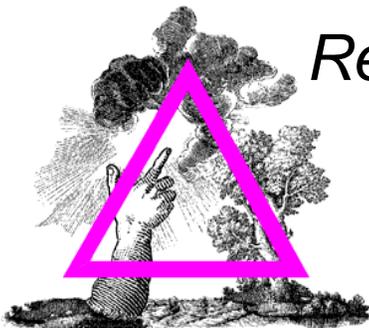


# AN ECONOMIC PERSPECTIVE ON OCEAN ACIDIFICATION AND ATMOSPHERIC CARBON DIOXIDE STABILISATION

The Ocean in a high CO<sub>2</sub> world:  
Symposium in Monaco 6-9 October

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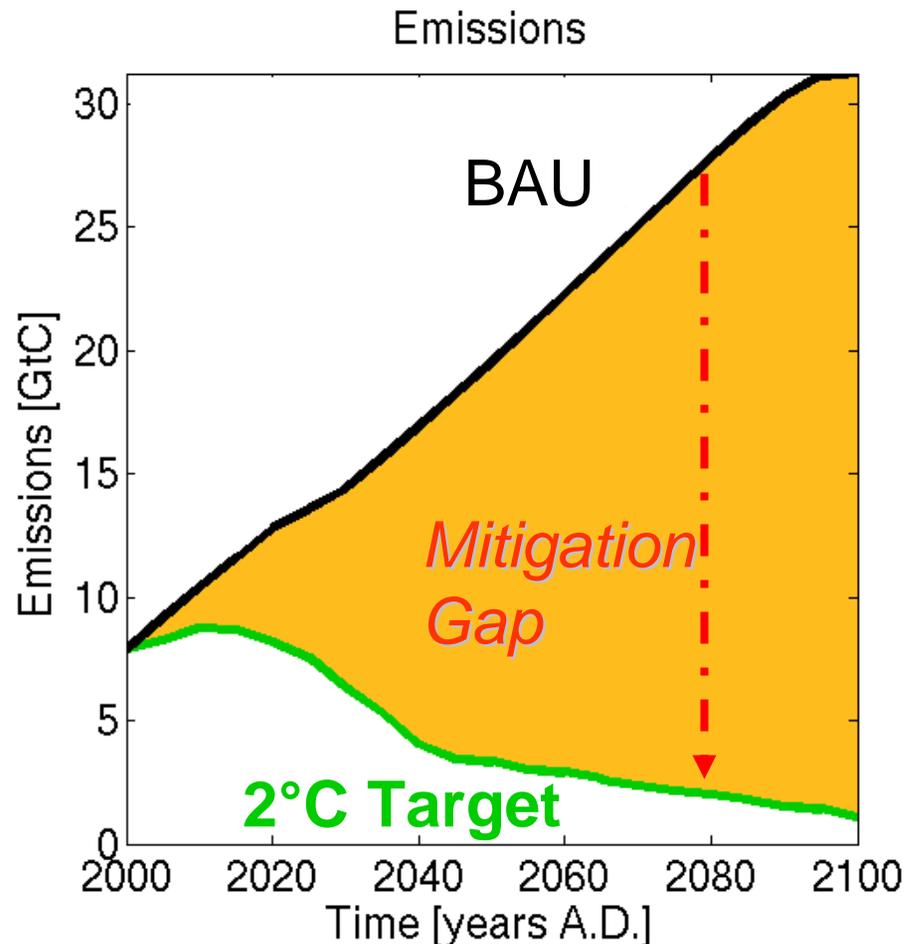
- Ocean acidification:  
Economic reasons for concern
- The economic value of the oceanic carbon pump
- Ocean acidification in the concert of arguments on a global CO<sub>2</sub> contract

# Economic Reasons for Concern

Potential impact chains triggered by ocean acidification:

- Marine food webs
  - commercial fish stock
  - food security for millions of people & multi-billion dollar industry
- Area & integrity of coral reefs
  - multi-billion dollar industry from tourism
- Oceanic carbon pump – pricing?

