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

**Max-Planck Institute of Economics**

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PIK

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Mercator Research Institute on
Global Commons and Climate Change

berlin

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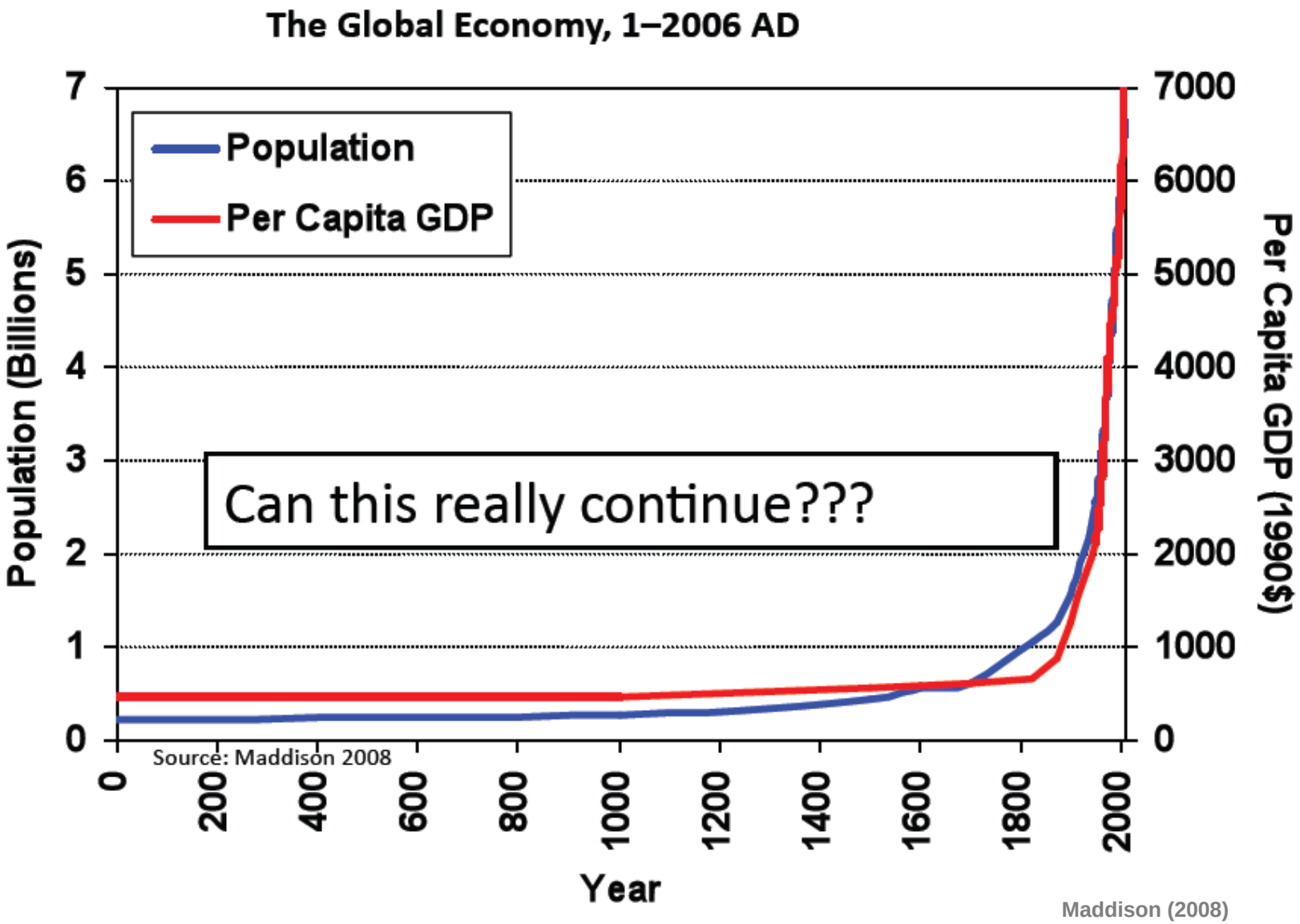
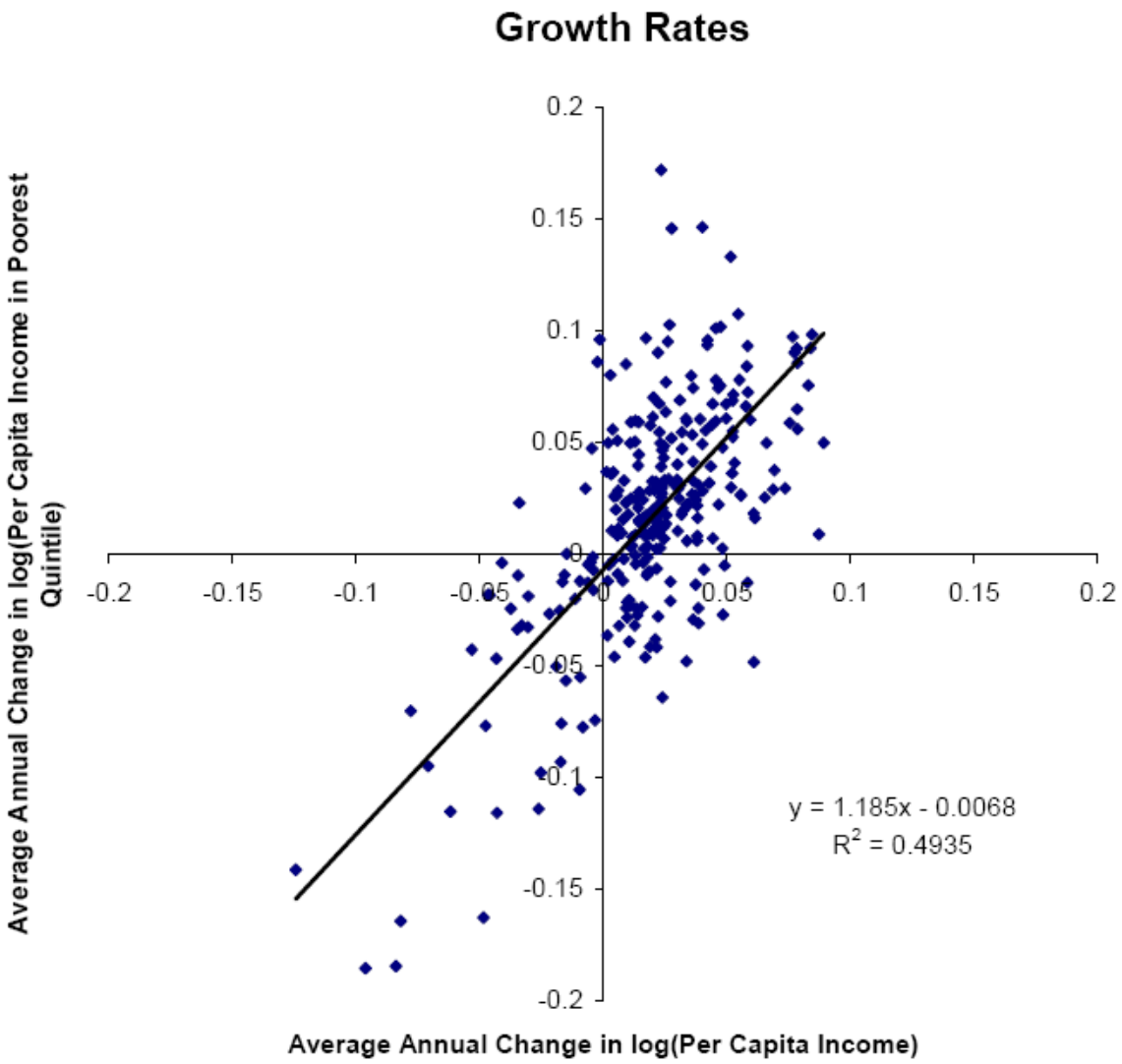
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP
Working Group III (WG III) – Mitigation of Climate Change

# Economic Growth in Perspective




Maddison (2008)

# Growth and Poverty Reduction



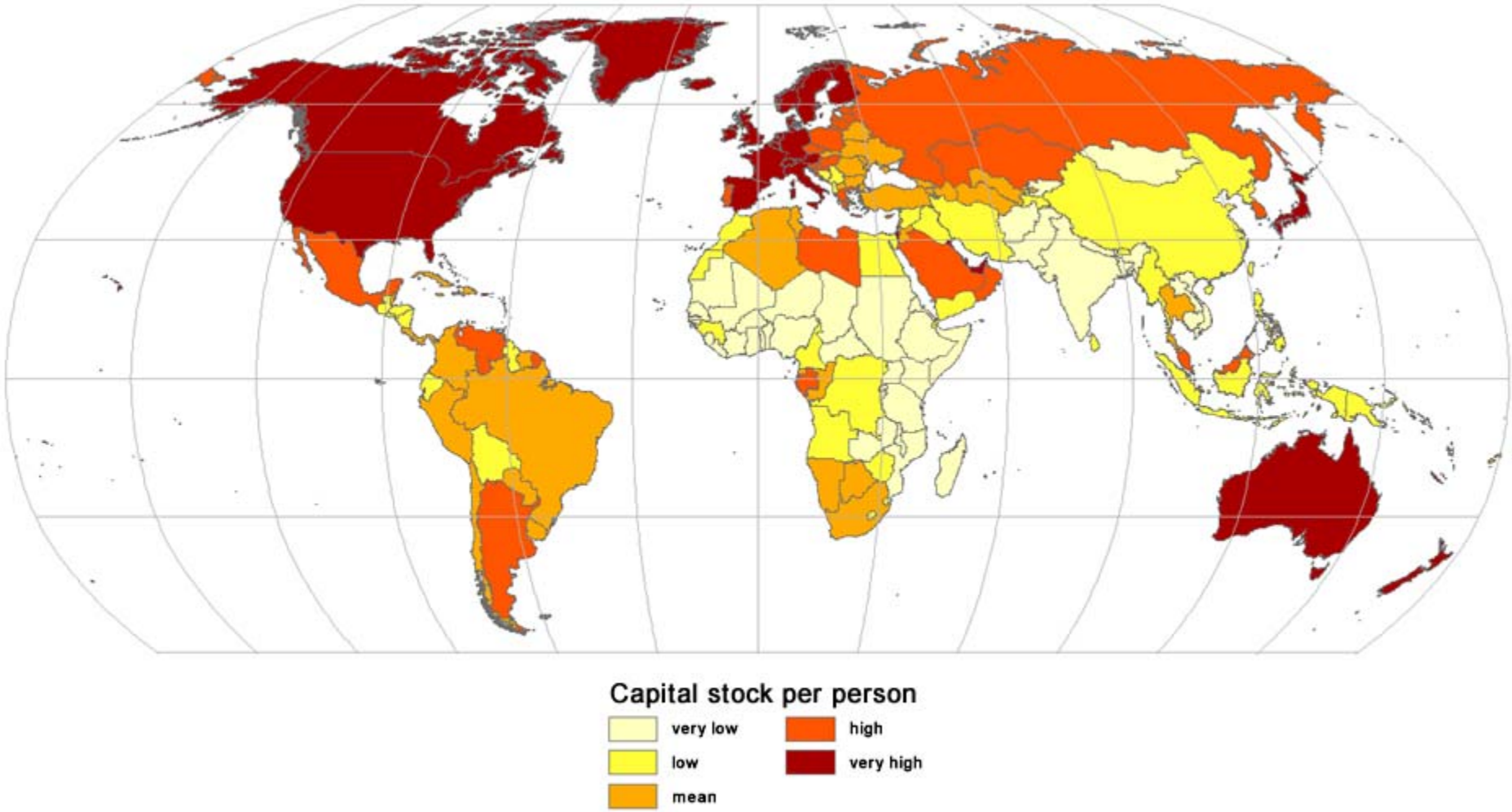

- People living in absolute poverty: >1 Billion

- Low economic growth could drastically reduce development in many countries
- Zero growth is not sufficient to reach environmental targets

⇒ Banning growth does not seem to be a feasible solution to protect the environment

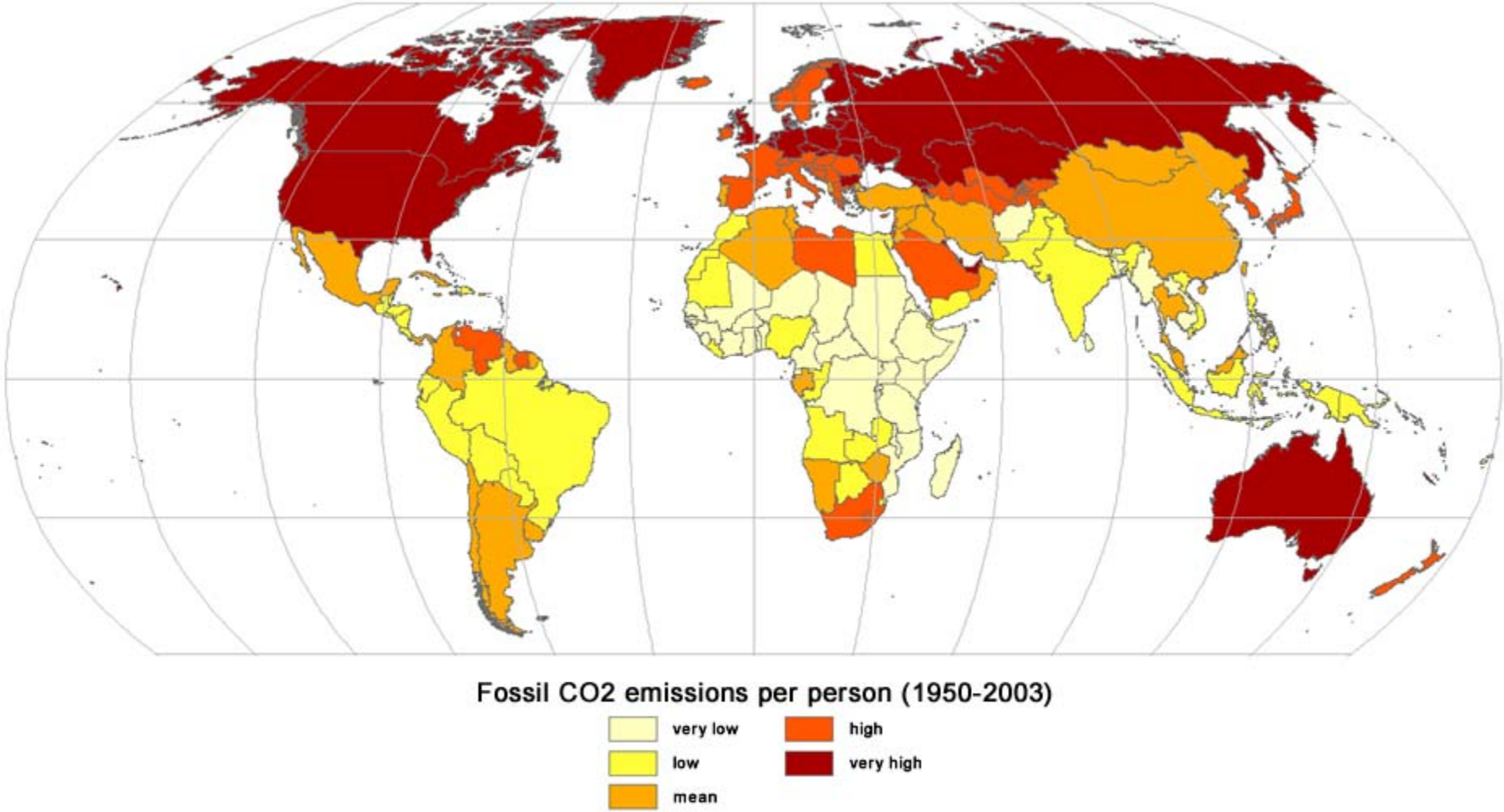
Dollar and Kray (2002)

# World Map of Wealth



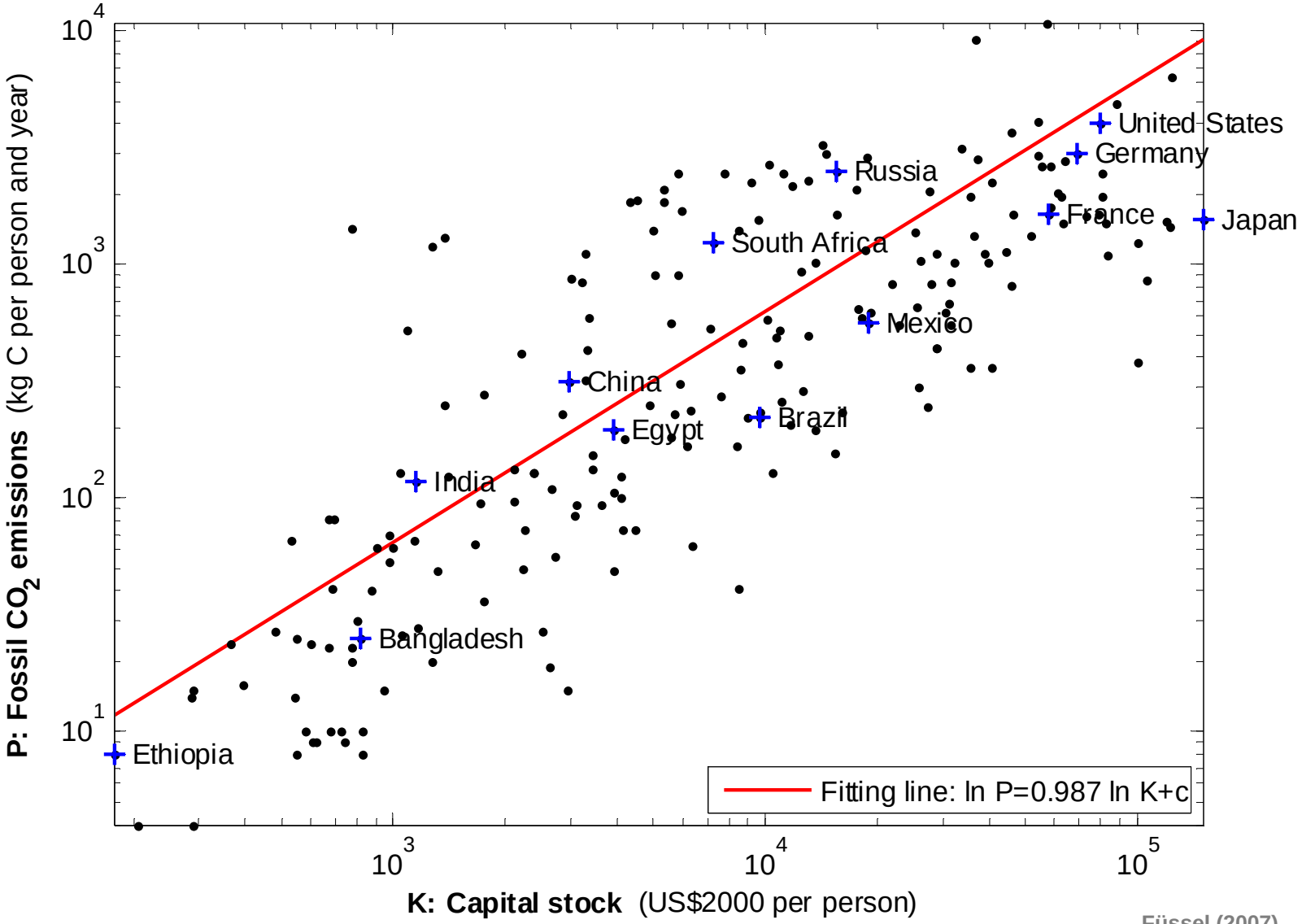

Füssel (2007)

