

Bert Metz

# Meeting a 2 degree target: Is it possible?

Symposium Climate Change:  
the Policy Challenge

Wellington, October 6, 2006



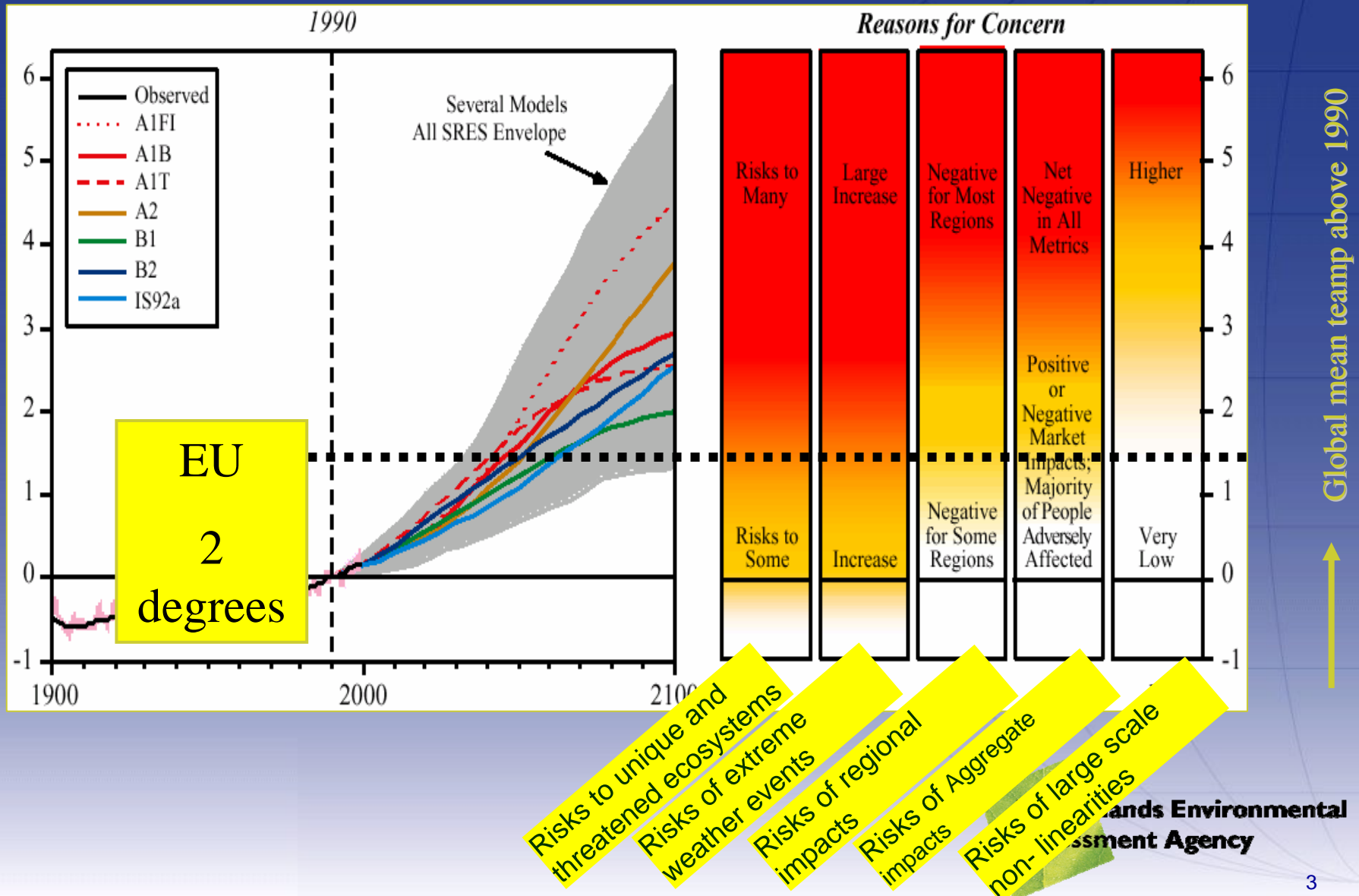
**Netherlands Environmental  
Assessment Agency**

# Ultimate objective of UNFCCC, 1992

“(...) stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system ..”