# CO<sub>2</sub>-Emissions Business as Usual (BAU) vs EU's 2°C-Target



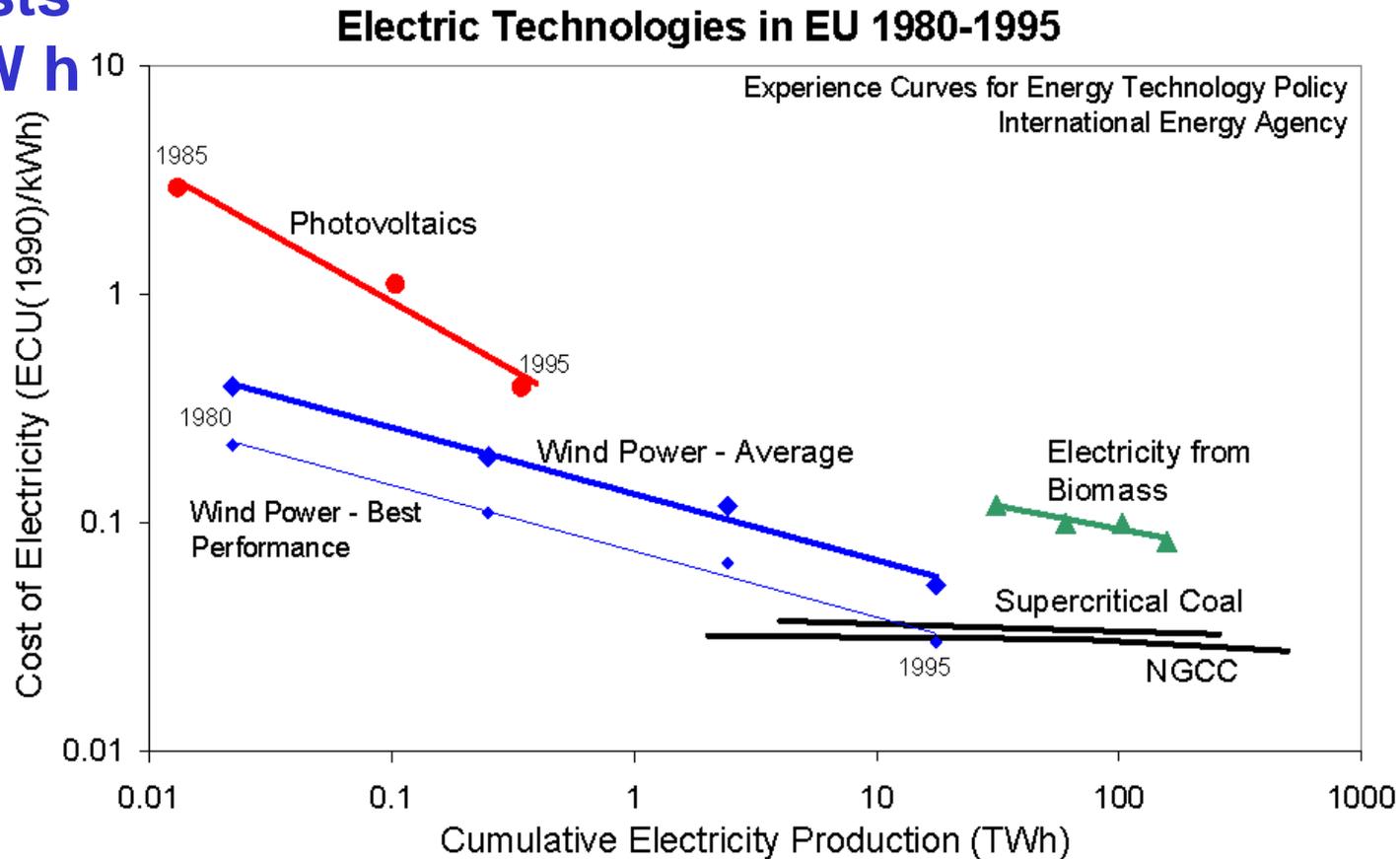
*Climate-Economists  
until 2006:*

„2° target  
costs >5%  
GWP

Too expensive!!  
Too dangerous!!“

# Mass Production lowers Costs

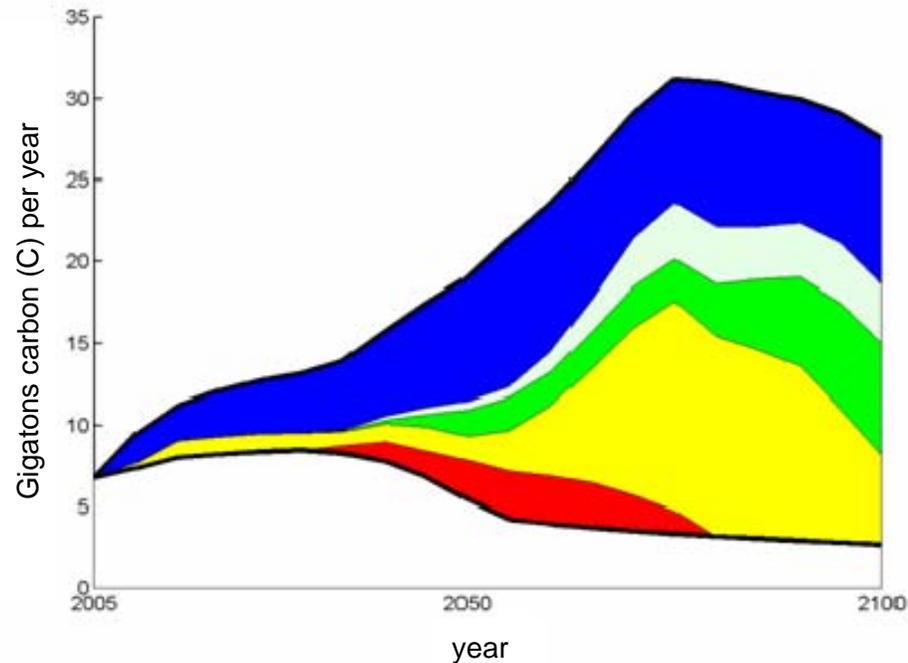
Costs  
/ kW h



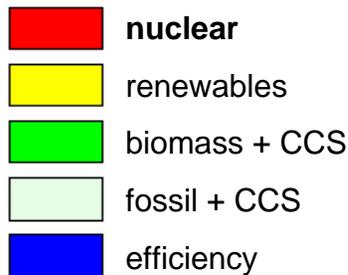
**Total Installed Capacity [TW h]**

Source: IEA (2000): Experience Curves for Energy Technology Policy; p. 21

# Options for CO<sub>2</sub> emissions abatement



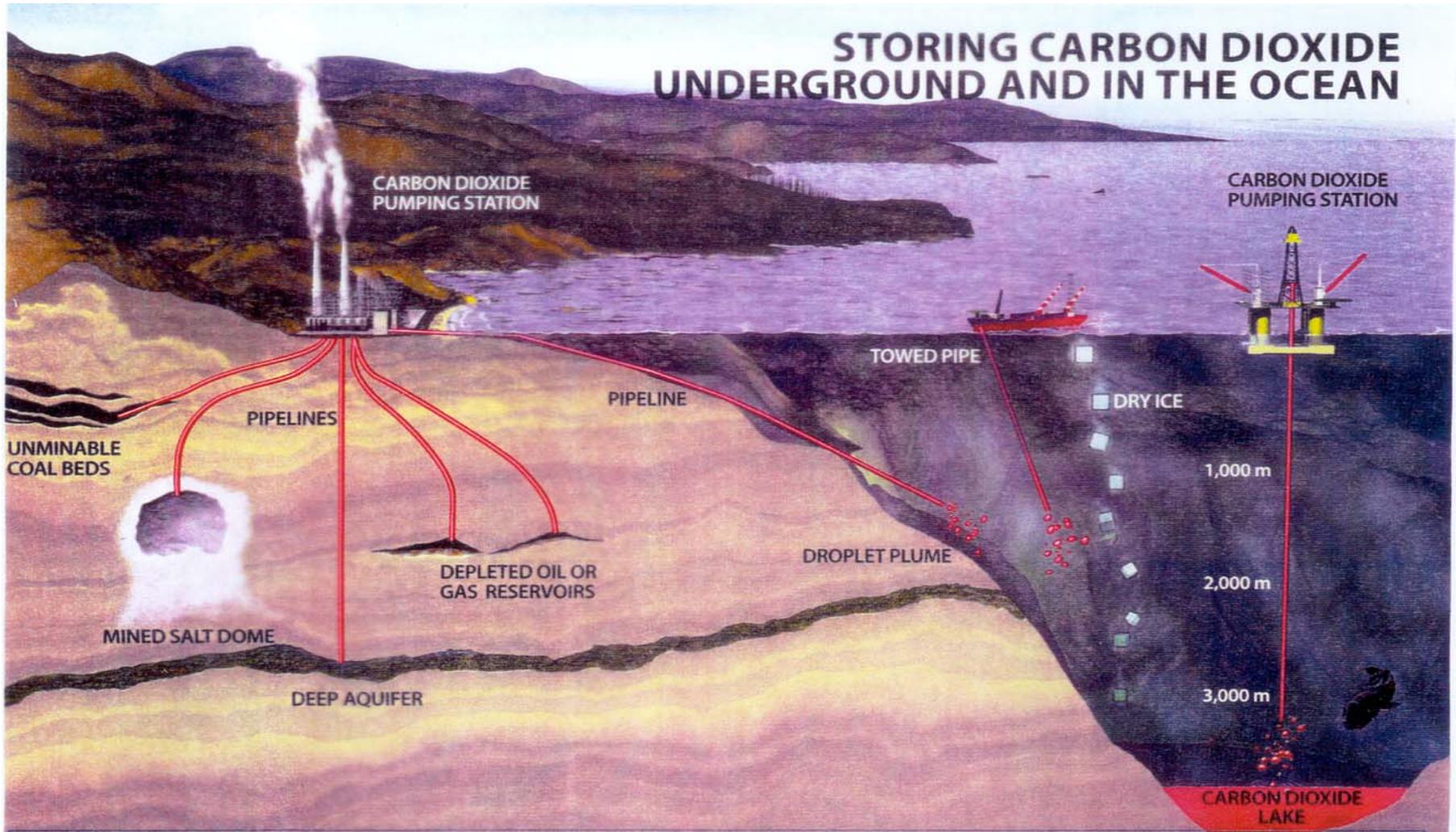
Energy-induced emissions



Edenhofer et. al. 2007

Coal/Oil/Nat.Gas cheap, pure time preference rate 1%

# Carbon Capture & Sequestration



STORAGE UNDERGROUND	ADVANTAGES	DISADVANTAGES	STORAGE IN OCEAN	ADVANTAGES	DISADVANTAGES
Coal Beds	Potentially low costs	Immature technology	Droplet Plume	Minimal environmental effects	Some leakage
Mined Salt Domes	Custom designs	High costs	Towed Pipe	Minimal environmental effects	Some leakage