# World Map of Carbon Debt



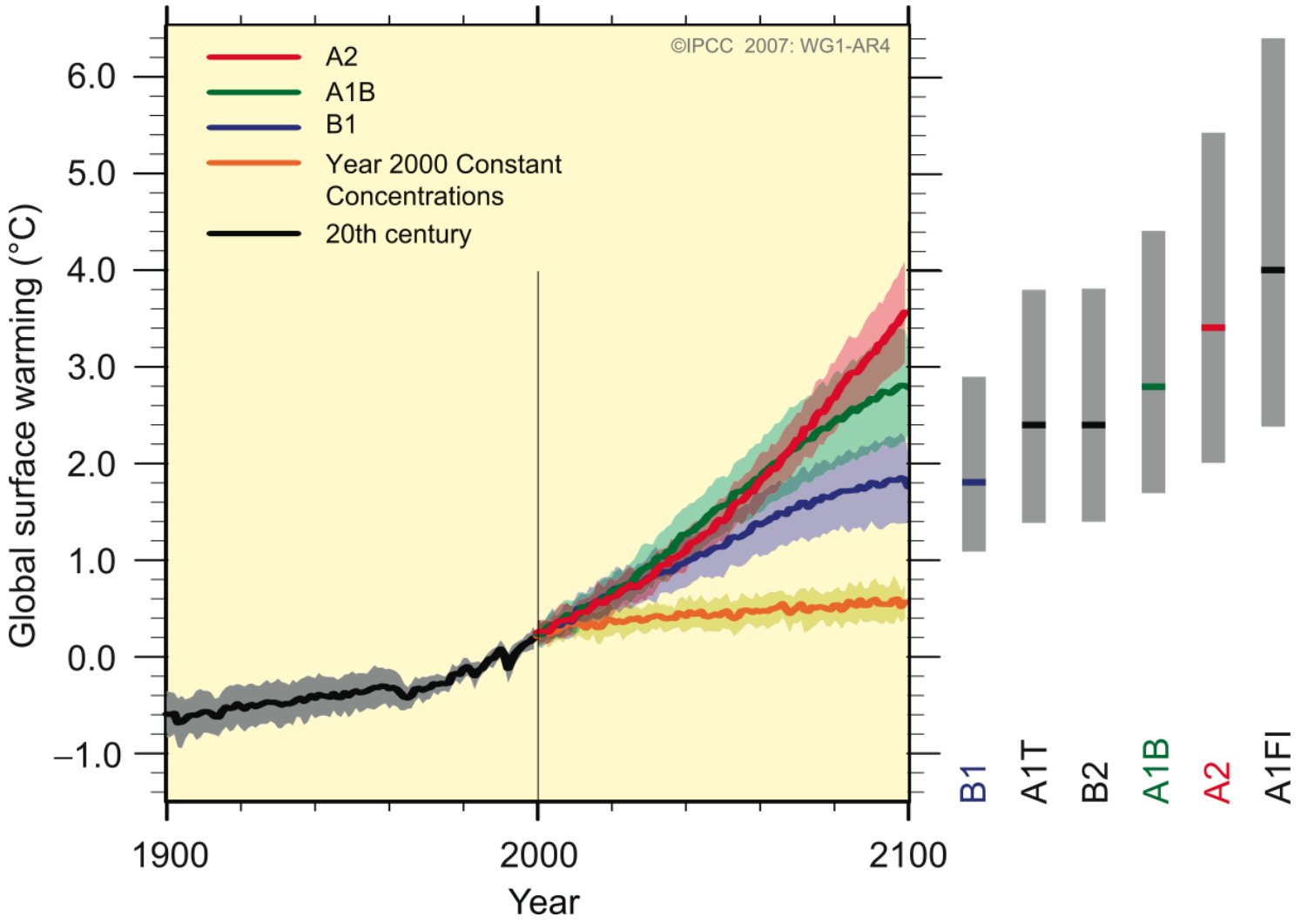

Füssel (2007)

# Carbon Debt and Wealth

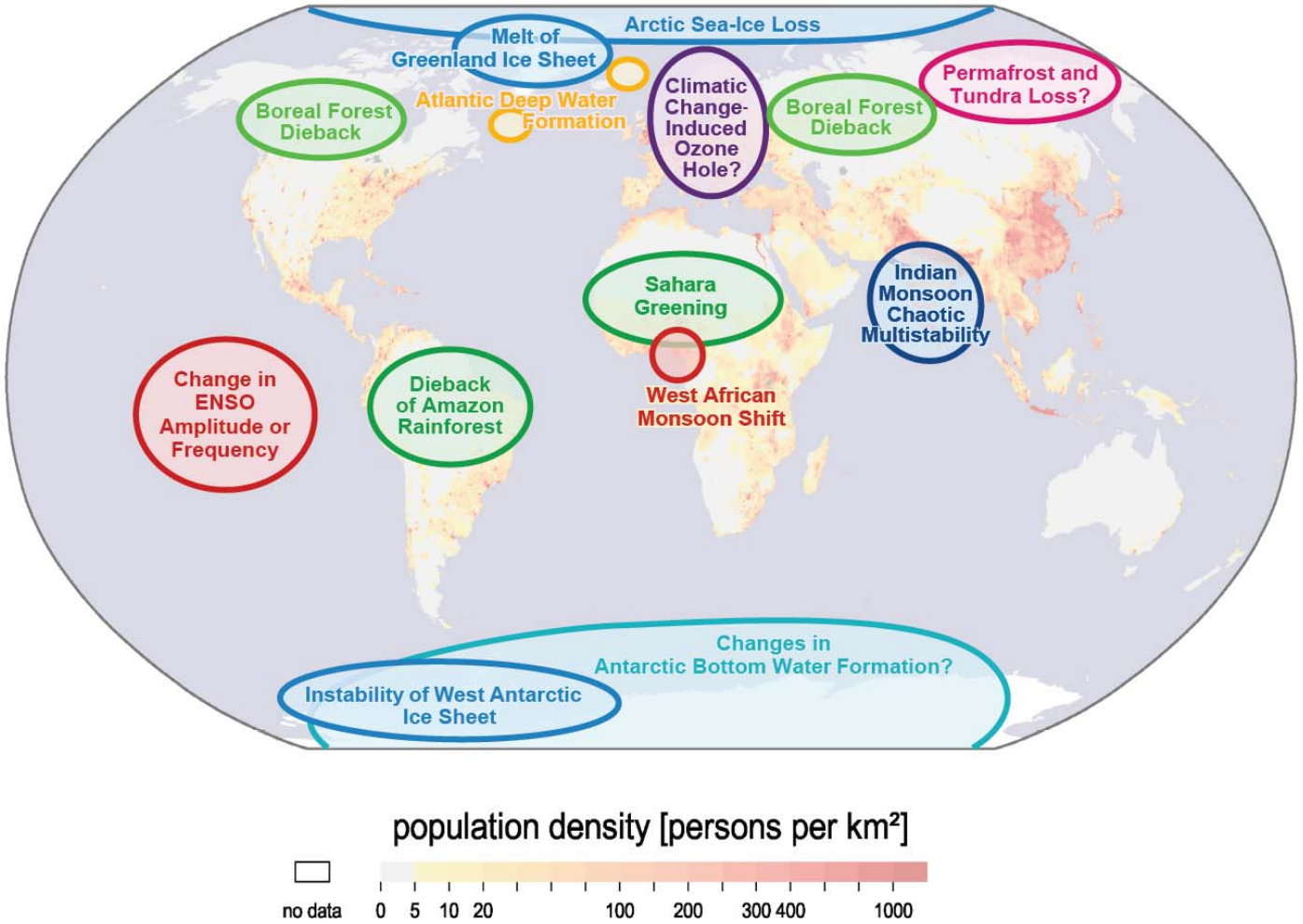



Füssel (2007)

# The impact of economic growth on the environment



# Climate Change: Tipping Points in the Earth System




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

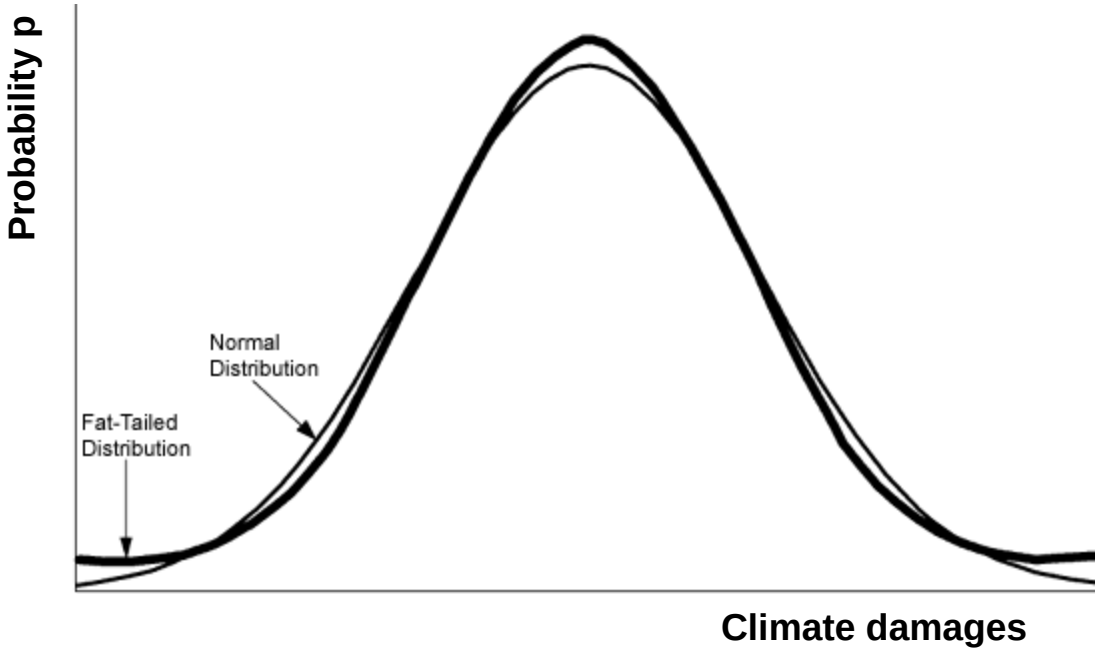
Schellnhuber, 1996; Lenton et al., 2008

# Cost-benefit Analysis or Risk Management?

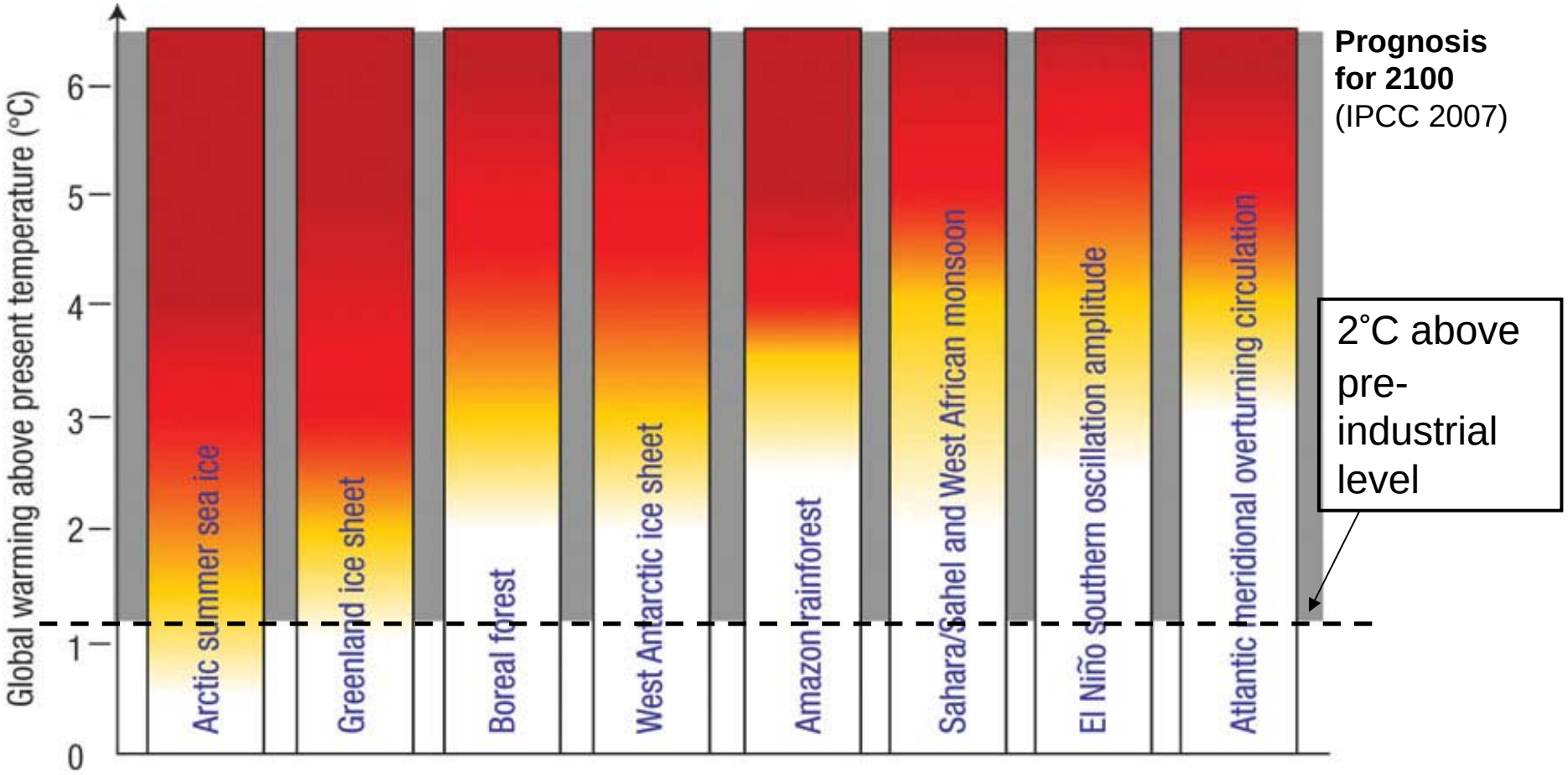
- Weitzmann 2009, 2010: The Dismal Theorem
  - Due to „fat-tailed“ climate sensitivity and uncertain tipping points there is a non-trivial probability of catastrophic damages
  - For CRRA utility functions the expected utility converges to minus infinity

$$U(C) = \frac{C^{1-\phi}}{1-\phi} \quad for \ \phi \neq 1 \ (\phi > 0)$$
$$= \ln C \quad for \ \phi = 1$$

$$If \ p(C) \ is \ a \ fat-tailed \ distribution:$$
$$\int_{-\infty}^{\infty} U(C)\, p(C)\, dC \to -\infty$$



# Burning Embers Diagram




T. M. Lenton & H. J. Schellnhuber (Nature Reports Climate Change, 2007)

# Climate Change Mitigation as Insurance

- In this case the cost-benefit calculus breaks down. With risk aversion, basically the entire income is used to avoid the possibility of catastrophic damages.

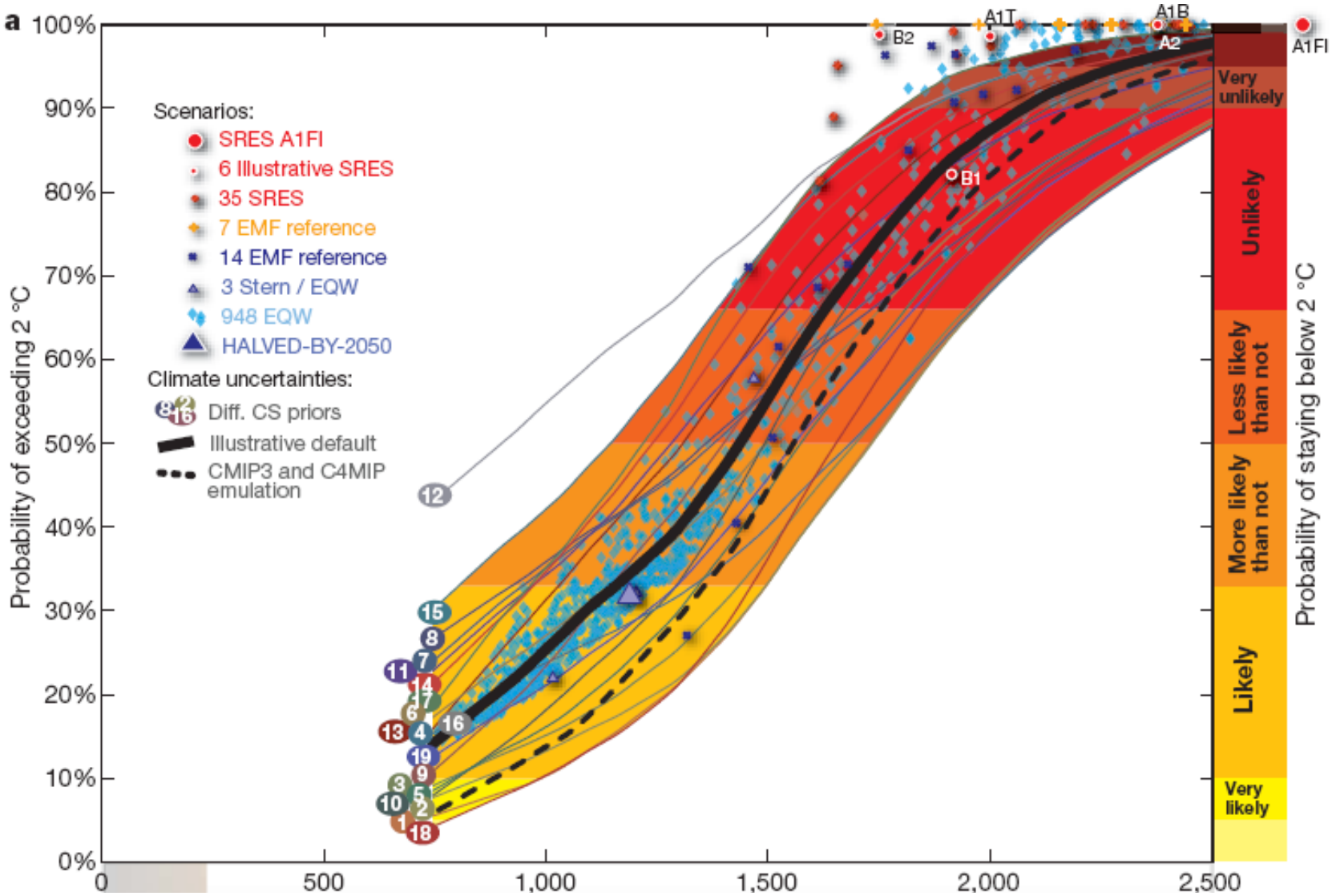
- Climate policy as **insurance against catastrophic climate change**!

