



The Atmosphere as a Global Common: From a Tragedy to a Drama

Prof. Dr. Ottmar Edenhofer

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Technische Universität Berlin

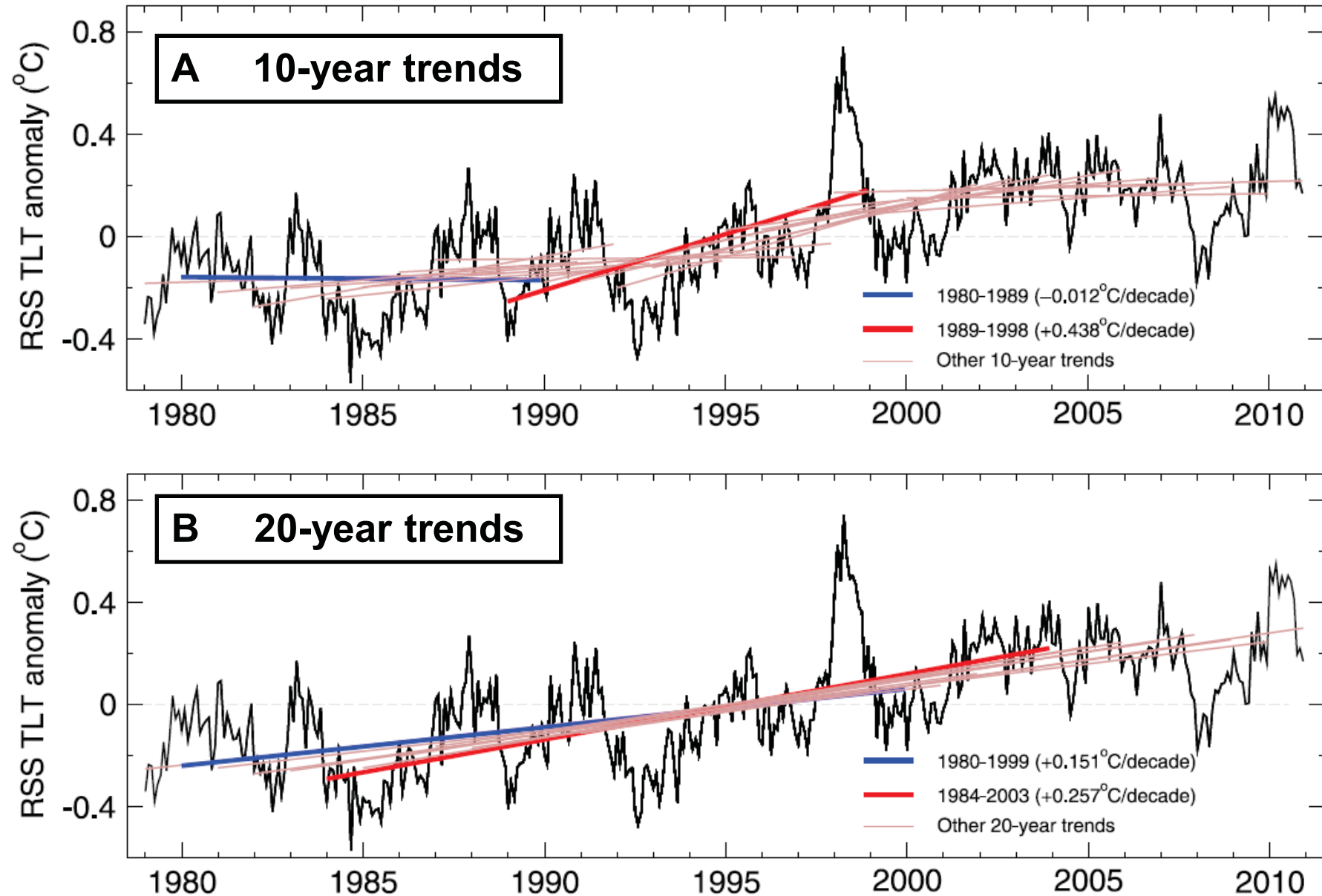
Overview

1. Has global warming stopped?
2. Scope of the challenge
3. Energy transformations in a first best world
4. An assessment of current climate policy
5. Four ideas for tomorrow's climate policy
6. Conclusions

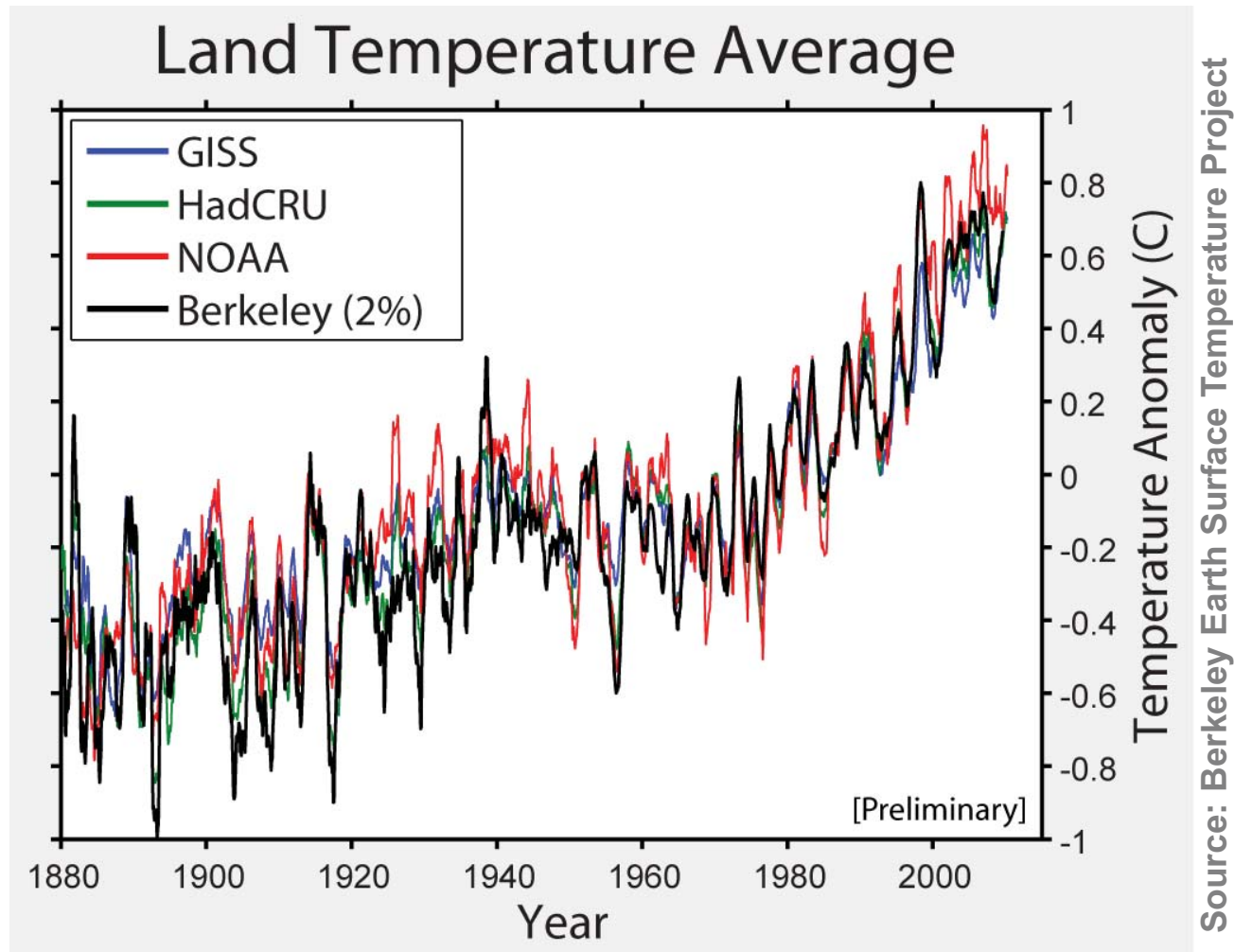
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Global warming: Short-term vs. longer term perspective

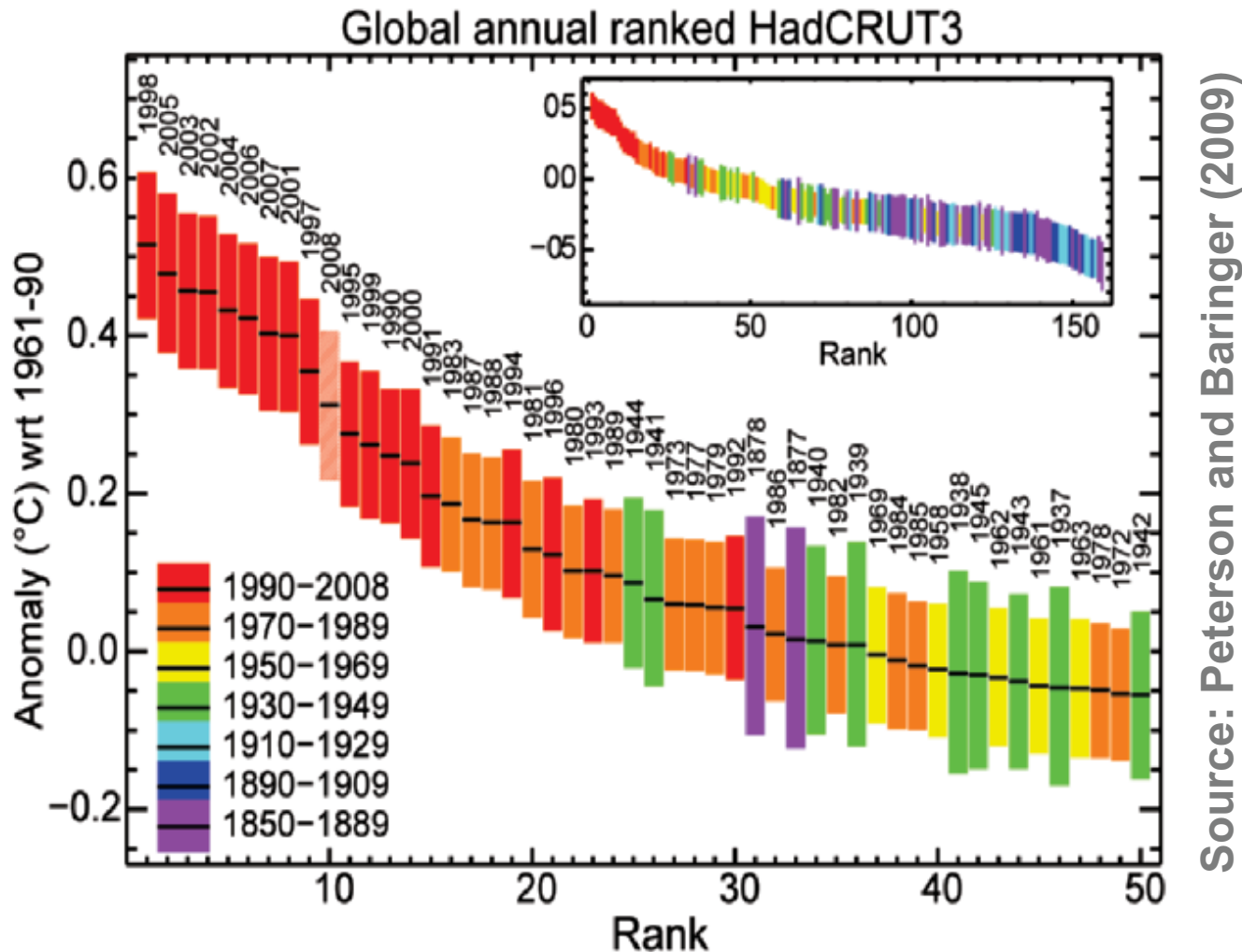


Long term trends show clear evidence



- Temporal slow downs of global warming have occurred already in the past
- Recent independent examination of IPCC results (Berkeley Earth Surface Temperature Project) has confirmed results

Average temperature anomaly per year

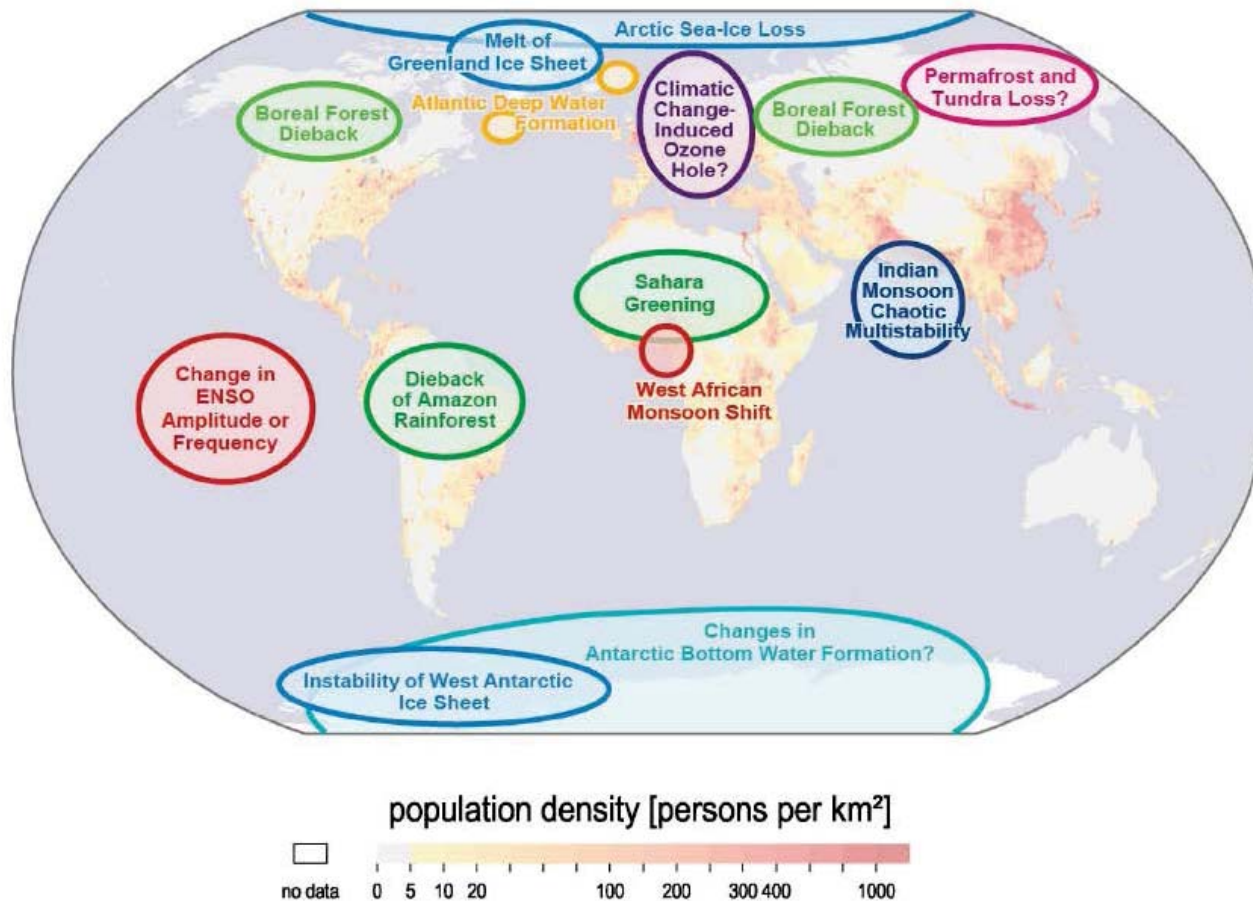


**Last decade was the warmest since
the beginning of industrialization**

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Reasons for concern: Tipping elements



