Feasible 2020 emission windows for staying below 2°C *ensuring consistency despite uncertainty*

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1. Context

- 2°C limit (UNFCCC, Ref. 1)
- Greenhouse gas budget (Ref. 2)
- Country pledges for 2020 reductions

Poorly quantified of relationship between short-term policy and its long-term climate outcome

2. Research question

"What is the window of emissions in 2020 for which technologically and economically feasible emissions scenarios exist that limit global temperature increase to below 2°C with a likely (>66%) chance?"

in other words,

"Is there a 'point of no return' by 2020 that, if exceeded would foreclose reaching 2°C in the long term?"

3. What is 'feasible'?

Feasibility is a subjective concept, entirely dependent on what is deemed possible or plausible in the real world.

Feasibility is judged here based on:

a) short-term technological feasibility
b) long-term technological feasibility
c) strong economic penalties
d) very strong economic penalties

4. Methodology

Integrated modelling approach:

a) MESSAGE (Ref. 4,5)
- detailed representation of GHG emitting sectors
- create feasible energy system transformation pathways to stay <2°C in a 2-stage approach

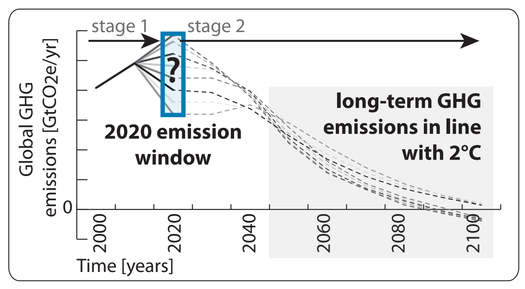
b) MAGICC (Ref. 5,6)
- probabilistic climate model
- computes transient temperature increase ranges over the 21st c.

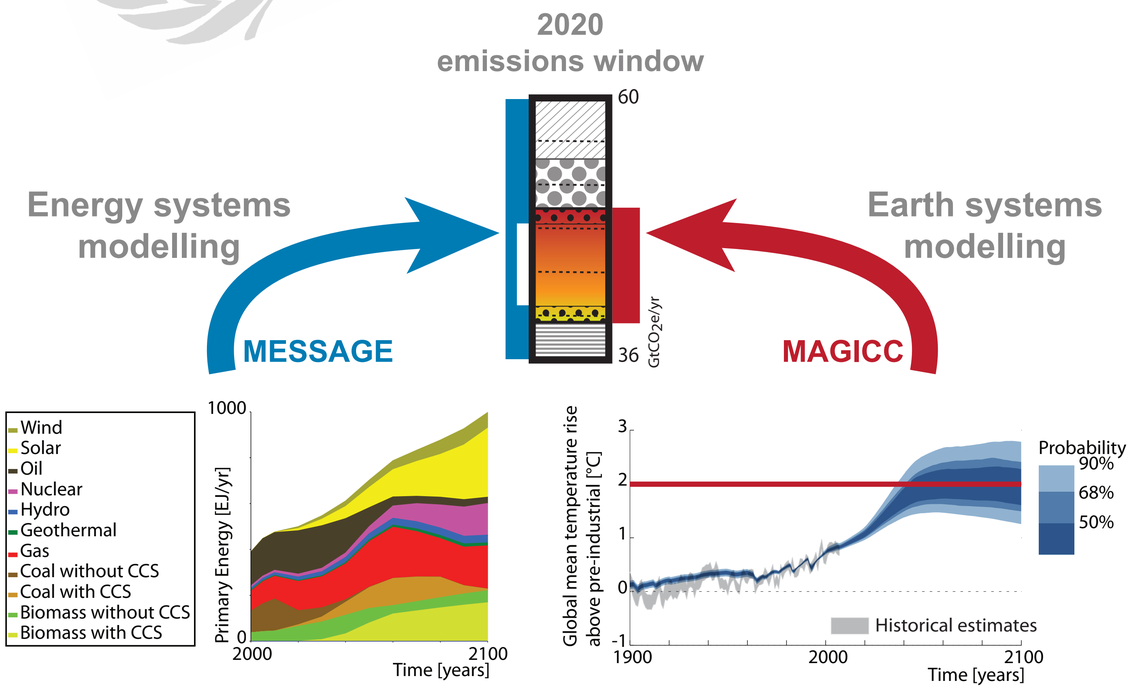
Twenty-four cases (based on Ref. 7):
- technology portfolio - 6 variations
- energy demand - intermediate, low
- political framework - delayed participation, 1.5°C emission budget

