Transformation of the Energy System

Energy Efficiency as an Optimum?

Extreme Energy Efficiency: Possible? Profitable? Essential.

Annual Meeting of the American Association for the Advancement of Science (AAAS) in Washington DC

Monday, 21 February, 2005

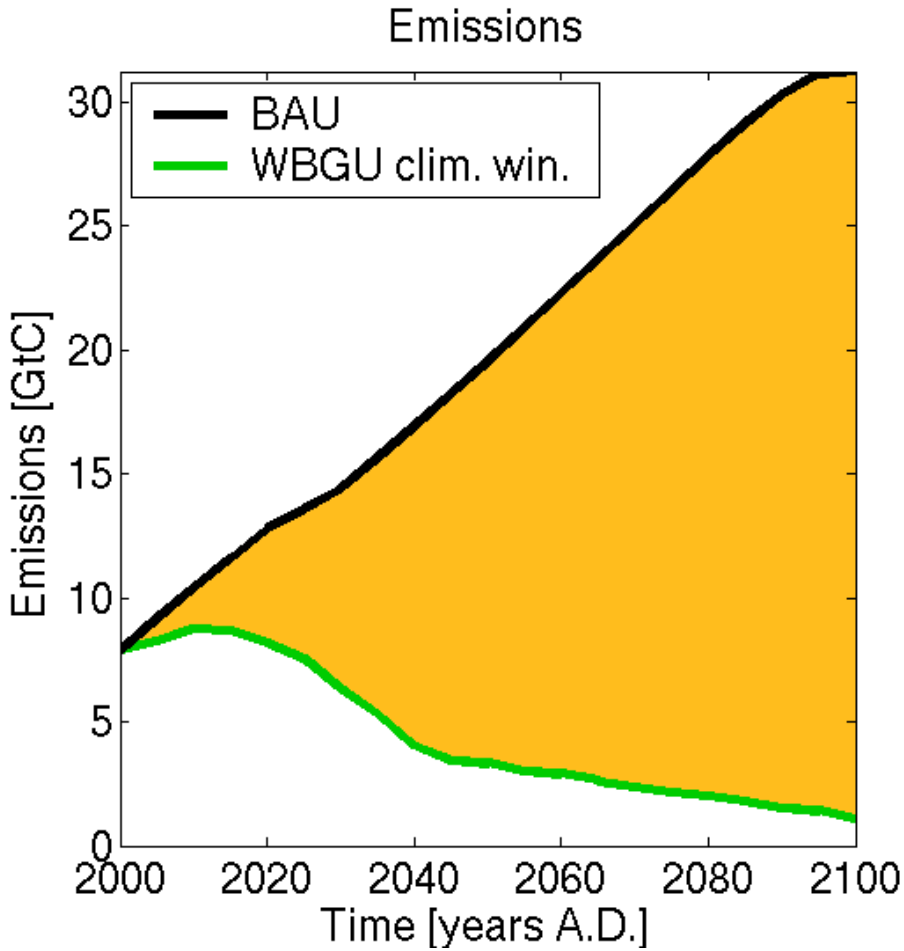
Dr. Ottmar Edenhofer
Department of Global Change & Social Systems

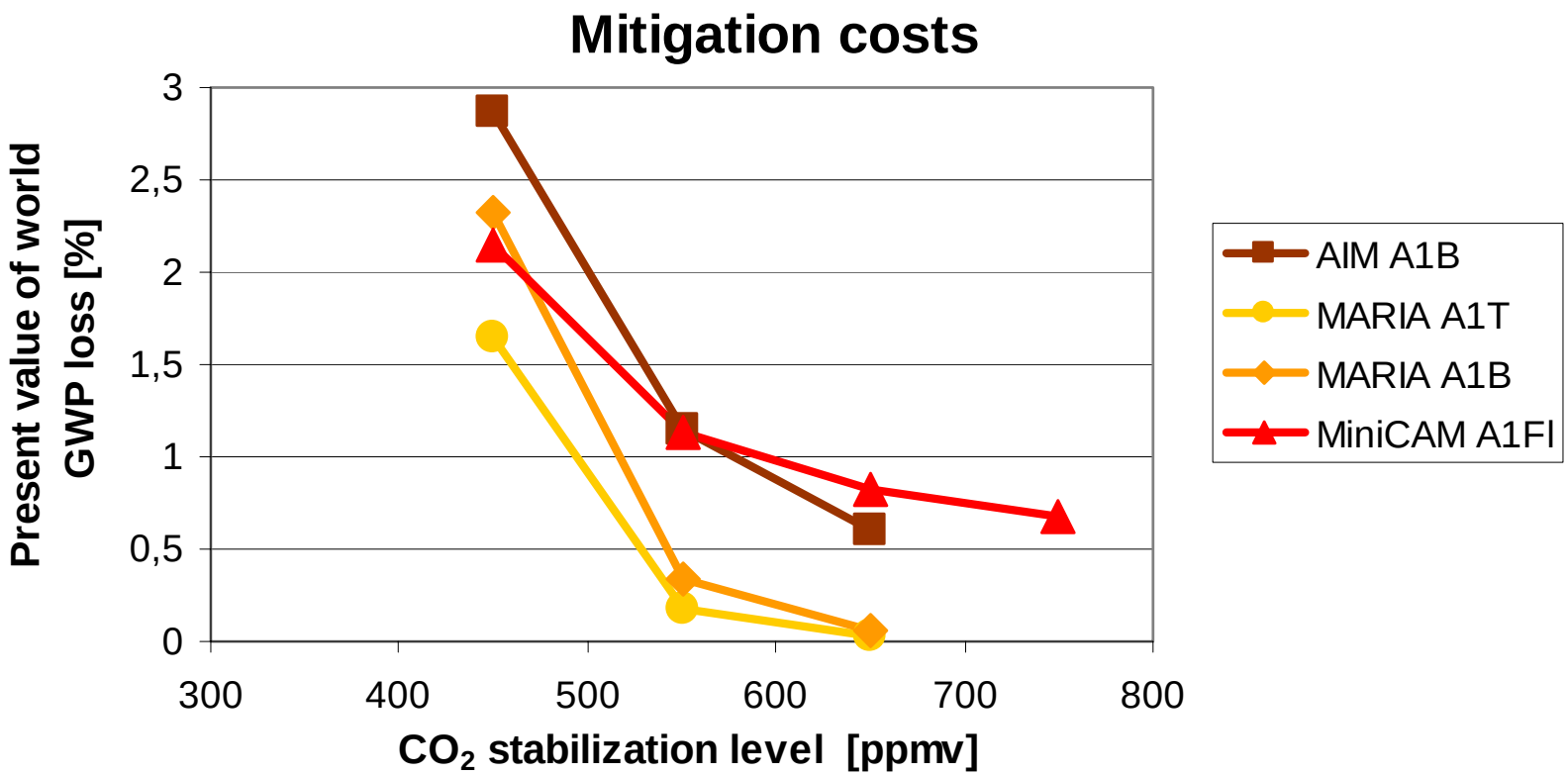
Ottmar Edenhofer
by speaker phone

Unable to attend in person due to family emergency

Since 1999, Dr. Edenhofer has been Deputy Head, Department of Global Change and Social Systems, Potsdam Institute of Climate Impact Research (PIK) where he has focussed on developing and using new modeling techniques to inform climate policy.