“Tipping processes of the climate system” show a strong reaction already to small climate changes

Schellnhuber, 1996; Lenton et al., 2008

Climate mitigation as insurance

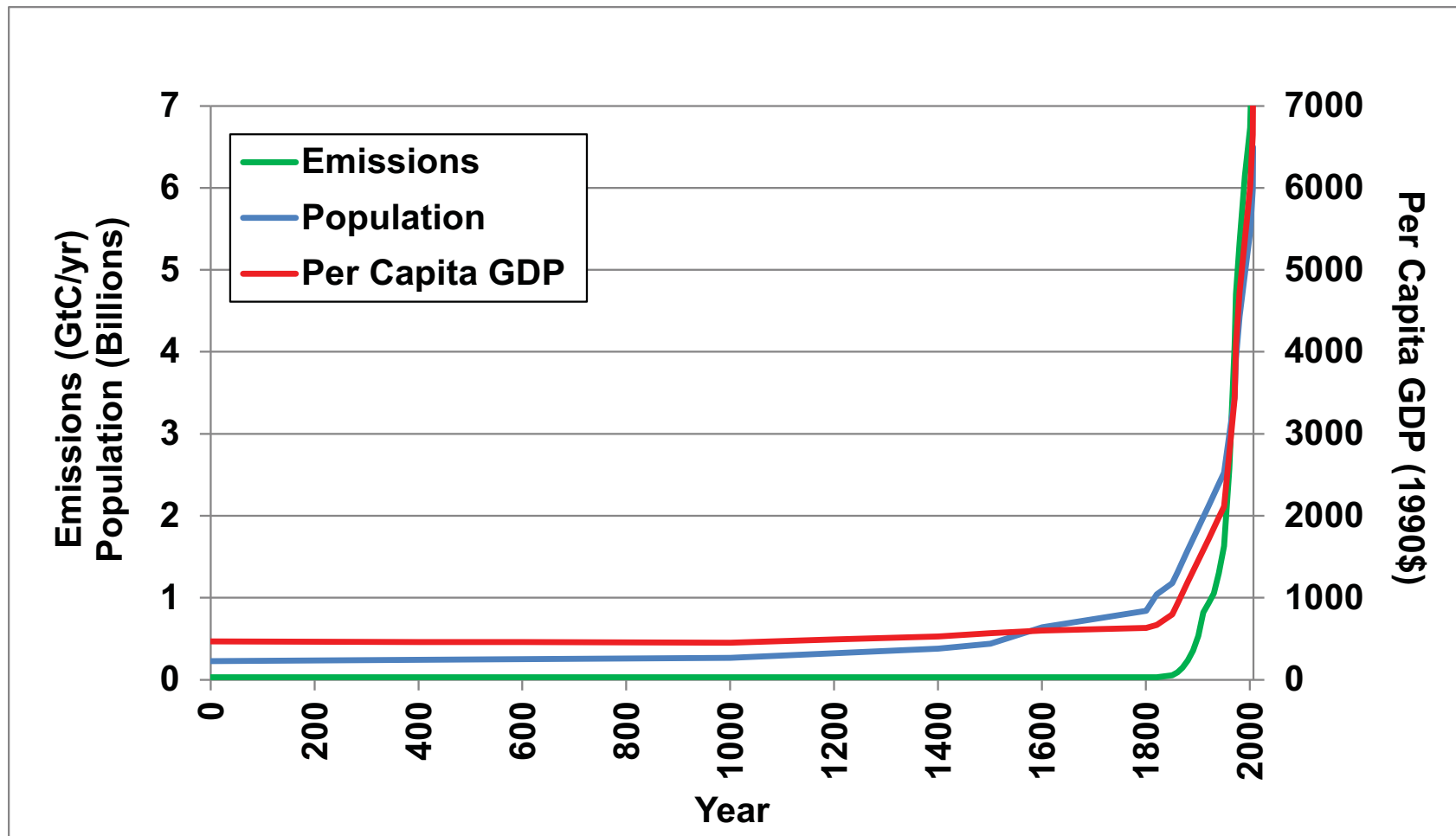
- Martin Weitzman (2009): With the possibility of ‘catastrophic climate damages’ the conventional cost-benefit type of analysis does not work anymore, because risk-aversion implies that one would pay any price – e.g. entire income – in order to avoid the catastrophe.
- Climate policy as an **insurance against ‘catastrophic climate change’**

Probability (in percent) to exceed given global temperature increase

Stabilization level in ppm CO ₂ -eq	2°C	3°C	4°C	5°C	6°C	8°C
400	22	7	3	1	1	0
450	60	15	7	3	2	0
550	88	51	19	11	6	2
650	94	77	42	19	12	5
750	97	88	65	34	17	8
1000	99	94	86	65	42	15

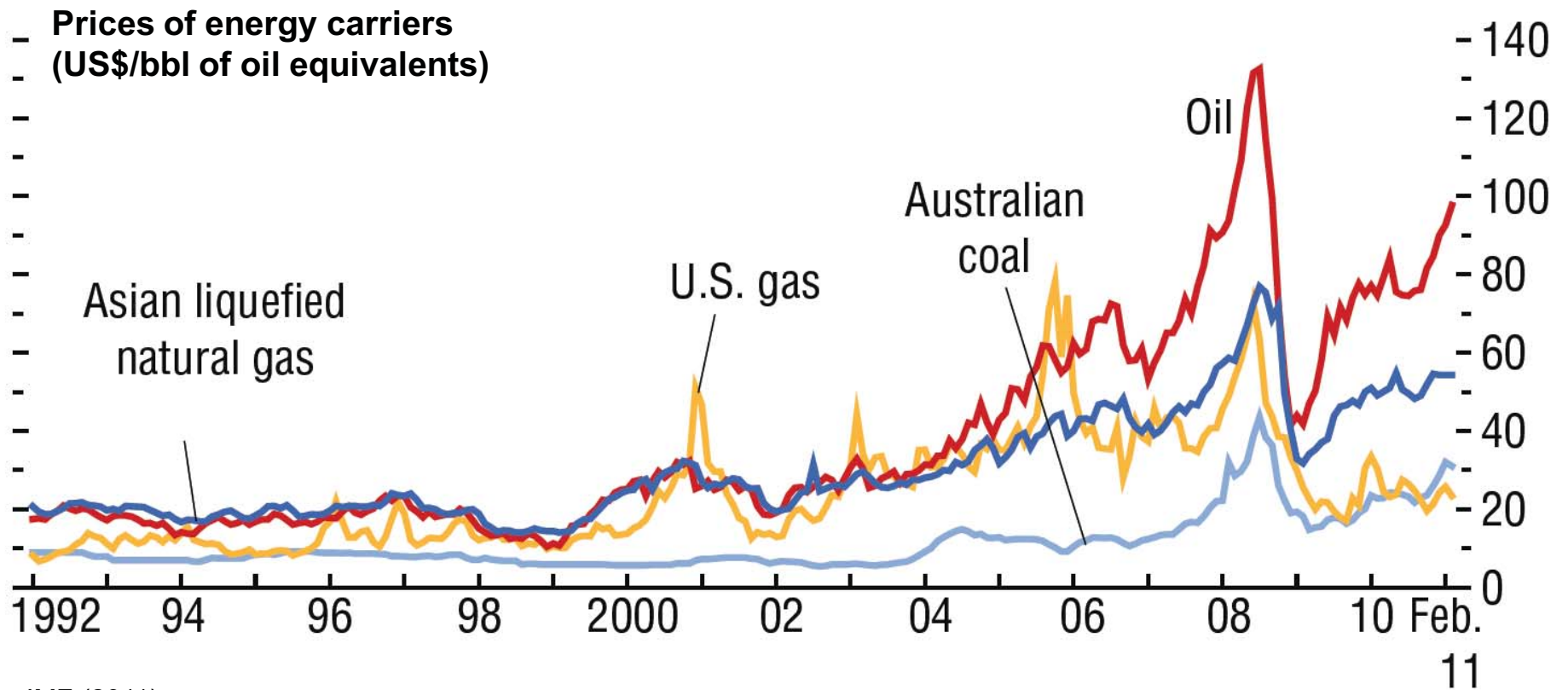
Table 1: Likelihood (in percentage) of exceeding a temperature increase above the pre-industrial level at equilibrium (adapted from Rogelj et al. 2012))