TABLE 1—LIKELIHOOD (IN PERCENTAGE) OF EXCEEDING A TEMPERATURE INCREASE AT EQUILIBRIUM

| Stabilization level (in ppm $CO_2$e) | 2°C | 3°C | 4°C | 5°C | 6°C | 7°C |
|---|---|---|---|---|---|---|
| 450 | 78 | 18 | 3 | 1 | 0 | 0 |
| 500 | 96 | 44 | 11 | 3 | 1 | 0 |
| 550 | 99 | 69 | 24 | 7 | 2 | 1 |
| 650 | 100 | 94 | 58 | 24 | 9 | 4 |
| 750 | 100 | 99 | 82 | 47 | 22 | 9 |

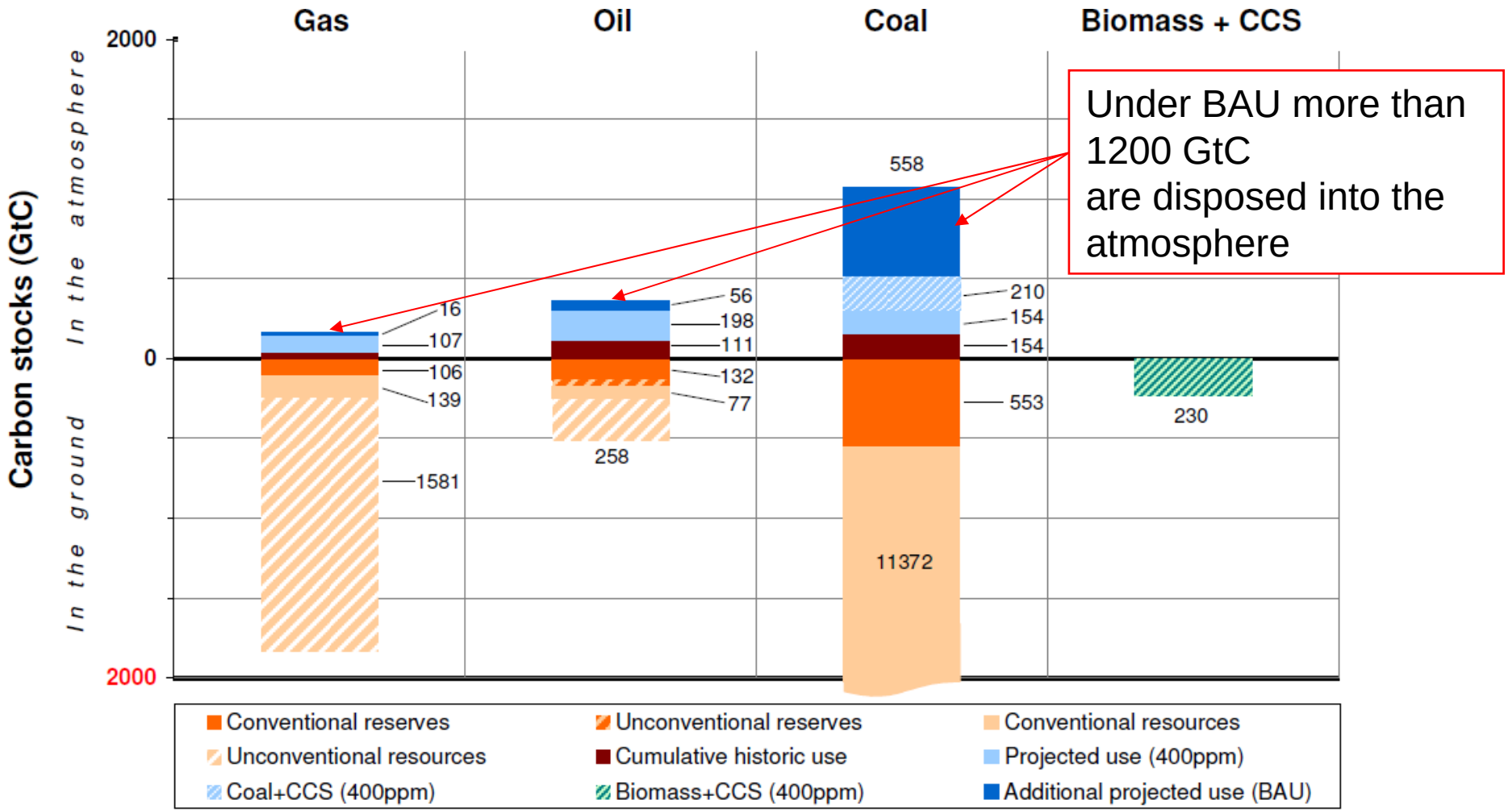
Stern (2008)

# Climate Policy as a Hotelling Problem




Meinshausen et al (2009)

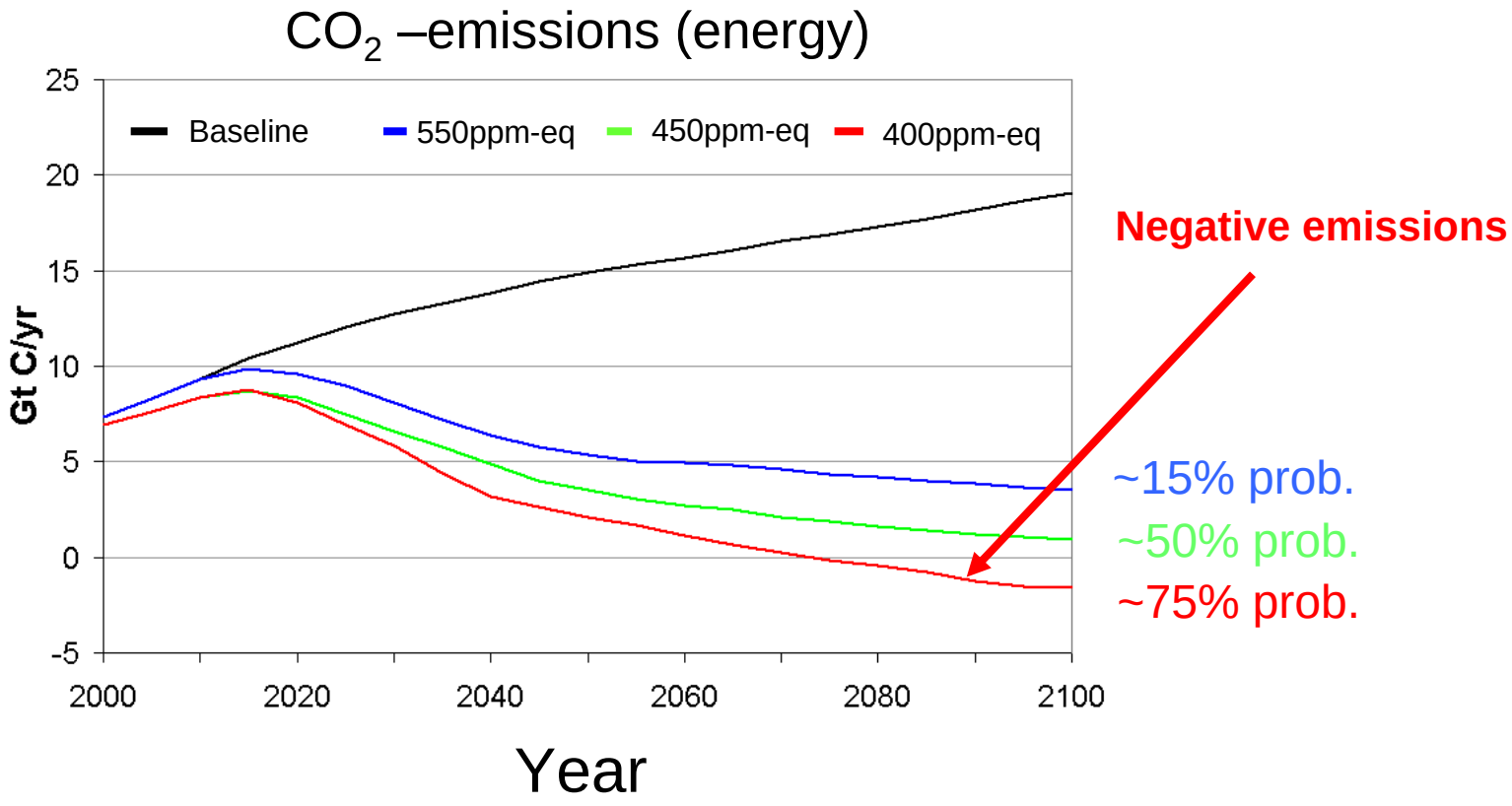
# Unlimited Resources – Limited Disposal Space




Kalkuhl et al. 2009

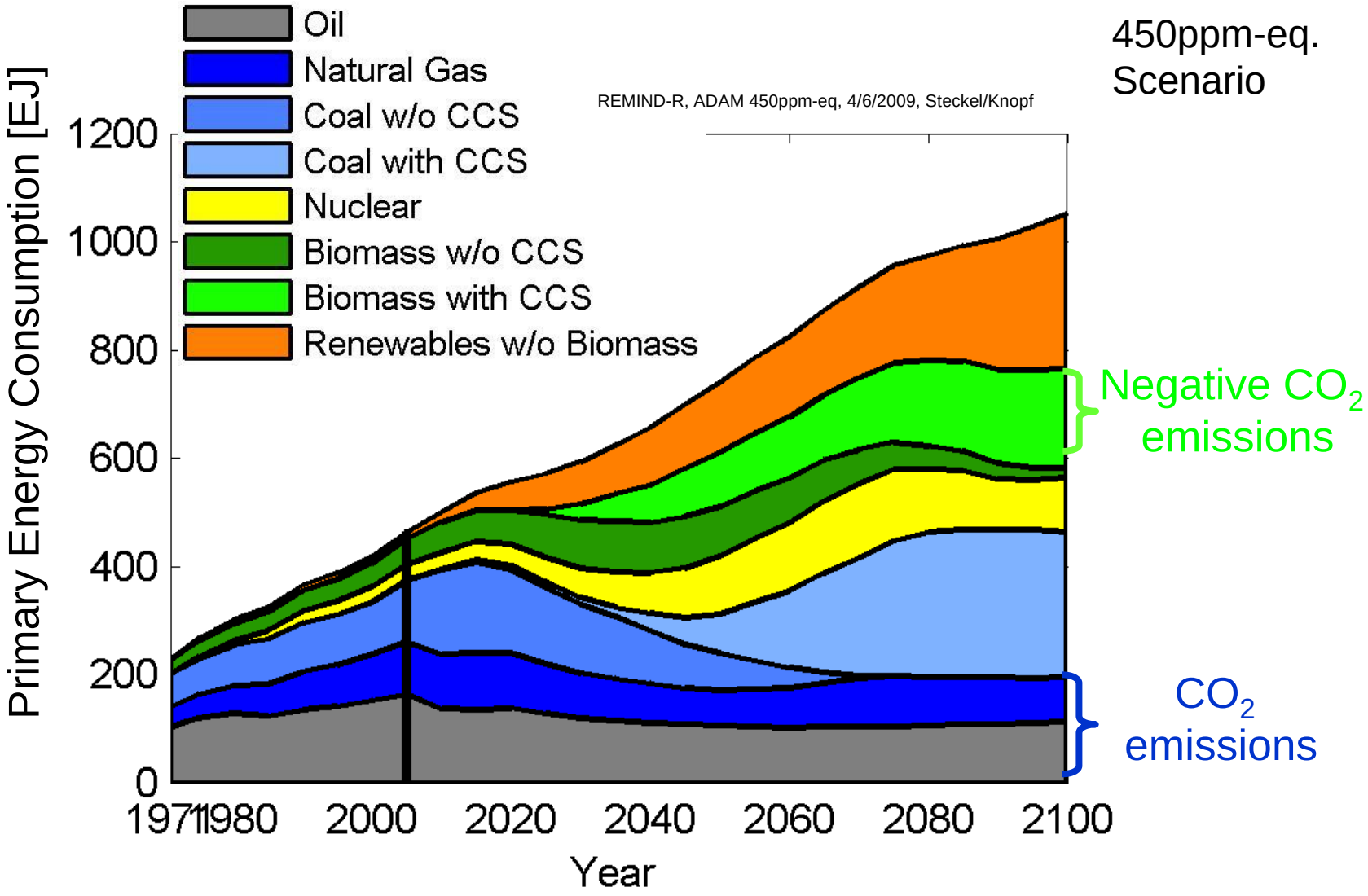
# Stabilisation of Atmospheric $CO_2$-Concentration

3 stabilisation goals with different probabilities of attaining the 2˚ goal: 550ppm-eq, 450ppm-eq, 400ppm-eq



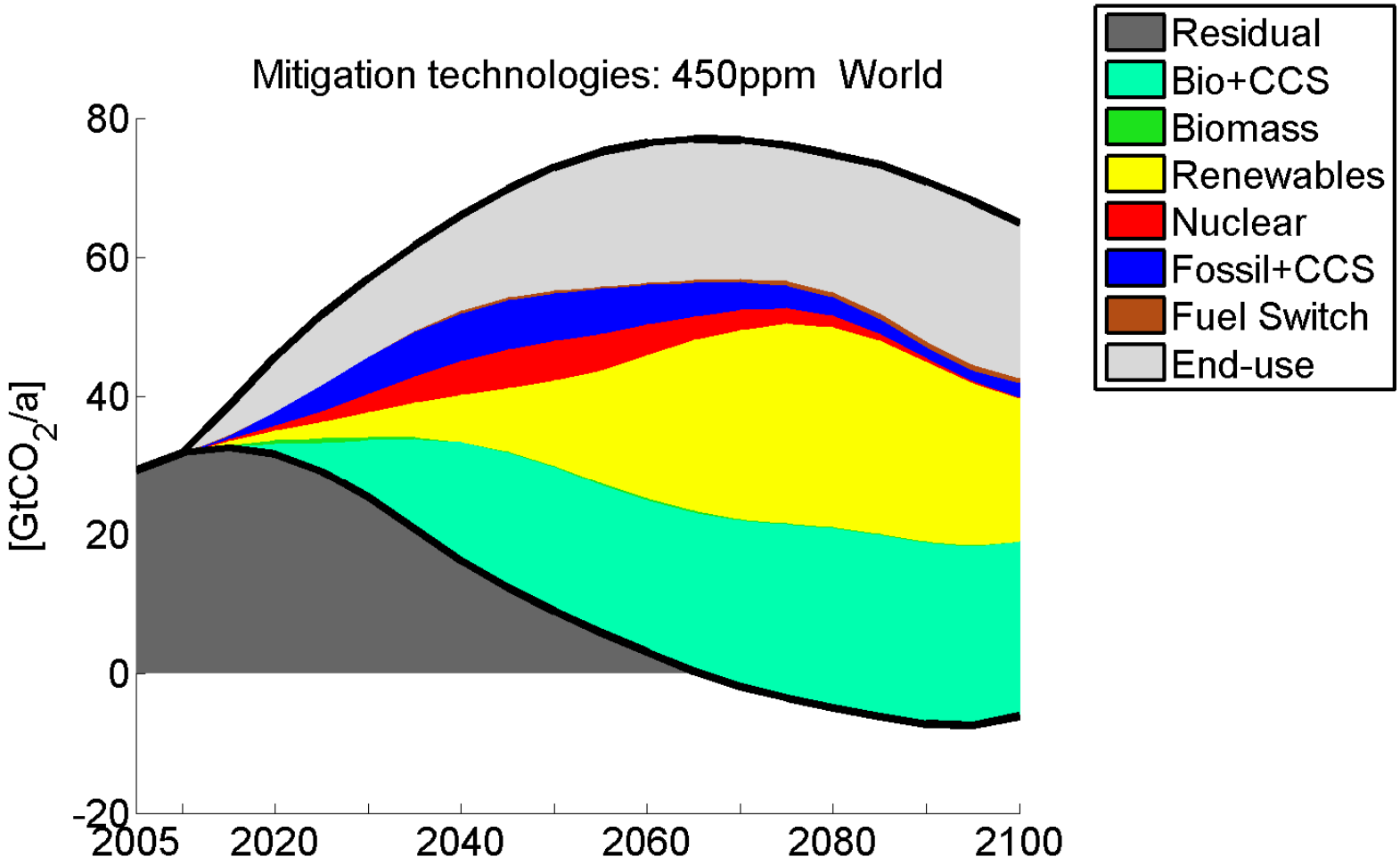

Knopf, Edenhofer et al. (2009)

