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IPCC TRUST FUND PROGRAMME AND BUDGET

Workshop on the Use of Scenarios in AR6 and Subsequent Assessments

(Prepared by the Co-Chairs of Working Groups I, II and III)

(Submitted by the Secretary of the IPCC)

Workshop on the Use of Scenarios in AR6 and Subsequent Assessments

Rule 7.1 on IPCC Workshops and Expert Meetings in the Appendix A to the Principles Governing IPCC Work establishes, inter alia, that “IPCC Workshops and Expert Meetings are those that have been agreed upon in advance by an IPCC Working Group, or by the Panel as useful or necessary for the completion of the work plan of a Working Group, the Task Force on National Greenhouse Gas Inventories or a task of the IPCC. Only such activities may be designated as “IPCC” Workshops or Expert Meetings. Their funding should include full and complete provision for participation of experts from developing countries and countries with economies in transition” “An *IPCC Workshop* considers cross-cutting or complex topics requiring input from a broad community of experts. It requires nominations by Government Focal Points and, as appropriate, observer organisations. The relevant Working Group/Task Force Bureaux, or the IPCC Chair, may also nominate experts and will select the participants to the Workshop” “Proposals for IPCC Workshops or Expert Meetings will be submitted to the Panel for its decision through the relevant Working Group/Task Force Bureaux, or the IPCC Chair. The proposals will include descriptions of the topic(s) and clarify the choice for an Expert Meeting or a Workshop”.

Noting that the topic of scenarios is complex and cuts across multiple disciplines, and thereby requires input from a range of scientific communities and scenario users, this proposal is for an IPCC Workshop (IPCC-LIV(bis)/Doc. 2, Add. 2, Rev.1).

The IPCC Trust Fund Programme and Budget submitted to the Fifty-Fourth (Bis) Session of the IPCC (IPCC-LIV(bis)/Doc. 2) includes a request for the addition of a budget line to the proposed budget for 2022 for a Workshop on the Use of Scenarios in AR6 and Subsequent Assessments (up to 120 participants). The requested provision is an increase in budget of CHF 280,800, which comprises DC/EIT support of CHF 240,000 (60 journeys) and Other expenditure of CHF 40,800.

The proposal for a Workshop on Scenarios contained in Annex 1 has been prepared jointly by the Co-chairs of Working Groups I, II and III with the support of their respective Bureaux.

The IPCC is invited to consider this proposal and authorize the use of the above mentioned budget line for the funding of the Workshop.

Proposal for an IPCC Workshop on Scenarios

(Prepared by the Co-Chairs of Working Groups I, II and III)

1. Context

Scenarios provide a key integrative mechanism for linking the assessments of Working Groups (WGs) I, II and III. Working with the relevant scientific communities, IPCC has used the SRES¹ scenarios, representative concentration pathways (RCPs), shared socioeconomic pathways (SSPs) and “illustrative pathways” as methods to investigate the future implications of different developments and actions, as part of its assessments during the Fifth Assessment (AR5) and Sixth Assessment (AR6) cycles.

Ongoing challenges include:

- timeliness, given the time needed for scenarios development and publication by the scientific community, and their subsequent assessment by IPCC;
- innovation in the use of scenarios as part of the IPCC process, transparency and the boundary between research activities and the assessment process;
- ongoing scientific challenges associated with linking the approaches to quantify uncertainties when addressing physical aspects of the Earth system with different approaches needed to address uncertainties about socio-economic developments; and
- challenges in the IPCC timeline and process for implementing a coordinated and consistent assessment of possible futures across the WGs.

The purpose of the proposed Workshop is to address these challenges, both from a scientific perspective and with regard to the institutional processes linking the relevant scientific communities to the IPCC assessment.

2. Previous practice and forthcoming initiatives

Current arrangements for the allocation of responsibilities between IPCC and the relevant research communities with respect to socio-economic scenarios were developed at the IPCC Workshop on New Emission Scenarios held at Laxenburg in 2005,² and subsequently agreed by the Panel. To assure credibility, the arrangements envisaged the scientific community taking a driving role, with IPCC providing advice. This broke with previous practice whereby IPCC developed its own scenarios. Subsequently, meetings and activities have been organized both inside and outside the IPCC.