The lottery income from fossil resources



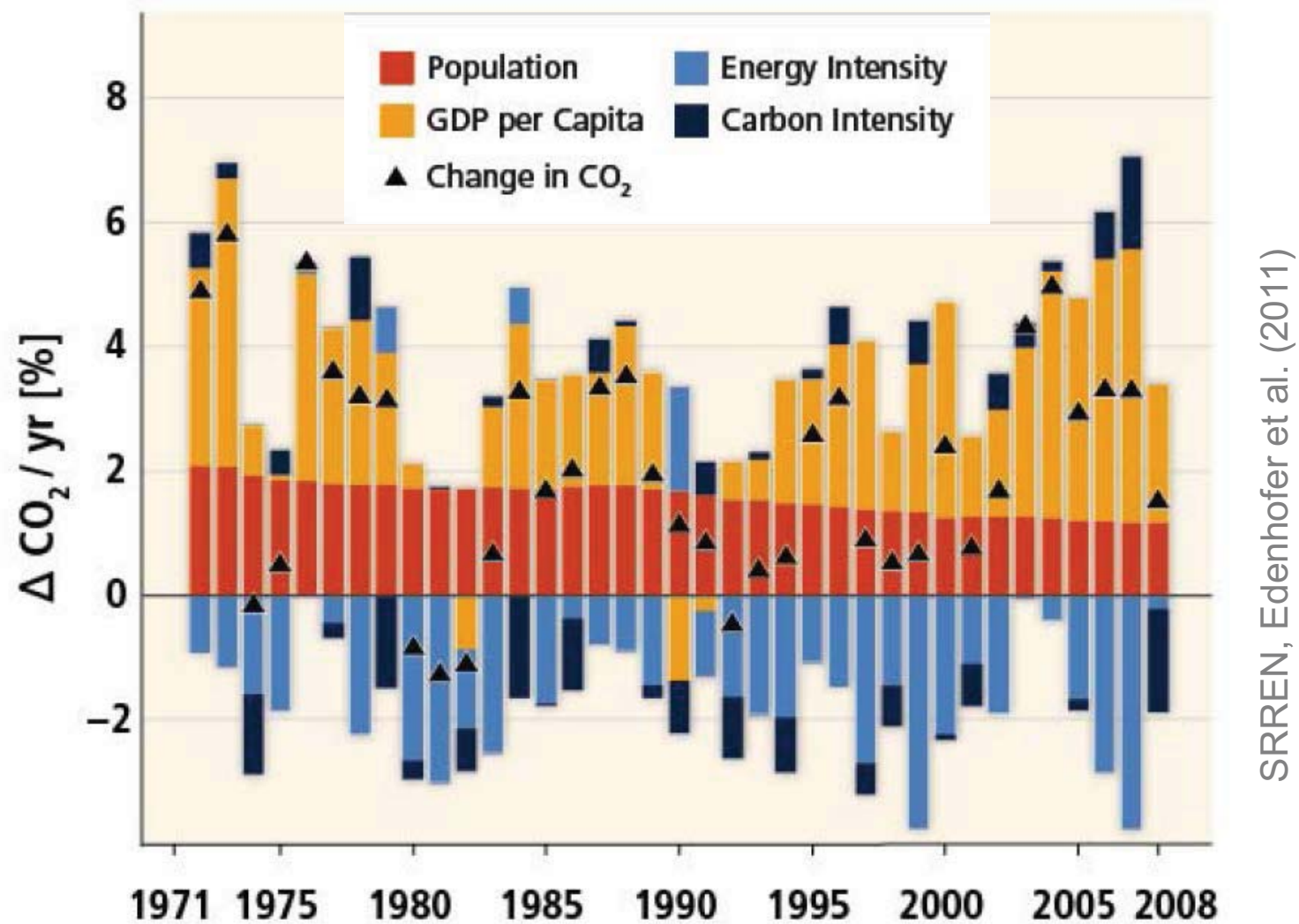
Edenhofer et al. 2012

The attractiveness of coal has increased



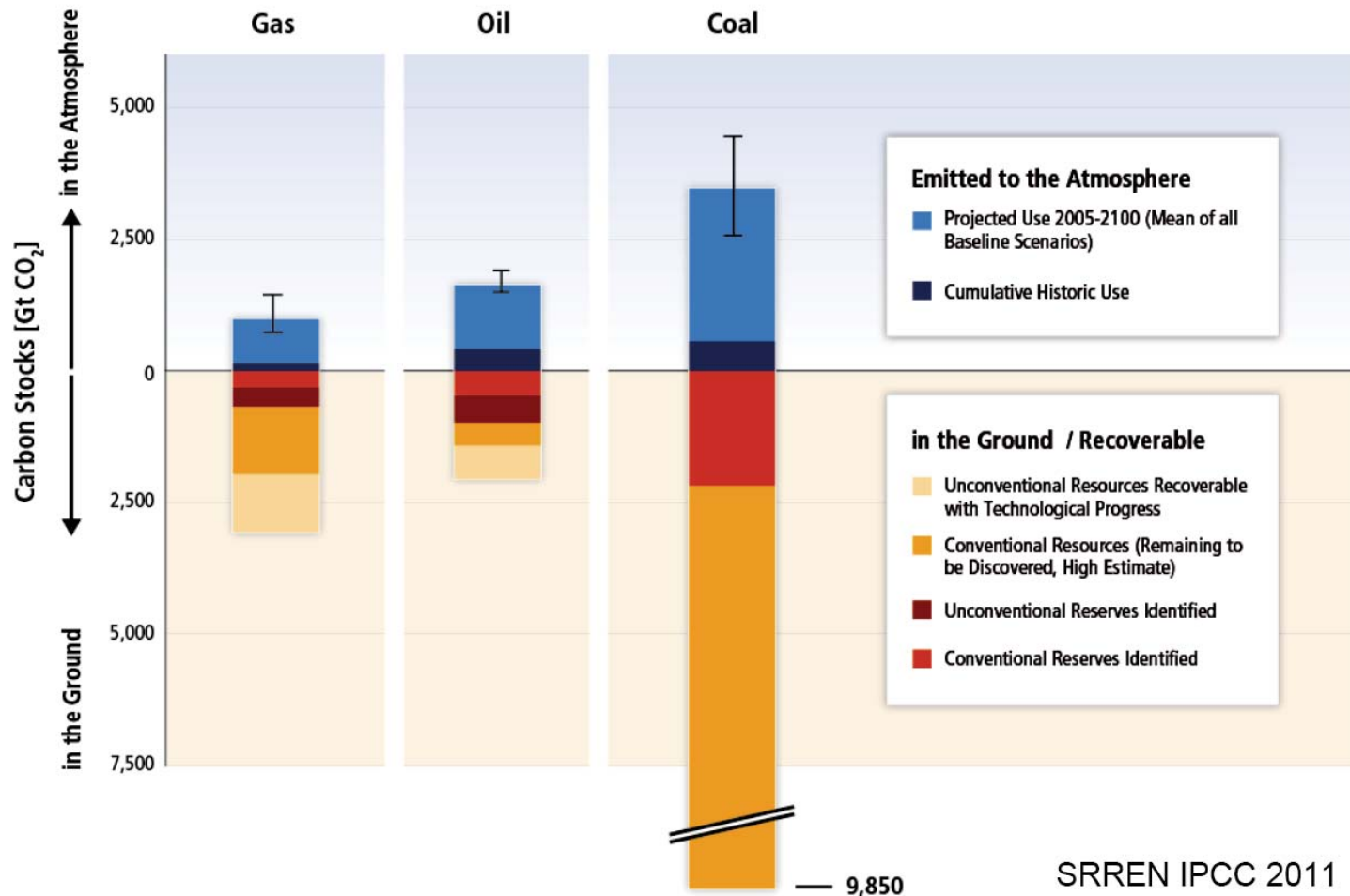
IMF (2011)

GHG emissions rose despite decreases in energy intensity



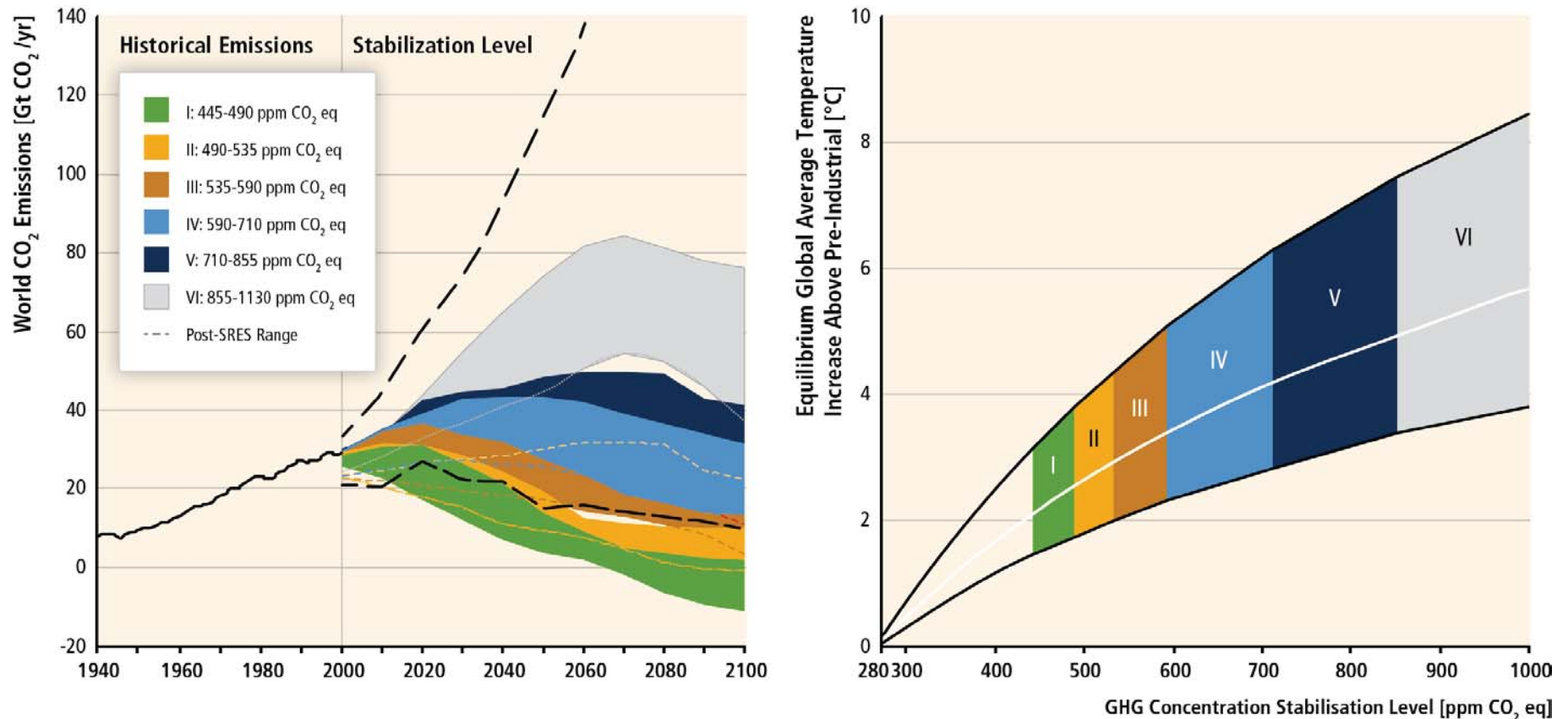
Economic growth – particularly in newly industrializing countries – drives global emissions

Fossil fuel availability does not constrain GHG emissions



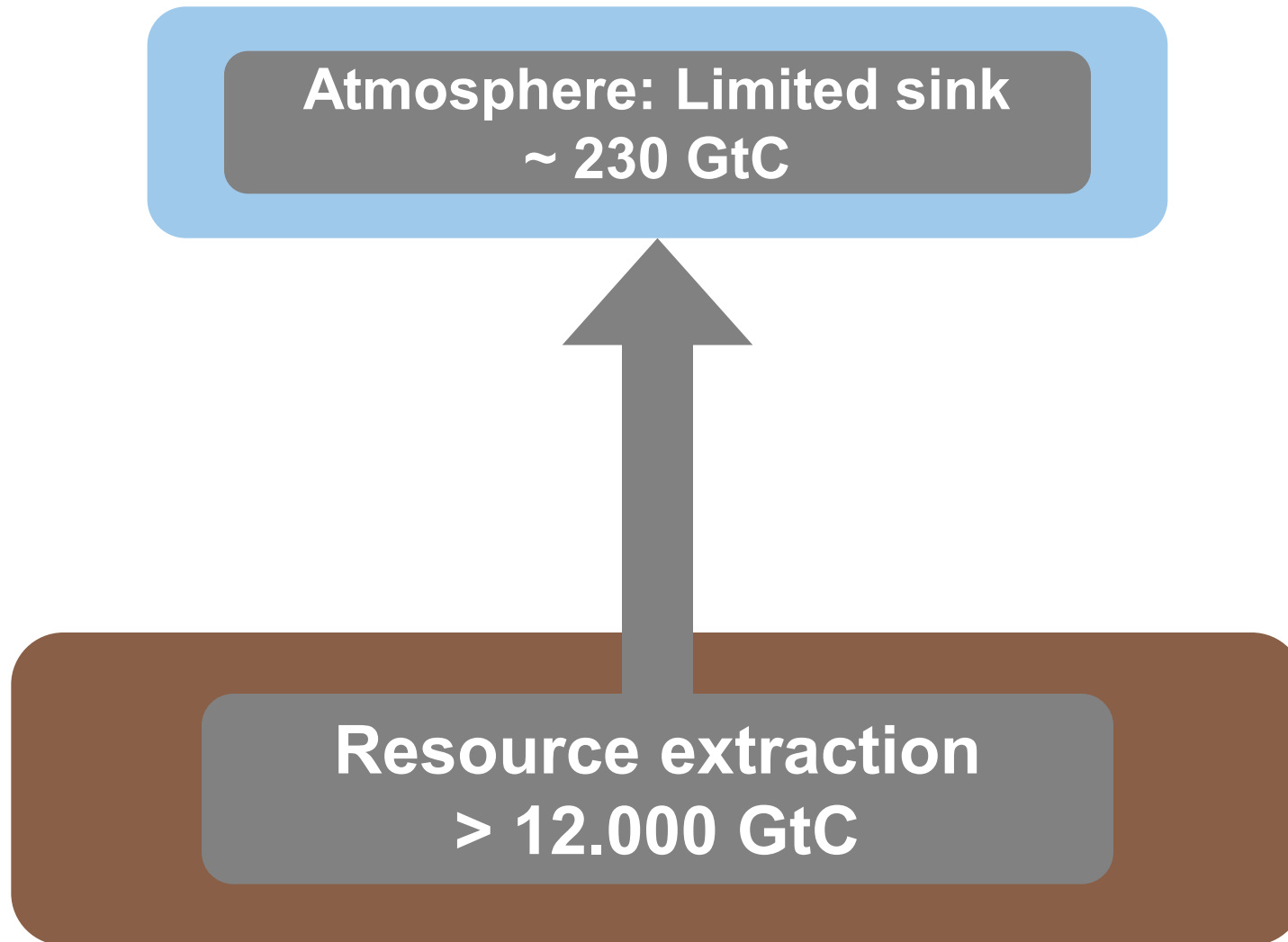
Conventional reserves alone largely exceed the 1000 Gt CO₂

Climate policy as insurance

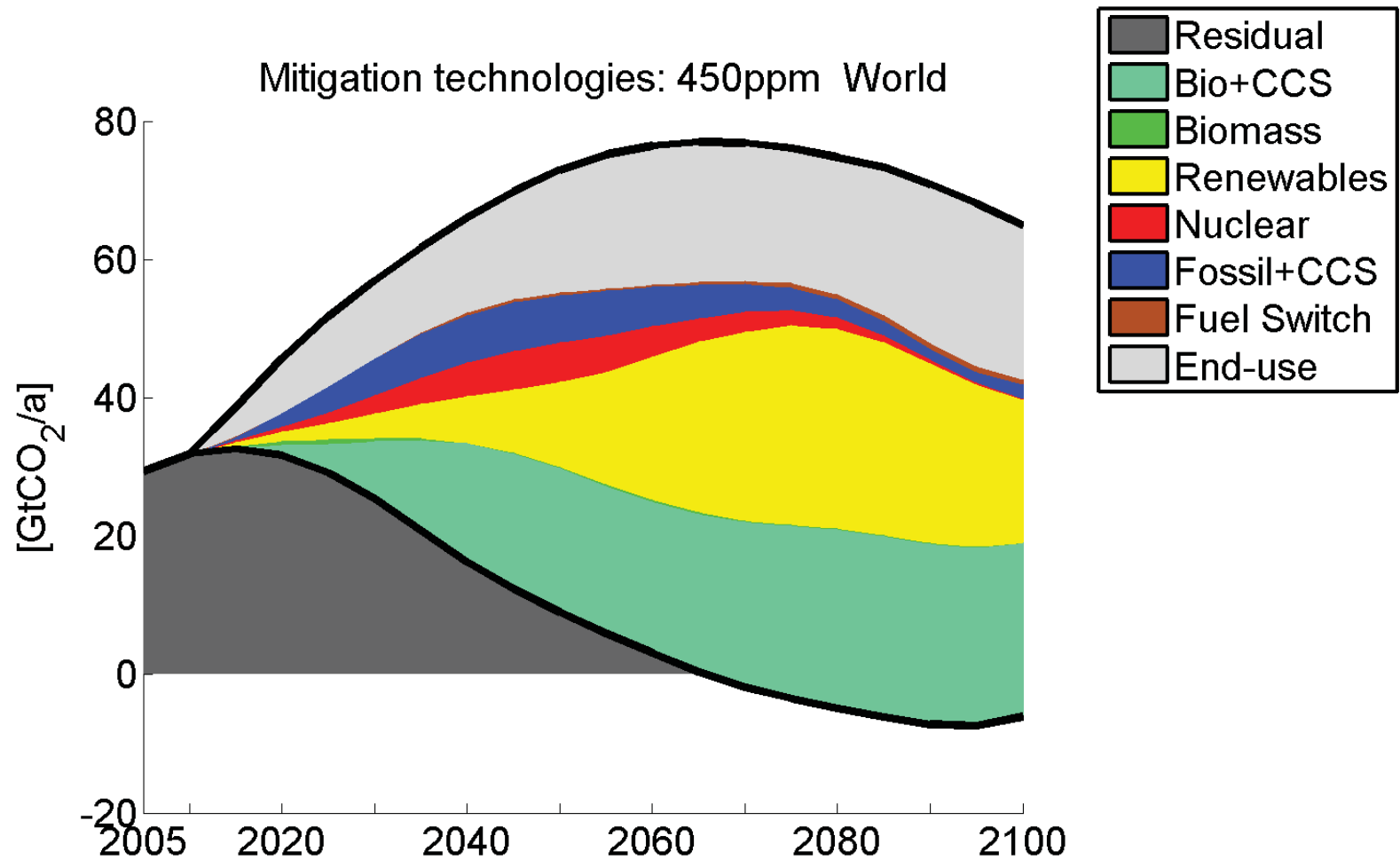


GHG emissions from the delivery of energy services contribute significantly to an increase in GHG concentrations in the atmosphere.

The atmosphere as a “global common“



Is a decoupling possible?