# Transformation of the Energy System



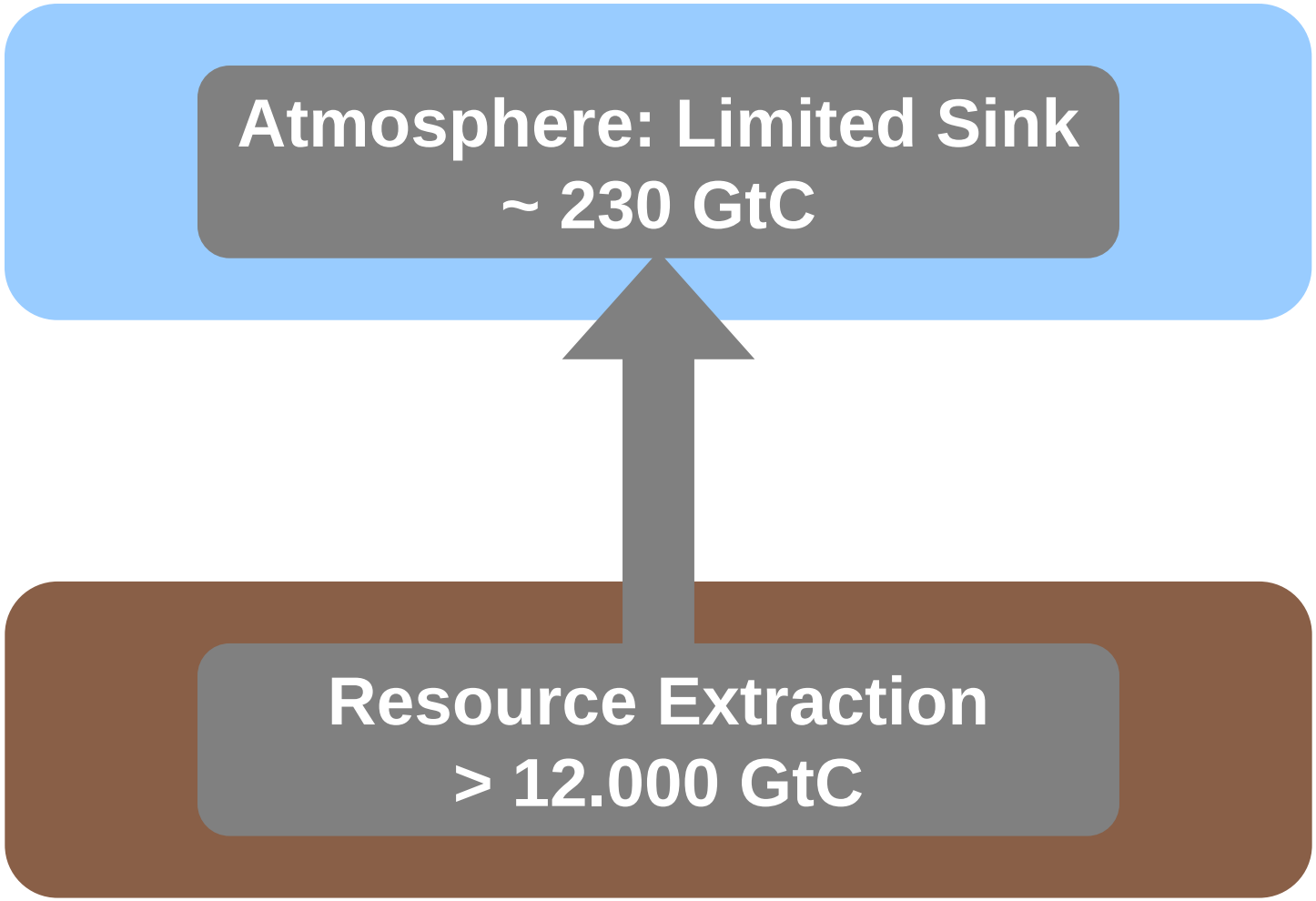

Based on IEA Data (1971-2005) and REMIND-R results for 450ppm-eq (ADAM); Graphic by Steckel/Knopf (PIK)

# … and What About Energy Efficiency?




Luderer et al. 2011

# The Atmosphere as a Global Common



# Managing the Atmosphere with a Sky Trust

1) **Determine Magnitude of Atmospheric Disposal Space**

   → Balance Costs & Risks of Climate Change with Mitigation

2) **Adopt efficient Policy Instruments: Carbon Tax or ETS**

3) **Distribute the Climate Rent**

# From Tragedy to Drama: Strategic Options

**Country Calculus for Mitigation Program**

| | Benefits | Costs |
|---|---|---|
| **Domestic** | Avoided domestic damages & Co-Benefits | Domestic mitigation costs (energy, growth) |
| **Global** | Avoided damages in other regions (ethics) | Costs for other regions (ethics); Access to mitigation in other regions |

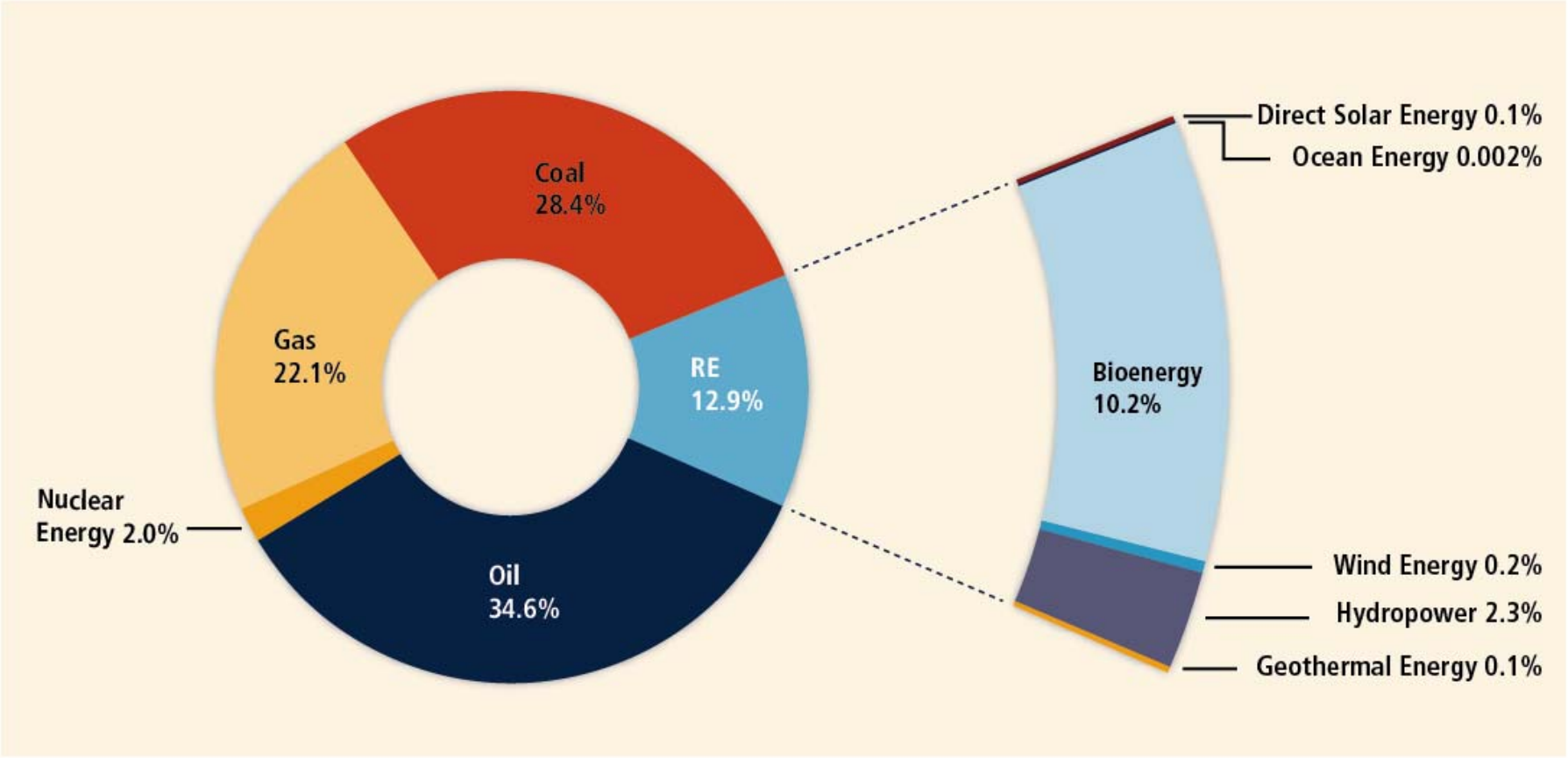
**Demand for Mitigation**

**Supply of Mitigation**

# Living in a Second-Best World: Technology Policies

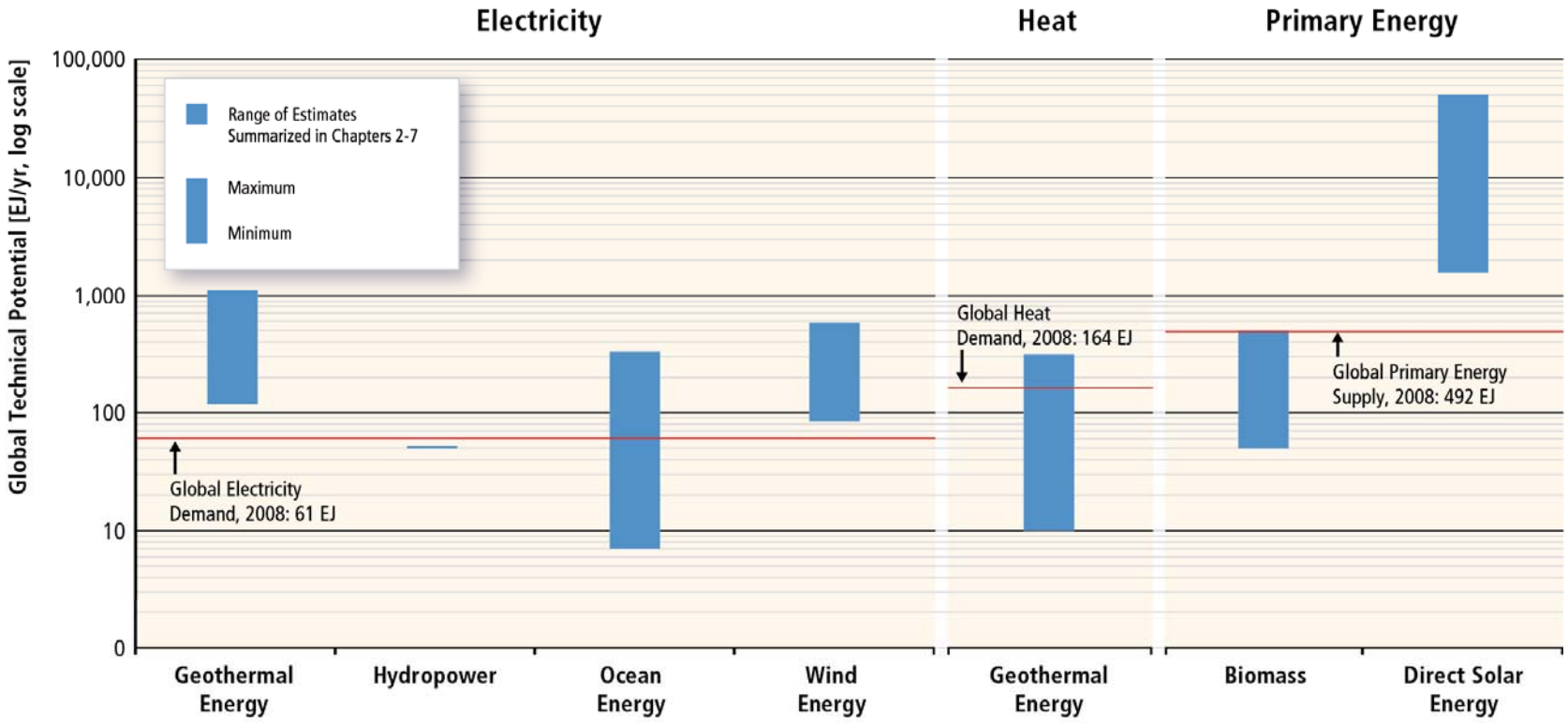
- Supporting Renewables: Fatal Aberration?
- Subsidizing CCS: Almost First Best?
- Combine both Options: A Bridge towards an International Agreement?

# The current Global Energy System is Dominated by Fossil Fuels




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

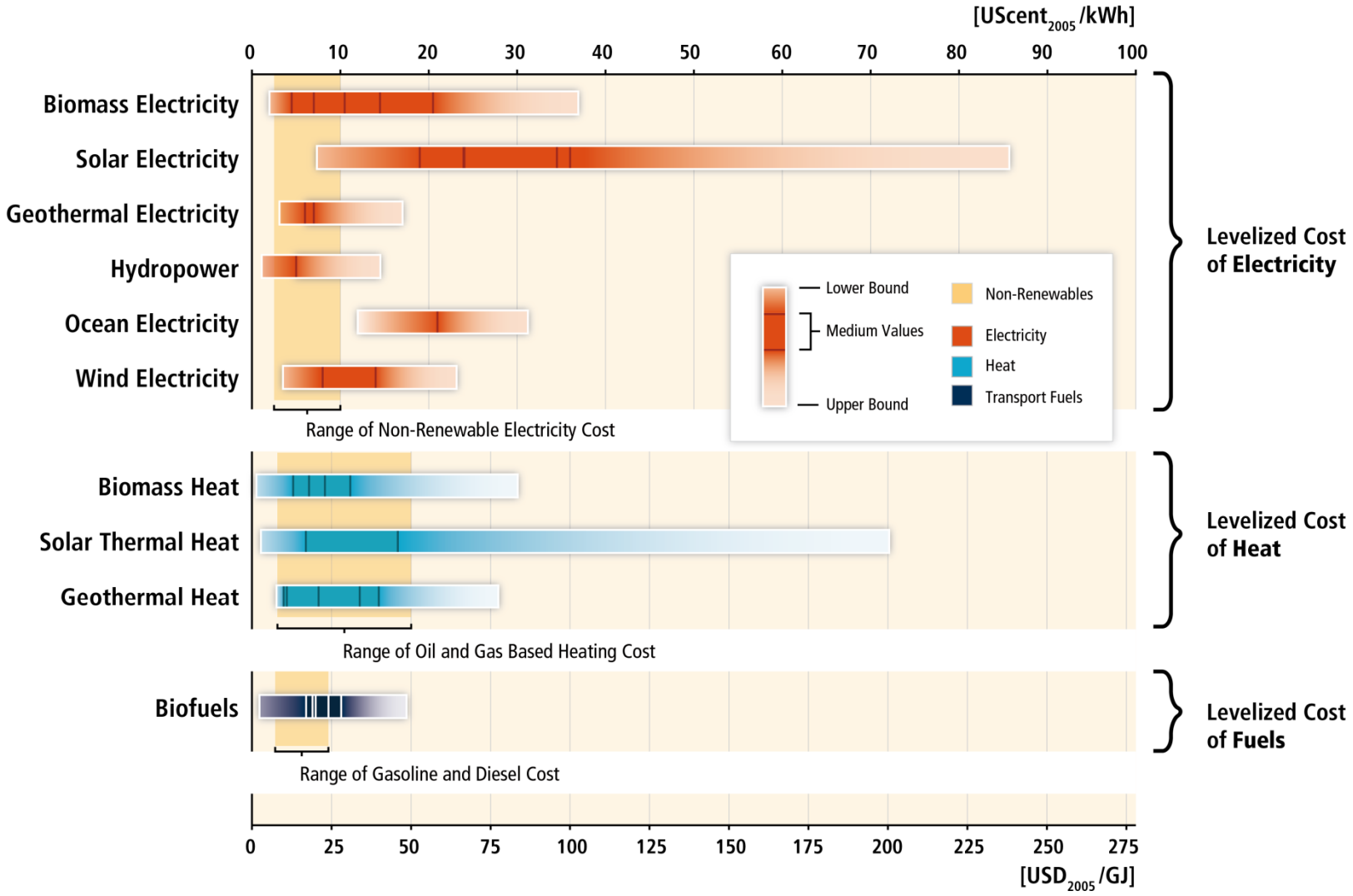
# The Technical Potential of Renewable Energy