¹ Special Report on Emission Scenarios (2000). These were first used in AR4, but are still occasionally used in the literature assessed by WG II.

² IPCC, Workshop on New Emission Scenarios 29 June – 1 July 2005 (Meeting report), <https://archive.ipcc.ch/pdf/supporting-material/ipcc-workshop-2005-06.pdf>

In 2007, the Integrated Assessment Modelling Consortium (IAMC) was established to lead the development of new scenarios. In 2008, at the Noordwijk Expert Meeting,³ IPCC decided to organise AR5 around a set of scenarios – “representative concentration pathways” (RCPs) – whose starting point was GHG concentrations rather than socio-economic drivers. This broke with the practice with the SRES (Special Report on Emission Scenarios) scenarios used in TAR and AR4. The adoption of the RCPs involved a “parallel process”, whereby the research communities associated with WG III worked backwards to derive emission pathways consistent with these concentration pathways, while the communities associated with WG I worked forwards to derive the climatic outcomes of these concentrations, including ocean changes, and the WG II community elaborated the related impacts. This largely defined the scenarios approach during AR5.

Late in the AR5 cycle, but too late for the AR5 assessment, the community developed five narrative-based shared socio-economic pathways (SSPs) based on the capacity of societies to mitigate and adapt to climate change, thus strengthening the WG II perspective. The SSPs can be combined with the RCPs in a two-dimensional space mapping concentrations levels and socio-economic background.⁴ The SSPs have been adopted during the AR6 cycle: SSP/RCP combinations underpinned some of the scenarios assessed in the Special Report on Global Warming of 1.5°C; are explicitly cited in the Special Report on Climate Change and Land; climate simulations driven by a core sub-set of five SSP “illustrative” scenarios are assessed in the AR6 WG I report; and SSPs are explicitly in the approved scope of the AR6 WG III report. The Special Report on the Ocean and Cryosphere in a Changing Climate assessed literature based on the RCP scenarios while the AR6 WG II report also has limited coverage of literature based on the SSPs.

IPCC organised two Expert Meetings on scenarios in AR5 and AR6. These included the cross-WG Expert Meeting on Scenarios held in IIASA, Laxenburg in 2015,⁵ and the WG III IPCC Expert Meeting on Mitigation, Sustainability and Climate Stabilisation Scenarios held in Addis Ababa in 2017.⁶ Each of these meetings generated sets of recommendations for IPCC and relevant research communities. Among the 2017 recommendations for IPCC were: to strengthen cross-Working Group collaboration on scenarios; consider carefully how to use the SSPs; and establish a clearer distinction between ‘assessment’ and ‘research’. Among the recommendations for the research community were: to establish a scenario database that includes relevant scenarios from a variety of sources; to enhance transparency by being more explicit about assumptions, trade-offs, and uncertainties; and to broaden the range of people (including social scientists, businesses and other stakeholders) involved in the design of storylines that feed into scenarios.

Meanwhile the World Climate Research Programme (WCRP), co-sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), and the International Science Council (ISC), organizes the Coupled Model Intercomparison Project (CMIP), which sets standards for modelling the Earth system from a physical perspective. An important aspect of CMIP is the coordinated effort to produce future climate projections, and this relies directly on specification of forcing scenarios (historical and future pathways of greenhouse gas emissions and concentrations, land-use change, and other drivers). The results from its 6th phase, CMIP6,⁷ relied on a set of eight alternative 21st century scenarios and a set of long-term extensions (with a priority core set) and these results featured

³ Moss, R. et al; 2008. Towards new scenarios for analysis of emissions, climate change, impacts, and response strategies (p. 132). Intergovernmental Panel on Climate Change.