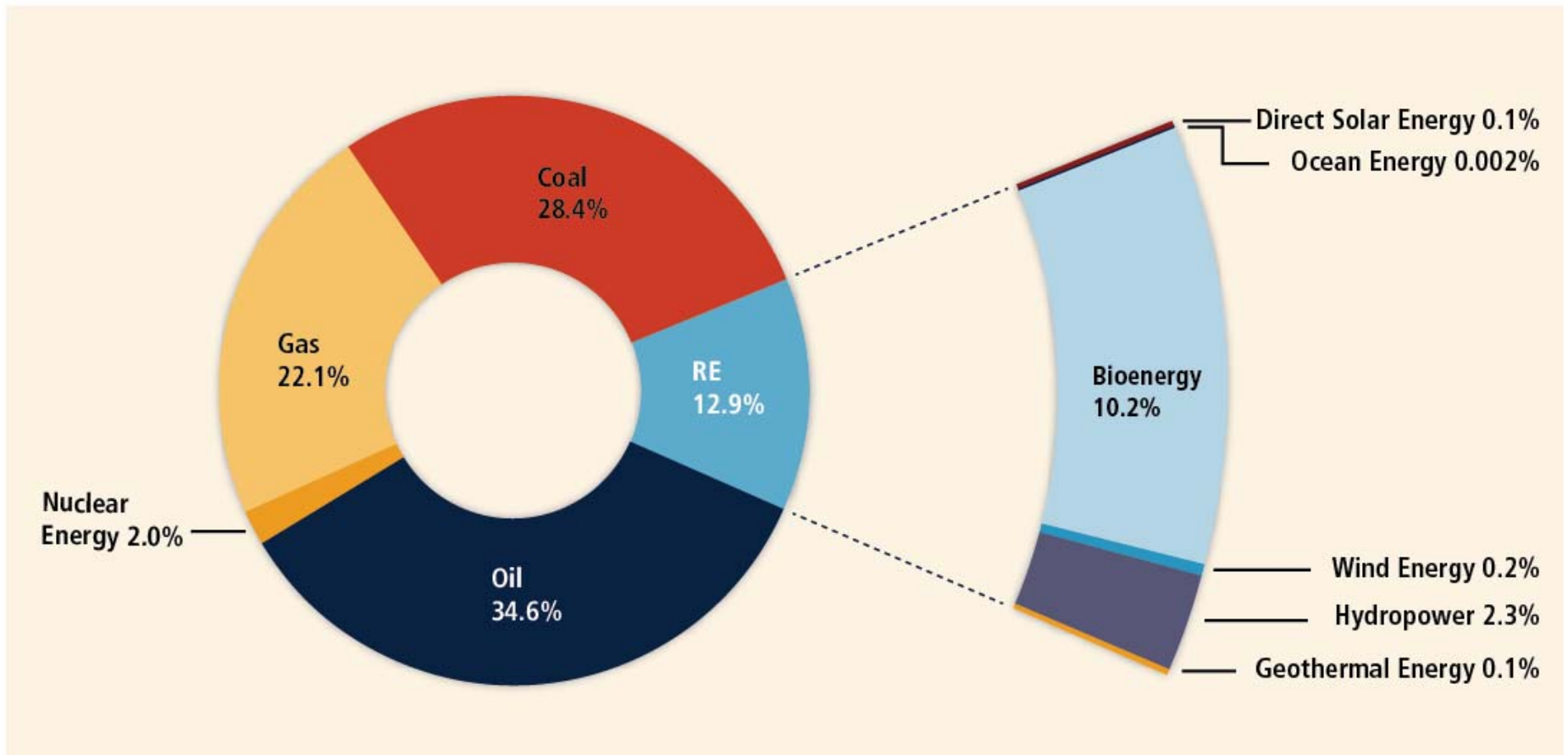


Luderer et al. (2011)

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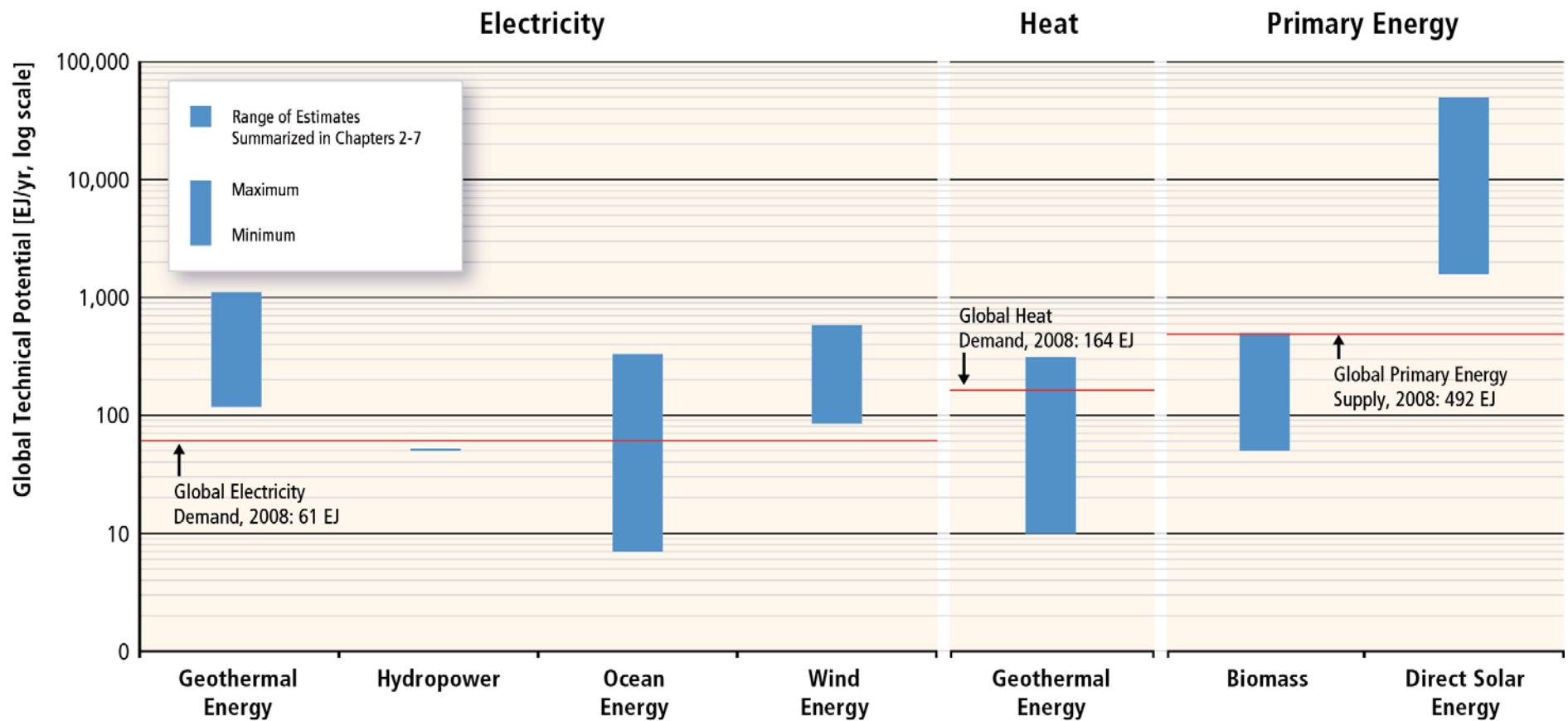
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The current global energy system is dominated by fossil fuels



Shares of energy sources in total global primary energy supply in 2008.

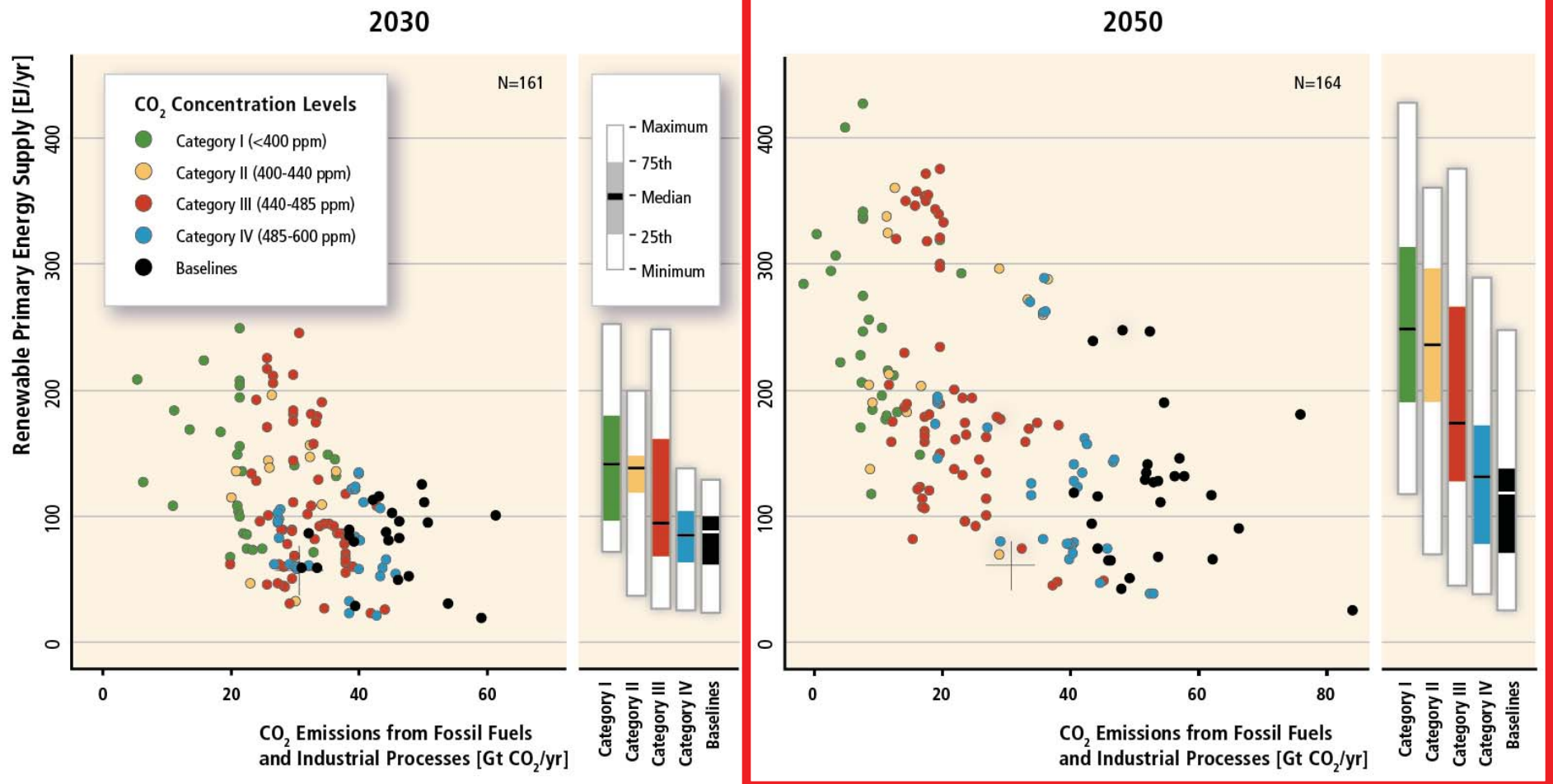
The technical potential of renewable energies far exceeds recent energy demand



Range of Estimates of Global Technical Potentials

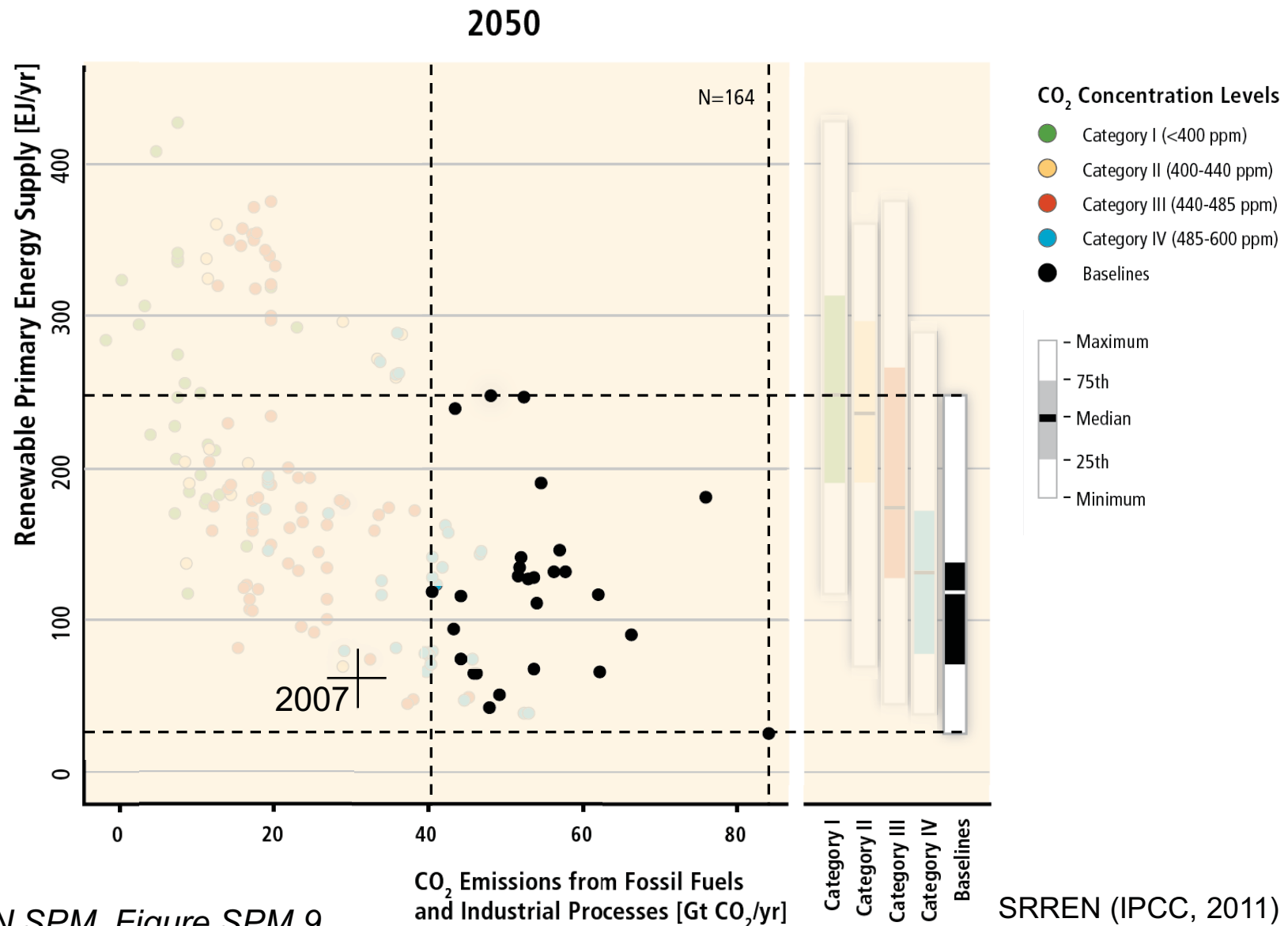
Max (in EJ/yr)	1109	52	331	580	312	500	49837
Min (in EJ/yr)	118	50	7	85	10	50	1575

