



Emission scenarios in IPCC Reports 1990-2020

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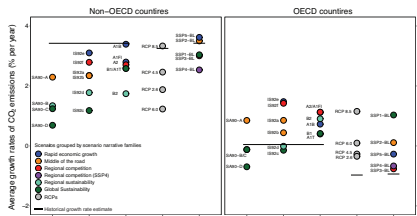
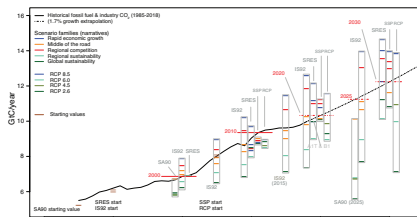
Validation of Emission Scenarios: “An Assessment of the Performance of Scenarios against Historical Global Emissions for IPCC Reports”

Global Environmental Change, Elsevier (Accepted October 2020).

CO2 emissions from fossil fuel and Energy

Global emissions followed a medium-high emissions pathway well within scenario ranges. The historical period covered both high and medium-low growth sub-periods, highlighting the importance of long-term (rather than short-term) assessments.

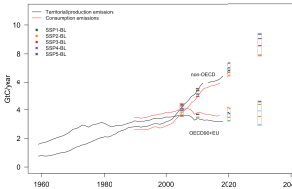
Historical carbon-dioxide emissions against the emissions scenarios (SA90, IS92, SRES, RCP/SSP) informing IPCC assessment reports between 1990 and 2021



Regionally, difference in emissions growth rates between non-OECD and OECD has widened.

Consumption-based may be a better indicator for UNFCCC processes?

Territorial emission expresses the emissions produced inside a country (used now). Consumption-based emissions consider also the goods consumed (e.g., imported from other countries) and thus international trade (Global Carbon Project, 2019).

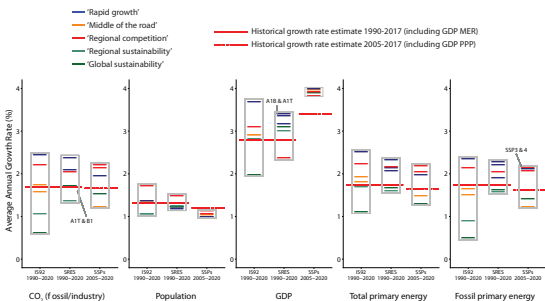


Emissions from the manufacture of traded goods and services are increasing².

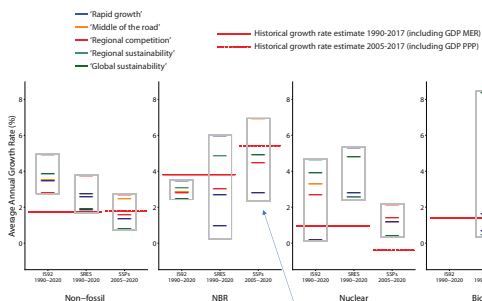
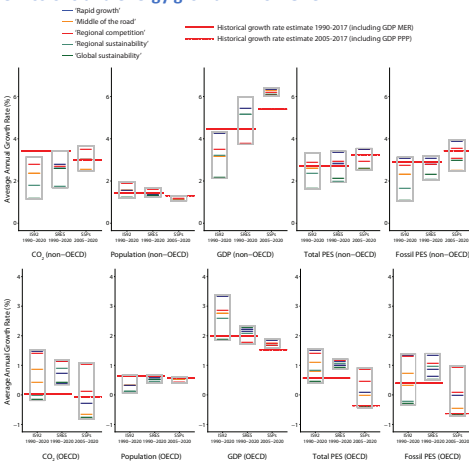
EU-28 and North America are the two regions that export the largest number of emissions². When adjusting for consumption, per capita emissions decline in India by -0.1 and China by -0.9 tons CO₂/person, while they increase by 1.3 and 1.4 tons CO₂/person for the United States and EU^{3,4}, respectively.

Socioeconomic projections versus historical developments

Global: Historical trends are within the ranges of scenarios projections are



Non-OECD & OECD: Scenarios almost overestimated emissions and energy growth in non-OECD



The projected growth in global Non-biomass renewables (NBR) in SSPs may be too conservative

References

1. Pedersen, J. T. S. et al. An Assessment of the Performance of Scenarios against Historical Global Emissions for IPCC Reports. Global Environmental Change (2020).
2. Peters, G. P., Davis, S. J. & Andrew, R. A synthesis of carbon in international trade. Biogeosciences 9, 3247–3276 (2012).
3. GCP. Supplemental data of Global Carbon Budget 2019 (Version 1.0) [Data set]. (2019). doi:10.18160/gcp-2019
4. WB. Population, total. The World Bank Data (2019). Available at: <https://data.worldbank.org/indicator/SP.POP.TOTL>.

Scenario literature

- SA90: IPCC. *Climate Change: The IPCC Response Strategies, Working Group III*. (1990).
- IS92: Leggett, J. et al. Emissions scenarios for the IPCC: an update. *Climate change 1992: the supplementary report to the IPCC scientific assessment* 69–95 (1992).
- SRES: Nakicenovic, N. & Swart, R. *Special Report on Emissions Scenarios*. (Cambridge University Press, 2000).
- RCP: van Vuuren, D. P. et al. The representative concentration pathways: an overview. *Climate Change* 109, 5–31 (2011).
- SSP: Riahi, K. et al. The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change* 42, 153–168 (2017).

Authors

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Box: Scenario definitions and successive developments 1988-2020

Emission scenarios represent plausible, challenging, and relevant narratives of how the future might unfold under a consistent set of assumptions. The qualitative narratives (from SRES onwards) provide a logic underlying the quantitative scenario elements and aim to provide a basis for further elaborating on the scenarios by users, such as researchers and policymakers.

SA90 scenarios. The series covers two baselines and two intervention scenarios. Used in the first IPCC Assessment report (AR1).

IS92 scenarios. An update of SA90 and the first series to provide estimates for the full suite of GHGs. It adjusted the non-intervention scenarios of SA90, with two emissions scenarios similar to (IS92a/b) and two higher (IS92c/f) than SA90-A - of “medium-high” and “high” cumulative emissions pathways. The IPCC mandate explicitly excluded the development of new climate policy scenarios. Included in three IPCC assessment reports (AR2, AR3 (impacts), AR4 (impact)).

SRES scenarios introduced the concept of storylines/narratives. These socioeconomic scenarios derived alternative quantitative futures with no-policy assumptions from four so-called scenario families/narratives, represented by four markers and two illustrative scenarios, including scenarios narrowing the North-South income gap. SRES were included in literature informing IPCC AR3 and AR4.

RCP/SSP scenarios. The RCPs originally comprised four abstract emissions pathways, developed to explore a wide range of possible climate futures. The RCP4.5, RCP6, and RCP8.5 could represent baselines (i.e., low, medium, and high emission futures). At the same time, RCP2.6 implies climate policy. The SSPs comprise five narratives partly inspired by the SRES. They were designed to span a range of futures regarding the socioeconomic challenges to mitigation and adaptation. The SSP-RCP combinations include additional three radiative forcing levels by 2100 (7.0, 3.4, and 1.9 Wm⁻²). Here the 1.9 Wm⁻² explores the 1.5 °C goal defined by the Paris Agreement. Requested by the UNFCCC