Deep Saline Aquifers	Large capacity	Unknown storage integrity	Dry Ice	Simple technology	High costs
Depleted Oil or Gas Reservoirs	Proven storage integrity	Limited capacity	Carbon Dioxide Lake	Carbon will remain in ocean for thousands of years	Immature technology

# Economists claim carbon cuts won't break the world's bank



Panel beaters: could low-carbon energy be surprisingly affordable?

Transforming the world's energy industry to stop the flood of greenhouse gases into the atmosphere might actually be quite cheap.

Figures of tens of trillions of dollars are often cited, and used to question whether measures such as the Kyoto Protocol, which attempts to limit carbon emissions, are too expensive. But according to a suite of economic models released late last month, the costs of stabilizing carbon dioxide levels could be tiny — equivalent to setting back the growth of global GDP (gross domestic product) by less than 1% over 100 years; global GDP generally grows 2–3% each year. In some cases, the right policies for limiting carbon emissions could even create a surprising win-win situation, leading

London. “But only if we do the right things.”

The models simulate a complex issue in economics: how government climate policies such as research investment or greenhouse-gas regulation can bring about technological development. It is obvious that technologies evolve, but the processes involved have been factored into economic models only since the late 1990s, in part because it is difficult to untangle how advances occur. The Innovation Modelling Comparison Project, published in a special issue of *The Energy Journal*, is a two-year

**“Reducing greenhouse gases will be relatively cheap — but only if we do the right things.”**

effort involving eleven different models that represent the latest thinking on the problem.