Mitigation gap for WBGU clim. window




Mitigation costs
Present value of world GWP loss [%]
3
2,5
2
1,5
1
0,5
0
300
400
500
600
700
800
CO2 stabilization level [ppmv]
AIM A1B
MARIA A1T
MARIA A1B
MiniCAM A1FI

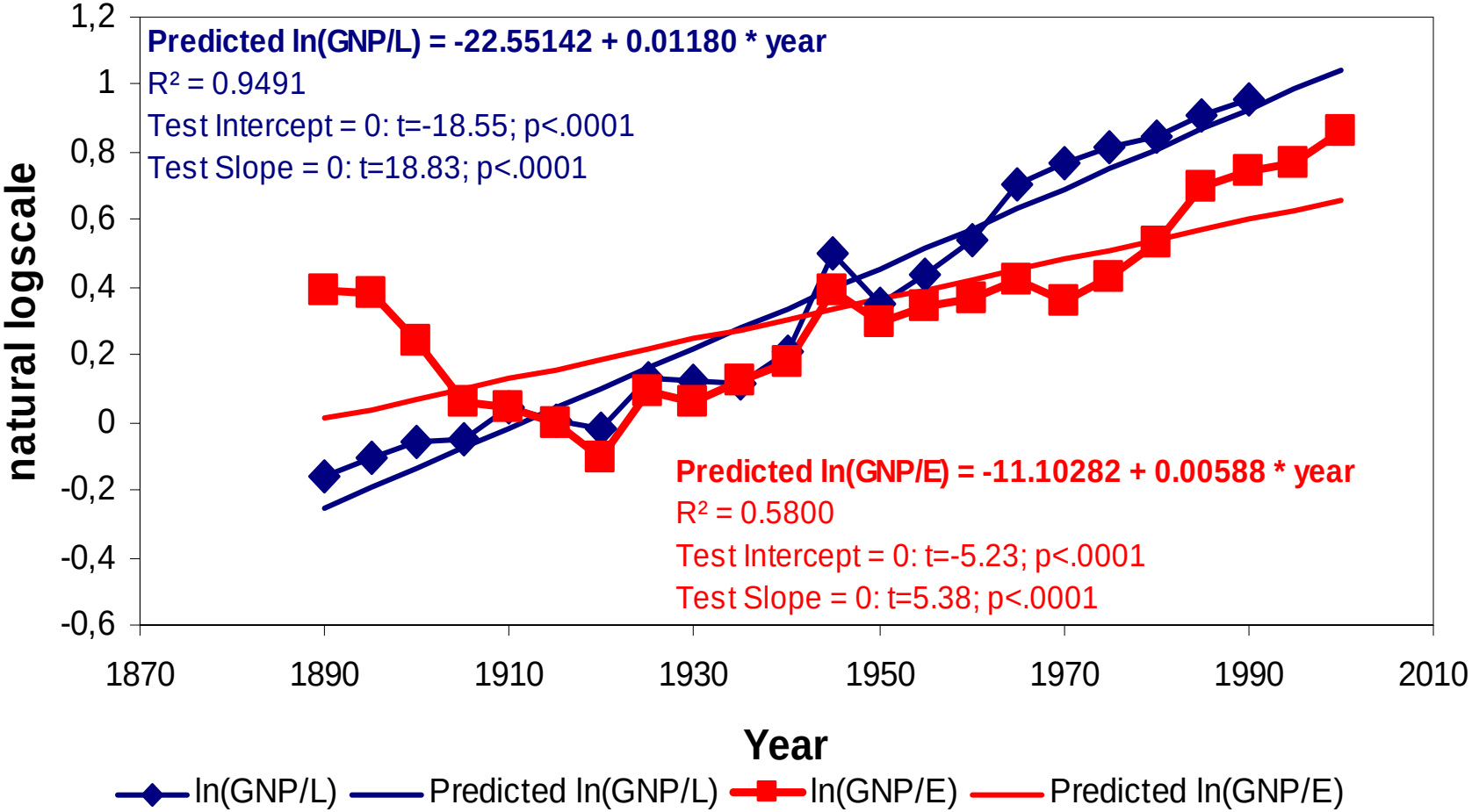
Aspects of Technological Change

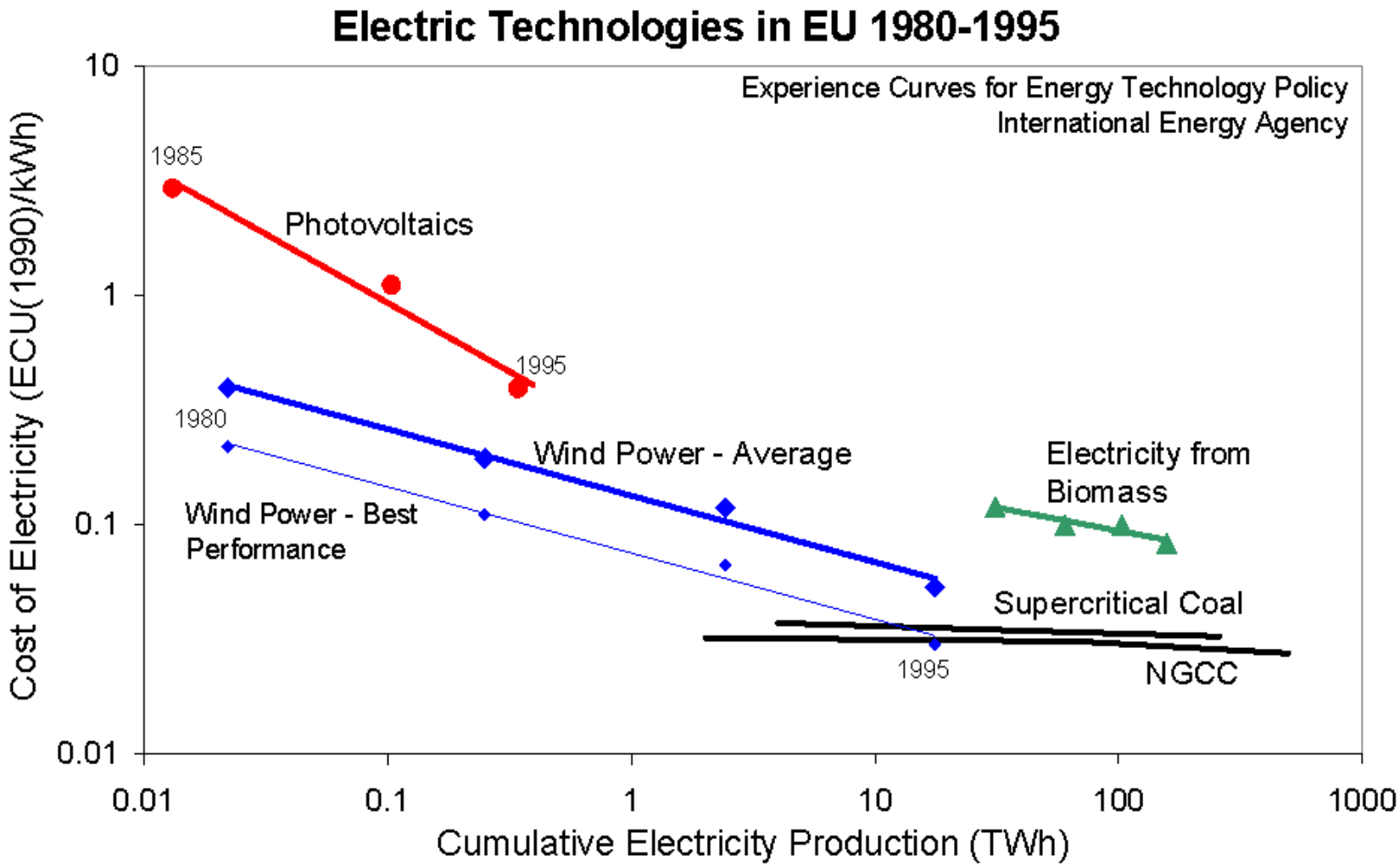
1. Technological change driven by investments

