-hanging fruit, another Party was of the view that delaying action locks in the high carbon infrastructure, and that it will be more difficult to reduce emissions in the future.

82. Responding to these questions, the TEC expert said that the evaluation of the technology transfer process over the last 20 year should be seen in the light of the mandates provided by the technology transfer frameworks that were developed during that time. He underlined that in the past two years **the technology mechanism has undergone a fundamental change** and is now moving fast, but that more work is needed to make it fully operational. A key message from the TEC is that factors other than funding are equally important for a successful transfer of technologies, including identifying the right partners in the recipient country, establishing good national coordination between institutions working on TNAs, NAMAs, and NAPs, and having an adequate research and development programme.

83. The CTCN expert responded that the technology mechanism created by Parties captures the full spectrum of technology transfer, diffusion and adoption. The CTCN, hosted by the United Nations Environment Programme (UNEP), will be fully operational soon and will start receiving requests from Parties through their national designated entities.[55] It will identify, based on TNAs, barriers to technology transfer and provide guidance on how to mitigate them. The impact of projects depends on how the recipients of the information and the technology system will implement the recommendations from the CTCN, including on changing policies and

[55] Some 30 countries identified such entities.

regulatory structures and on developing the capacity and skills needed. The CTCN will ask developing countries receiving assistance for feedback on its services and will adjust its activities accordingly.

84. The **questions on climate finance** included how climate finance needs compare to what has been provided,[56] if there is scope for expansion and possible improvement of the effectiveness of the Adaptation Fund and application of its best practices to the work of the Green Climate Fund and the TEC, when SCF will know the financial needs for the period ending in 2050 by sector and region and how these needs will be structured and communicated, and what the rate of co-investment is that will catalyse funding of climate projects and will keep the right appetite for risk.

85. A Party commented that funding for adaptation will be significantly lower for meeting the 1.5 °C rather than the 2 °C goal. Another Party was of the view that SCF should work on the long-term finance pathways needed to achieve the long-term global goal and the modalities for achieving this. Yet other Parties were of the view that the Adaptation Fund should be seen as the benchmark for adaptation finance, because it provides access to finance to national and regional implementation entities and that most support schemes worked when cross-cutting issues were considered (e.g. technical, economic and market potential).

86. Regarding the **support schemes that worked**, an expert gave an example of an oil-importing agreement with Caribbean States that allowed for partial payment combined with a loan at favourable rates, with the condition that the savings generated are invested in poverty eradication and renewable energy programmes. She said that extreme weather events and market signals generated by the price of oil should be the main drivers for climate finance and technology, but that markets failed to react to these drivers. Therefore, the new agreement should look at the market failures in each country and try to address them. The SCF should have also a role in this.

87. She also suggested that the CTCN should develop **a registry of proven technologies** and thus contribute to reducing the risk inherent in investing in climate technologies. She also said that the Adaptation Fund, which receives funding through the carbon market, will eventually dry up due to market failures. However, the Fund has proven to be one of the most efficient funds because the transaction costs were reduced by providing direct access to funds.

88. During the **general discussion**, a Party underlined that in some countries domestic carbon emissions are at their lowest level in two decades despite economic growth and noted that the UNEP Emissions Gap Report also showed **signs of a beginning of the decoupling of emissions from economic growth**. He talked about international efforts made outside the UNFCCC process to reduce emissions, including by reducing international financing for coal plans and cutting fossil fuel subsidies. Responding to this comment, the GEF expert noted that supporting fuel switching is one of the priorities of the GEF action plan.

89. Another Party underlined that it is making tremendous efforts to support mitigation action domestically and internationally, announced that they surpassed their pledged funding for fast-start finance, and that it is committed on scaling up the mobilization of climate finance in the context of meaningful mitigation action and transparency of implementation. Its GHG emissions in 2011 were reduced by 18 per cent compared to 1990, while the region's gross domestic product grew by 45 per cent in the same period.

90. Yet another Party commented that many developing countries have undertaken TNAs but that the technology transfer is not happening. Responding to this comment, the TEC expert said that countries need to follow up and implement the institutional, policy, regulatory and technology road map identified in TNAs. The TEC and the CTCN were created to support the countries' efforts on this matter.