Global RE Primary Energy Supply from 164 Long-Term Scenarios versus Fossil and Industrial CO₂ Emissions

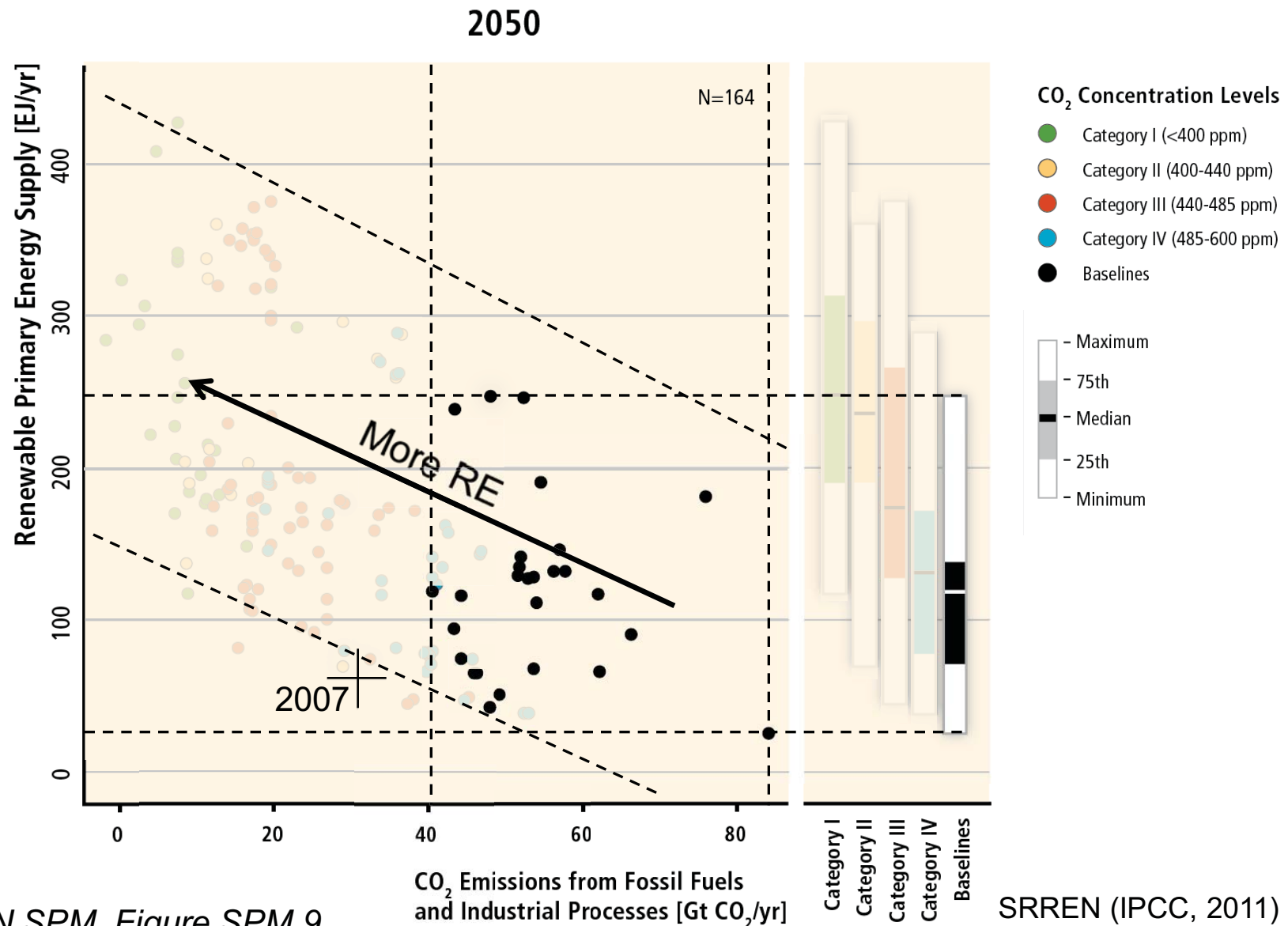


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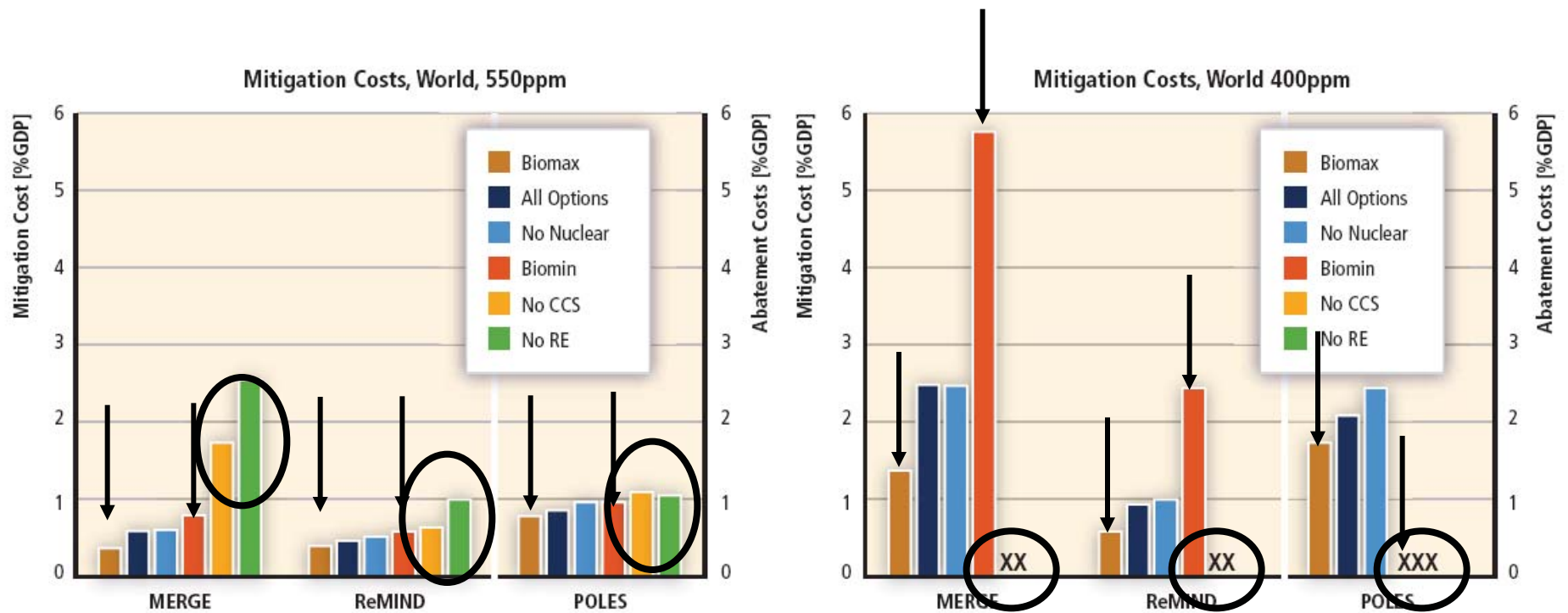
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Global RE Primary Energy Supply from 164 Long-Term Scenarios versus Fossil and Industrial CO₂ Emissions



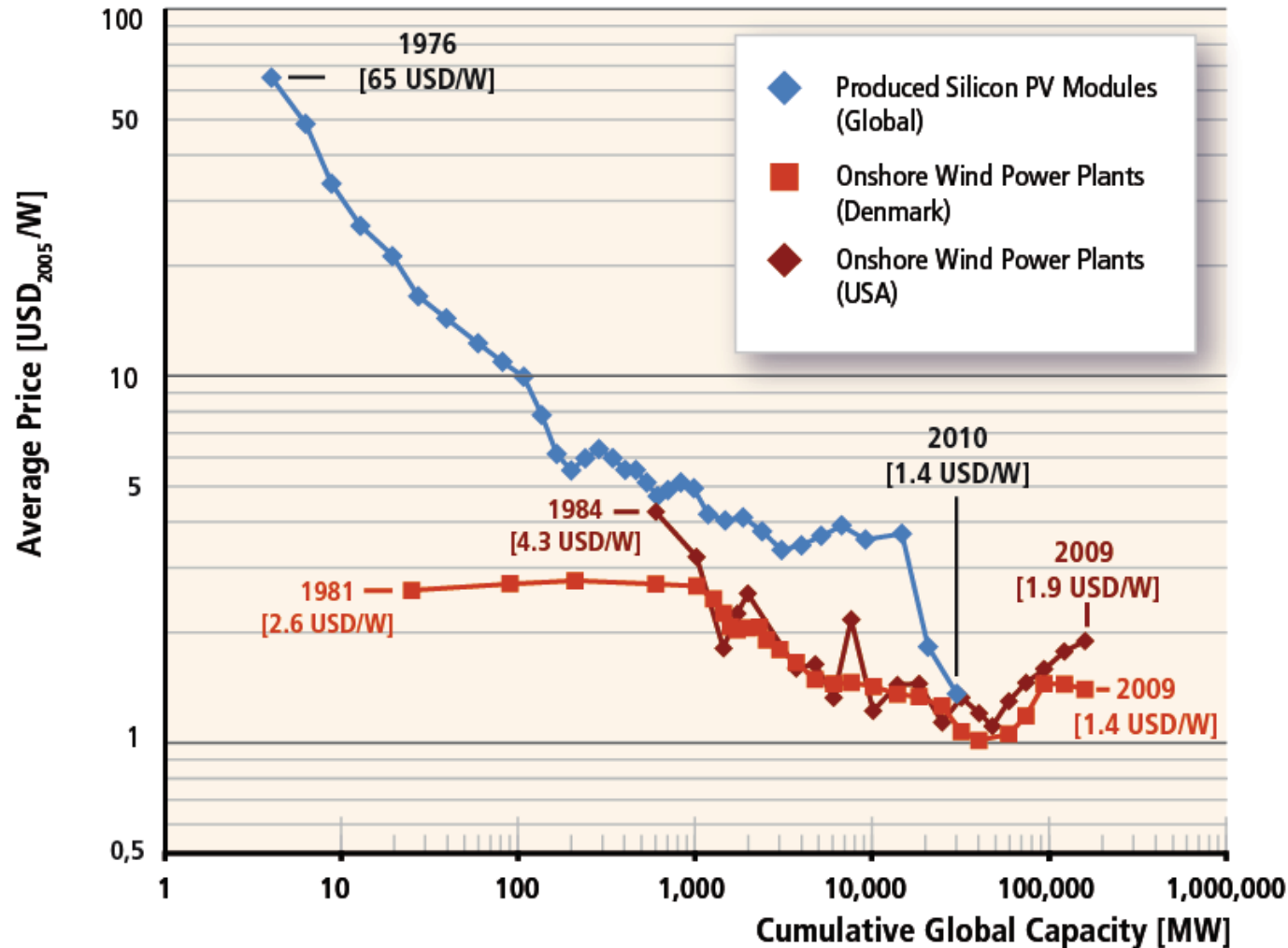
The cost of mitigation depend on several key factors



Costs hinge critically on:

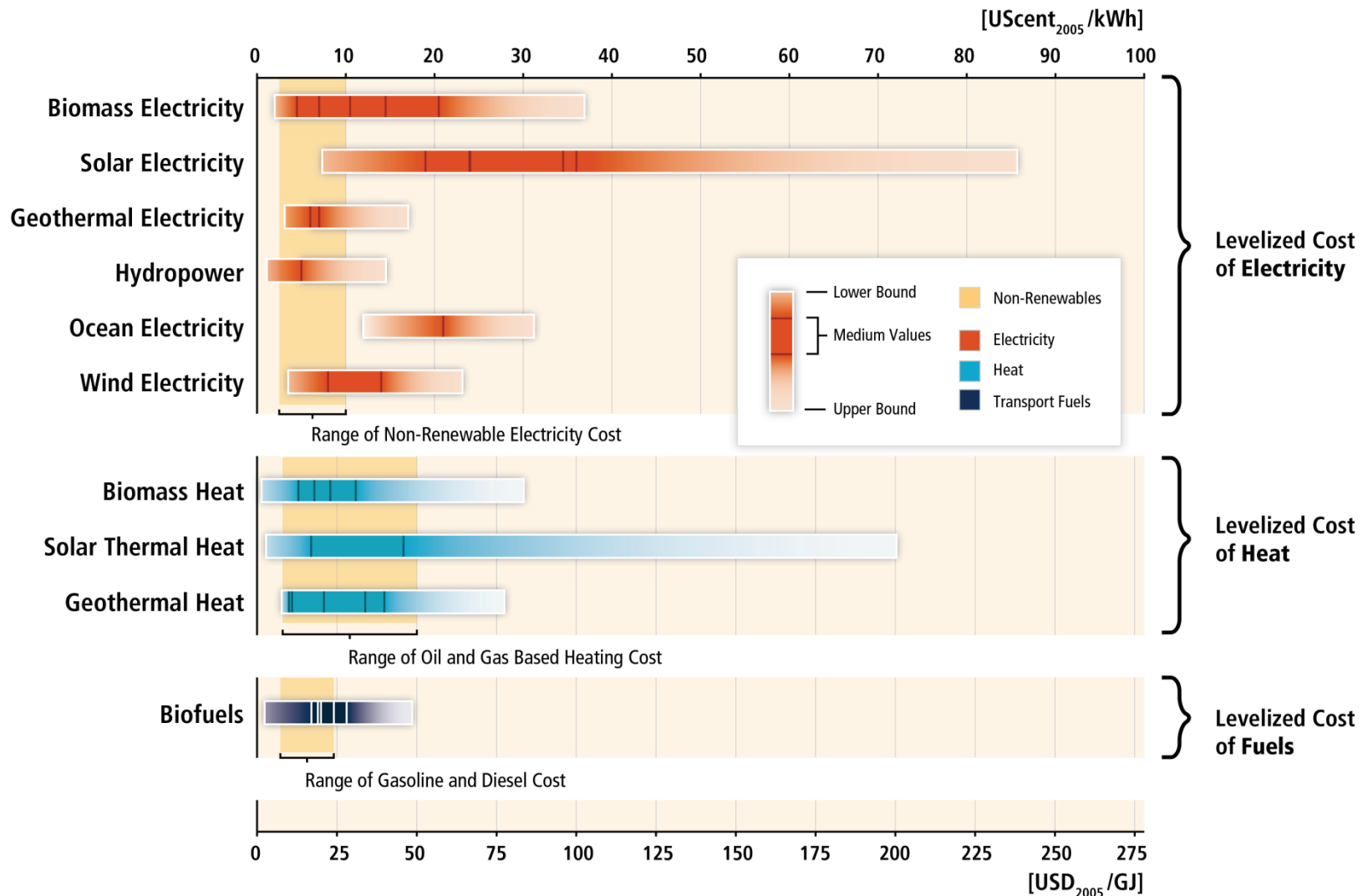
- The stabilization target
- The biomass potential
- The availability of technologies, RE and CCS in particular