2. Learning-by-doing

3. Relevant mitigation options

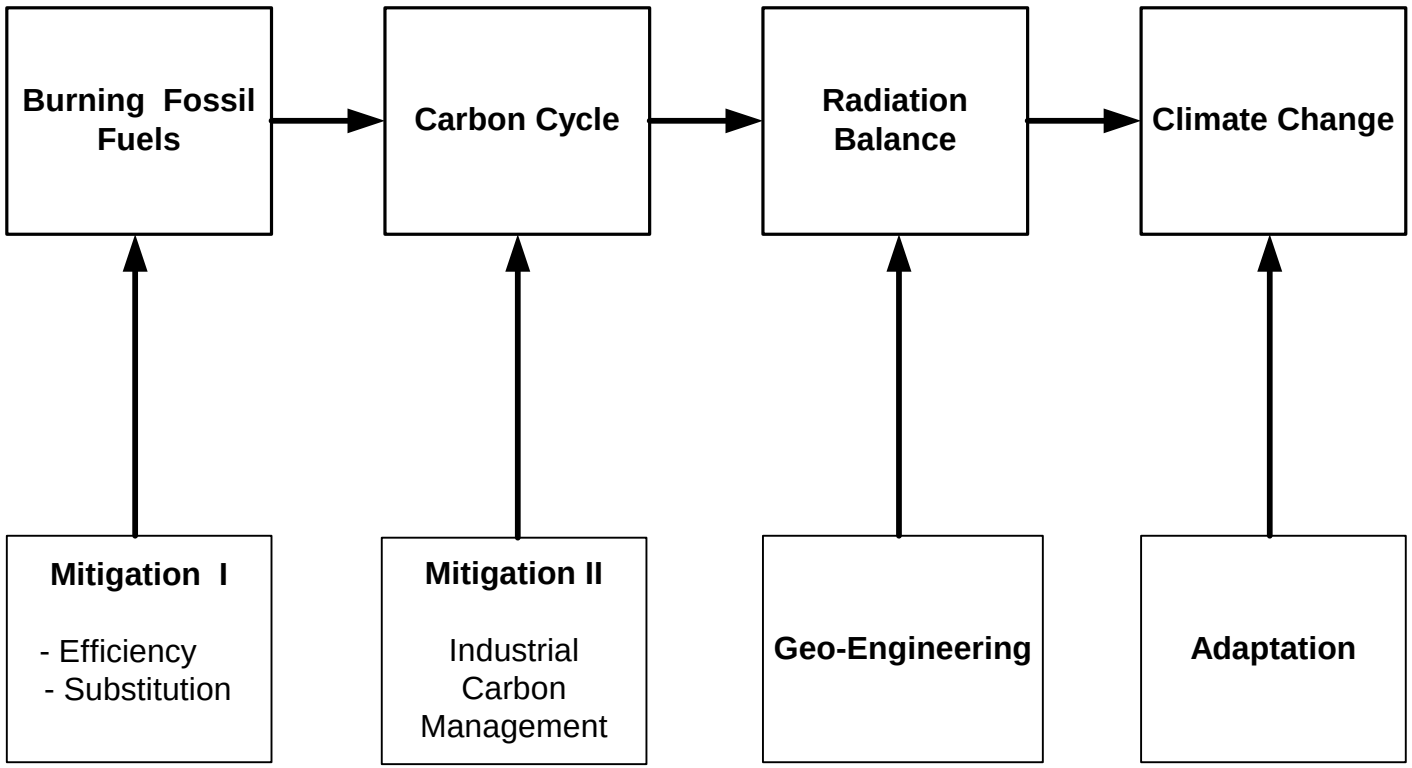
Growth Rate of Labour and Energy Productivity: USA