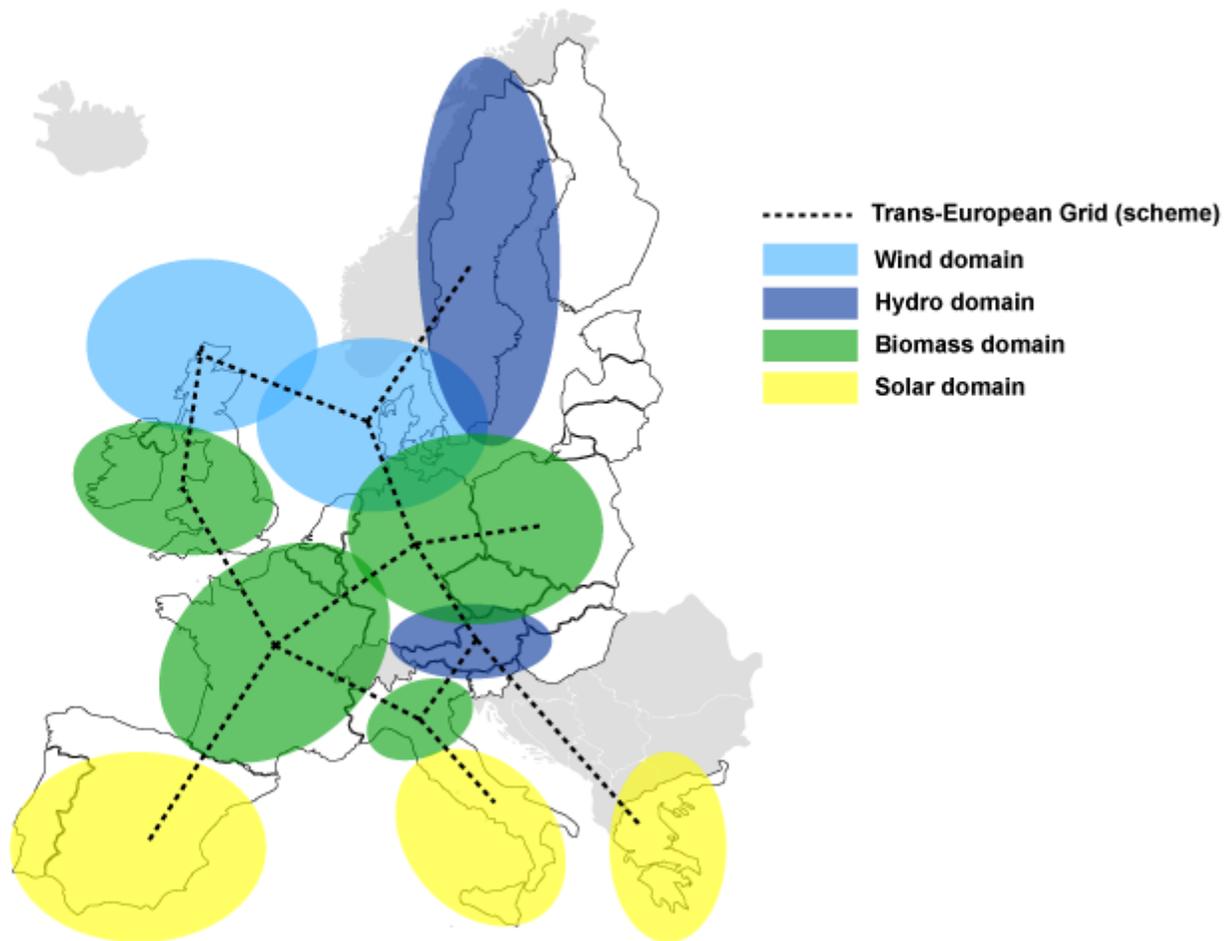
The results are striking. Nine of the models predict that stabilizing carbon dioxide levels at