⁴ O’Neill, B. C., Kriegler, E., Riahi, K., Ebi, K. L., Hallegatte, S., Carter, T. R., Mathur, R., & van Vuuren, D. P. (2014). A new scenario framework for climate change research: The concept of shared socioeconomic pathways. *Climatic Change*, 122(3), 387–400. <https://doi.org/10.1007/s10584-013-0905-2>

⁵ https://www.ipcc.ch/site/assets/uploads/2018/05/EMR_Scenarios-1.pdf

⁶ <https://www.ipcc.ch/event/ipcc-expert-meeting-on-mitigation-sustainability-and-climate-stabilisation-scenarios-26-28-april-2017-addis-ababa-ethiopia/>

⁷ <https://gmd.copernicus.org/articles/9/1937/2016/gmd-9-1937-2016.html>

prominently in the WGI contribution to AR6. CMIP7 is now in the planning phase, and will undoubtedly feature prominently in the AR7. A subset of climate scenarios from the CMIP6 ScenarioMIP projections is also the focus of the CORDEX dynamical downscaling. Further initiatives, some also laid out as model intercomparison projects (e.g. Fish MIP, Ag MIP), include impact modeling efforts for biodiversity, biomass, fisheries, agriculture etc.

The *Integrated Assessment Modelling Consortium* (IAMC), established following the IPCC's decision to step back from producing its own socio-economic scenarios in 2005, facilitates and fosters the development of integrated assessment models (IAMs), including model diagnosis, intercomparison, and coordinated studies. It also promotes interactions between IAMC members and members of other scientific research communities including earth system modelling, the impact, adaptation, and vulnerability (IAV) community and the technology and engineering communities. IAMC holds annual meetings.

The self-organised *International Committee on New Integrated Climate Change Assessment Scenarios* (ICONICS) brings together climate change researchers from a broad range of perspectives and disciplines to develop policy-relevant scenarios, and explore the implications of different possible futures for the challenges and opportunities human and natural systems could face with increasing climate change. ICONICS is running a major scientific *Forum on Scenarios for Climate and Societal Futures* in June 2022.

The Analysis, Integration and Modeling of the Earth System project (AIMES)⁸, is a global research project of Future Earth that develops innovative, interdisciplinary ways to understand the structure, dynamics and evolution of the natural and social complex system, including integrative Earth-system modeling (development of increasingly complex coupled models of climate, biogeochemistry, ecology and human dimensions).

The purpose of the proposed Workshop is not to duplicate these activities or to take on tasks that belong to the scientific community. The purpose is rather to review IPCC's needs with respect to its assessment activities, the interaction between the Working Groups, and how it interacts with the relevant scientific communities and organisations.

3. Progress during the Sixth Assessment (AR6) cycle

Scenarios have played a significant role enabling coordinated assessment activities during AR6 both within and across Working Groups. The principal framework has been the RCP/SSP (representative concentration pathways/shared socio-economic pathways) matrix approach which combines levels of climate forcing with a range of possible backgrounds for socio-economic development.

WG I employed a core set of five “illustrative” scenarios based on five RCP/SSP combinations. These were driven by emissions projections derived from the integrated assessment models (IAMs) assessed by WG III. The Earth system models (ESMs) assessed during the CMIP6 process proceeded under the auspices of the World Climate Research Programme (WCRP). CMIP6 generated climate projections at both global and regional levels. RCPs have been used to generate regional climate projections which were then available for use in the WG II report on impacts, adaptation and vulnerability.

Work in the WG I domain has resulted in the further development of climate model emulators, simple physically-based models that are used to approximate the large-scale climate responses of complex ESMs. The calibrated physically-based emulators can adequately reflect assessments regarding future global mean surface temperature and knowledge about climate system behaviour. These have been used by WG III to derive probabilistic ranges for key climate variables for any given emission pathway. Their application in WG III ensures consistency with WG I assessment in the calculation of temperature responses to emissions.

⁸ <https://aimesproject.org/>

Endorsed by WG III, the Integrated Assessment Modelling Consortium (IAMC) has facilitated, as it did in AR5, the establishment of a scenario database hosted by the International Institute for Applied Systems Analysis (IIASA). A database was established to hold data from published scenarios assessed in the Special Report on Global Warming of 1.5°C (SR15) and a separate database has been established for scenarios assessed in the WG III contribution to AR6. This latter database now includes input assumptions as well as outputs, and covers national and regional as well as global models, including non-IAMs and sectoral models. The AR5 and SR15 scenario databases have enabled active secondary research activity which has contributed to the literature available for assessment by IPCC.