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

The Options for Climate Policy



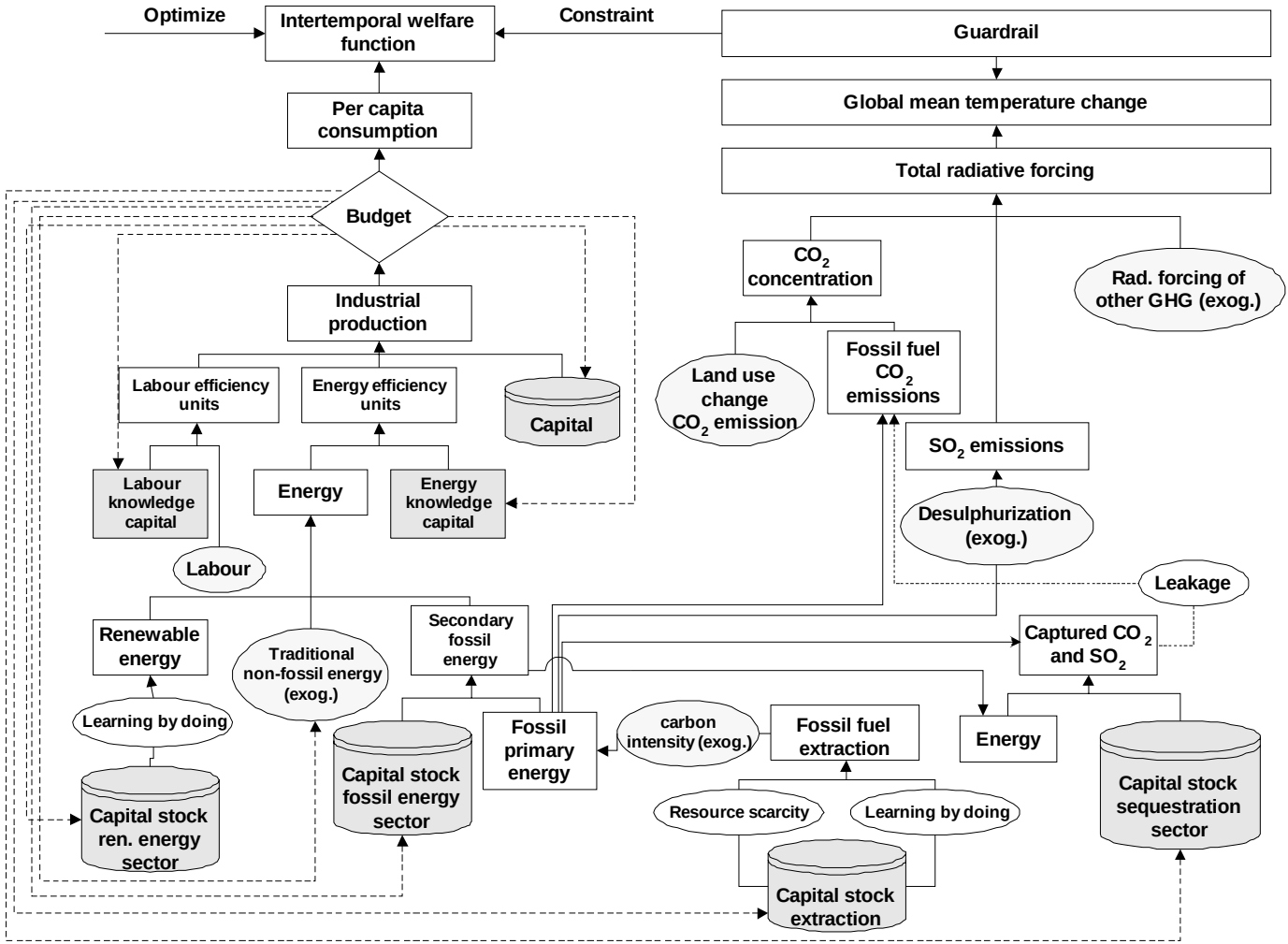
Structure of MIND

Mitigation options

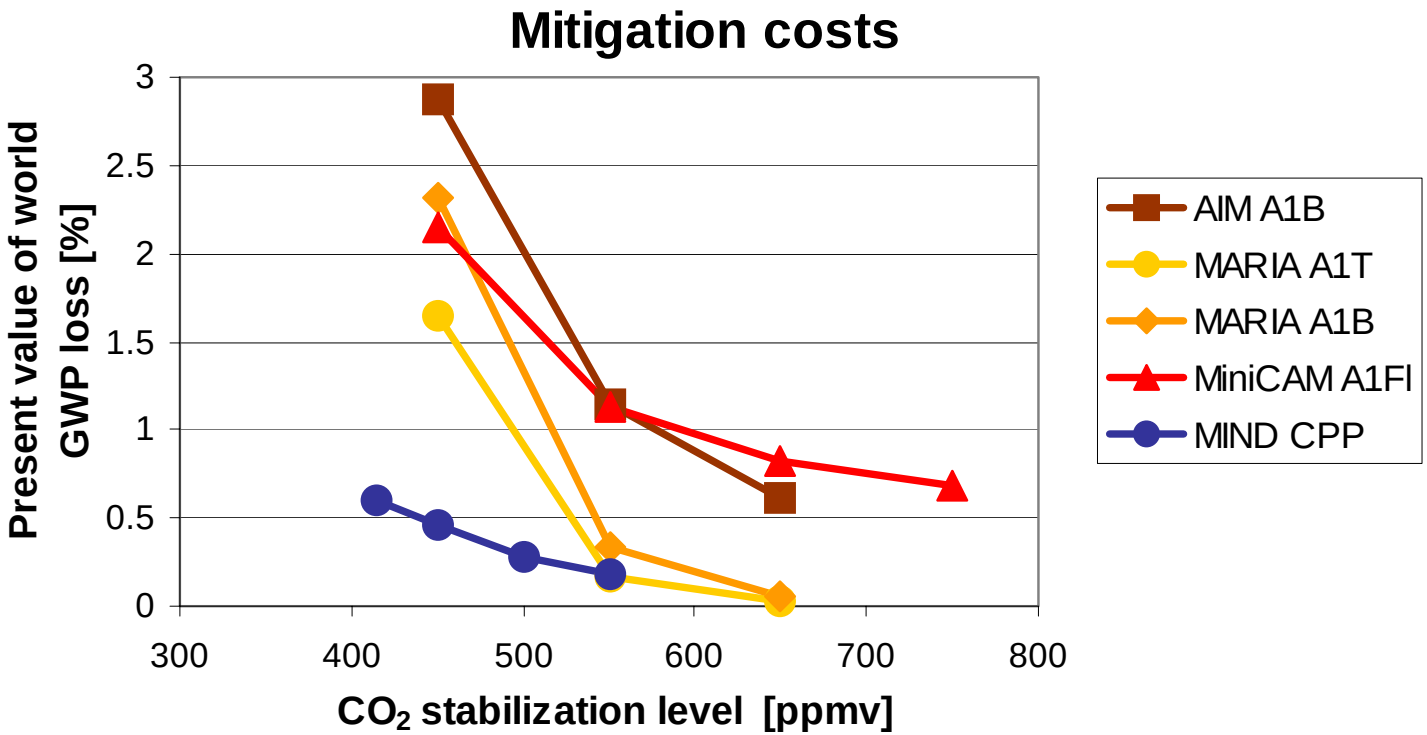
- Efficiencies
- Renewable energy sources
- Carbon capturing and sequestration (CCS)