450 parts per million, widely seen as the most

# Economic Costs of Climate Protection

- **Stabilisation @450ppm**  
**△ 0.5...1.5% GWP loss**
- **Induces momentum in climate policy:**
  - Environmentalists may be satisfied as the 2° target gets a chance
  - Economists are satisfied as costs are low.
- **Society can act...**
- **...in spite of ongoing normative discrepancies**

## Potential interconnected renewable energy domains (2030)



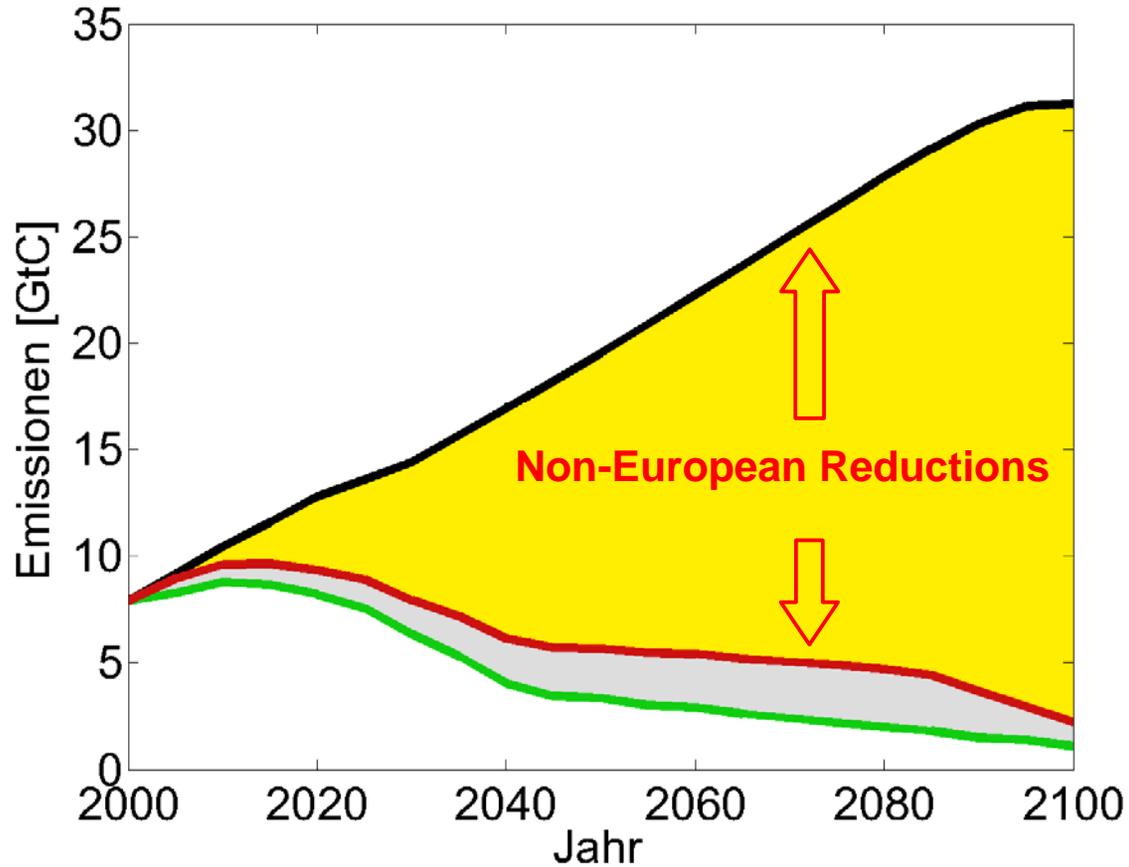
Sources: Own calculations based on

European Wind Atlas, [www.windatlas.dk](http://www.windatlas.dk)

IES - Institute for Environment and Sustainability <http://ies.jrc.ec.europa.eu/index.html>