91. Regarding a question on providing an example of when **intellectual property rights** prevented technology transfer and how this will be addressed, the TEC expert answered that this matter should not be addressed in the UNFCCC process but under the auspices of the World Trade Organization as part of trade-related aspects of intellectual property rights. He said that, in general, intellectual property rights facilitate and catalyse, not inhibit, the development of technologies. He also added that developing countries identified in their TNAs the lack of finance, policy and regulatory structures, as well as gaps in knowledge and human capacities, as key barriers to technology transfer. Intellectual property rights were not among these five key barriers, he added, and it is unfortunate that this issue has become a distraction from accelerating technology transfer. This point was echoed by the GEF expert.

[56] In the context of this question, a Party provided information on the amount of climate finance required from various sources, as well as on finance provided, as reported in the fifth national communications of Parties included in Annex I to the Convention. Another Party recalled that the commitment made by developing countries to mobilize short-term finance was not reported in those national communications.

92. One Party asked about the **role of the private sector in investing in adaptation**, from a business risk perspective, and about how Parties could **better engage subnational actors** to scale up action on mitigation and increase resilience, particularly in the pre-2020 period. The TEC expert answered that there is a trend of decentralization of the economic and political power to the subnational level, increasing the importance and role of subnational level actors as they become responsible for mitigation and adaptation projects. He also noted the importance of integrating national programmes with action by states and cities. For example, he noted that there are many corporations looking at making cities more resilient to climate change. He also talked about spatial integration as an additional dimension to sectoral integration and about improving vertical communications from local to city, state and national levels. The GEF expert noted that working with cities and local governments had been successful in the past, that the GEF would like to build on this good experience in the future and that mainstreaming adaptation in national planning was an important step forward.

93. Regarding a question on how the GEF has managed to implement a large number of projects at USD 1/tonne CO_2, the expert responded that the GEF has indeed financed many cost-effective clean energy and technology investments, which is part of GEF's role and design.

94. Regarding the question on **leveraging private sector investment** and the existence of **guidelines on the bankability of mitigation and adaptation projects**, the GEF expert said that such resources exist. He provided an example regarding the concentrating of solar power, where the GEF took on higher risks 15 years ago by investing in big technology projects in developing countries, and noted that this made possible the implementation of those projects, which are now in operation. In general, the GEF is looking at technologies that are at the end of the research and development pipeline and might be attractive in the future, such as smart grids, fuel switching and carbon dioxide capture and storage, as well as at new financial instruments and investments that integrate multiple benefits.

95. In response to a question, the SCF expert explained some of the **difficulties in defining what constitutes new and additional financing**, including in defining what a low-carbon technology is and what sort of role the TEC and the CTCN may play in the future in this matter, in deciding whether or not to count in this category those funds that are leveraged by a project, as well as in estimating the flows of funds countries may encounter delay or hurdles in receiving disbursed funds.

D. Reflections on second meeting of the structured expert dialogue

96. It is our perception that the discussions in Warsaw were very productive and informative and that they supported Parties in internalizing the key findings of AR5 WGI relevant to both themes of the review. SED 2 saw you engaging in a constructive and productive manner in all discussions with the IPCC and other experts.

97. Parties had a rich exchange of views with experts on the adequacy of the long-term global goal and the overall progress made so far towards achieving the long-term global goal, including the likelihood of meeting and maintaining the goal, on the basis of AR5 WGI. They also heard from experts some of the lessons learned on the effectiveness of technology and finance support. We congratulate you and the experts on this successful meeting and encourage you to maintain this positive spirit.

98. The presentations and discussions underlined some particular issues that might require consideration at the third meeting of the SED on the basis of the forthcoming contributions of WGII and WGIII to AR5, including:

(a) Risk management, including the relationship between risk and overshooting of the goal, geographical distribution of risks given regional differences in impacts and in economical or other costs of adaptation for various levels of warming;

(b) Underlying assumptions, feasibility and cost of impacts, mitigation, and adaptation in terms of RCPs and other scenarios considered by the IPCC, as well as temporal aspects of emission pathways while considering aspects such as short-lived GHGs and commitments in carbon infrastructure.

99. We believe that our approach to the SED meeting worked well, and we will continue to consider the two themes of the review in parallel, maintaining the balance between them in terms of the time allocated to them, the format of activities, and the experts and panellists invited from developed and developing countries. We also believe that an adequate amount of time was allocated to our meeting and we aim to make similar arrangements for the consideration of the contributions of WGII and WGIII to AR5.