Renewable energy equipment has declined in price



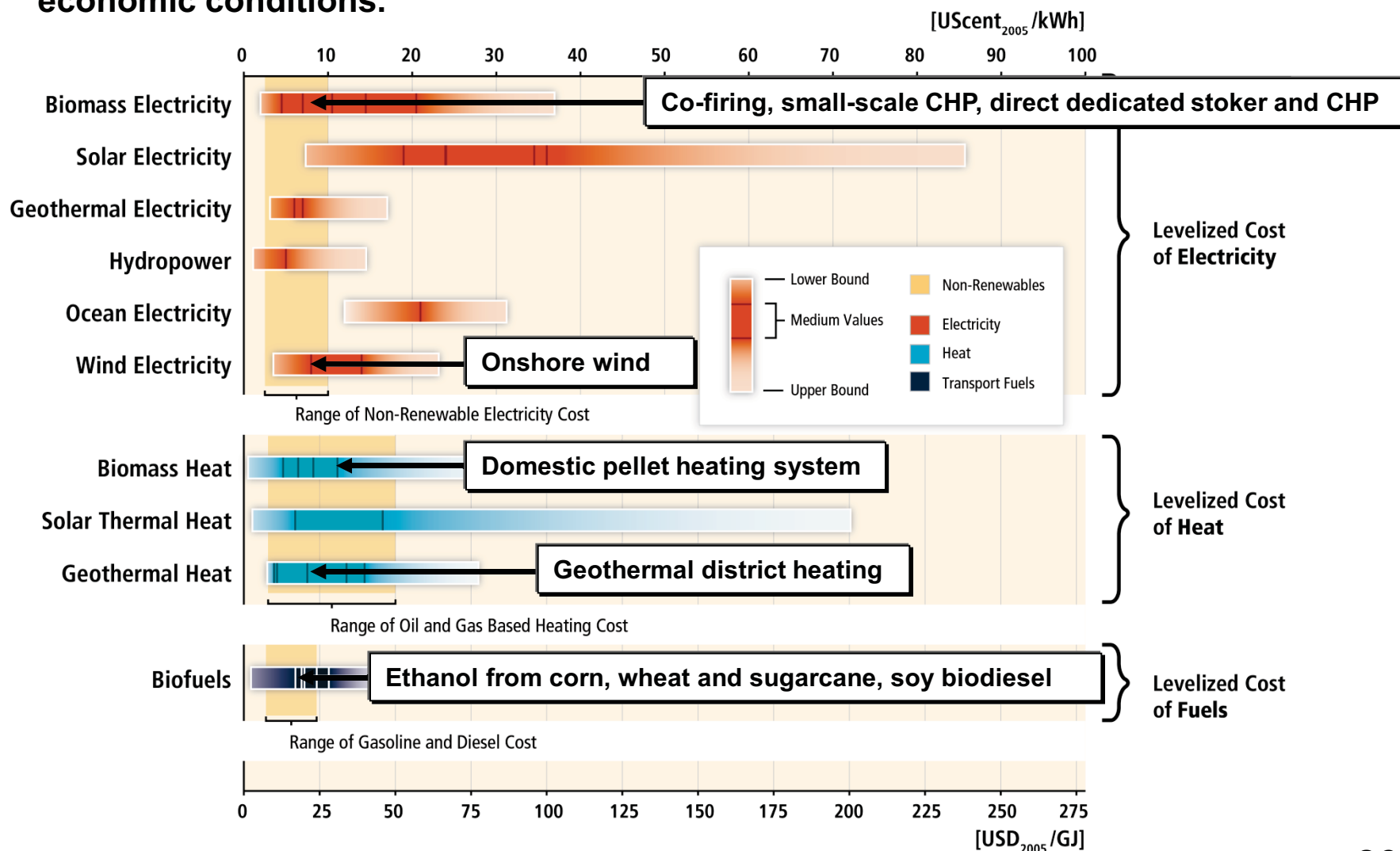
Further cost reductions are expected for several renewable energy technologies.

Costs are generally still higher than fossil alternatives



Some technologies can already be competitive today

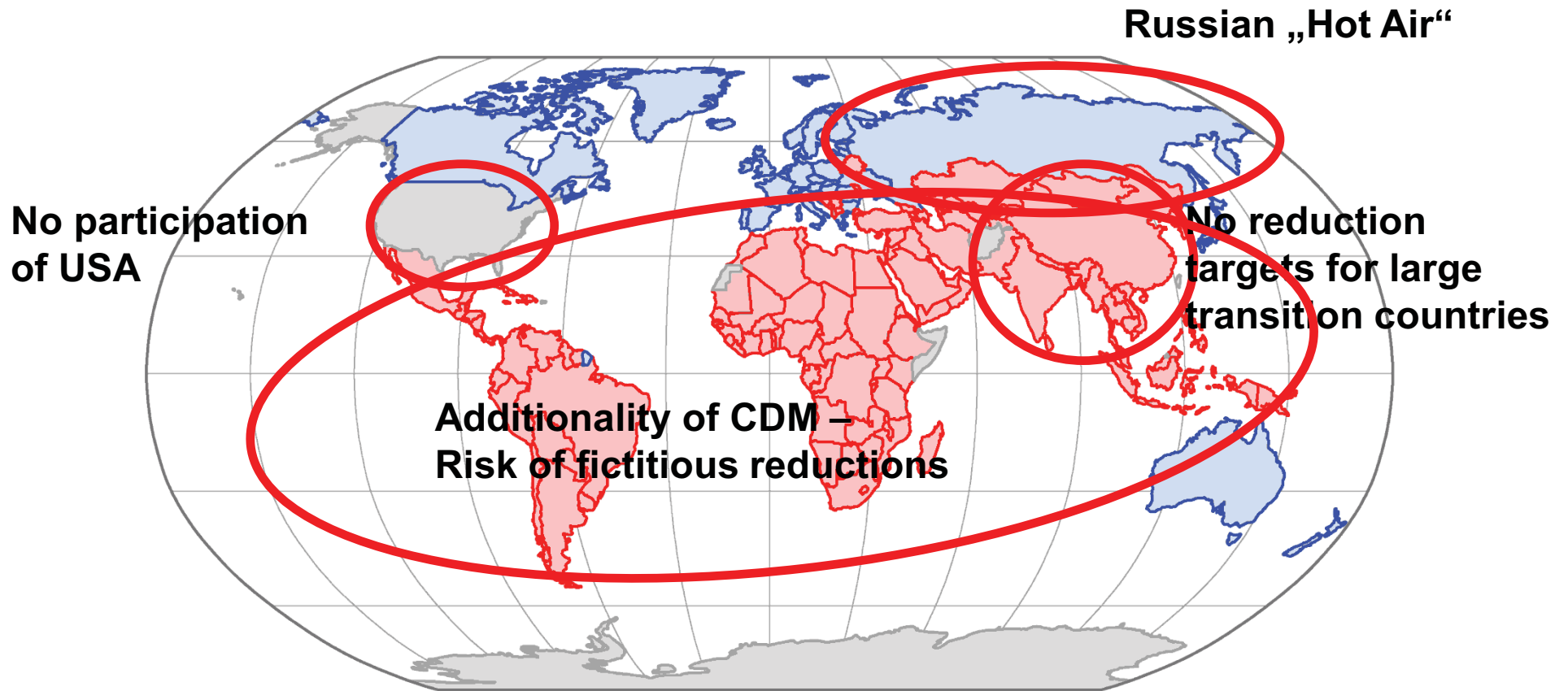
The lower end of the cost ranges represents favourable geographic and economic conditions.



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The Kyoto Protocol 2008-2012



- **Kyoto Annex-B: Cap-and-trade on country-level**
 - 25% of global GHG-emissions
 - MRV system for emissions accounting
- **Non-Annex-B: Clean Development Mechanism**
 - 60% of global GHG-emissions

Copenhagen: Climate policy with “collection box”

Pledged reduction targets for 2020:

- Japan: 25% wrt 1990
- EU: 20-30% wrt 1990
- USA: 17% wrt 2005
- Canada: 17% wrt 2005



- ➔ Implementation of the minimal Copenhagen targets means that emissions in 2020 will be 10-20% higher than today
- ➔ Copenhagen implications for 2050: high probability for exceeding 2 C warming target, 50% chance for exceeding 3 C

The Durban Outcome

1. Ad Hoc Working Group on the Durban Platform for Enhanced Action (AWG-DPEA)

- *“develop a Protocol, another legal instrument or an agreed outcome with legal force under the UNFCCC applicable to all Parties”*
- negotiation until 2015 / COP 21
- implementation from 2020 onwards

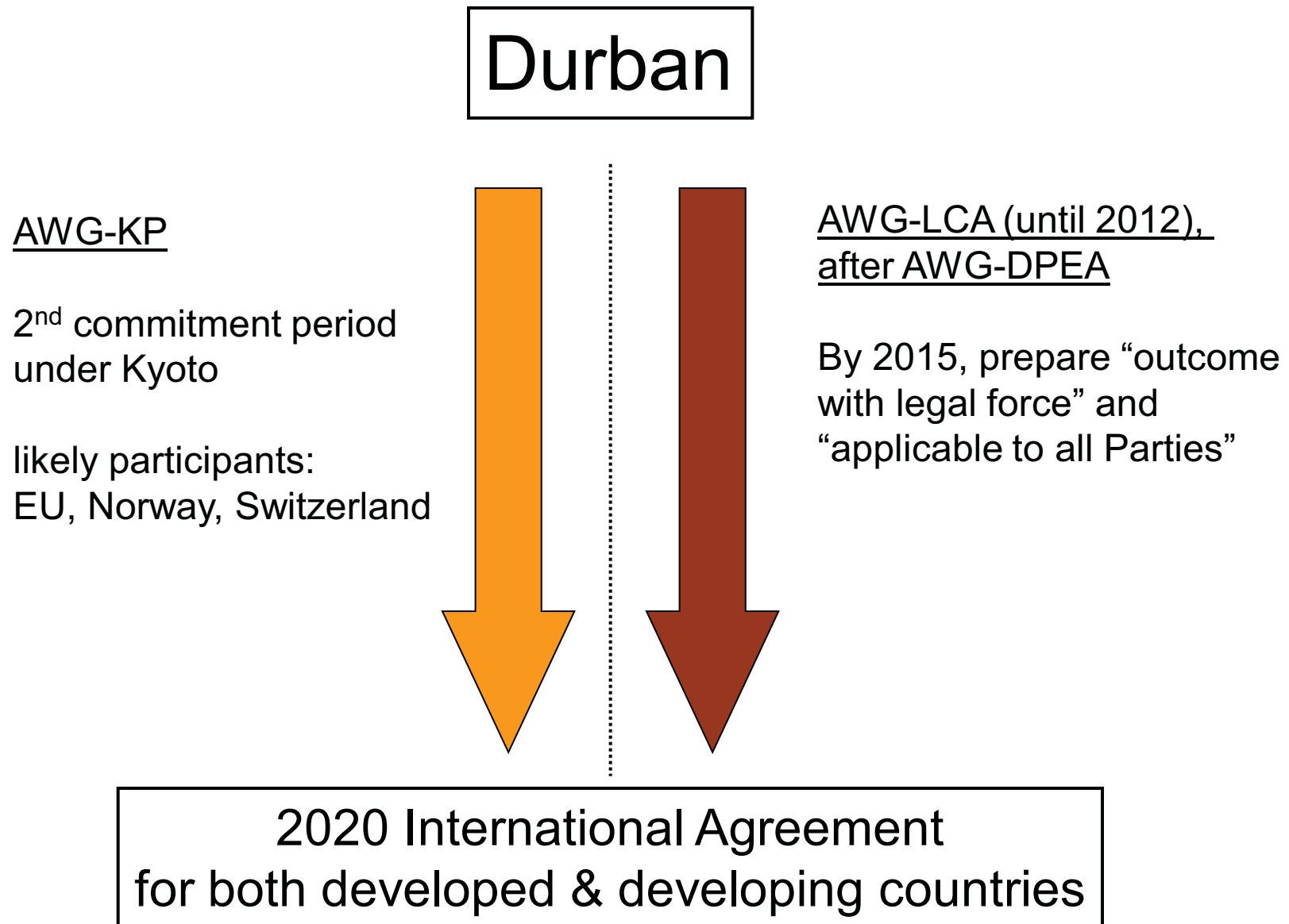
2. Kyoto 2nd commitment period

- agreement on length (2017 or 2020?) and ambition (targets for signatories) postponed → COP 18 in Qatar

3. “Operationalization” of Cancun Agreements

- Establishment of Green Climate Fund

Negotiation tracks in UNFCCC process



A theoretical view on global climate policy



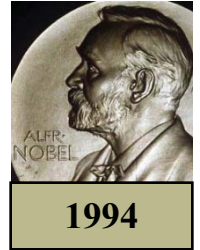
- Common sense and theory: Low prospects for international cooperation on climate change mitigation
- Abatement of emissions is a pure public good
- Free-riding incentives inhibit cooperation, especially when there is much to gain from it (Carraro & Siniscalco 1993, Barrett 1994)

Searching for economic explanations

- *Game theory:*
Analysis of strategic behavior in situations of conflict
- Equilibrium-state according to John Nash:

*Everybody chooses the strategy
(=behavior) that is most advantageous for
themselves – given the behavior of
everybody else*

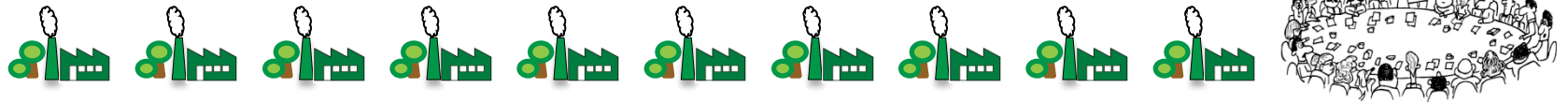
⇒ Incentives of the “climate game”
correspond to a prisoner’s dilemma



John F. Nash *1928,
Nobel prize 1994

Searching for economic explanations: Game theory

- Dilemma: Incentives in the climate game
 - “Everybody cooperates on climate change” is globally optimal



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- Every single country is better off if only the others mitigate



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- “No climate protection” is the globally least desirable state



Searching for economic explanations: Game theory

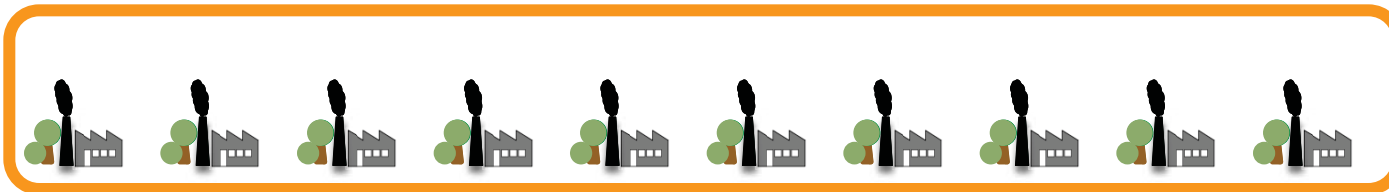
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Nash
Equi-
librium

- What determines countries' incentives?