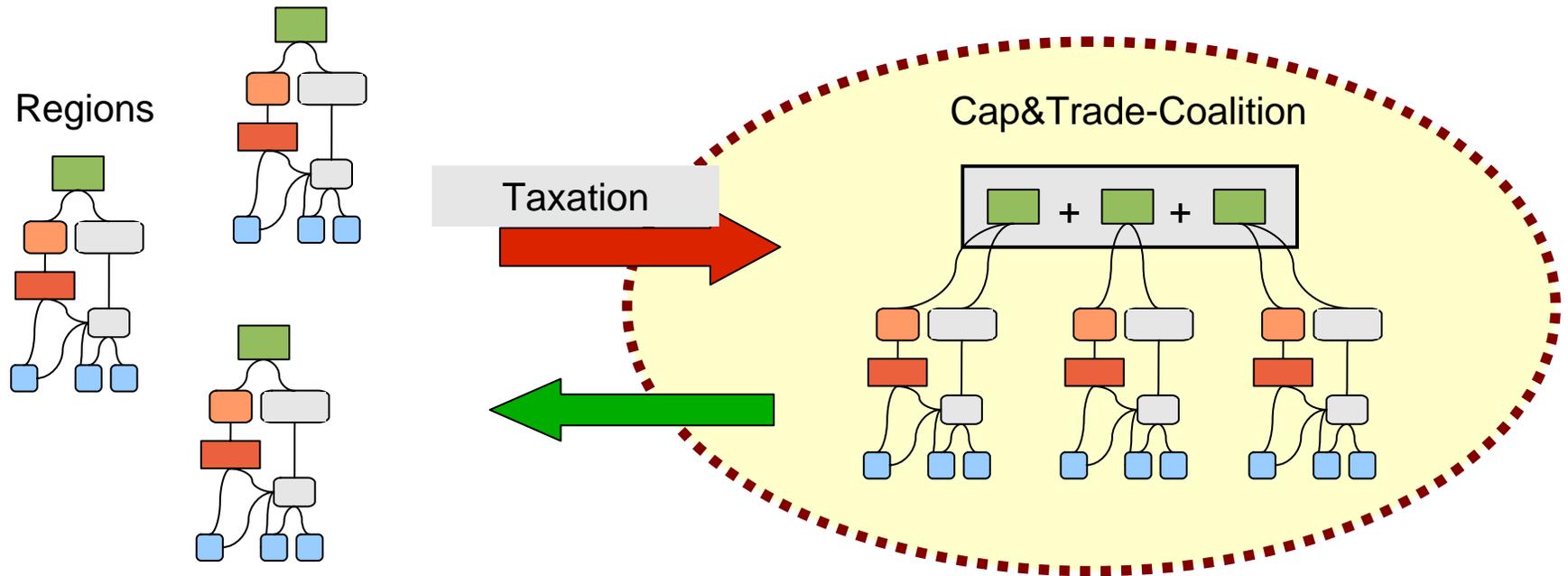
EEA - How much bioenergy can Europe produce without harming the Environment

# European Contribution to Mitigation



Edenhofer et al., 2008

# As long as there is no Global Deal: Coalitions & Climate Policy



Edenhofer et al., 2008

# Edenhofer meets Schwarzenegger on Linking



Aug 2007

Sep 2008:  
Elected IPCC  
WG III CoChair;

