The EU, the IPCC and the Science of Climate Change: The 2°C target
The hierarchy of visions and targets

**Avoiding dangerous climate change**
All nations; UNFCCC

**Temperatures**
e.g. <2°C limit
EU, Norway, Chile etc.

**Concentrations**
e.g. long-term 350ppm
Hansen; 350ppm.org

**Global Emissions**
e.g. at least -50%
by 2050 globally
G8

**“Burden Sharing” National Emissions**
-20%/-30% by 2020
e.g. EU

-60% by 2050
e.g. UK Gov CO2 target, or K.Rudd, PM Australia

-70% to -90% by 2050 for Annex-I
e.g. Turner Report (-80% by 2050 UK), Garnaut Review

**Impacts**
-70% to -90% by 2050 for Annex-I
e.g. Turner Report (-80% by 2050 UK), Garnaut Review
Overview

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Impacts

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Overview
Large water supply risks projected

Projections and model consistency of relative changes in runoff by the end of the 21st century

SRES A1B:

3.3°C above 1860-1890
2.8°C above 1990

IPCC AR4 SYR Figure 3.5.
"For sustained warmings above this threshold, it is likely that the ice sheet would eventually be eliminated “ … “ raising global-average sea level by 7 m.”

From IPCC WG1 Presentation (Thomas Stocker), June 2008, SBSTA, Bonn
Arctic Sea Ice Extent

From IPCC WG1 Presentation (Thomas Stocker), June 2008, SBSTA, Bonn


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Arctic Sea Ice Extent: Observations and Model Runs

September Sea Ice Extent: Observations and Model Runs

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Conclusion on Impacts: EU’s 2°C target

“[…] RECOGNISES that 2°C would already imply significant impacts on ecosystems and water resources;

…EMPHASISES that the maximum global temperature increase of 2°C over pre-industrial levels should be considered as an overall long-term objective to guide global efforts to reduce climate change risks in accordance with the precautionary approach; […]”

(2610th Environment Council Meeting, Luxembourg, 14 October 2004)
"To avoid the worst impacts of climate change, all countries need to carry their fair share of responsibility to limit a global temperature increase to **below 2°C. ...**"
Overview

Impacts
Avoiding dangerous climate change
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Temperatures
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e.g. long-term 350ppm
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<2°C unlikely or very unlikely at ~550ppm
<2°C with 50:50 chance (or less) at ~450ppm

Best estimate climate sensitivity is 3°C, i.e. the peak of the pdf. Given the left skewedness of climate sensitivity pdf's, the median will be >3°C. Thus, at 441ppm, there is a 50% or less chance to stay below 2°C.
<2°C likely or very likely below 400ppm

Upper bound of likely range (66%-90%) for climate sensitivity is estimated with 4.5°C, so that a 378ppm CO2eq stabilization has a 83%-95% chance staying below 2°C.
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© malte.meinshausen@pik-potsdam.de, see Meinshausen (2006)
Nitrous Oxide, Methane, Halocarbons, trop. Ozone, etc...
Nitrous Oxide, Methane, Halocarbons, trop. Ozone, etc...
...approx. offset by Aerosols etc. on a global average
Without climate mitigation, \( \text{CO}_2 \text{eq} \) concentrations increase to 600 - 1550 this century.

600 to 1550 ppm are the \( \text{CO}_2 \) equivalence concentration levels this century. If the emissions develop according to the IPCC SRES non-mitigation scenarios B1 and A1FI, respectively. See footnote 14, IPCC WG1 AR4 SPM.
Peaking concentrations needed, if 2°C shall be avoided with 50% or better chance.

Climate inertia would prevent the full equilibrium warming materializing if concentrations peak and decrease subsequently, thus allowing not to overshoot 2°C. Concentrations need to peak ~500ppm CO₂ for 50% chance.
Conclusion Concentrations

- 2°C only likely at 400ppm CO$_2$eq or below (e.g. long-term 350ppm).
- We are currently already at 380ppm CO$_2$eq ...
- … and bound to go to or exceed 450ppm CO$_2$eq
- Thus, peaking of concentrations necessary to return quickly to lower levels, e.g. 400ppm or below
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Over the last years, emissions have risen rapidly, especially in China and India.

Does this invalidate current reference and mitigation scenarios?
Source: Raupach et al. 2007, PNAS; own illustrations; see as well van Vuuren & Riahi (forthcoming)
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IPCC SRES scenarios still valid?