Fossil fuel extraction

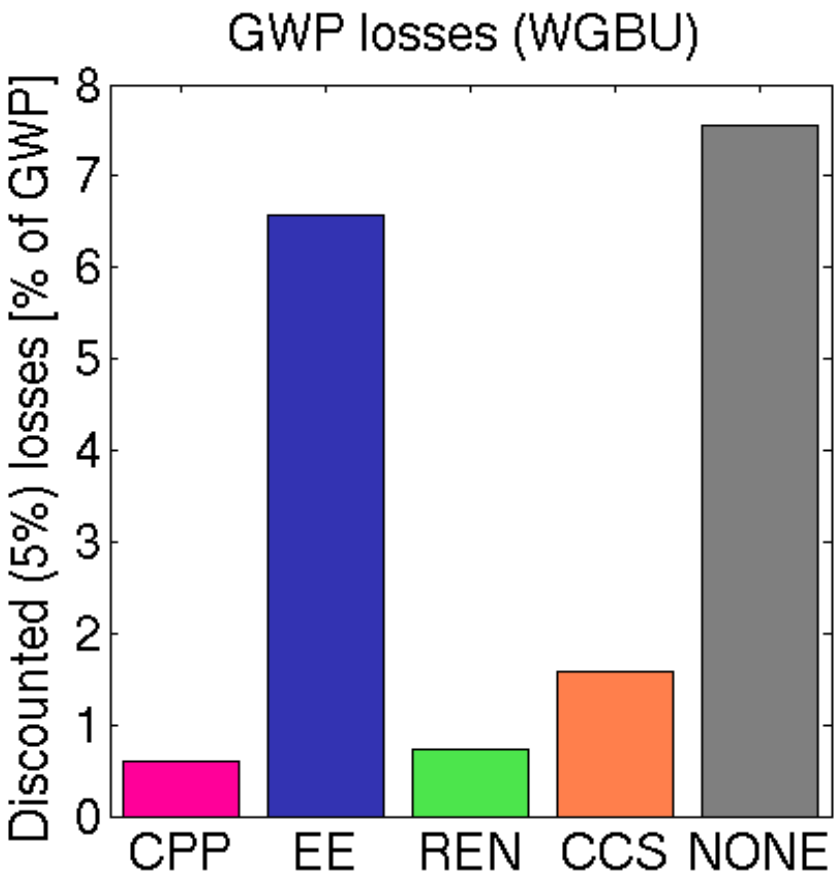
- Learning by doing
- Rogner curve



Mitigation costs

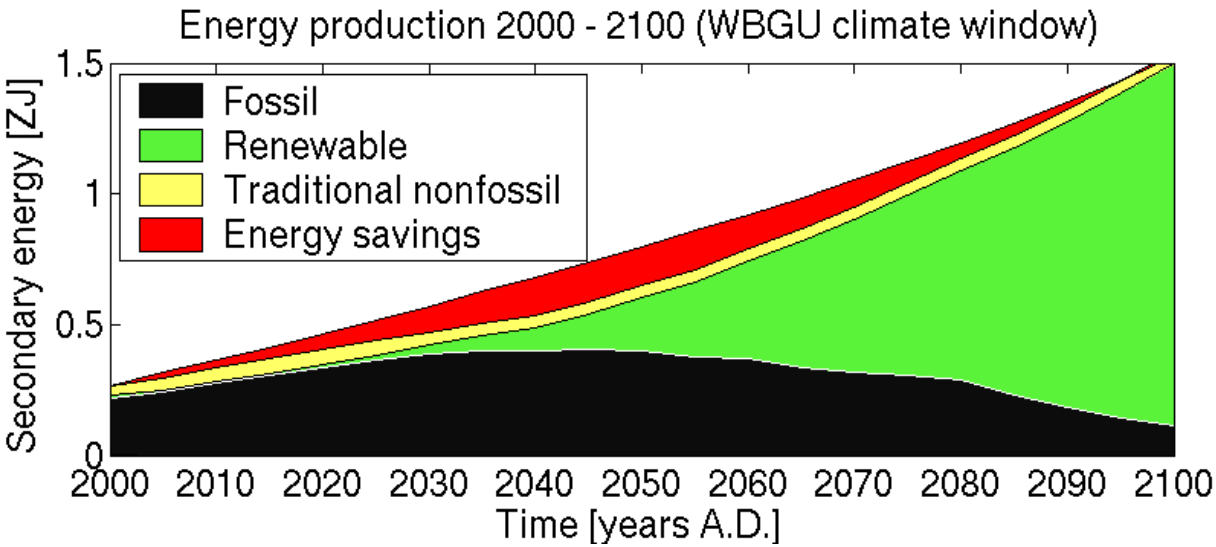


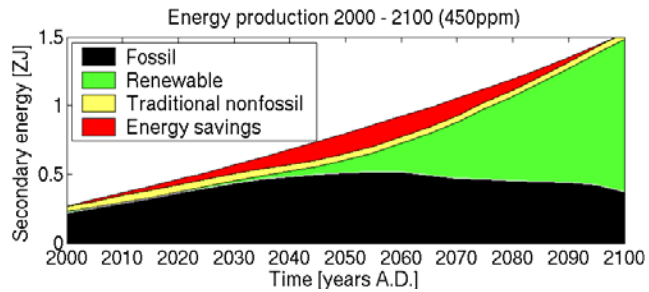
Costs for different mitigation options

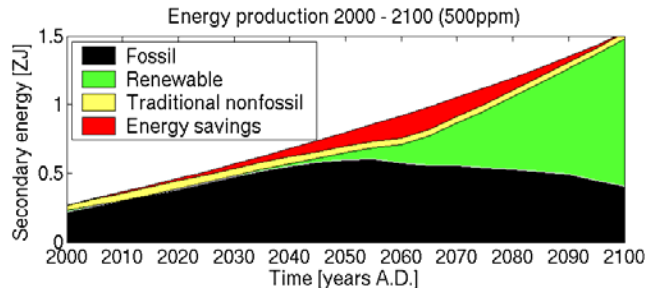


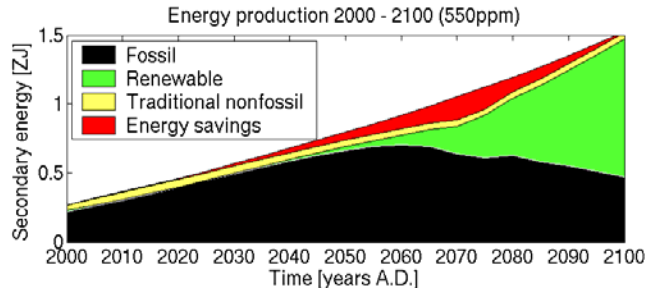
Climate target: WBGU climate window

Transformation of the energy system

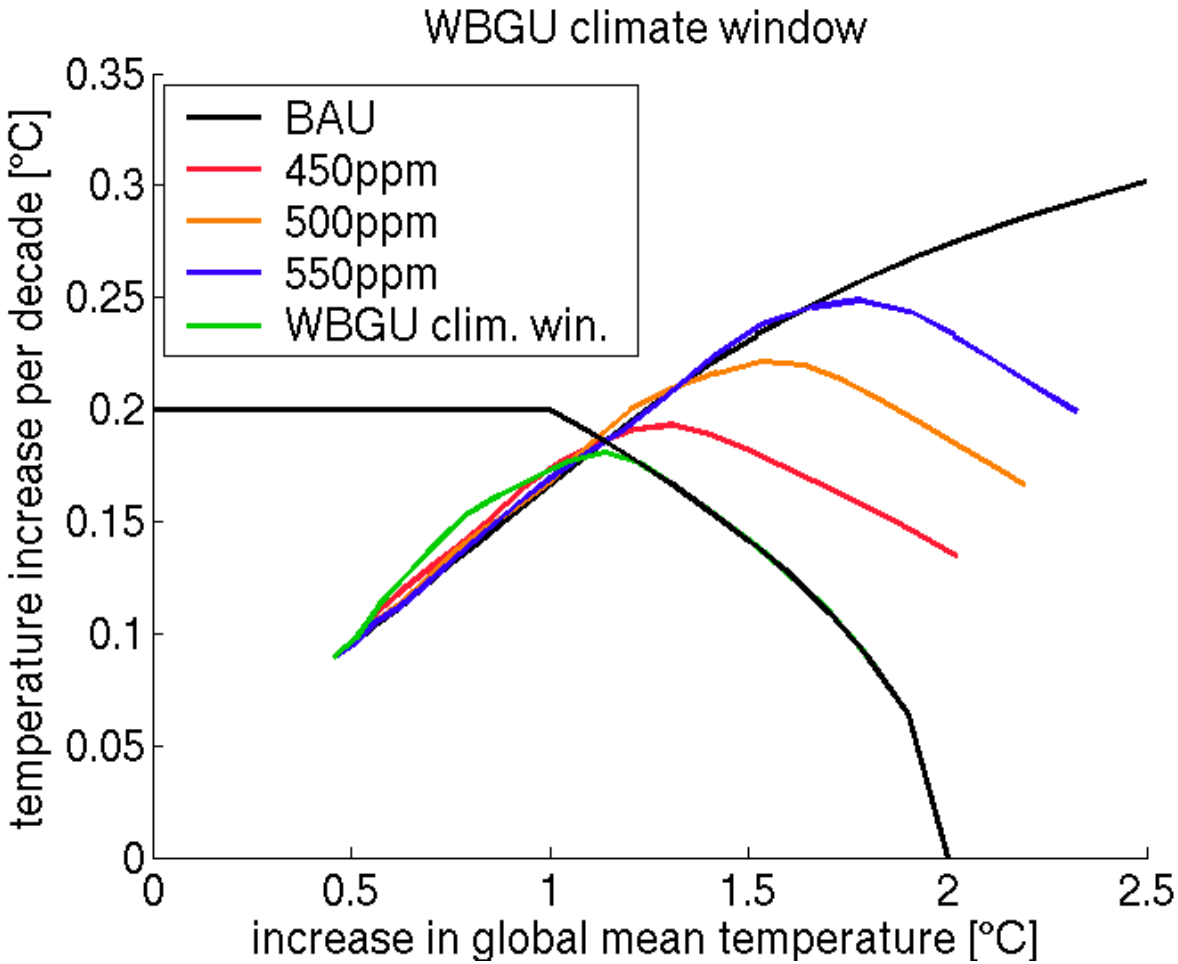








Climate protection targets



The Carbon Problem

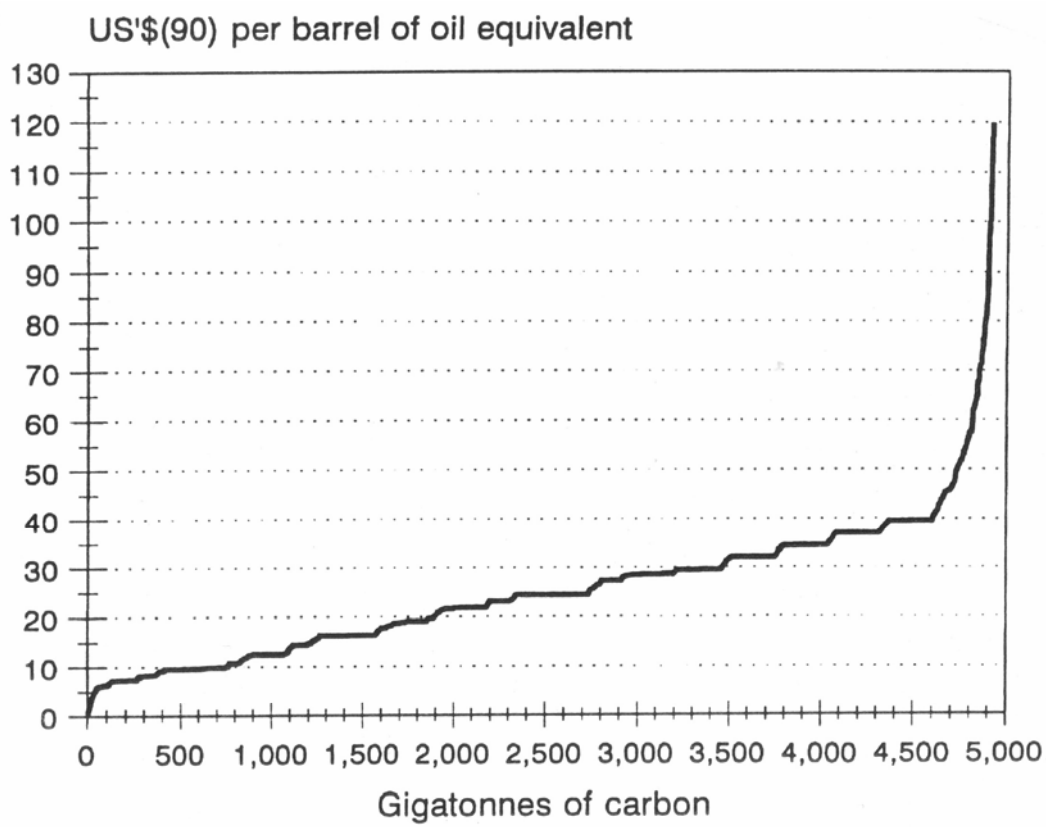
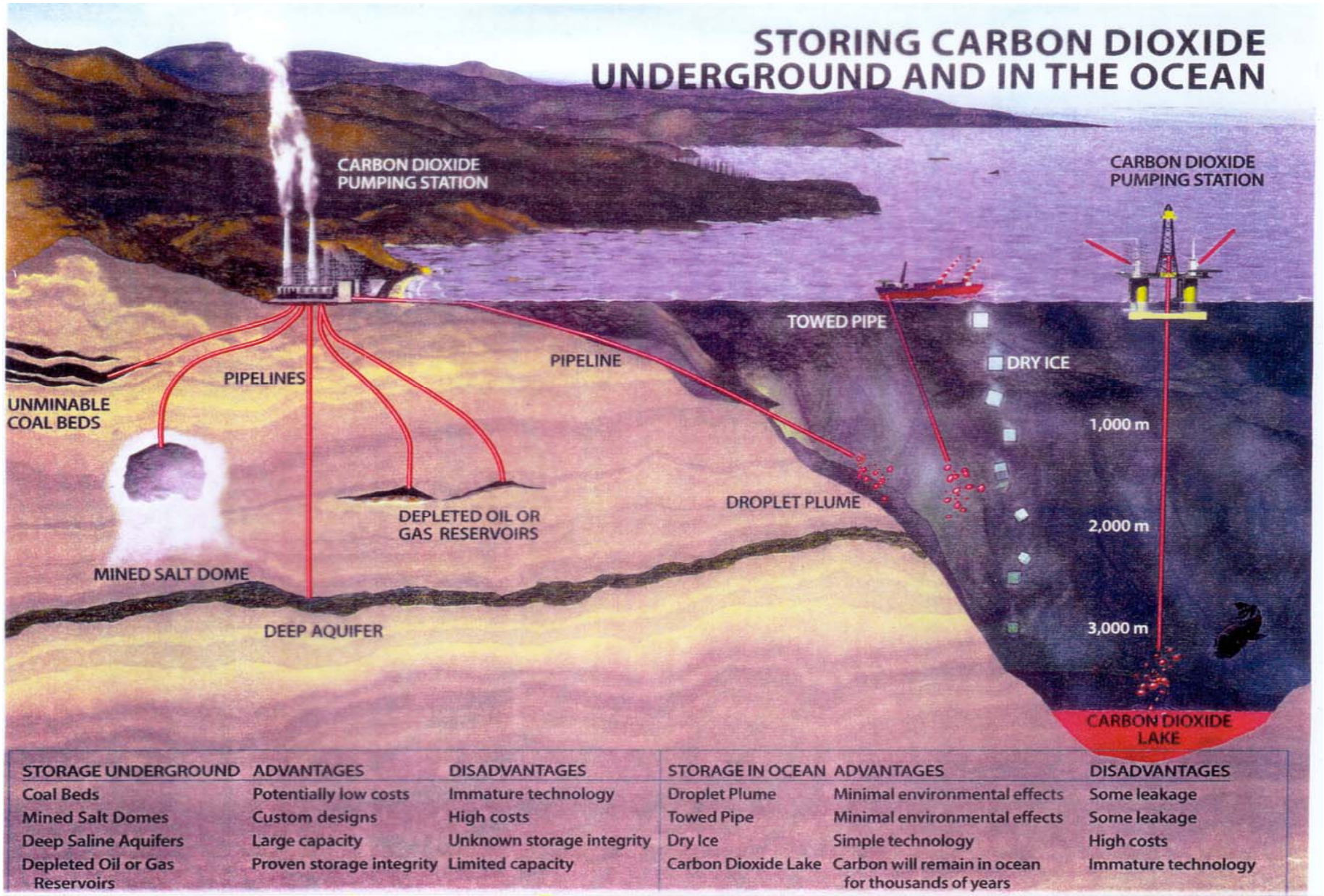