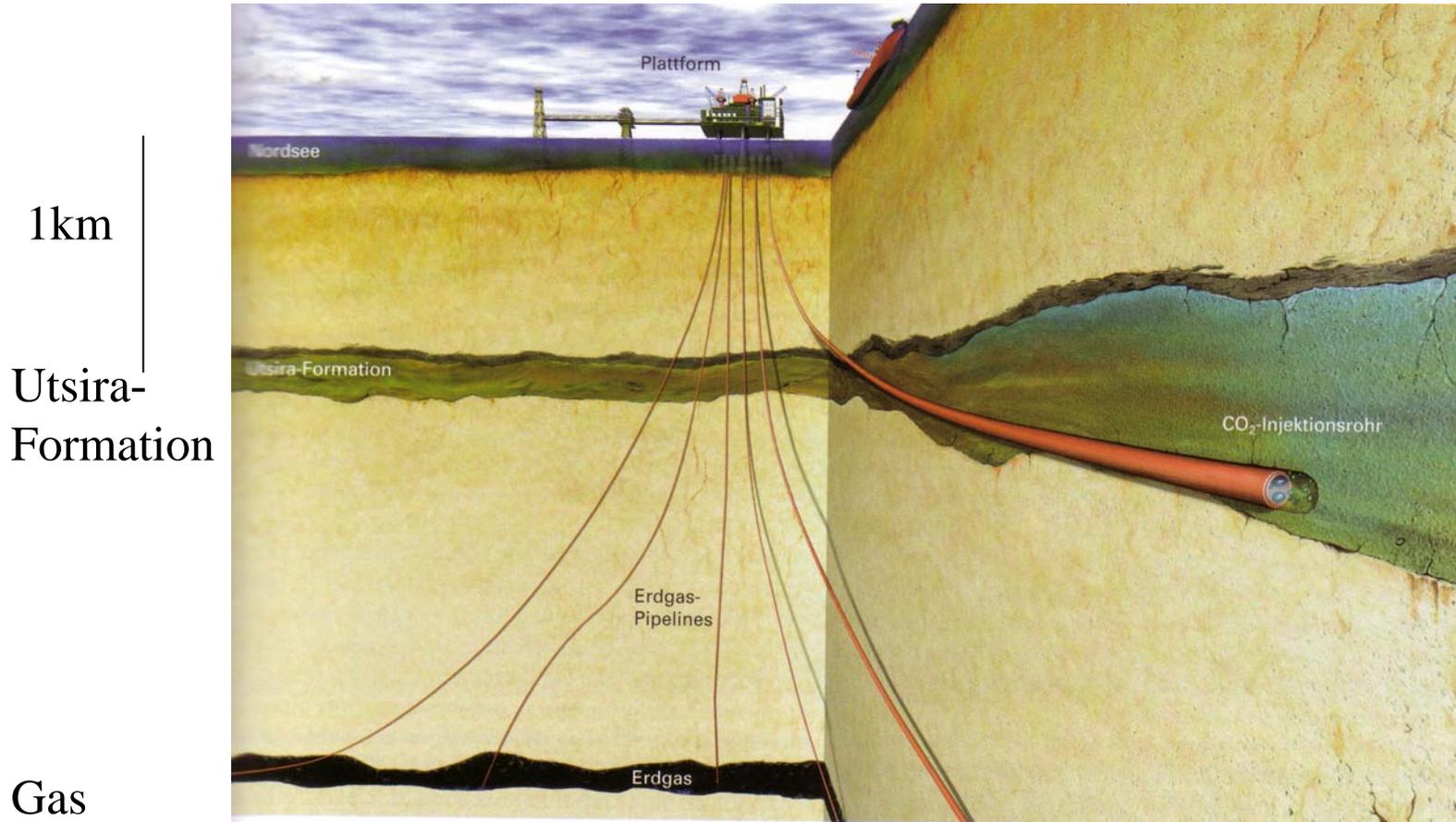
# Pricing Carbon

- These climate policies correspond to a carbon price of 20...200\$/tC.
- The ocean absorbs 2GtC/yr.
- → 0.1% ... 1% GDP -  
**Carbon pump's value under emission cap**
- However: 2Gt/yr would even push up the carbon price – above numbers are lower bounds.

# Consequences for a new Global Carbon Protocol

- Stricter CO<sub>2</sub> emission targets
- Emphasis on carbon rather than radiation management
- Need for intensified research on the impacts of sub-seabed CO<sub>2</sub> sequestration & potential leakage

# Carbon Sequestration in Geological Formations: An Example Operated *at Present*



(by Statoil; platform off-shore Norway)

# Ocean Acidification Community may Contribute to Honest Brokering



- How much CO<sub>2</sub> mitigation?
- At the expenses of which side effects?
- OA-community could offer consistent metric to discuss
  - Reduction of atmospheric CO<sub>2</sub> vs.
  - Leakage from sub-seabed CO<sub>2</sub>

# Summary

- **Large economic numbers at risk – yet indirect effects still to be researched**
- **‘Willingness to pay’ to be researched**
- **The oceanic carbon pump obtains an economic value under a climate policy regime.**
  - **Such a regime appears economically feasible (0.5...1.5% GDP costs only for transforming the energy system)**
- **The ocean acidification community could provide objective metrics to weigh benefits and side-effects of sub-seabed CO<sub>2</sub> sequestration.**