5. Schematic overview

Climate policy

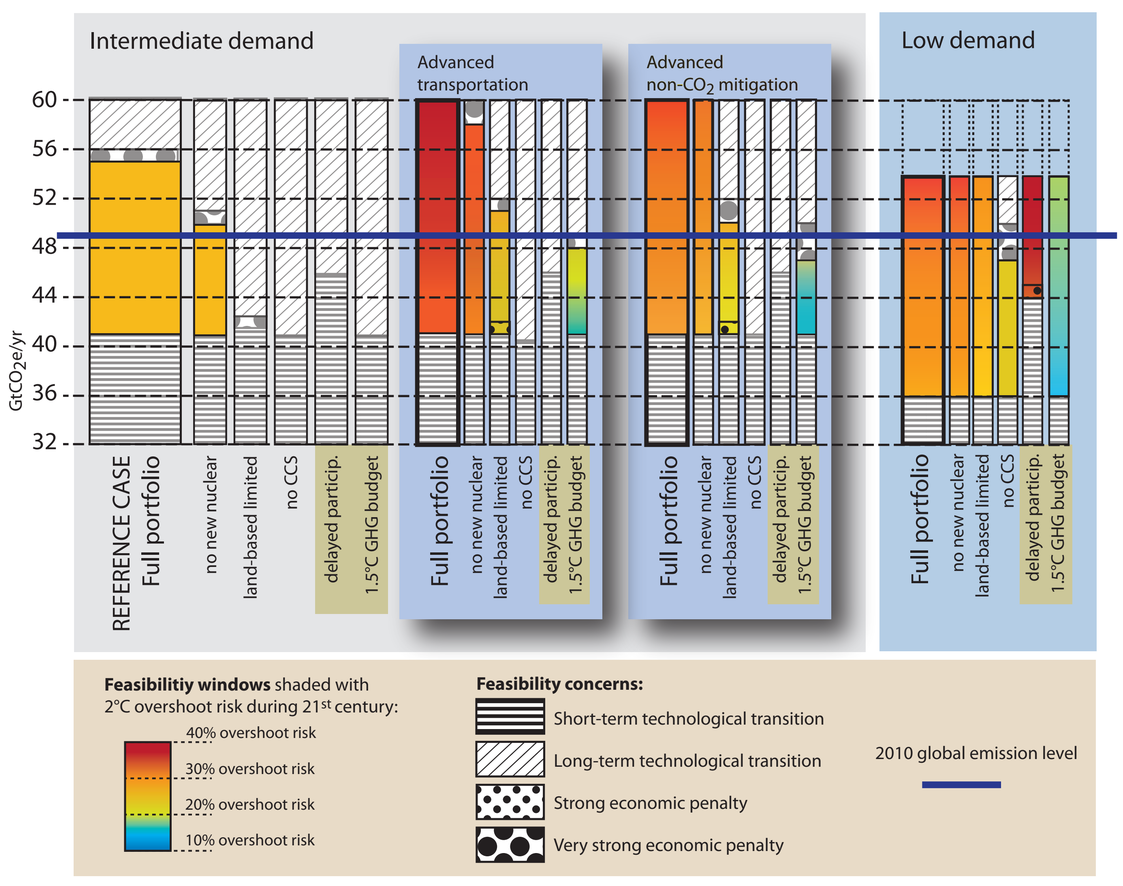
Scientific modelling





6. Results

feasible 2020 emission windows for staying below 2°C



7. Main conclusions

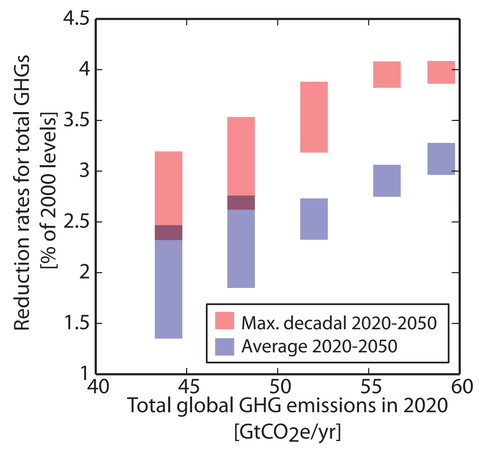
a) Current pledges (50-55 GtCO2e/yr, Ref. 8) not on robust path to 2°C
b) 41-47 GtCO2e/yr emission window in 2020 keeps most options open to stay <2°C, and the possibility to return below 1.5°C by 2100
c) Lowering future energy demand and CCS is paramount
d) Delay in full participation significantly reduces options
e) High 2020 emission imply higher long-term costs

8. Additional results

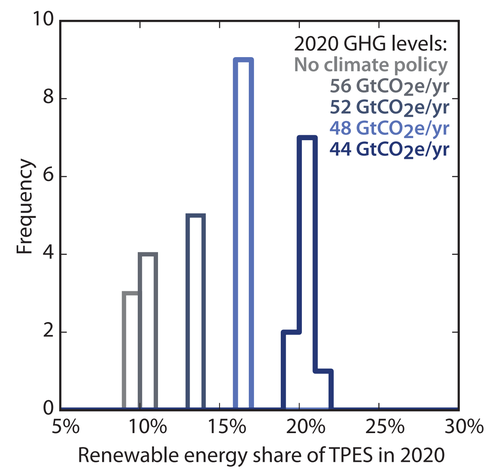
a) Costs (energy system)
- until 2020: higher costs for lower 2020 levels
- post 2020: ~44 $GtCO_2e/yr$ in 2020 minimizes costs over the 21st century

Current pledges (50-55 $GtCO_2e/yr$) imply ***higher long-term costs***
- 13-21% higher from 2020-2050
- 20-41% higher from 2020-2100

b) Reduction rates



c) Renewable shares in 2020



9. References & Acknowledgments

References:
(1) FCCC/CP/2010/7/Add.1 Decision 1/CP.16 (UNFCCC, 2010); (2) Meinshausen, M. *et al.* Nature, doi:10.1038/nature08017 (2009); (3) Riahi, K. *et al.* Tech. Forecast. and Soc. Ch. (Special Issue) 74, 887-935 (2007); (4) Rao, S. & Riahi, K. Energy Journal 27, 177-200 (2006); (5) Meinshausen, M. *et al.* Atmos. Chem. Phys., doi:10.5194/acp-11-1417-2011 (2011); (6) Rogelj, J. *et al.* Nature Clim. Change, doi:10.1038/nclimate1385 (2012); (7) Riahi, K. *et al.* in Global Energy Assessment - Chapter 17 (2012); (8) UNEP. Bridging the Emissions Gap (UNEP, 2011)

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