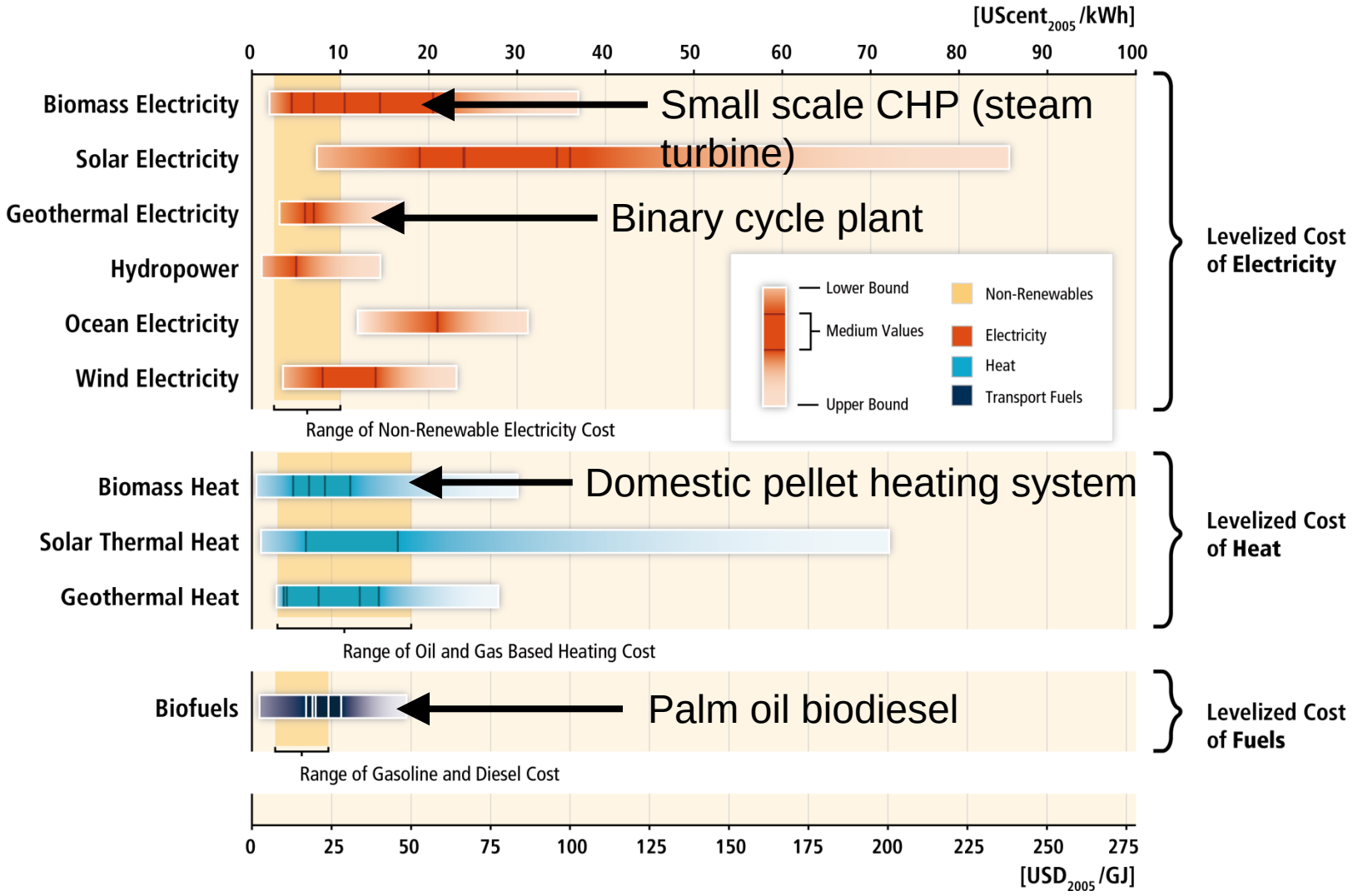

Range of Estimates of Global Technical Potentials

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

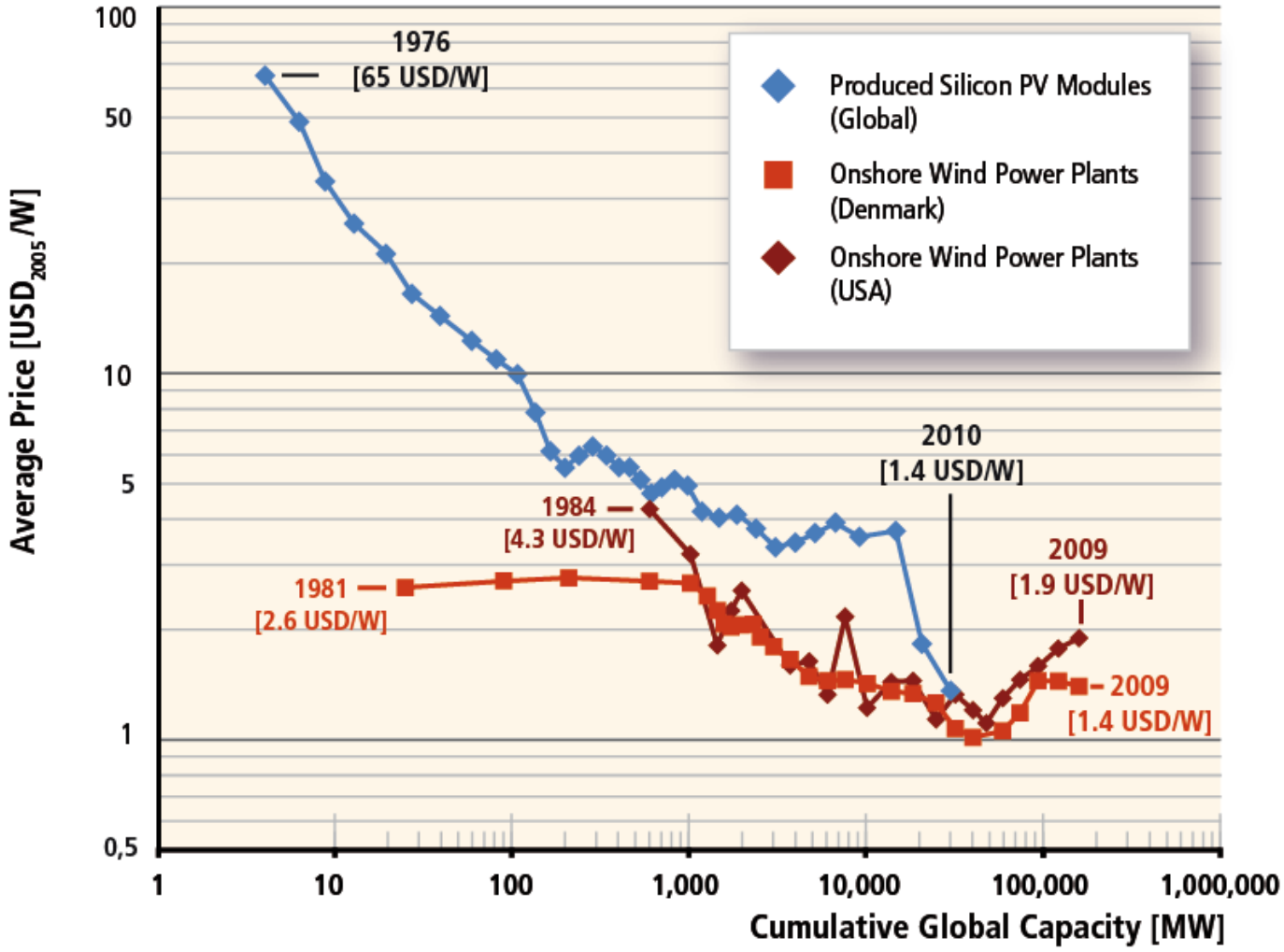
# The Costs of Renewables are Often Still Higher Than Those of Non-Renewables. But…



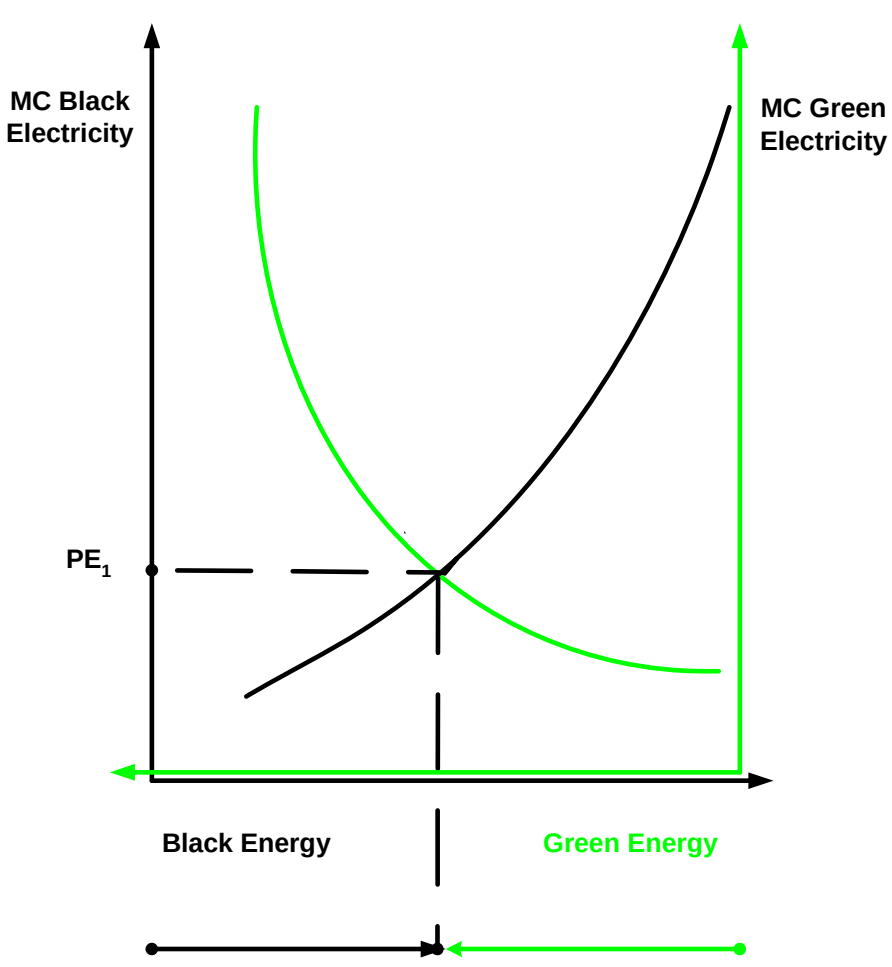
# ...Some RE Technologies Are Already Competitive

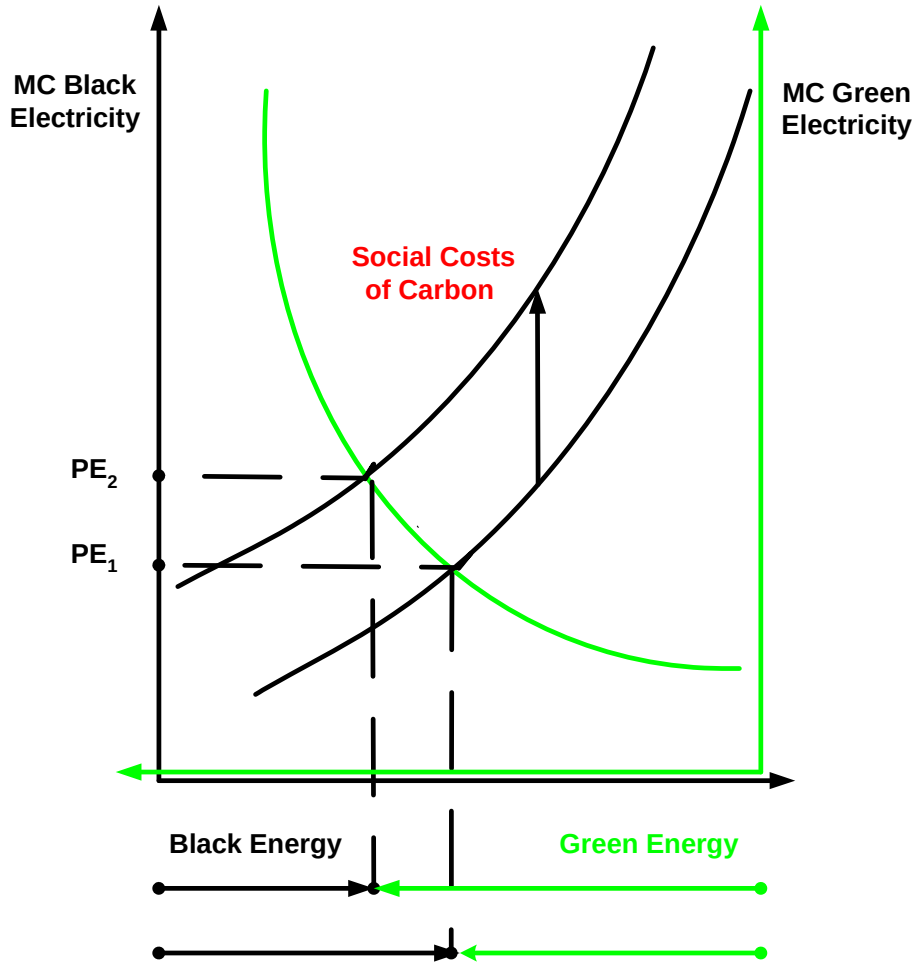


# Renewable Energies have a Potential to Lower Costs



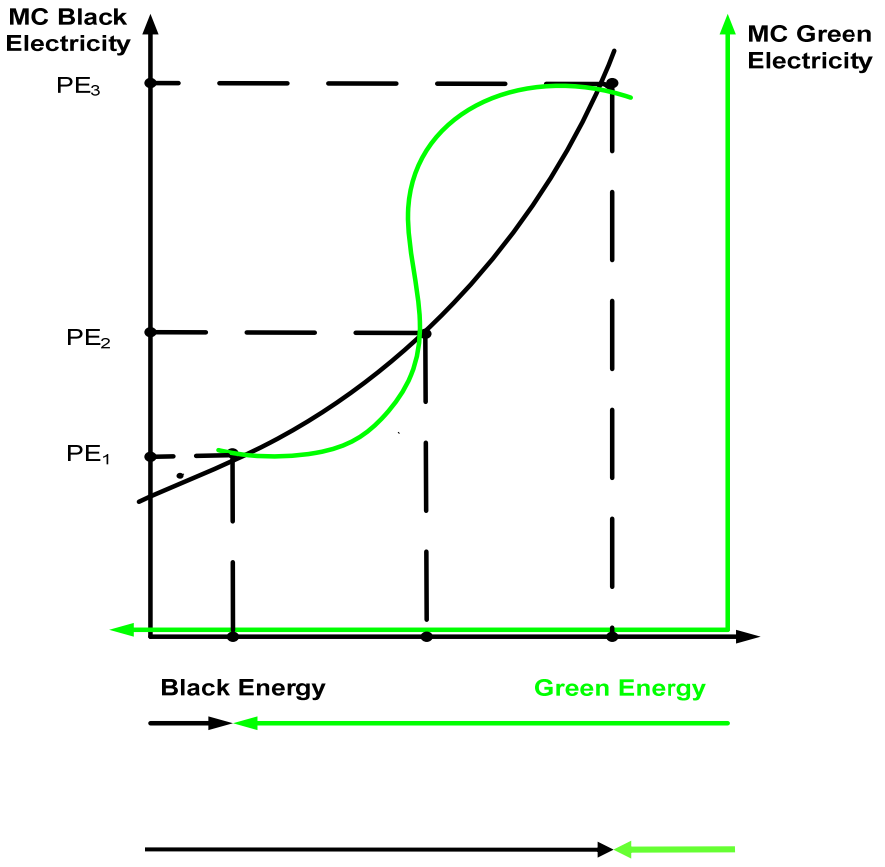
# Case 1: Carbon Pricing is Necessary and Sufficient




Edenhofer et al. 2007

# Case 2: Additional Promotion of Renewables is *not* Reasonable



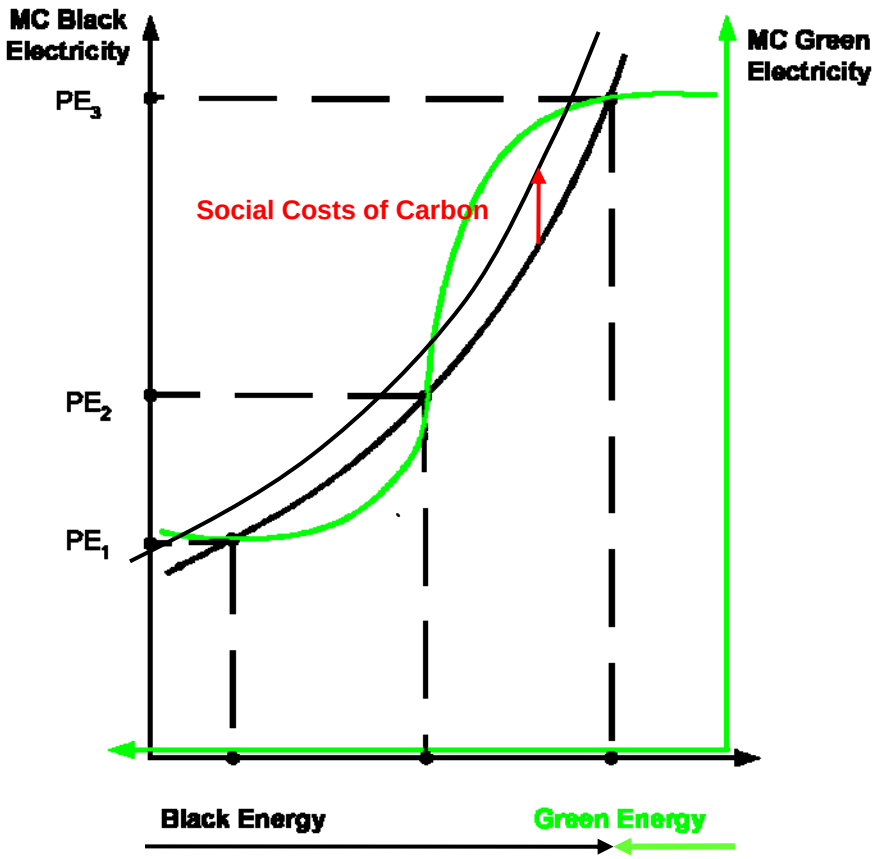

- Several stable equilibrium points (PE3 and PE1) are possible if the supply curves show a non-convex behavior ($PE_2$ is not stable).

- Without additional policy support, the system will steer towards the neighboring equilibrium point $PE_3$.

- $PE_3 > PE_1$: the system is efficient.

Edenhofer et al. (2007)

# Case 3: Additional Promotion of renewables *is* Reasonable

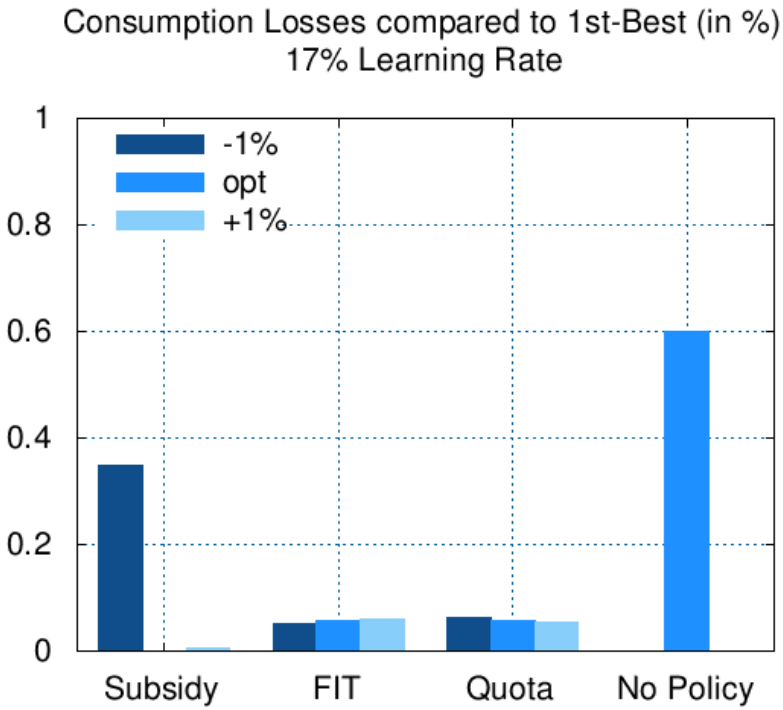


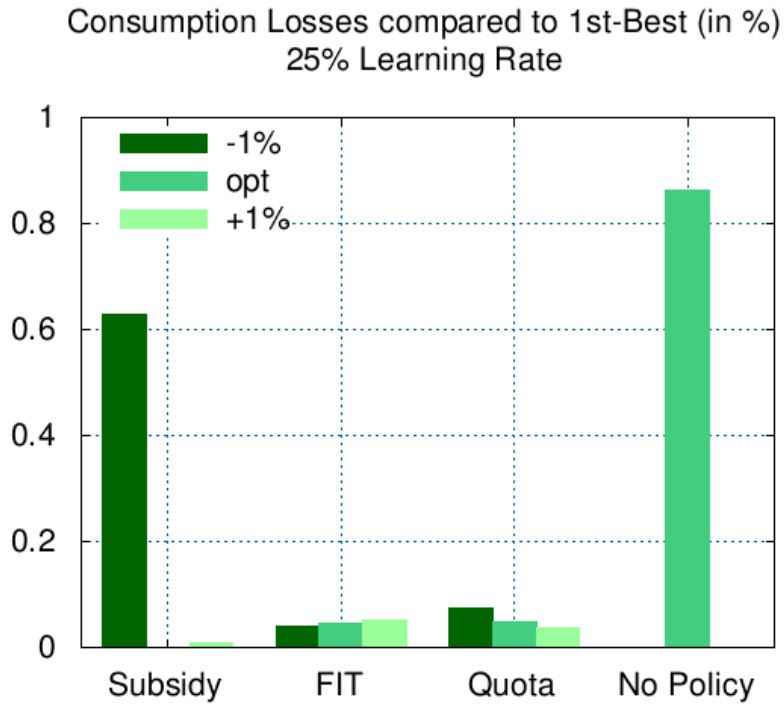

- The internalization of the social costs of energy supply (e.g. via a cap and trade system) improves the competitiveness of renewable energies

- As long as the cross-over point $PE_3$ does not vanish, this, however, still results in an inefficient state.