Figure 8 Aggregate quantity-cost curve for carbon contained in the global fossil resource base.

Source: H.-H. Rogner, An Assessment of World Hydrocarbon Resources, International Institute for Applied Systems Analysis (IIASA), May 1998

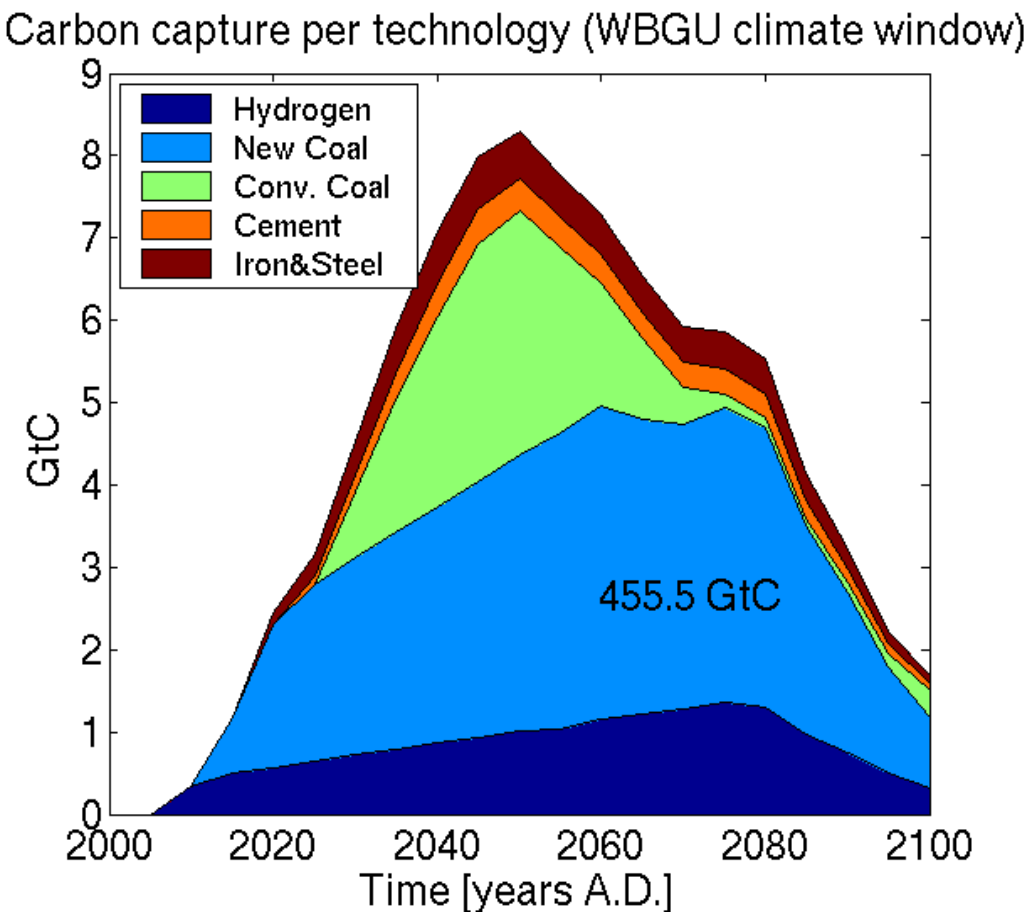
Carbon Management

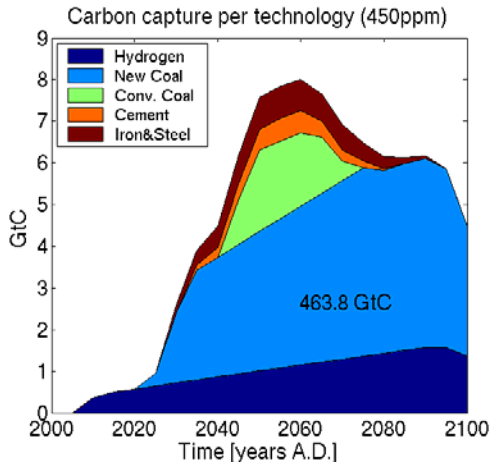


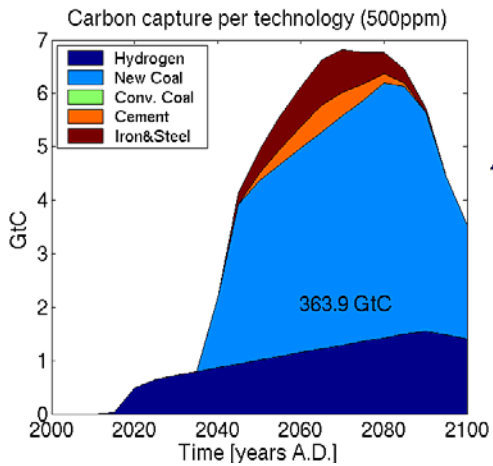
STORAGE UNDERGROUND	ADVANTAGES	DISADVANTAGES
Coal Beds	Potentially low costs	Immature technology
Mined Salt Domes	Custom designs	High costs
Deep Saline Aquifers	Large capacity	Unknown storage integrity
Depleted Oil or Gas Reservoirs	Proven storage integrity	Limited capacity