Perception and valuation of benefits

- **Valuation**

- Further research and assessment of risks (e.g. IPCC AR5 and subsequent reports) of great use
- Remaining irreducible uncertainty is defining feature of the problem; 100% understanding no prerequisite for decision-making

- **Perception**

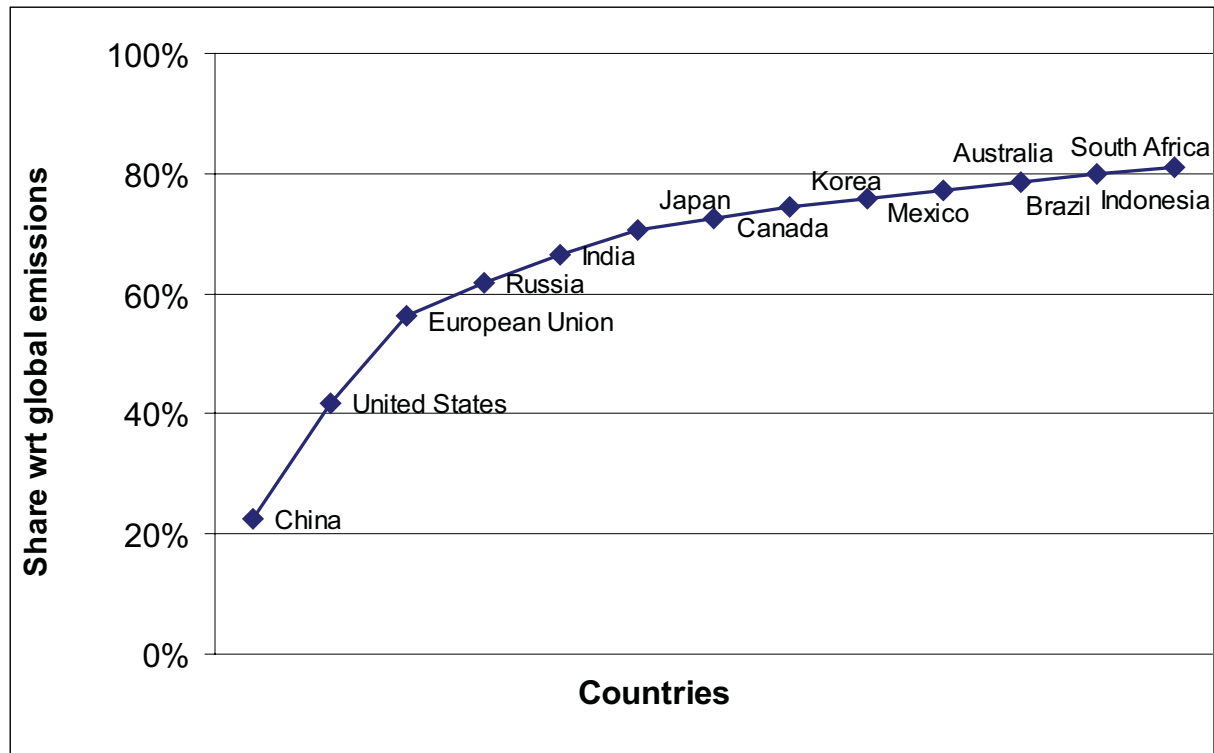
- Controversial debate offers excuse for still ignoring future damages
 - but early action could be important
- Ethics of 'justice':
 - Valuation of future damages (intergenerational justice, debate on discounting)
 - Valuation of damages in other regions + in future, e.g. Africa, small-island-states (intra-generational justice)

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I. Reducing the coalition size

Cumulative emissions of countries in the *Major Economies Forum on Energy and Climate* (MEF). [Year 2008. Only CO₂, without LULUCF emissions]



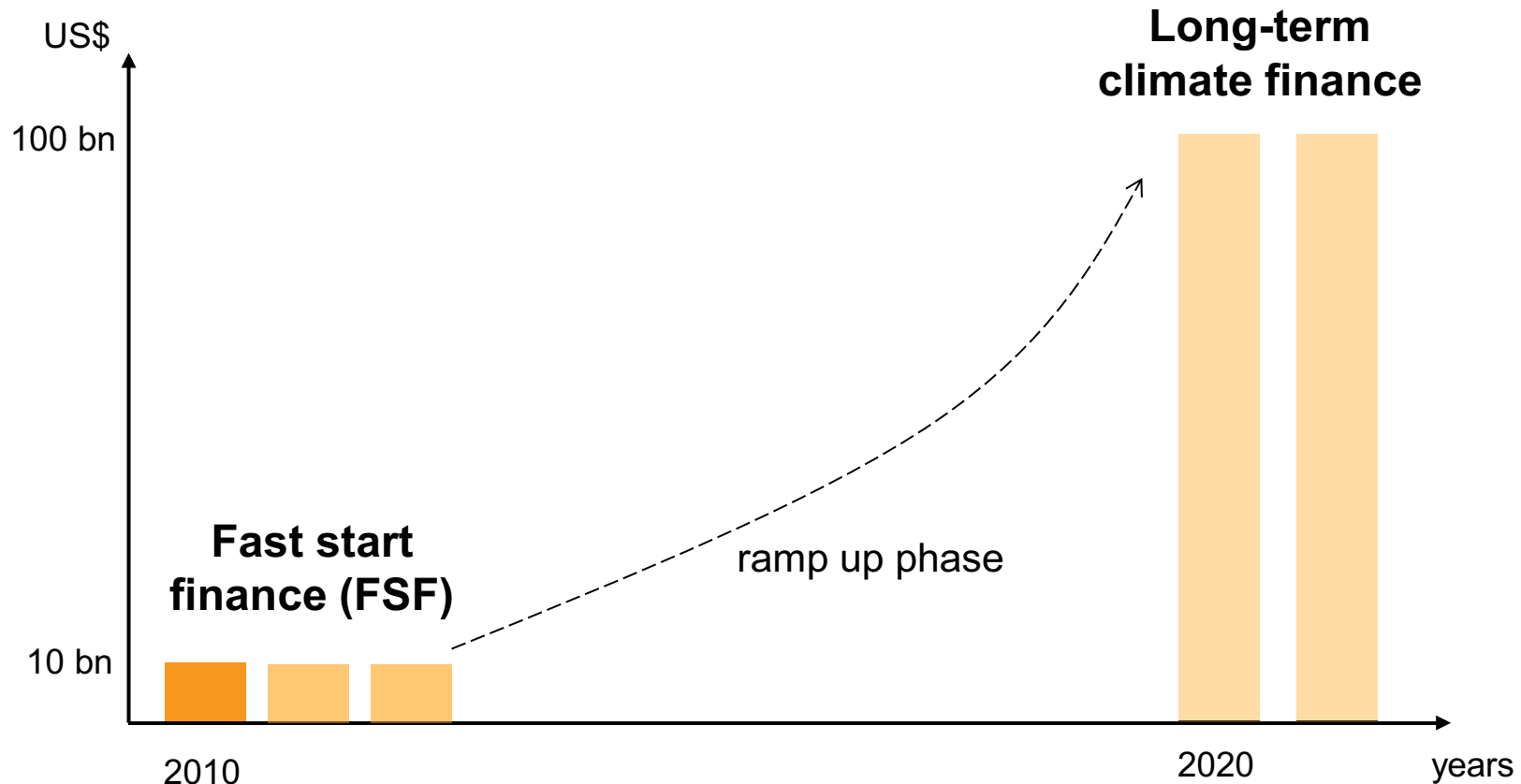
- Reducing the complexity of negotiation process
- ... but at the price of cost-effectiveness

II. More issues: “Issue-Linking”

Idea: Find mechanism to make cost-benefit ratio of climate mitigation (from individual country perspective) more attractive

- Link climate cooperation with R&D cooperation
- Green Fund as a vehicle to foster cooperation?
- Create and link emission trading markets
- Trade sanctions against climate free-riders

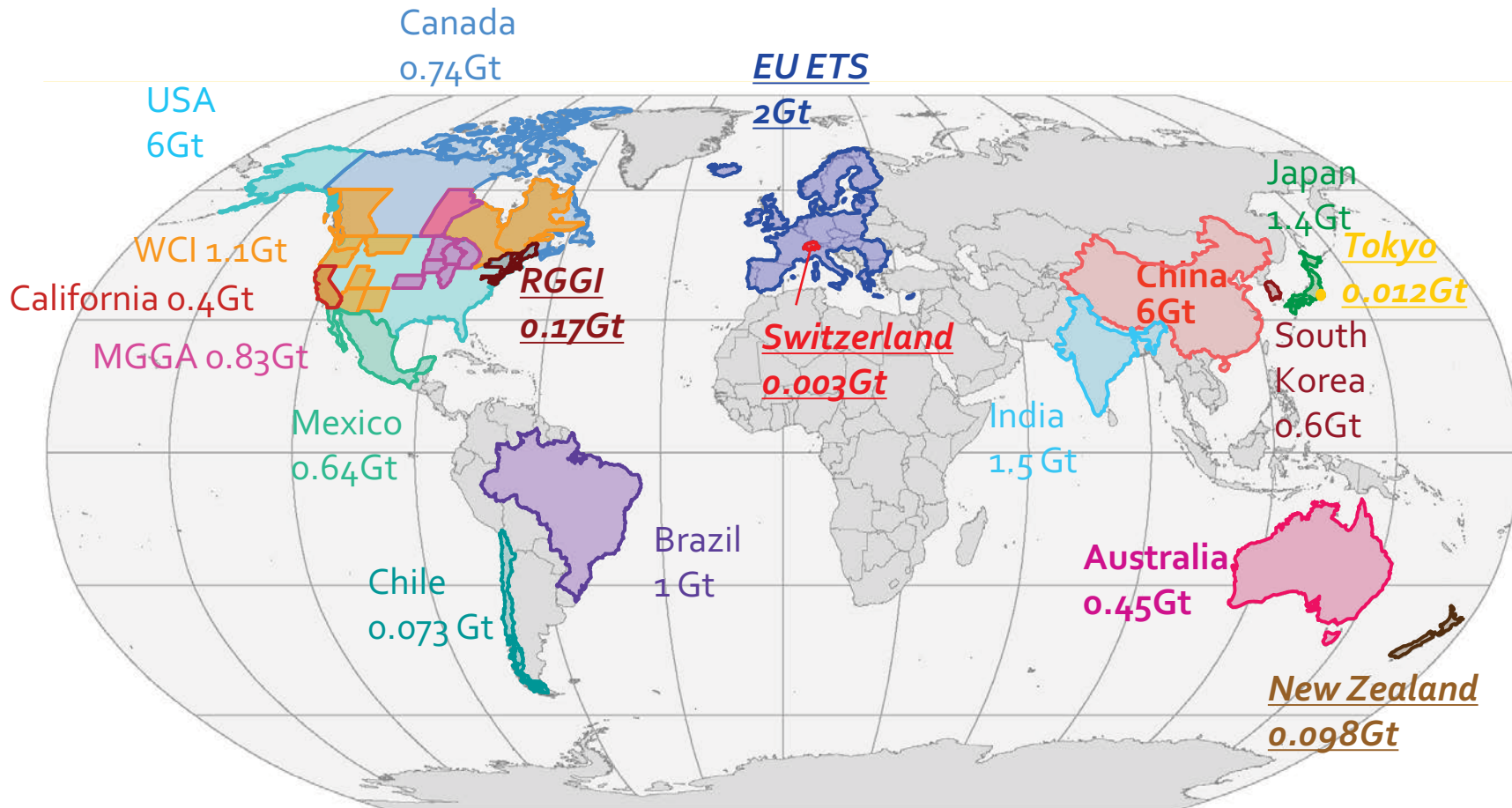
III. Side Payments: Green Climate Fund



↑
For 2010 industrialized
countries had earmarked
US\$ 12 billions

Brunner (2011)