Edenhofer et al. (2007)

# Robustness of Policy Instruments

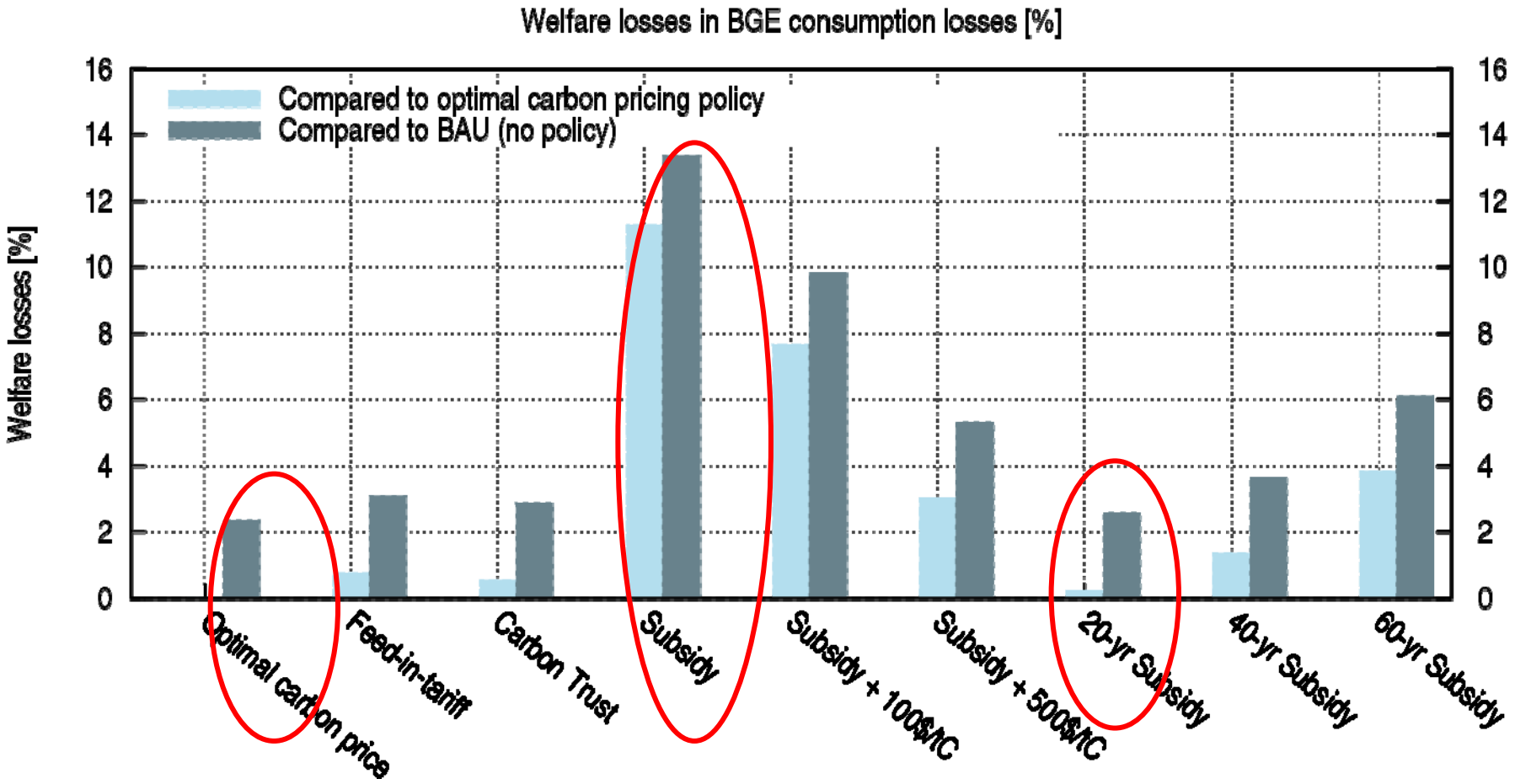



Consumption losses relative to the 1st-best optimum of optimal and “close-to-be-optimal” instruments that deviate by +1% and -1% from the optimal value.

Kalkuhl, Edenhofer, and Lessmann 2012

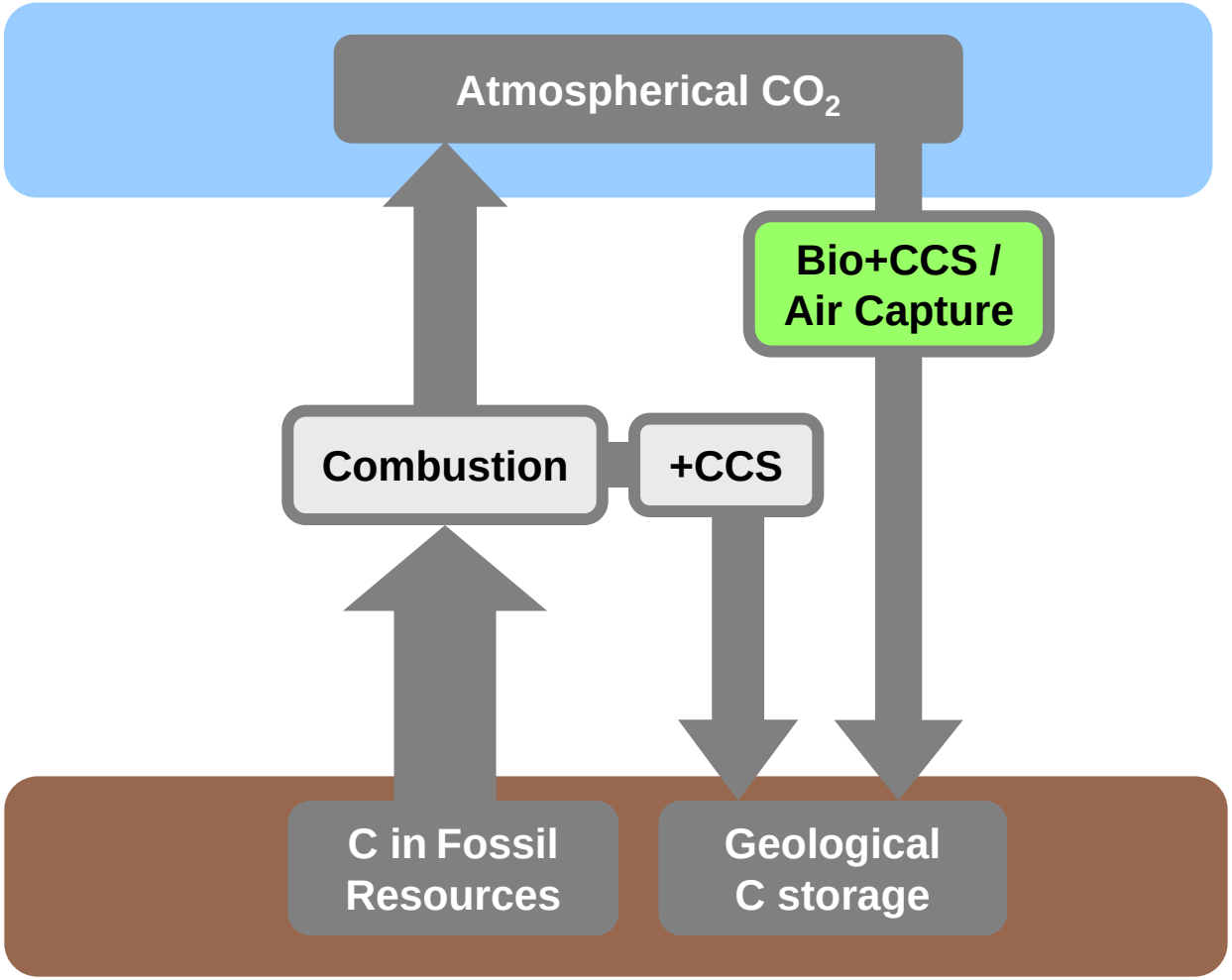
# 2nd Best-Technology Policy




Kalkuhl, Edenhofer & Lessmann 2011

# Carbon Capture and …

## …Storage (CCS)

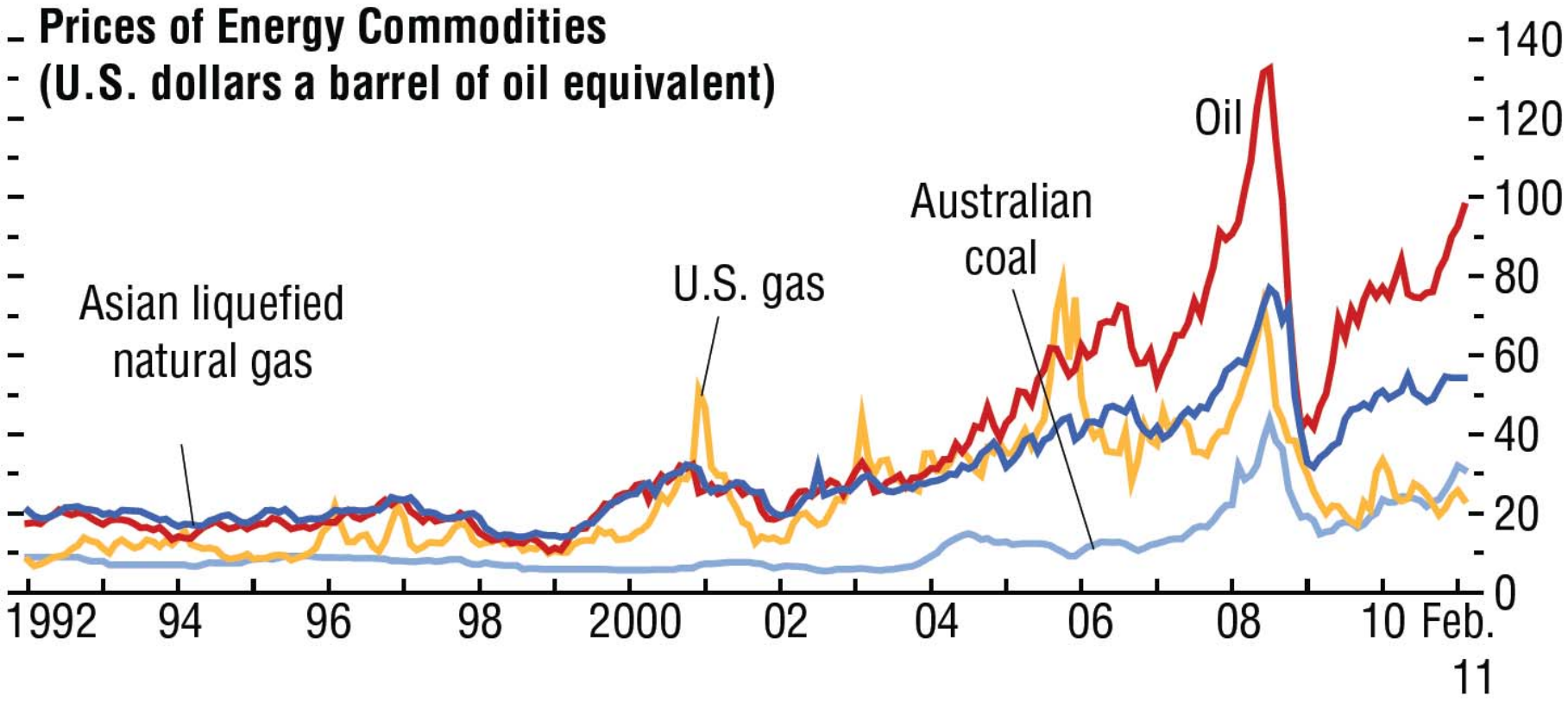



**Not fully sustainable**

# The peculiar role of CCS

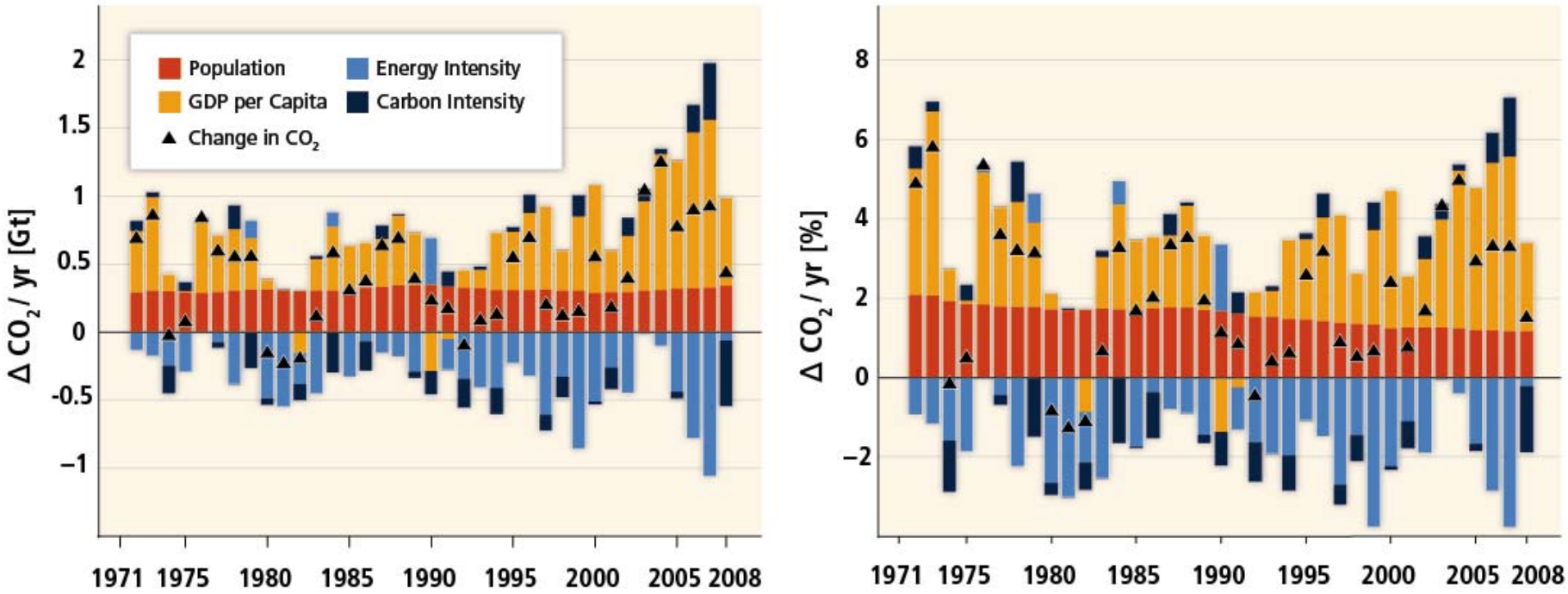
- Subsidies for CCS create a scarcity rent and an implicit carbon price.
- No leakage and sufficient storage capacities might enable the policy maker to achieve a first-best solution.
- However, these assumptions are highly unrealistic.

# Renaissance of Coal?



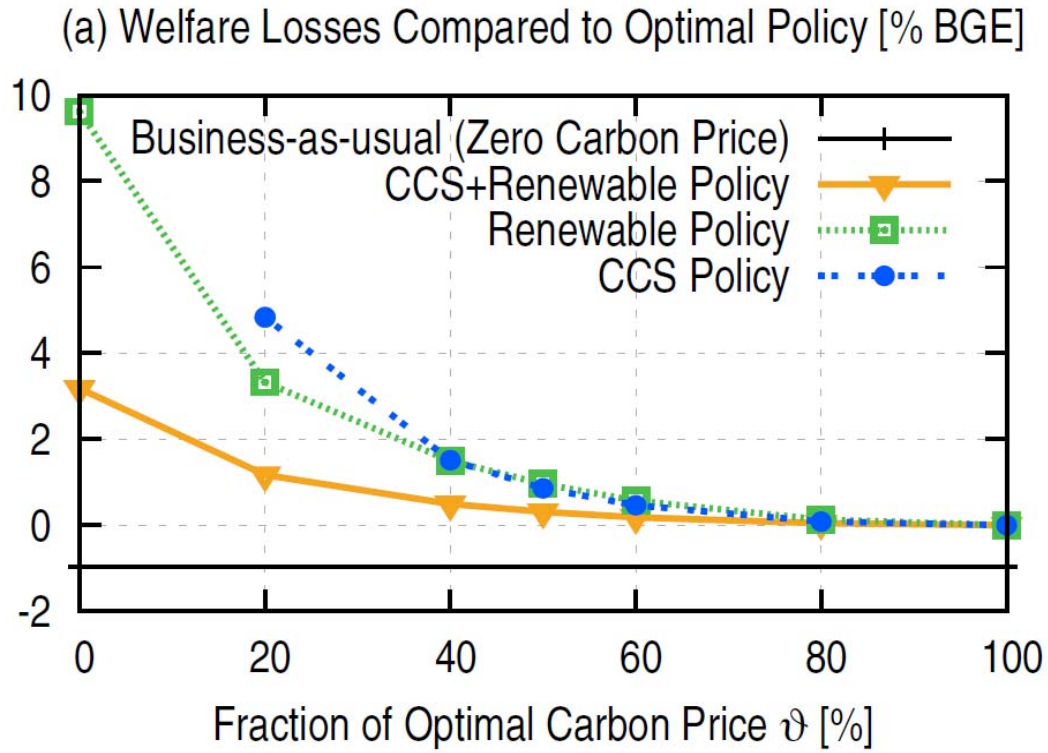

IMF (2011)

# Renaissance of Coal?




IPCC SRREN 2011

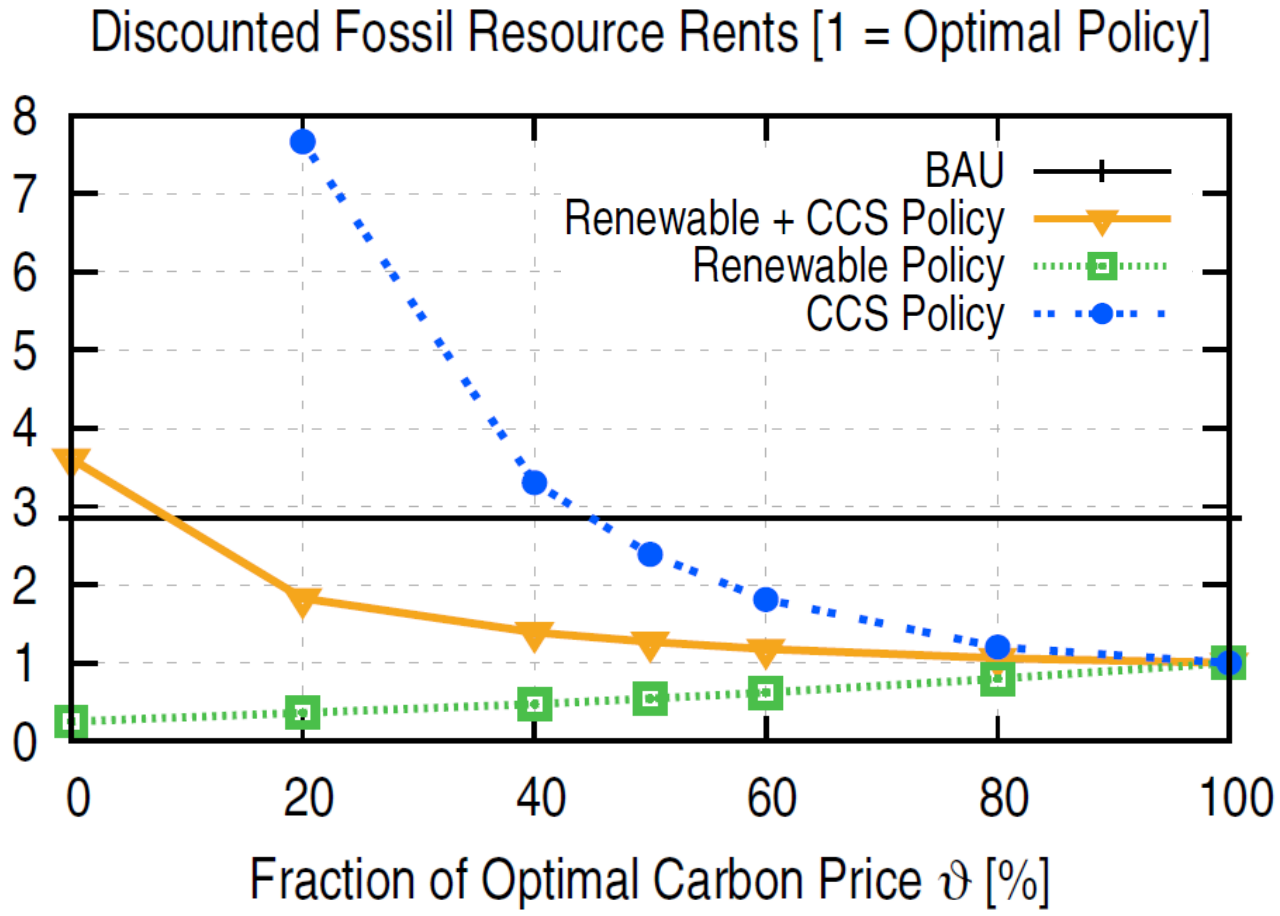
# Combining CCS and Renewables Policy




Welfare losses (in balanced-growth equivalents) of optimal second-best policies compared to the social optimum ($\vartheta$ = 100%) under a carbon budget. The negative welfare losses of the laissez-faire (business-as-usual) economy indicate the mitigation costs due to the carbon budget constraint.