- Absolutely!
- **BUT** recent studies remind us starkly of the fact that the world did not yet embark on a mitigation track …
- … and will not do so without decisive action.
- China is planning the first steps on its own: 20% energy efficiency target in present five year plan & 10% renewable goal by 2015.
- → It is up to us industrialized countries to throw our weight behind these initiatives.
Global GHG emissions (Kyoto GHGs including LULUCF)

Non-mitigation Scenarios
Global GHG emissions (Kyoto GHGs including LULUCF)

Non-mitigation Scenarios

Emissions continue to rise without climate policies: IPCC SRES scenarios

Shown emissions are the weighted sum of all greenhouse gas emissions, as controlled under the Kyoto Protocol, weighted by their IPCC SRES 1996 GWP.
Global GHG emissions (Kyoto GHGs including LULUCF)

Non-mitigation Scenarios

CION S450: Scenario presented by EU Commission, Jan 07

See Commission Staff Working Document accompanying the communication
"Limiting global climate change to 2 degrees Celsius - The way ahead for 2020 and beyond", Figure 11
**STERN 500 (S450):**
Medium path presented by Stern; peaking at 500, stabilizing at 450

See e.g. Figure 8.4 in Stern Review "The Economics of Climate Change". This path peaks at approx. 500 ppm CO2 equivalence and stabilizes around 450 ppm CO2eq. The higher path "peaked" and stabilized at 550 ppm, the lower at 450 ppm.
Global GHG emissions (Kyoto GHGs including CFCs)

Grey: Pathways with ~50% chance of staying below 2°C

Pathways (EOI and FAIR-SIMCAP) that peak around 500 ppm CO2 equivalence and stabilize subsequently around 450 ppm CO2 equivalence under medium-range (CMIP) carbon cycle feedback assumptions.
Global GHG emissions (Kyoto GHGs including)

Green: Pathways with likely chance of staying below 2°C

Pathways (EQW and FAIR-SiMCanP) that peak around 475 ppm CO2 equivalence and stabilize subsequently around 400ppm CO2equivalence under medium-range (CMIP) carbon-cycle feedback assumptions.
Global GHG emissions (Kyoto GHGs including LULUCF)

Non-mitigation Scenarios

Relative Emissions (1990 = 0%)

Absolute Emissions (GtCO2eq/yr)

1990 2000 2010 2020 2030 2040 2050 2060

(c) malte.meinhaus@pik-potsdam.de, September 2008
Global GHG emissions (Kyoto GHGs including G8 (Heiligendamm): Reference to halved global emissions by 2050
The reference year, from which global emissions shall be halved remained open, thus three options 1990, 2000, and 2007 shown here.
Global Emissions need to peak around 2015
Conclusions Global Emissions

• G8: Halved global emissions by 2050.
• Time is not running out.
• Time has run out: Peaking of global emissions by 2015 is the most pressing, most near-term goal to be achieved.
The hierarchy of visions and targets

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Impacts
EU, Norway, Chile etc.
Equal per capita emissions by 2050

### IPCC Box 13.7: Implications for international agreements

<table>
<thead>
<tr>
<th>Scenario category</th>
<th>Region</th>
<th>2020</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A-450 ppm CO₂ -eq</strong></td>
<td>Annex I</td>
<td>-25% to -40%</td>
<td>-80% to -95%</td>
</tr>
<tr>
<td></td>
<td>Non-Annex I</td>
<td>Substantial deviation from baseline in all regions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-15% to -30% below baseline</td>
<td></td>
</tr>
<tr>
<td><strong>B-550 ppm CO₂ -eq</strong></td>
<td>Annex I</td>
<td>-10% to -30%</td>
<td>-40% to -90%</td>
</tr>
<tr>
<td></td>
<td>Non-Annex I</td>
<td>Deviation from baseline in Latin America and Middle East, East Asia</td>
<td>Deviation from baseline in most regions, especially in Latin America and Middle East</td>
</tr>
<tr>
<td><strong>C-650 ppm CO₂ -eq</strong></td>
<td>Annex I</td>
<td>0% to -25%</td>
<td>-30% to -80%</td>
</tr>
<tr>
<td></td>
<td>Non-Annex I</td>
<td>Baseline</td>
<td>Deviation from baseline in Latin America and Middle East, East Asia</td>
</tr>
</tbody>
</table>

1) GHG concentration levels for the Annex I and non-Annex I countries as a group.