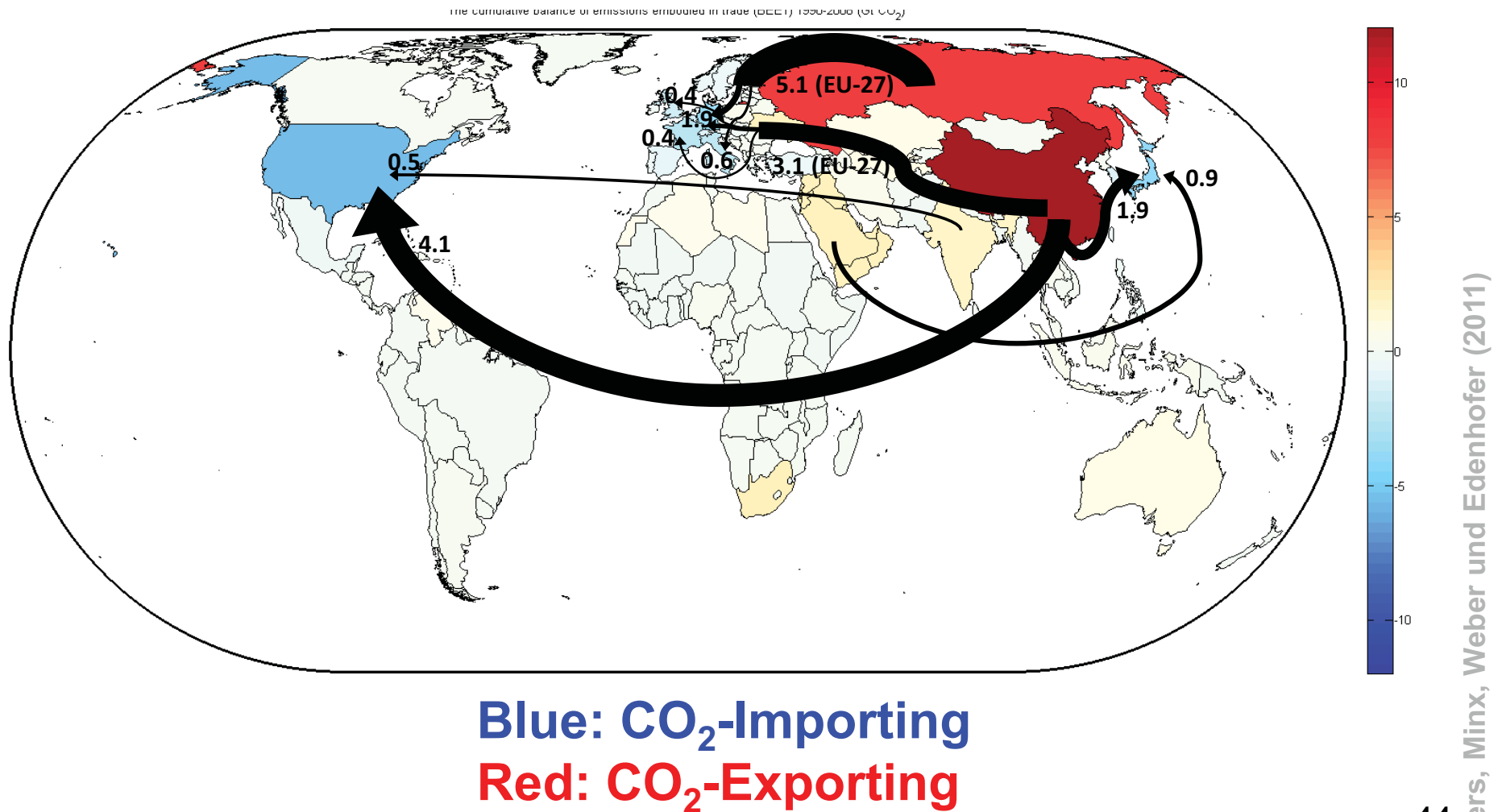
Linking of regional cap-and trade initiatives



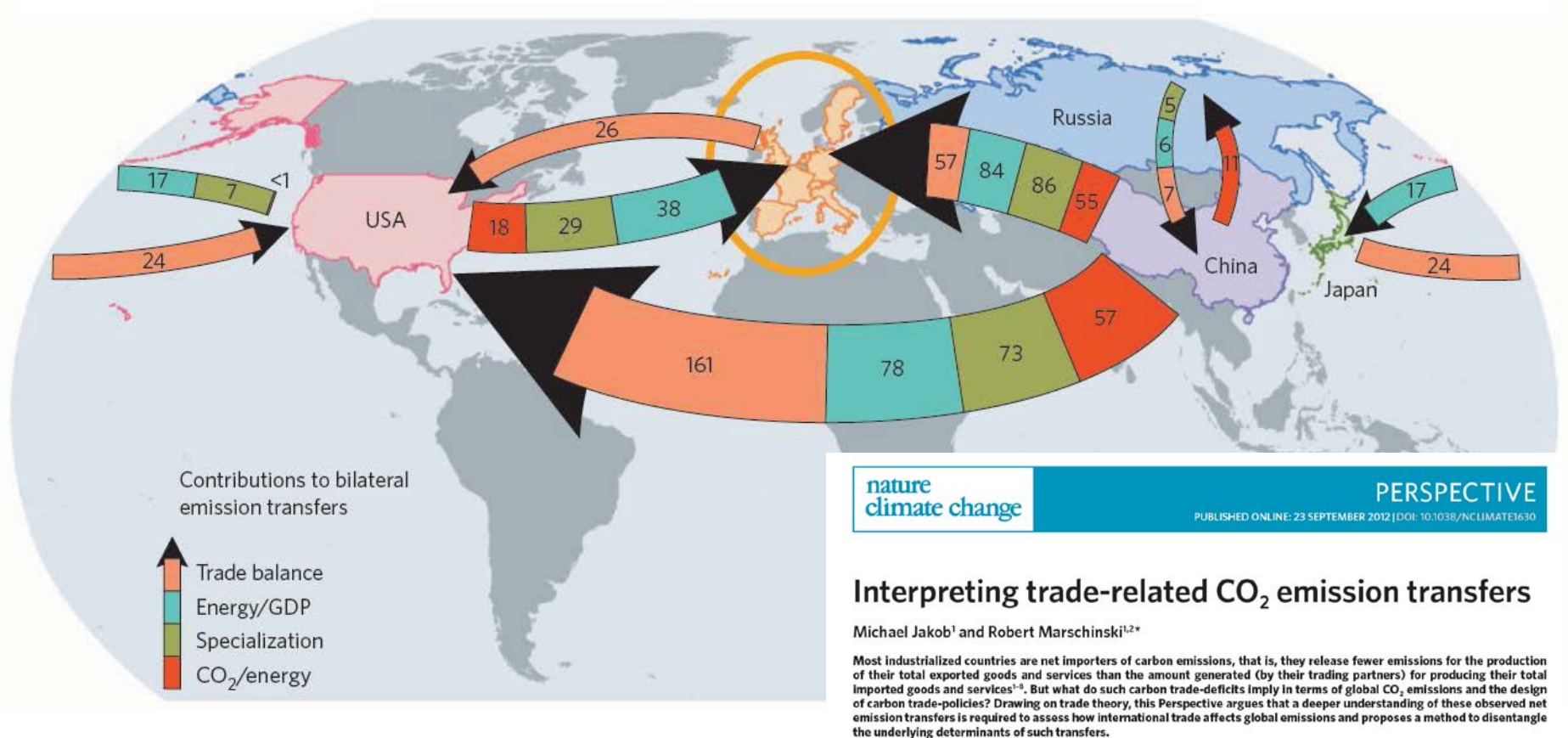
- Australia's ETS from 2015 on will be among the world's biggest
- Linking to other carbon markets would increase the abatement possibilities and increase the efficiency of the system
- BUT: Many offset possibilities could be problematic with respect to linking as their environmental integrity is often difficult to assess (see CDM)

Justification for trade sanctions?

CO₂-trade balances for different world regions 1990-2008



Consumption-based emissions in 2004

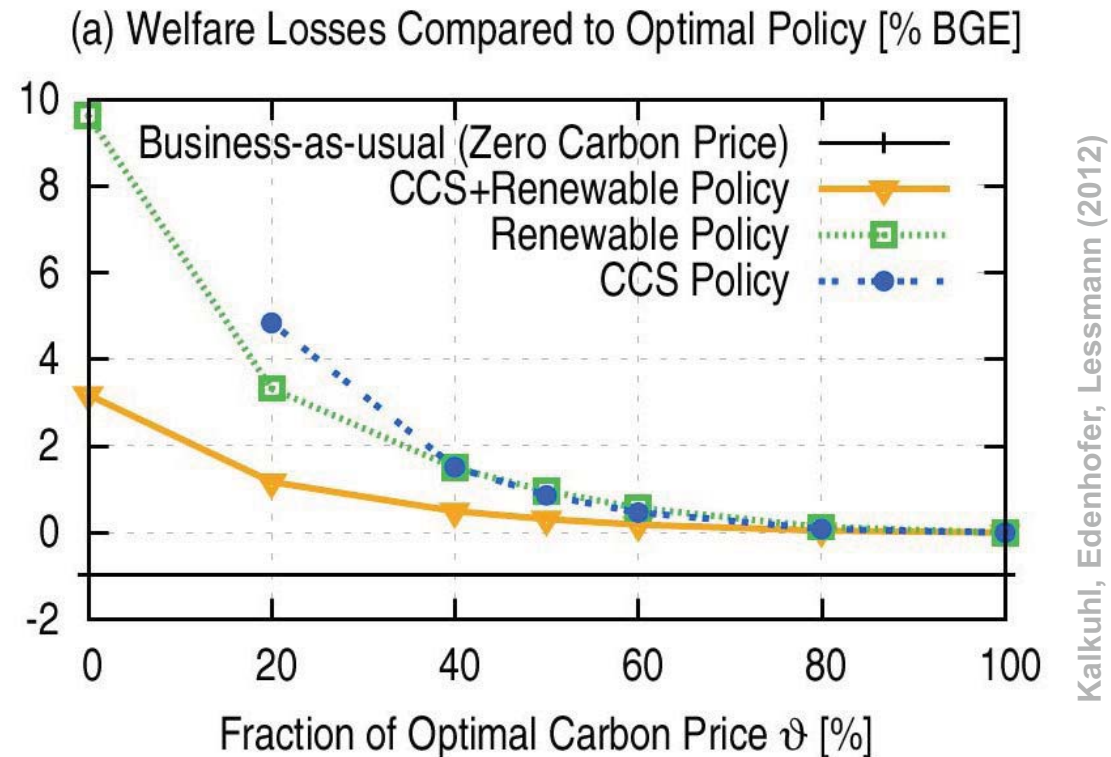


- Specialization is only one component determining trade-related emissions.
- Net imports are an inappropriate indicator for burden sharing schemes

Border Tax Adjustments (BTA)?

- In the case of a unilateral climate policy, taxing net imports according to the carbon content is a risky option.
- If the domestic industry is more (less) carbon-intensive than the export-industry, imposing a BTA leads to increasing (decreasing) emissions in the carbon net exporter country.
- Admittedly, the empirical findings are inconclusive. However, a substantial risk remains that BTA has unintended consequences.

Could technology policy substitute CO₂-pricing?

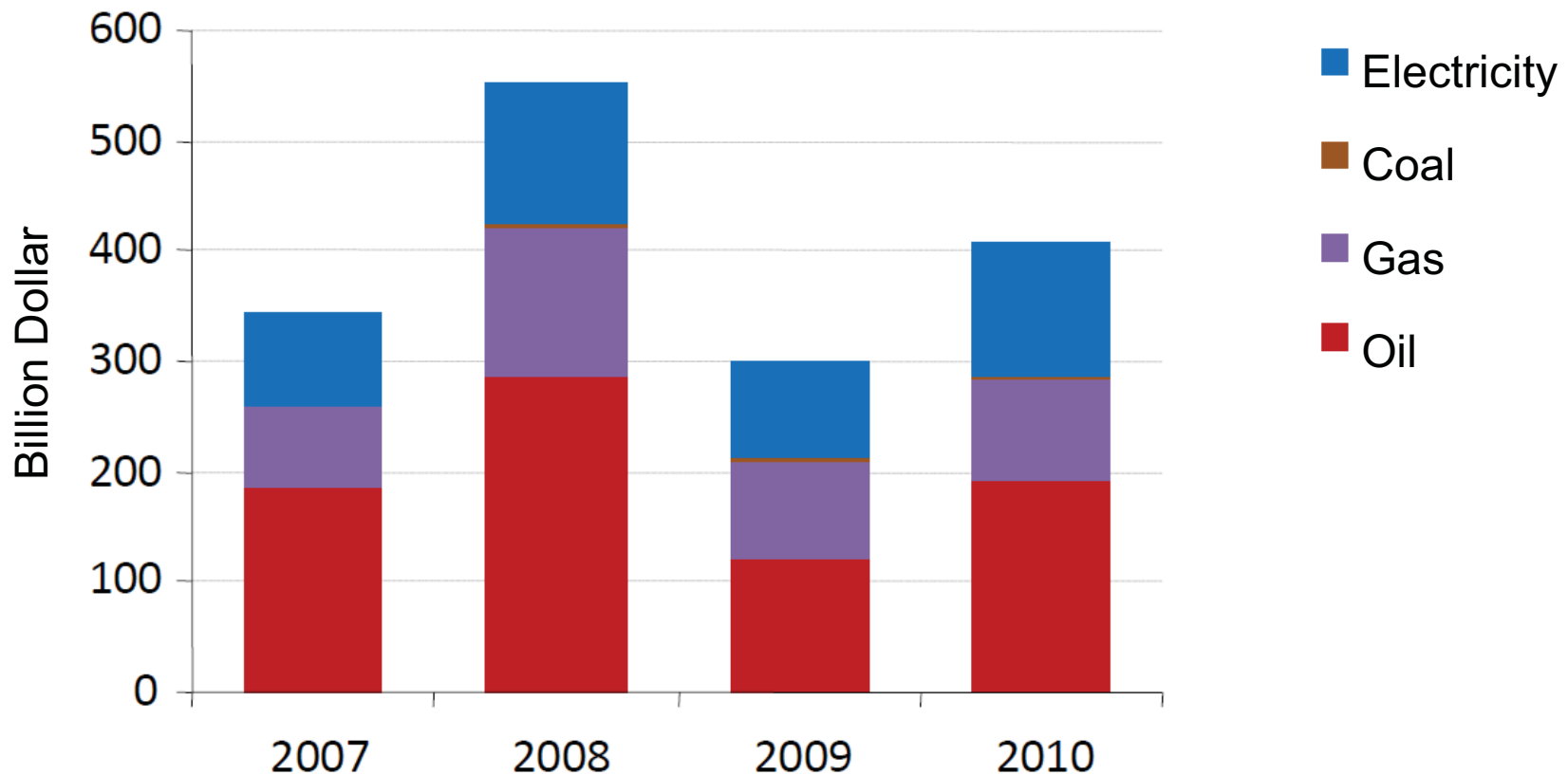


For a given climate target:

- Technology policy can compensate a CO₂-price that is 50% below its socially optimal level
- But: increasing use of technology policy to compensate an insufficient CO₂-price will increase total mitigation costs

IV: No regret policies – Reducing fossil fuel subsidies

Global subsidies for fossil energies: 409 Billion \$ in 2010, a rise of 35% compared to 2009.



IEA World Energy Outlook 2011

IV: No regret policies – Reducing fossil fuel subsidies

- Current subsidies for fossil energies correspond to a **negative carbon price** of 9US\$ per ton CO₂ on average [Source: own calculation]
- Without further reforms, subsidies for fossil fuels will reach 660 Billion Dollar in 2020: 0.7% of global GDP
- Phase-out of subsidies until 2020:
 - Energy demand lowered by 4.1%
 - Oil demand reduced by 3.7 Millionen Barrel/day
 - Reduction of CO₂ -emissions by 1.7 Gt
- Many countries are planning or already implementing reforms:

Most important reason: Pressure on national budgets

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Concluding remarks

- Climate change problem will not be solved by resources becoming scarce
- Climate policy can be seen as an insurance against catastrophic risks
- Reaching a 2°C target is still possible at relatively low costs, but ...
- ... game-theoretical analysis proves the dilemma of international negotiations
- Issue linking and technology policy could break the stallment of negotiations

Thank you for your attention!

Ottmar.Edenhofer@pik-potsdam.de