Kalkuhl, Edenhofer, and Lessmann (2012)

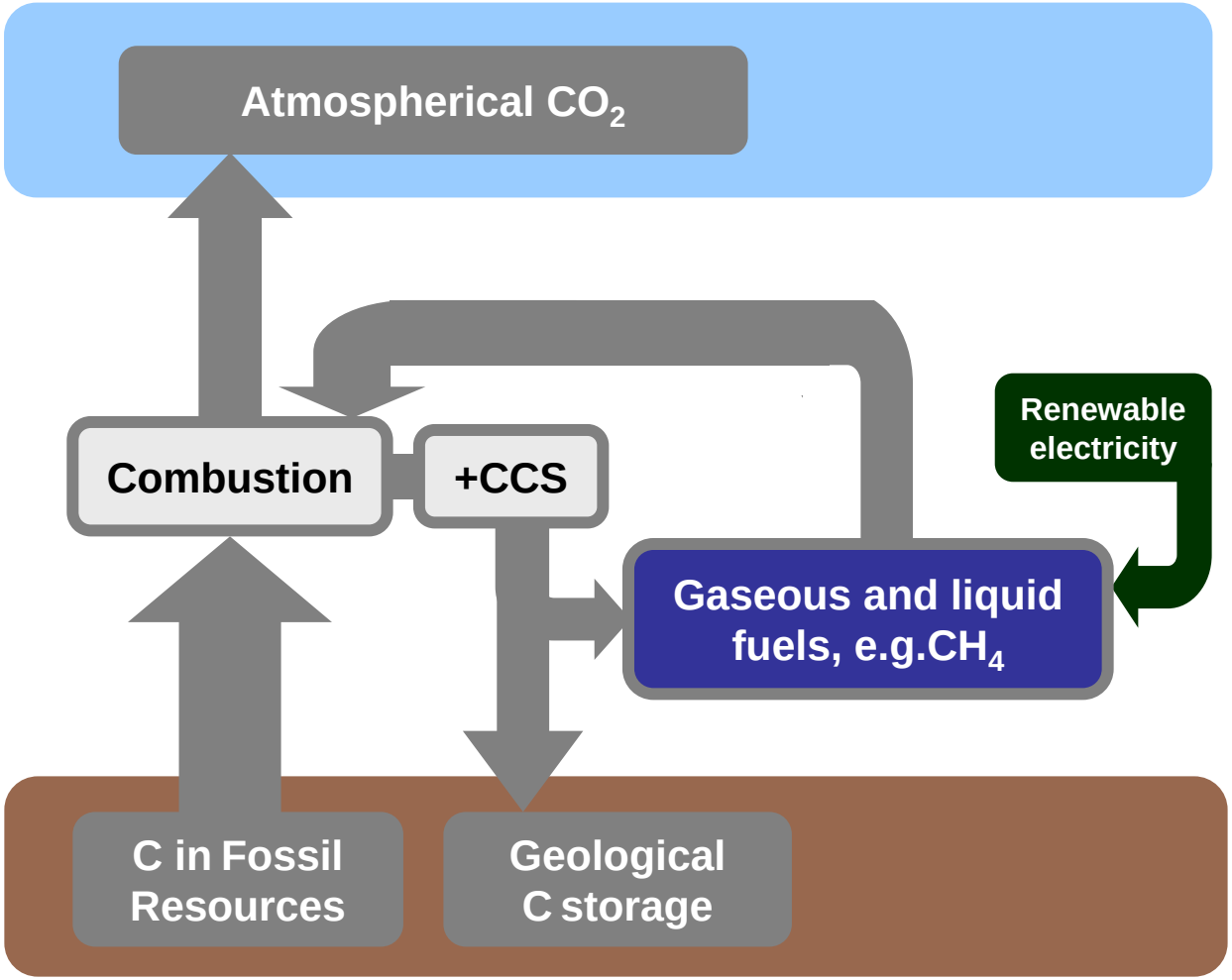
# Rent Distribution




Kalkuhl, Edenhofer, and Lessmann (2012)

# Carbon Capture and …

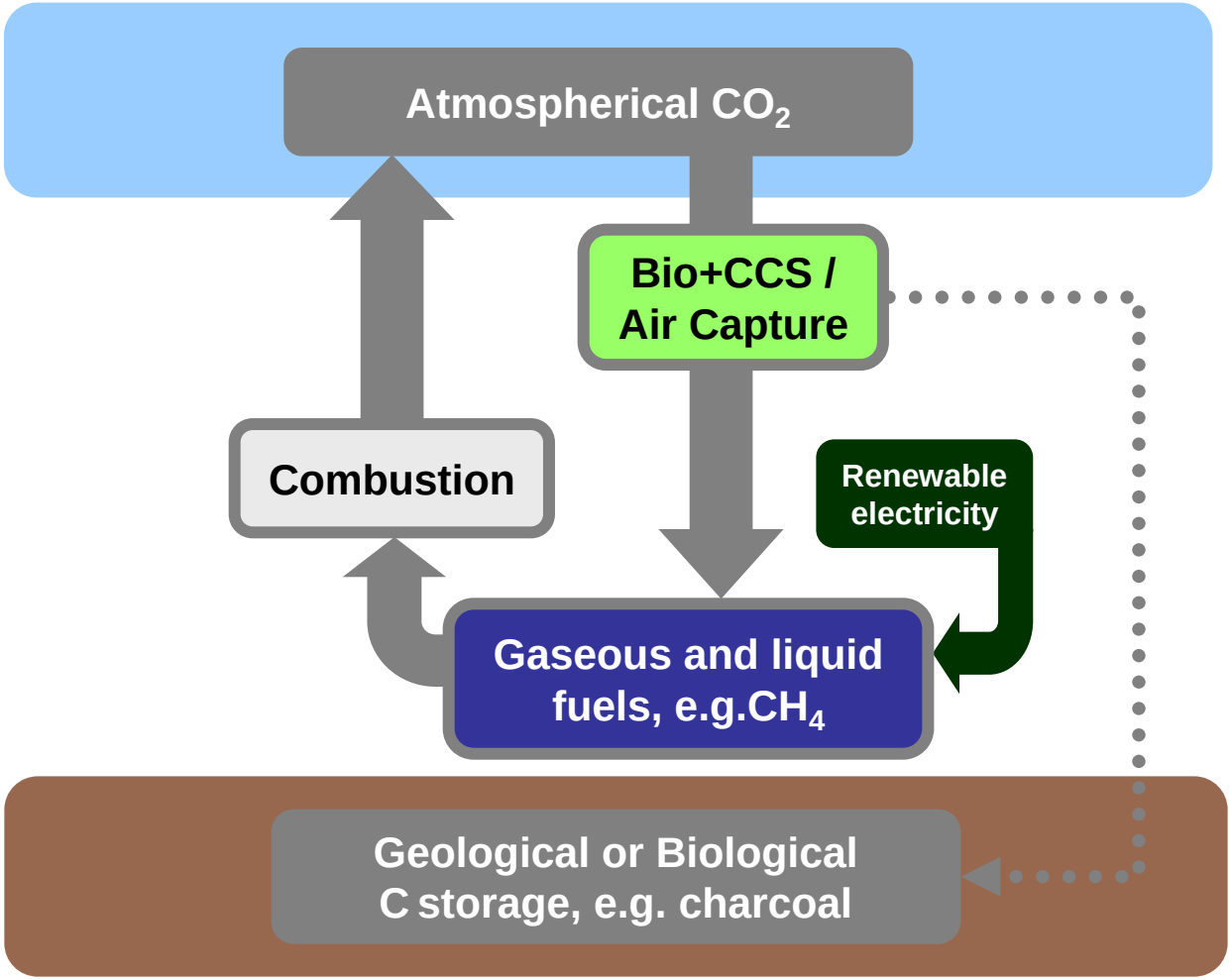
## …Use (CCU)



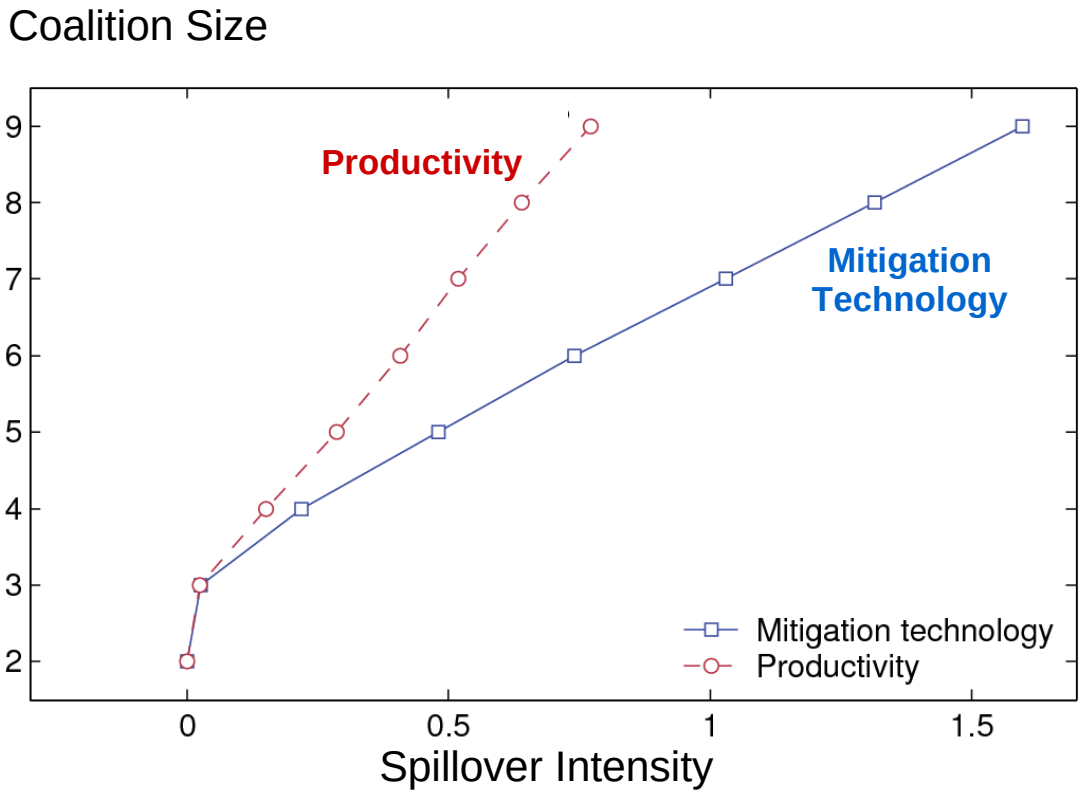

Transitional

# Carbon Capture and …

## …Cycling(CCC)



# Linking Climate Cooperation with Technology Policies

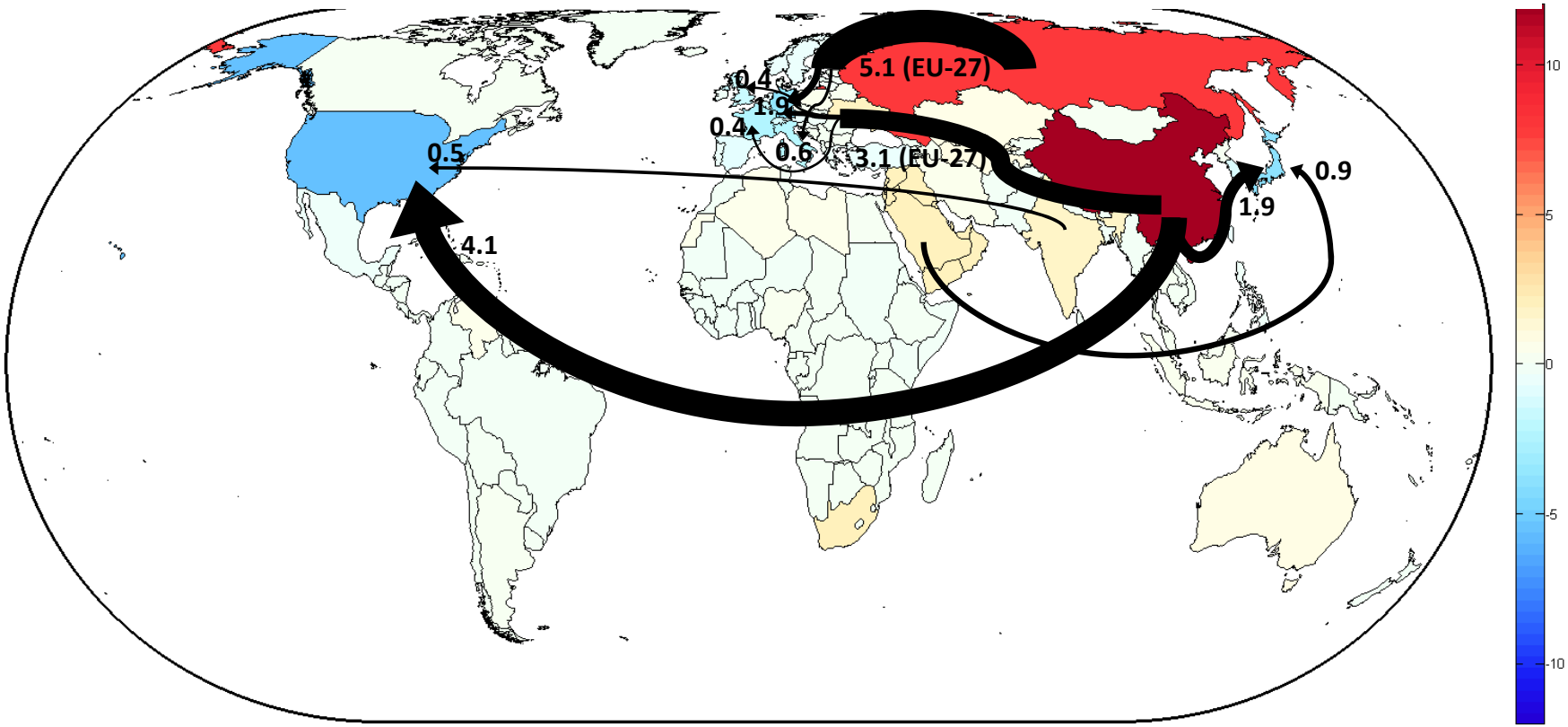



- Combine agreement on emission reductions with agreement on research on
  - mitigation technology
  - general (labor) productivity
- Full cooperation can be reached

Lessmann and Edenhofer (2011)

# Justification for Trade Sanctions?

## $CO_2$-trade balances for different world regions 1990-2008

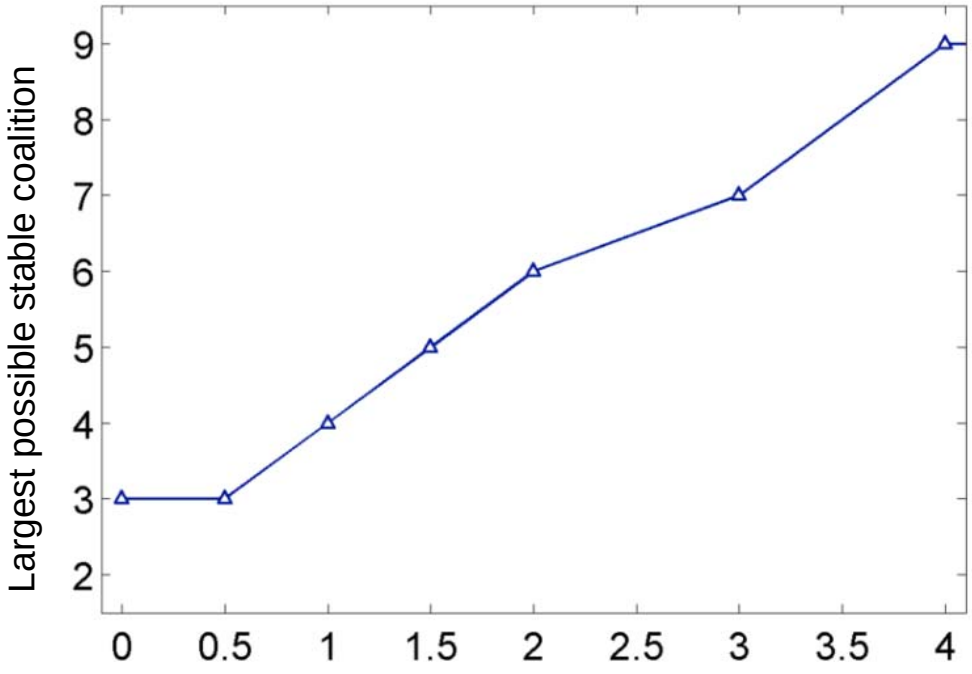



**Blue: $CO_2$-Importing**

**Red: $CO_2$-Exporting**

Peters, Minx, Weber and Edenhofer (2011)

