The probability to reach the 2°C target

What would be needed to reach this target?
RCP 2.6

- Peak in 2020/2025
- 40-50% reduction in 2050
- Net negative for CO₂ in 2100
RCP 2.6

- Nuclear
- Renewables
- Biofuels + CCS
- Oil + CCS
- Biofuels
- Oil

Major changes in the global energy system

Default

BioEnergy + CCS (BECS)
IMAGE 2.6

- Published in Climatic Change (2007), Energy (2007)
- Further review by IAMC

- Implemented in energy system model / physical world oriented IAM by cost-optimisation over time reducing abatement costs (all gases, land use)
- Most important measures include energy efficiency, CCS, bio-energy + CCS… non-CO$_2$, nuclear, renewables
Most information now available at 0.5x0.5 degree
### Table: Description of scenario literature on medium to low mitigation scenarios

<table>
<thead>
<tr>
<th></th>
<th>Peaking year</th>
<th>2050</th>
<th>No. of scenarios</th>
<th>Cumulative emission 2000-2050</th>
<th>Cumulative emissions 2000-2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>&lt;2020</td>
<td>-55 to -25 (-60 to -30)</td>
<td><strong>25 (18)</strong></td>
<td>280-430</td>
<td>385-485</td>
</tr>
<tr>
<td>III</td>
<td>&lt;2040 (&lt;2030)</td>
<td>-30 to 25</td>
<td><strong>79 (21)</strong></td>
<td>355-460</td>
<td>550-655</td>
</tr>
</tbody>
</table>

Note: Table account for the studies included in AR4, EMF-22, the ADAM project and the Rao et al. (2008) study.
Questions based on being the lowest

Range of Scenarios published so-far

Emissions (GtCO₂) vs. Years

Radiative Forcing (W/m²) vs. Years

- MES-A2R 8.5
- AIM 6.0
- MiniCAM 4.5
- IMAGE 2.9
- IMAGE 2.6
Research question based on RCP2.6 (1/7)

- How many technologies can you loose?
- Amount of CCS feasible??
What can be achieved by non-CO$_2$/forests/biofuels

- Lot of uncertainty for forestry – and little integrated assessment
- For non-CO$_2$ emissions reduction potential still limited to around 50%.
- Biofuels: Estimates from 0-400 EJ/yr in sustainable way
Is the experiment reproducible under different climate cycle assumptions (3/7)

- Most low stabilisation runs only done by small climate models (PNAS paper)
- IAMs currently advise overshoot (den Elzen, 2007)… but how reversible the carbon cycle?

Feedback (ppm CO₂)

The low end of climate-carbon cycle feedback

backs related to tundra, ecosystem response, artic etc.
When do countries need to reduce emissions (4/7)

- **EMF-22**: 2.6 W/m² not feasible with strong delay in participation of developing countries (China/India/Brazil/Russia 2030-2050; Rest > 2050)
Research question based on RCP2.6 (5/7)

The maximum speed of reduction

- How to achieve this?
- What is the maximum speed of reduction (socially / politically)?
- Building global coalitions?
- What experience do we have from earlier situations (CFCs, WTO, putting the man on the moon...)

<table>
<thead>
<tr>
<th>Occurance</th>
<th>-5.0%</th>
<th>-3.8%</th>
<th>-2.6%</th>
<th>-1.4%</th>
<th>-0.2%</th>
<th>1.0%</th>
<th>2.2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;500 ppm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-5.0%</td>
<td>-3.8%</td>
</tr>
<tr>
<td>Ca. 550 ppm</td>
<td>-5.0%</td>
<td>-3.8%</td>
<td>-2.6%</td>
<td>-1.4%</td>
<td>-0.2%</td>
<td>1.0%</td>
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<td>-0.2%</td>
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<td>2.2%</td>
</tr>
</tbody>
</table>

Avg. Max rate: -2.8%
Avg. Rate: -1.1%
-2.5% -0.6%
-2% -0.2%
Is the IMAGE 2.6 too high or too low (costs and benefits) (6/7)?

Bill Nordhaus (2007)
The optimal policy reduces the global temperature rise relative to 1900 to 2.8 °C in 2100 and to 3.4 °C in 2200.

Jim Hansen (2007):
Based on climate model studies and the history of the Earth, the Hansen and Sato conclude that additional global warming of about 1°C or more, above global temperature in 2000, is likely to be dangerous.
Research question based on RCP2.6 (7/7)

Bringing impacts, adaptation and mitigation together

- Aiming to integrate impact/adaptation research better into the mainstream assessment
- Organise these communities
- Couple it better to IA

(keep risk approach / monetary approach connected)

Make adaptation explicit