# Appendix IV

## 1. Emissions Scenarios

For the future climate change estimation we have to know concentration of greenhouse gases and other atmosphere pollutants in years to come. These concentrations depend on their emission from different sources, natural as well as man-made.

Emission scenarios describe emission of the greenhouse gases, aerosols and other atmospheric pollutants together with information about land use and land cover in the future, and ensure inputs for climate models. They are based on the assumptions about driving forces like economy and population growth, technology development and other. Levels of future emissions are highly uncertain as well as probability of scenarios realization, therefore scenarios give perspective how future might look like. Scenarios assist in climate change analysis, including climate modeling and the assessment of impacts, adaptation, and mitigation.

Special report on emission scenarios (SRES) was published by IPCC in 2000. It describes emission scenarios that are used for climate projections for the Fourth IPCC Report. For development of new scenarios for the Fifth IPCC Report (expected to be completed in 2014) Representative Concentration Pathways (RCPs) are published.

## 2. The SRES Scenarios

IPCC group in 2000 has published 40 different emission scenarios depending on the assumptions for future greenhouse gas pollution, land-use and other driving forces. Scenarios similar to each other are organized into families. The major families of SRES emissions scenarios are:

- The A1 - very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. It includes convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family has three groups which differ in technological development: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B).

- The A2 - a very heterogeneous world which means self-reliance, preservation of local identities and continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines.

- The B1 - convergent world with the same global population that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid changes in economic structures and the introduction of clean and resource-efficient technologies. The stress is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.

- The B2 - a world in which point is on local solutions to economic, social, and environmental sustainability. Global population continuously increase at a rate lower than A2, intermediate levels of economic development, and technological change less rapid and more diverse than in the B1 and A1 storylines.

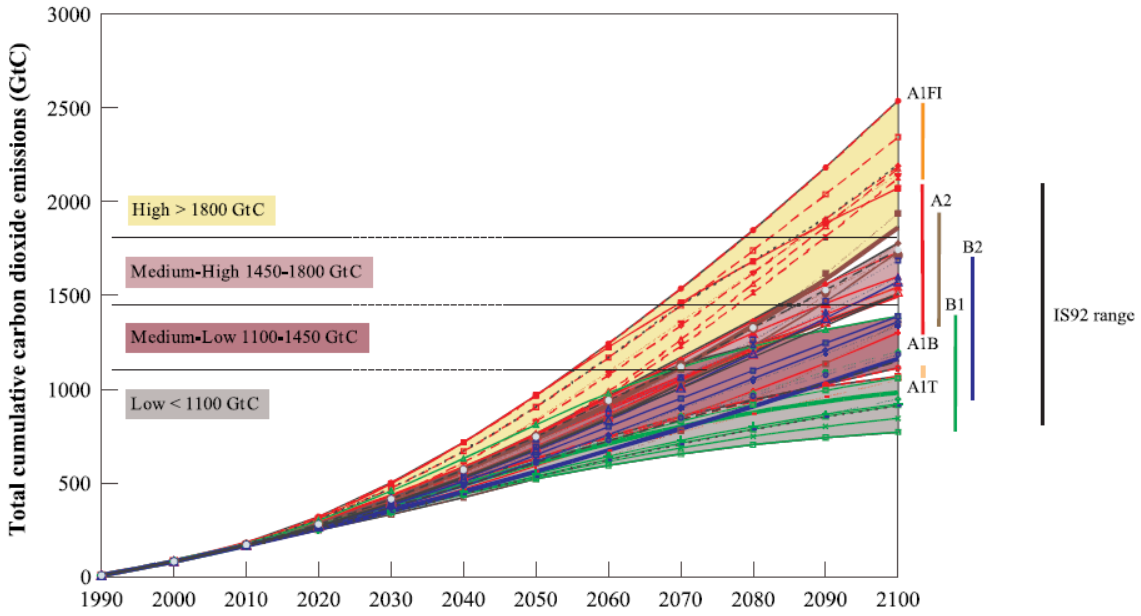


Figure 1. Carbon emissions for four emission scenarios

## 3. Representative Concentration Pathways (RCPs)

RCPs are not new, fully integrated scenarios. They do not present package of socioeconomic, emission and climate projections. Wide spectrum of socio-economic and technological development scenarios can lead to the same radiative forcing. RCPs are sets of projected radiative components that depend on changes in atmospheric composition, but do not include direct impacts of land use (albedo) or the forcing of mineral dust. These sets serve as input for climate models, pattern scaling, and atmospheric chemistry modeling and will be used for Fifth IPCC Report. Four RCPs are chosen and named according to their radiative forcing in 2100 (Table 1.). RCPs with lower forcing (RCP6.0, RCP4.5 and RCP2.6) are not derived from the one with higher forcing (RCP8.5, or even RCP6.0). That implies that differences between RCPs can be assigned to differences between models and scenarios assumptions (scientific, economic, and technological).