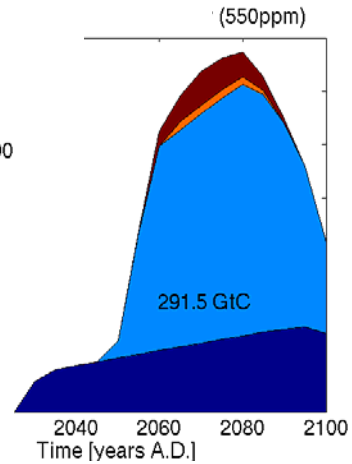
STORAGE IN OCEAN	ADVANTAGES	DISADVANTAGES
Droplet Plume	Minimal environmental effects	Some leakage
Towed Pipe	Minimal environmental effects	Some leakage
Dry Ice	Simple technology	High costs
Carbon Dioxide Lake	Carbon will remain in ocean for thousands of years	Immature technology

Carbon capturing and sequestration



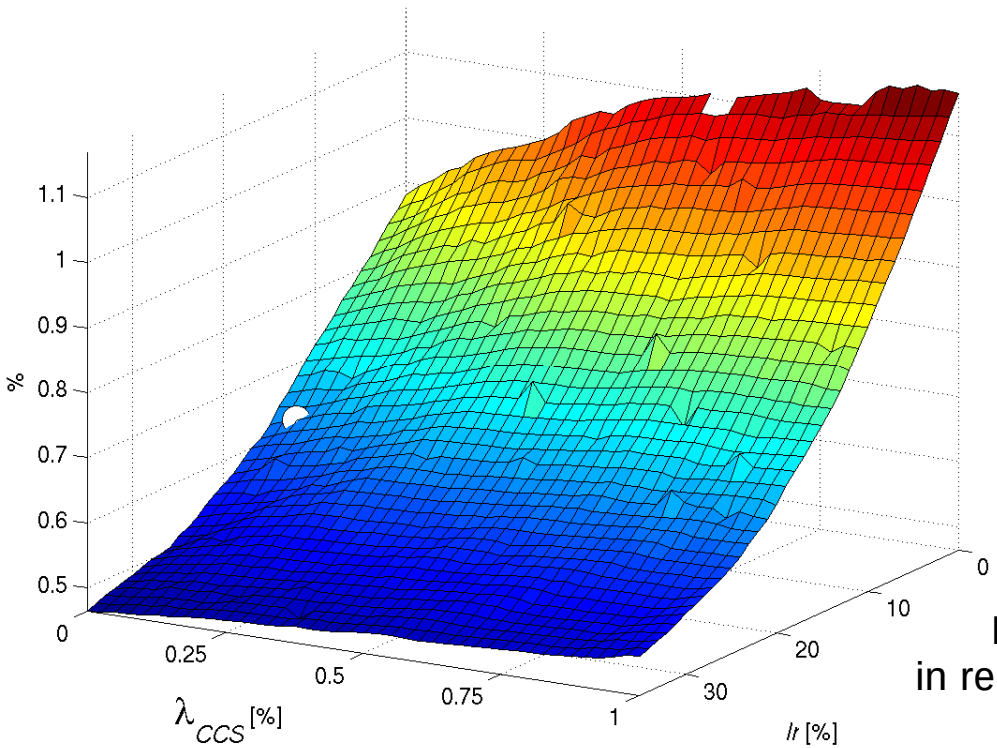






Sensitivity of welfare losses

Cumulative discounted welfare losses



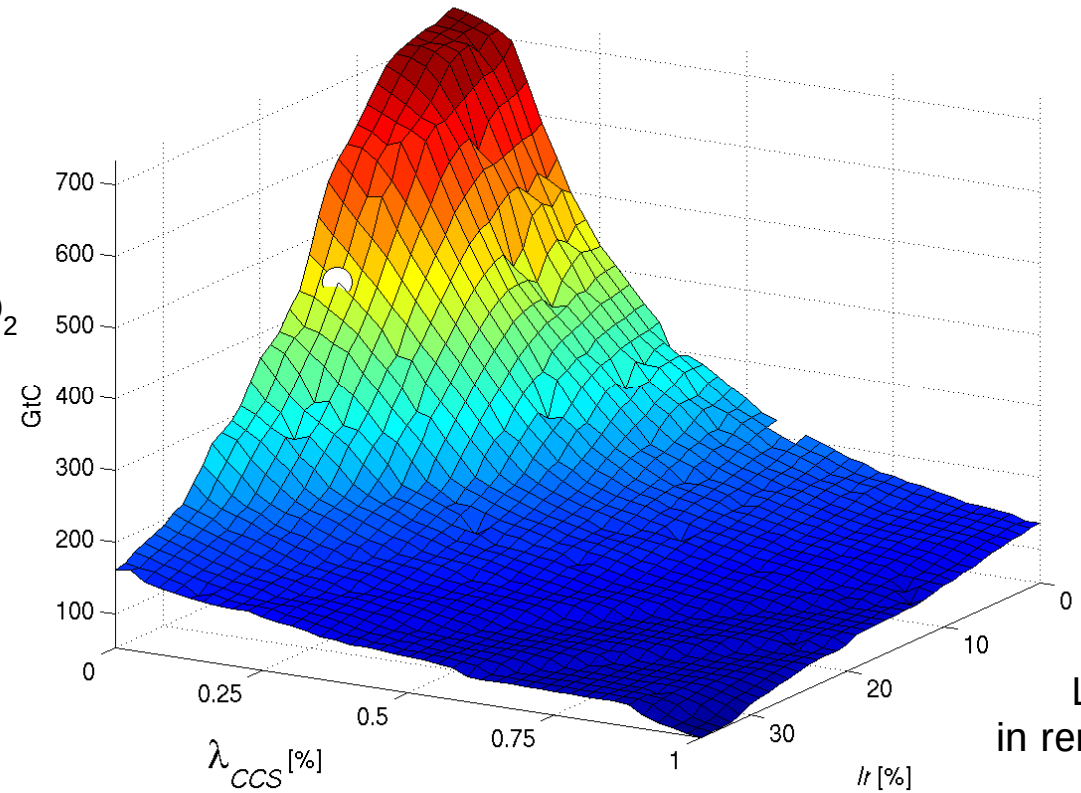
CCS leakage rate

Learning rate in renewable energies

Climate target: WBGU climate window

