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A Sustainable Future: Stabilising the Climate and Transforming the Energy System

Berlin, 7 April 2011

International Conference on Micro Perspectives for Decentralized Energy Supply
Projections of Global Mean Temperature

IPCC 2007
Tipping Points in the Earth System

Why 2°C?

Global Damage is a Highly Non-Linear Function of $\Delta \text{GMT}$

(Smith et al. 2009 PNAS)
World Map of Wealth

Capital stock per person

- very low
- low
- medium
- high
- very high

Source: Füssel (2007)
World Map of Carbon Debt

Carbon emissions per person from fossil fuel burning (1950-2003)

very low
low
medium
high
very high

Source: Füssel (2007)
Carbon Debt and Wealth

Fitting line: \( \ln P = 0.987 \ln K + c \)

Source: Füssel (2007)
The Great Transformation

Primary Energy Consumption [EJ]

- Oil
- Natural Gas
- Coal w/o CCS
- Coal with CCS
- Nuclear
- Biomass w/o CCS
- Biomass with CCS
- Renewables w/o Biomass

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

models →

MERGE  
TIMER  
POLES  
REMIND  
E3MG

Baseline

Many different pathways to transform the energy system

400 ppm-eq

Different possibilities to reach low stabilisation

400ppm can be achieved by all models

(Knopf, Edenhofer et al. 2009)
Fukushima, 10 March 2011

Seemingly safe and clean…
Fukushima, 16 March 2011

...evidently not!
A global phase-out of nuclear

With a nuclear phase-out, CCS and renewable energy sources become more important

Edenhofer et al. 2010
A global phase-out of nuclear is affordable

Mitigation costs increase only moderately when abandoning additional deployment of nuclear energy but increase considerably when only limited deployment of renewable energy sources is possible.

Edenhofer et al. 2010
Global Fossil Fuel Prices 1991 - 2008

Source: IMF International Commodities Database
Renaissance of Coal

\[ \Delta \text{CO}_2 \text{ per year [%]} \]

- Change in CO\(_2\)
- Population
- GDP per Capita
- Energy Intensity
- Carbon Intensity

The Supply Side of Global Warming

Cumulative historic carbon consumption (1750-2004), estimated carbon stocks in the ground and estimated future consumption (2005-2100) for business-as-usual (BAU) and ambitious 400-ppm-CO₂-eq. scenario

Source: Kalkuhl, Edenhofer and Lessmann, 2009
Atmosphere As a Global Common

- Atmosphere is a scarce resource – fossil carbon is not
- Economic approach to deal with scarcity in an efficient way:
  - Establish prices on scarcities
- How to determine the scarcity price on carbon?
  - Assigning property rights according to the scarcity of the atmosphere
  - Distributing the emission rights according to principles of fairness and justice
Allocation of Emission Rights

Consumption losses [%]

- USA
- Japan
- Europe
- Russia
- Middle East
- Latin America
- Asia (Others)
- China
- India
- Sub-Saharan Africa
- Rest of the World
- World

Knopf et al. 2010

Per capita
Per GDP
C&C: Contraction & Convergence
C&C with historical Responsibility
CDC: Common but Differentiated Convergence

Gains
Losses
Market Prices for staple foods and crude oil
monthly averages 1991 - 2008

Source: IMF; FAO International Commodity Prices
Annual World Biofuel Production 1991 - 2008

Source: BP Statistical Energy Review; WRI
Reducing Deforestation: Fossil vs. LUCF CO$_2$ Emissions

CO$_2$ emissions per person and year, 1950 - 2003

CO$_2$ emissions from fossil fuel combustion and cement production, and including land use change (kg C per person and year from 1950 - 2003)

-1000 - 0  
1000 - 2000  
0 - 100  
2000 - 5000  
100 - 1000  
5000 - 15000

Ratio

Emissions per year from fossil fuel combustion and cement production

Emissions per year from land use change
Change of agricultural production (all crops) in percent due to yield changes as a result of climate change between 1990 and 2050.

Source: Müller et al. 2010
Development Policy
Avoided Deforestation
Climate-friendly Technologies
Limiting and Trading of CO₂
Adaptation
Equity
Efficiency
Effectiveness
Global Deal
Development Policy
GLOBAL ABER GERECHT
Klimawandel bekämpfen, Entwicklung ermöglichen

EIN REPORT
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