Box 13.7: The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for the Annex I and non-Annex I countries as a group.
All approaches require large reductions by 2050

- Annex I: -80% to -90% below 1990
- Substantial deviation from reference in all Non-Annex I regions

Source: Niklas Höhne, n.hoehne@ecofys.de, Ecofys, Cologne
Is equal per-capita fair?

• Is “one glass for everyone” a fair distribution method for the remaining wine at a party, when some had many bottles already, others only a sip? (Nicholas Stern)

• → Historical responsibility (Brazilian proposal; Greenhouse Development Rights)
Thank you

- IPCC Fourth Assessment Report (AR4), www.ipcc.ch
- Hare, B. and M. Meinshausen (2006). "How much warming are we committed to and how much can be avoided?" Climatic Change 75(1): 111-149.
Five themes of Bali Action Plan

1. **Shared vision**
   - Long-term: At least 50% by 2050;
   - Mid-term Annex I: 25% to 40% by 2020;
   - Mid-term Non-Annex I: 15% to 30% below baseline;
   - Peaking global emissions next 10-15 years

2. **Mitigation**
   - Differentiation: “Burden Sharing” / “Allocation schemes”
   - Carbon market for financing mitigation
   - Aviation and maritime transport
   - REDD

3. **Adaptation**
   - Mainstreaming Adaptation, Finance, Capacity building

4. **Technology**
   - Technology-oriented agreements under UNFCCC

5. **Finance**
   - Carbon Market for financing mitigation,
   - Funds and extra national activities.

→ Agreement by Copenhagen, 2009
“Countries will be asked to meet different requirements based upon their **historical share** or contribution to the problem and their **relative ability** to carry the burden of change. *This precedent is well established in international law, and there is no other way to do it.*”

Al Gore  

→ **Greenhouse Development Rights Approach**
Deducing Capacity from Income

National income distributions showing portion of income (in green) that can be considered “capacity”

Slide by Paul Baer & Tom Athanasiou (EcoEquity), Sivan Kartha (Stockholm Environment Institute)
Deducing Responsibility from historical emissions

Cumulative fossil CO₂ (since 1990) showing portion that can be considered “responsibility”
National "Obligation Wedges"

Slide by Paul Baer & Tom Athanasiou (EcoEquity), Sivan Kartha (Stockholm Environment Institute)
Implications for United States

US mitigation obligation amounts to reduction target exceeding 100% by 2025 (i.e., “negative emission allocation”).

Slide by Paul Baer & Tom Athanasiou (EcoEquity), Sivan Kartha (Stockholm Environment Institute)
Implications for United States

Physical domestic reductions (~50% by 2025) are one part of the US’s “twofold obligation”. The second part is MRV support for international reductions.

Slide by Paul Baer & Tom Athanasiou (EcoEquity), Sivan Kartha (Stockholm Environment Institute)
Implications for China

China’s mitigation obligations are not trivial, but are small compared to China’s mitigation potential, and can be discharged domestically.

Slide by Paul Baer & Tom Athanasiou (EcoEquity), Sivan Kartha (Stockholm Environment Institute)
Implications for China

The majority of the reductions in the South are driven by industrialized country reduction commitments.

Slide by Paul Baer & Tom Athanasiou (EcoEquity), Sivan Kartha (Stockholm Environment Institute)
General Issues for post-2012 Framework

- Bottom up approach cannot work: international coordination essential
- Legally binding targets and trading system are essential (necessary but not sufficient)
- Need for early and rapid decarbonisations in the large emitters of the developing world.
- Elaboration of post-2012 regime architecture
  - Mixture of legally binding targets for growing group of richer and more able countries
  - Policies for decarbonisation in other developing countries
- Need for very rapid technological change
### Rough example for categorisation: 4 bins

| 1. Developed countries | Annex I + South Korea, Singapore ... | Binding QELROs; Financing obligations |

- ** Annex I + South Korea, Singapore ...**
- ** Binding QELROs; Financing obligations**
Thank you

More information:
Nitrous Oxide, Methane, Halocarbons, trop. Ozone, etc...

...approx. offset by Aerosols etc. on a global average
Thank you

• IPCC Fourth Assessment Report (AR4), www.ipcc.ch


• Hare, B. and M. Meinshausen (2006). "How much warming are we committed to and how much can be avoided?" Climatic Change 75(1): 111-149.