Sensitivity of captured CO_2

Cumulative captured CO_2

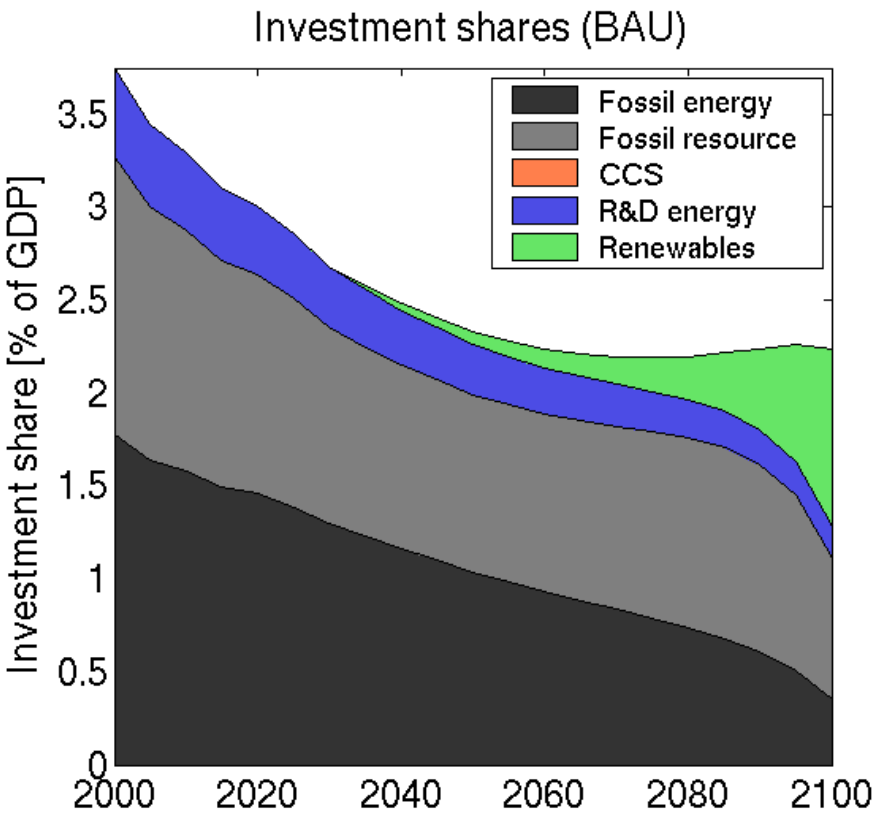


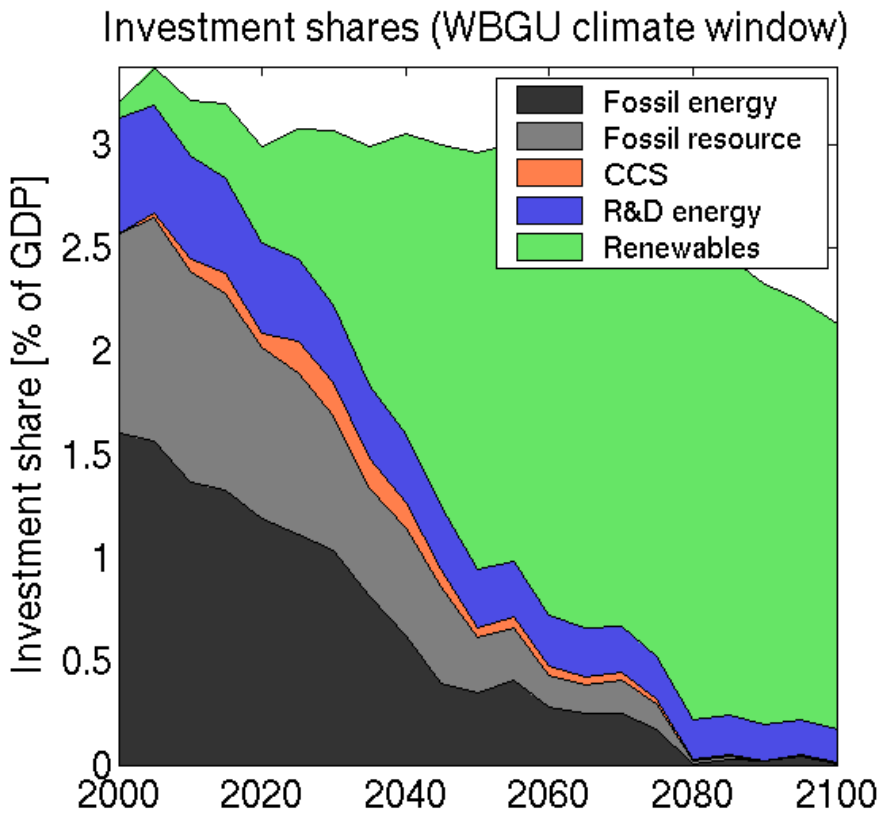
CCS leakage rate

Learning rate in renewable energies

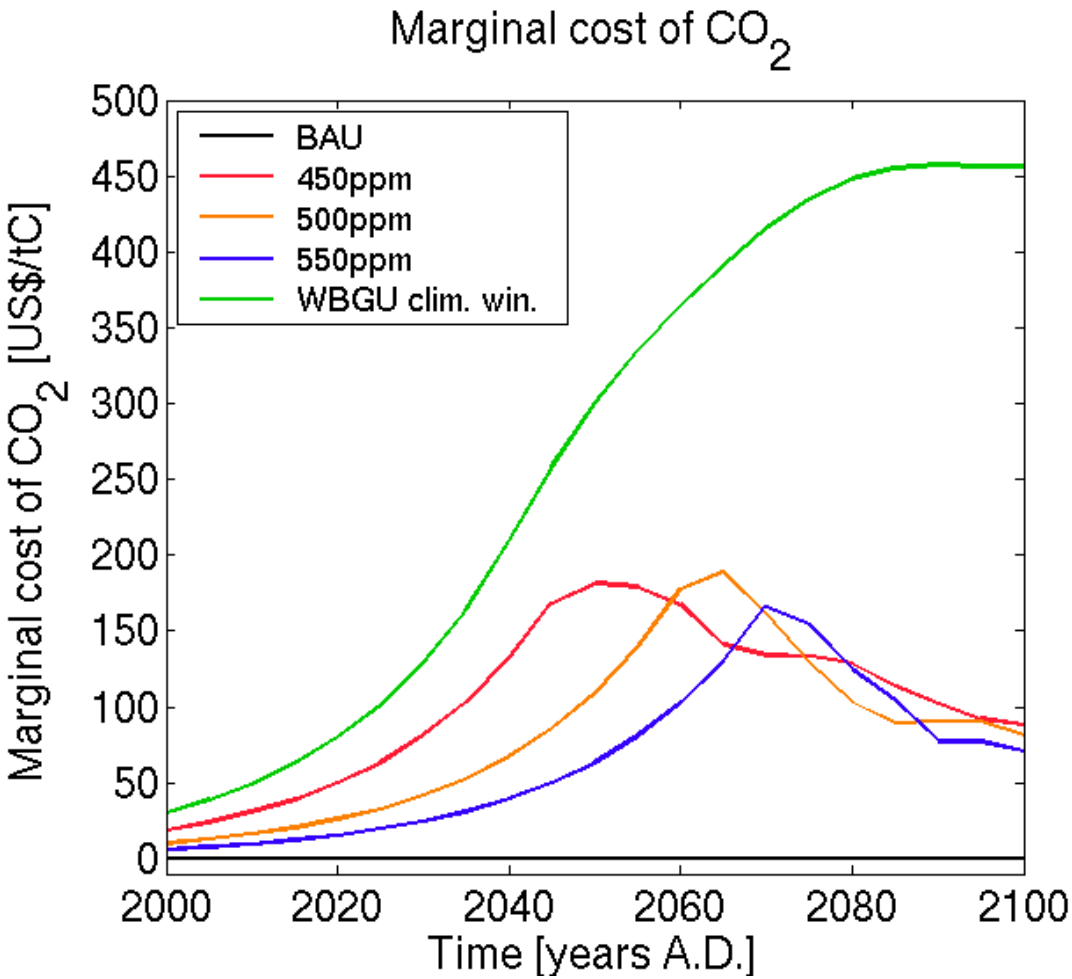
Climate target: WBGU climate window

Investment dynamics in the energy system





Permit price



Policy Instruments

- Promoting the most innovative renewable energy sources (Green Trading)
- Managing the risks of Carbon Capturing and Sequestration (CCS) by Carbon Sequestration Bonds
- Establishing tradable permit scheme (Black Trading)