A further development in SR15 and the WG III AR6 assessment has been the use of “illustrative pathways” (distinct from the “illustrative scenarios” used in the WG I AR6 report). Each of these is based on an individual modelled pathway taken to represent a particular class of scenario with a particular narrative, and which can be used to explore and communicate more effectively the implications of different levels of climate ambition and mitigation portfolios.

Thus, considerable progress has been made, with developments at the interfaces between the Working Groups proving particularly scientifically fruitful. Topics such as net zero CO₂ emissions, net zero GHG emissions, remaining carbon budgets, peak warming, and CO₂ vs non-CO₂ forcers, or risk assessments viewed through a probabilistic framing, have all benefited from these interdisciplinary efforts.

Nevertheless, some challenges may be identified. The RCP/SSP framing takes a different approach to uncertainty, compared with Earth system modelling which is amenable to more formalised probabilistic approaches. WG II assesses literature based on a broad range of disciplines taking a diversity of approaches. This is reflected in their less comprehensive use of scenarios. WG II has focused on climate outcomes based on central estimates of climate sensitivity for each of the RCP/SSP combinations, based on the core set of scenarios corresponding to CMIP6 simulations assessed in the WG I report.

The time taken to propagate scenarios and their assumptions through the literature and the IPCC assessment process means that the WG I “illustrative scenarios” rely on socio-economic projections produced several years ago: the SSPs were first published in 2016 since which time many technical, economic and social changes have taken place (e.g. COVID, enhanced climate ambition, technology deployment).

Models, scenario development and data curation are essentially unfunded and rely on voluntary efforts “piggy-backed” on projects funded with other aims in mind. This can contribute to a blurring of the lines between research conducted by the community and assessment conducted by IPCC.

The proposed Workshop has three objectives: 1) to advance the scientific agenda associated with scenario development and use with attention to overall scenario architecture; 2) to consider ways of further enhancing cross-Working Group collaboration; and 3) to consider institutional aspects, including the relationship between IPCC and relevant scientific bodies such as WCRP and IAMC, and resourcing issues. The recommendations of the Noordwijk Expert Meeting on Scenarios held in 2007 is pertinent to the third objective.

4. Goals of the Workshop

The Workshop would have the following goals:

- To take stock of the contribution of scenarios to the AR6 products, and the strengths and weaknesses of the approaches adopted;
- To identify any gaps in the AR6 scenario approach, taking account of the needs and expectations of government and other users;

- To consider how best to build on the RCP/SSP framework adopted in AR6 and possible scenario architectures for AR7 and beyond;
- To consider innovations in the scenario approach which could be pursued in concert with the relative research communities, for instance related to biodiversity;
- To consider how to further develop cross-Working Group collaboration on the use of scenarios;
- To address any improvements in the institutional mechanisms for developing, applying and curating scenario data and the respective roles of IPCC and the modelling communities. The role of TG Data is relevant in this respect; and
- To consider how the diversity of contributors to scenario-building processes could be improved.

5. Participation

The Workshop would engage modelers and scenario builders from the WG I, II and III domains as well as scientists from a range of disciplines and scenario users in governments and other stakeholder groups. Relevant communities include:

- Modelers and scenario builders with expertise in the physical science, natural and socio-economic aspects
- Experts on the physical science of climate change
- Domain experts in adaptation and mitigation
- Experts in biodiversity and ecosystem services
- Scientists with relevant cross-cutting socio-economic perspectives, e.g. economists, social scientists
- Representatives of IPCC member governments
- Stakeholders from the relevant UNFCCC constituencies⁹

6. Timing and format

We propose that the Workshop take place over three days in the last quarter of 2022 following the approval of the AR6 Synthesis Report and COP27. This then allows all the AR6 products, and reactions to them by governments and other stakeholders, to be taken into account. It also allows the Workshop report and any recommendations arising to be finalised before the end of AR6, for consideration by the Panel and the elected scientific leadership for AR7. In the event that this deadline proves infeasible, a second option is early in 2023 prior to the AR7 Bureau elections. We are proposing that 120 individuals attend the Workshop, with equal participation from developing and developed countries.

7. Hosting

The Co-chairs are seeking a host for this Workshop.

⁹ Business and industry NGOs; Environmental NGOs; Farmers; Indigenous peoples organizations; Local government and municipal authorities; Research and independent NGOs; Trade unions; Women and Gender; and Youth.