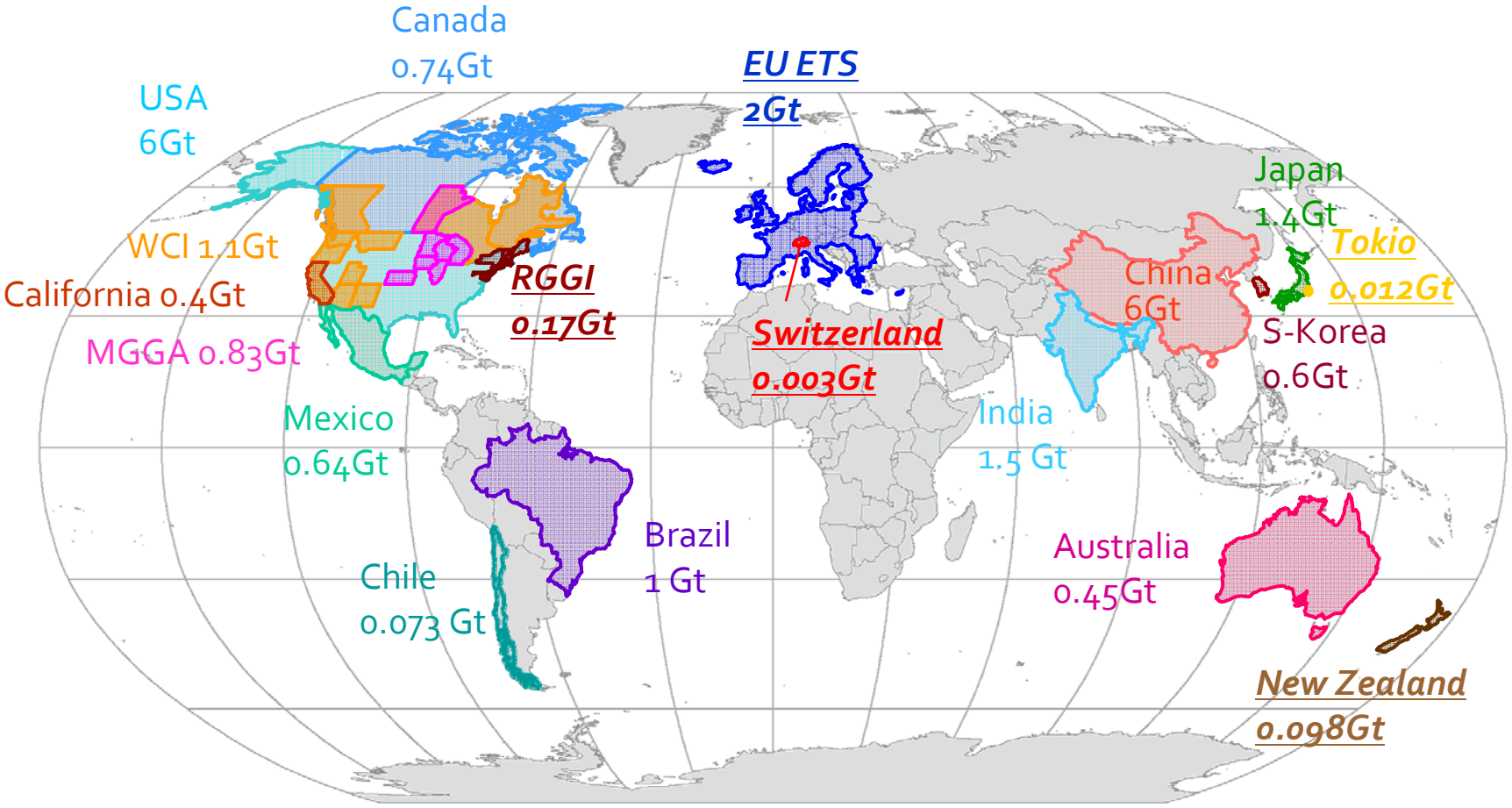
# Trade Sanctions Against Climate Non-Cooperators




- **Moderate tariffs deter free-riding, enable global cooperation and increase global welfare**
- **Credible, because climate coalition would gain from it**
- **Become obsolete once global cooperation is established**
- **Legitimacy essential: misusage, retaliation, WTO**

**Lessmann, Marschinski, and Edenhofer (2009)**

# Creation and ‚Linking' of Emissons Trading Systems

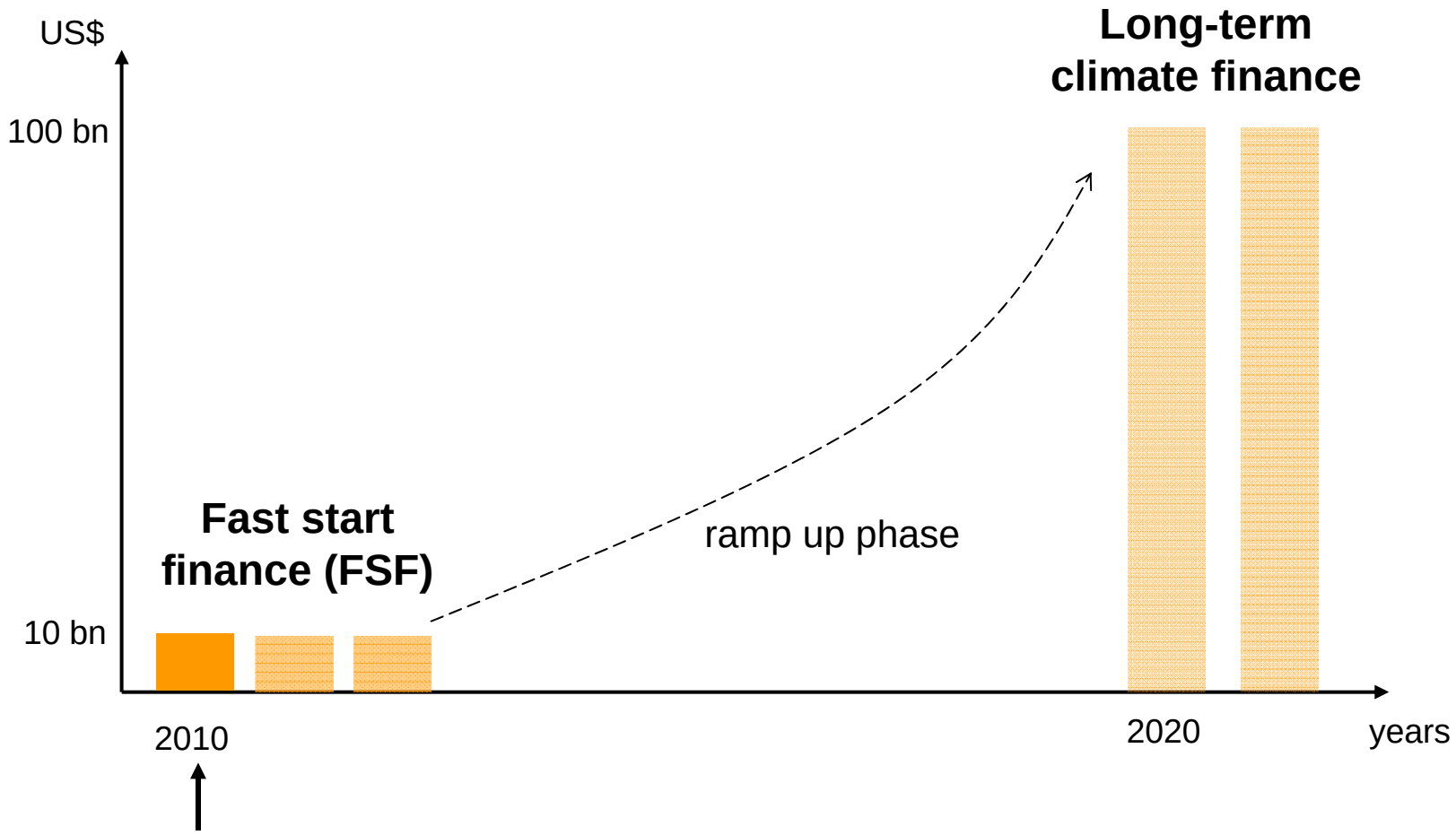



Flachsland (2011)

⇒ Reduction of mitigation costs by establishing access to low-cost abatement options

⇒ Potential for strategic incentives

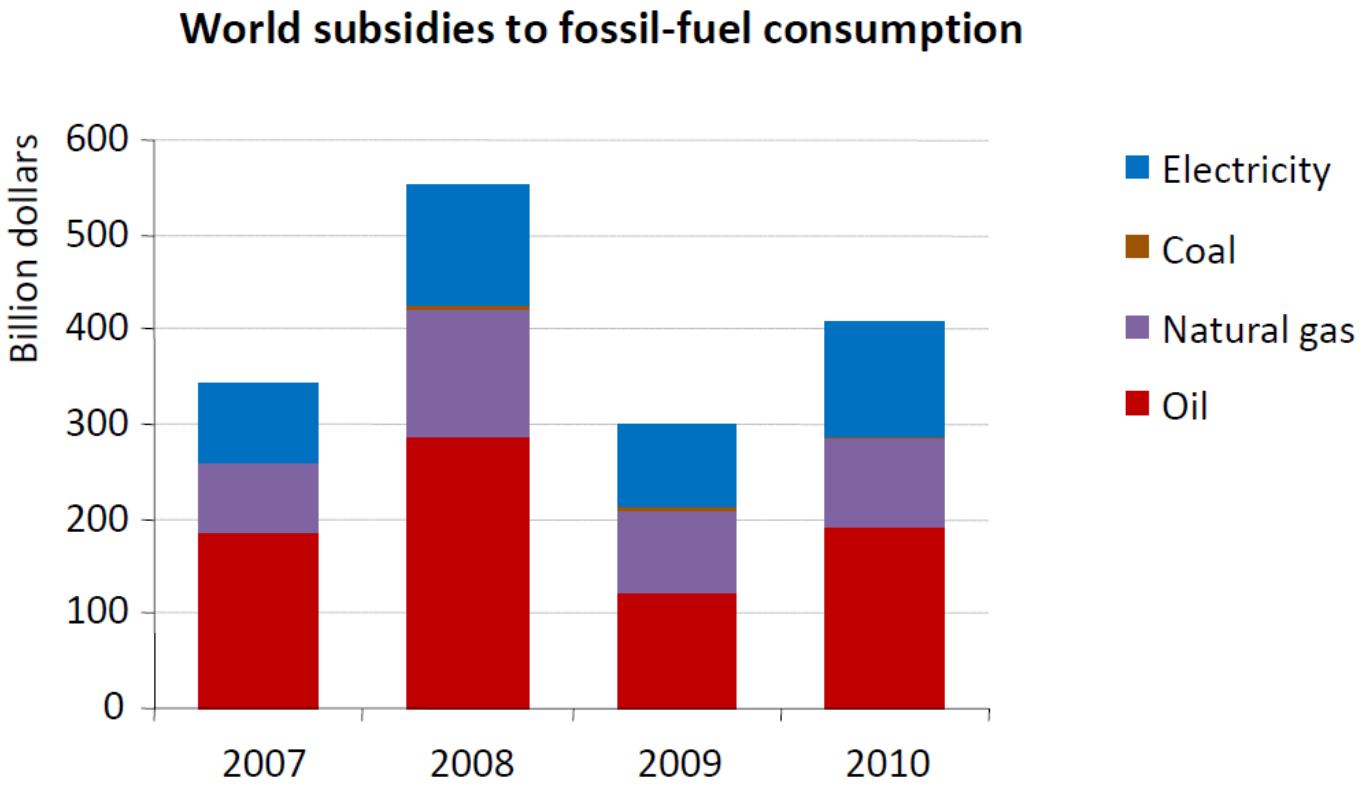
# Side Payments: Green Climate Fund




Current standing: For 2010 industrialized countries have earmarked US$ 12 billions

Brunner (2011)

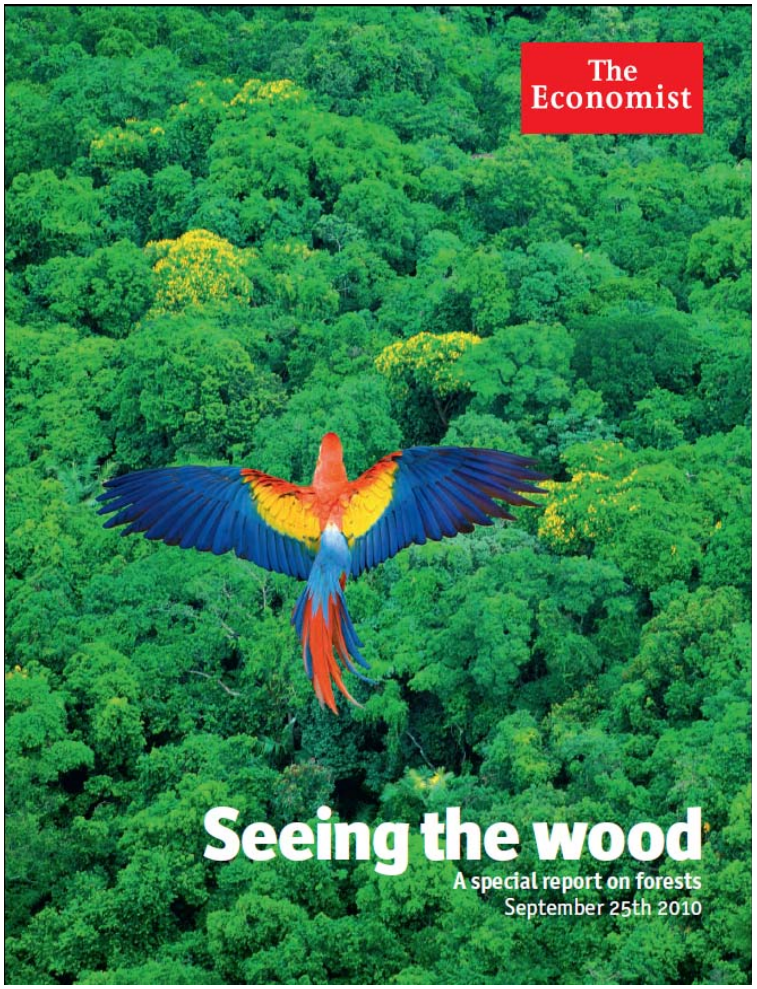
# No Regret: Reducing Inefficient Fossil Energy Subsidies




***Fossil fuel subsidies have been driven higher by the rebound in international energy prices they totalled $409 billion in 2010 – about $110 billion up on 2009***

IEA WEO (2011)

# Better REDD than dead?



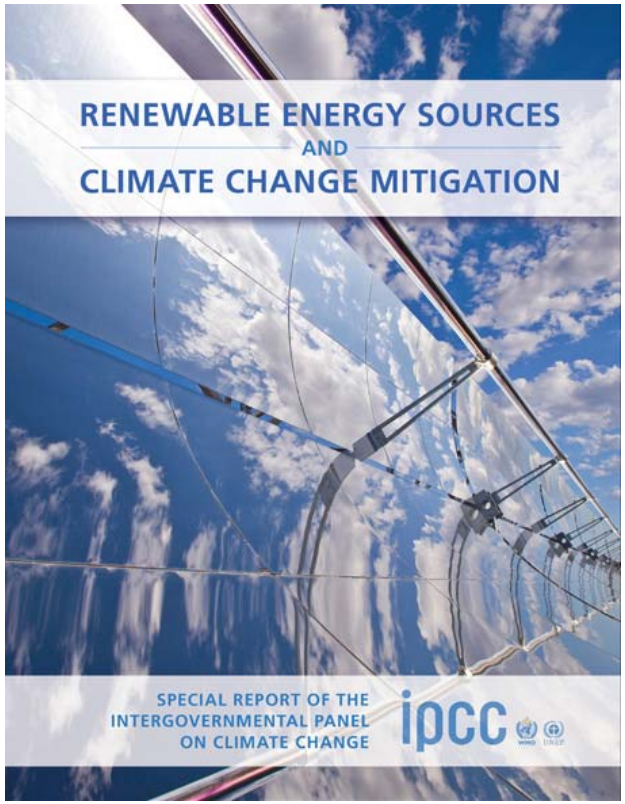
# Conclusions

- Climate Change is a Global Commons Problem: The atmospheric sink is being overused
- Key Question: Is it possible to transform the „Tragedy of the Commons“ into a „Drama of the Commons“?
- Appears difficult, but there are some promising technological and institutional options
- A world government will not be forthcoming in the next decades: Need to explore options for polycentric governance

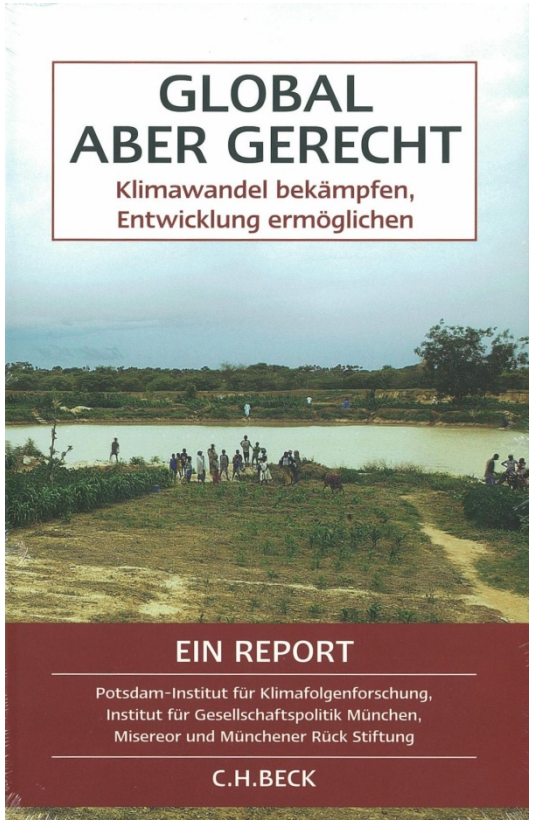
MCC
Mercator Research Institute on
Global Commons and Climate Change

www.mcc-berlin.net

# Recommended Reading




http://srren.ipcc-wg3.de/report




http://www.klima-und-gerechtigkeit.de/