Table 1. Overview of Representative Concentration Pathways (RCPs)

| | |
|---|---|
| RCP 8.5 | Rising radiative forcing pathway leading to 8.5 W/m² in 2100. |
| RCP 6 | Stabilization without overshoot pathway to 6 W/m² at stabilization after 2100 |
| RCP 4.5 | Stabilization without overshoot pathway to 4.5 W/m² at stabilization after 2100 |
| RCP 3-PD2 | Peak in radiative forcing at ~ 3 W/m² before 2100 and decline |

- The RCP2.6: scenarios with very low greenhouse gas concentration levels. It is a so-called "peak" scenario. In order to reach radiative forcing levels, greenhouse gas emissions (and indirectly emissions of air pollutants) are reduced substantially over time.
- The RCP4.5: stabilization scenario where total radiative forcing is stabilized before 2100 by employment of a range of technologies and strategies for reducing greenhouse gas emissions.
- The RCP6.0: stabilization scenario where total radiative forcing is stabilized after 2100 without overshoot by employment of a range of technologies and strategies for reducing greenhouse gas emissions.
- The RCP8.5: is characterized by increasing greenhouse gas emissions over time representative for scenarios in the literature leading to high greenhouse gas concentration levels.

### *3.1 RCP post-2100 extensions*

The extension of the scenarios beyond 2100 will be done using simple algorithms intended for use as pathways to drive long-term earth-system simulation experiments and is not the result of integrated assessment analysis or modeling. In order to provide data needed for conducting long-term climate change projections the concentration values from these scenarios have been extended. These extensions, the so-called ECPs (Extended Concentration Pathways), were calculated using simple rules developed in a series of stakeholder consultations. These do not represent fully consistent scenarios. The rules used for the extension are:

- RCP3PD: Constant emissions after 2100.
- RCP4.5: Constant concentrations after 2150 with smooth transition between 2100 and 2150.
- RCP6.0: Constant concentrations after 2150 with smooth transition between 2100 and 2150.
- RCP8.5: Constant emissions after 2100 and constant concentrations after 2250 with smooth transition of emissions between 2150 and 2250.

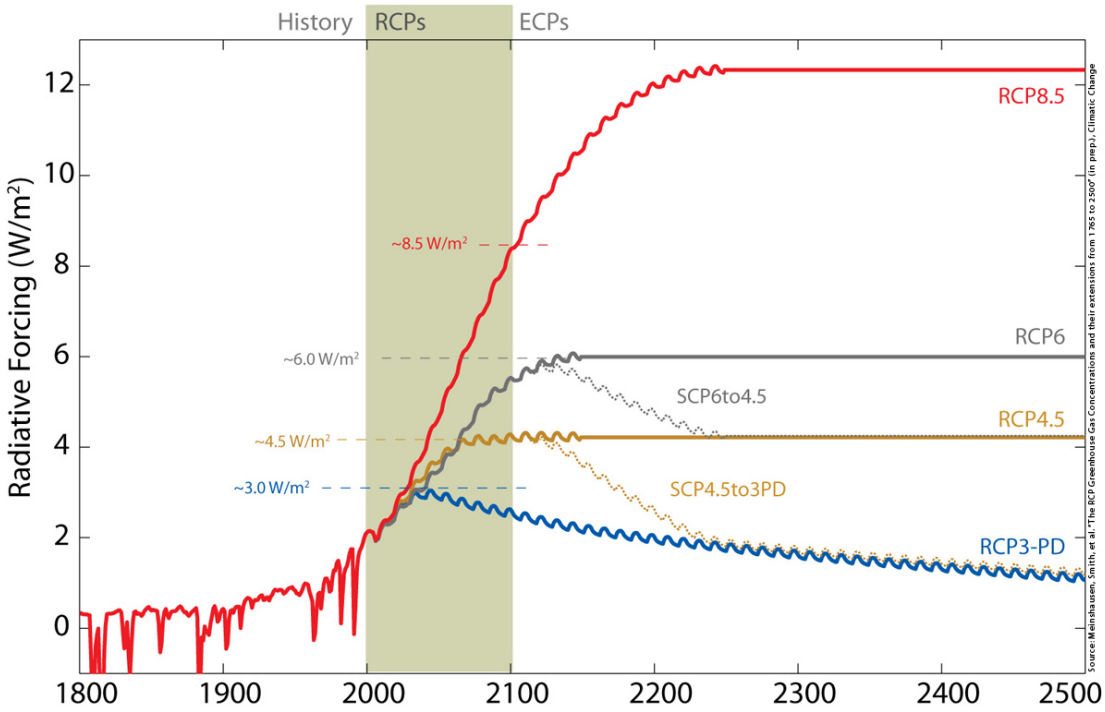


Figure 2. Global Anthropogenic Radiative Forcing. In addition, two supplementary extensions are shown, connecting RCP6.0 levels to RCP4.5 levels by 2250 (SCP6TO45) or RCP4.5 levels to RCP3PD concentrations and forcing (SCP45to3PD).

## 4. Conclusion

As agreed in the meeting held in Vienna our task is to propose the low and the high emission scenarios. To be in line with Project Proposal we suggest all project partners to use the RCP4.5 as low emission and RCP8.5 as high emission scenario.

## 5. Reference

http://www.wmo.int
https://tntcat.iiasa.ac.at:8743/RcpDb/dsd?Action=htmlpage&page=welcome
http://www.pik-potsdam.de