**Key question: what is dangerous?**

# How to avoid “dangerous anthropogenic interference with the climate system”?

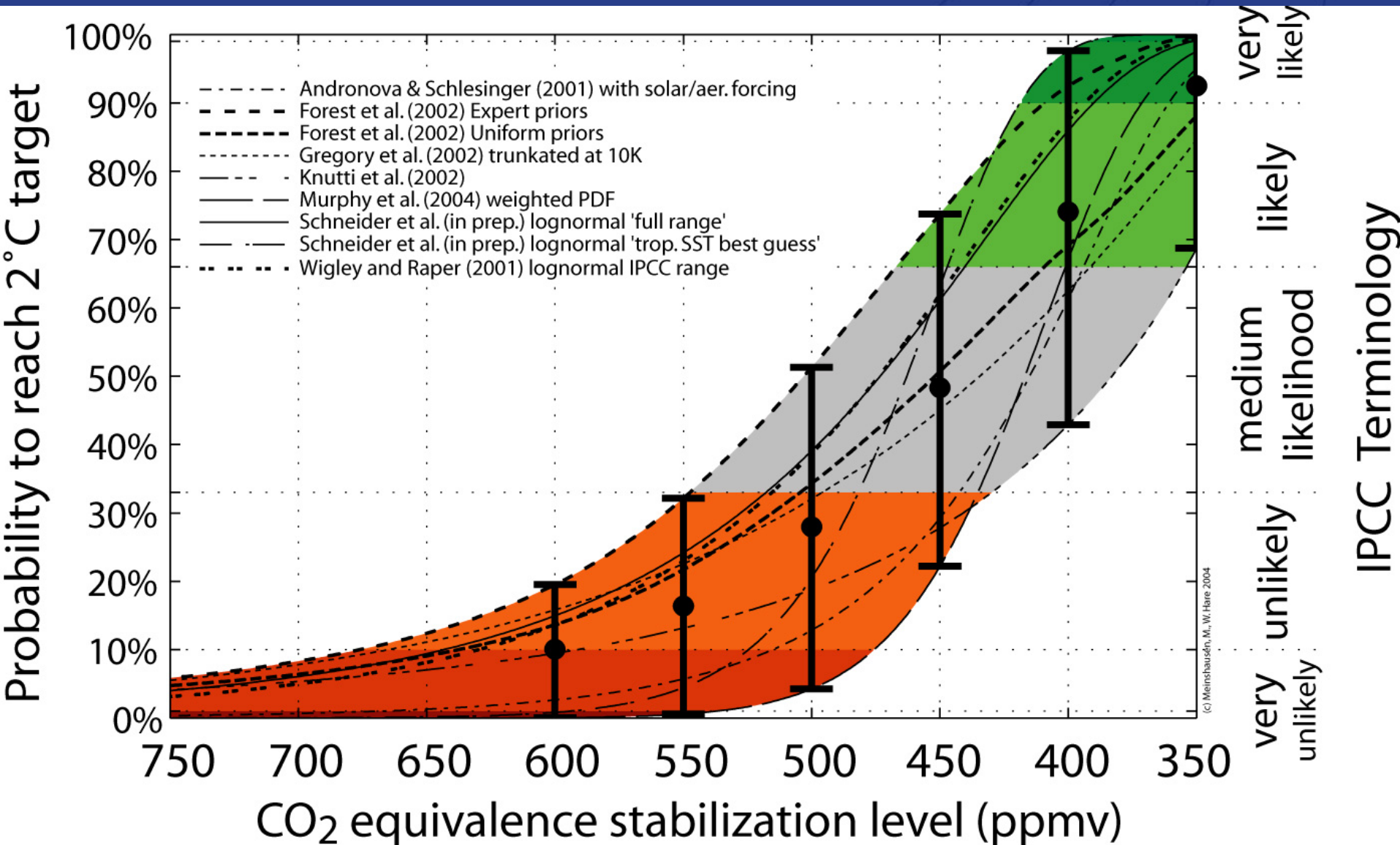




**Political choice:**  
**No increase over 2°C**  
**(above pre-industrial)**

# The probability to reach the 2°C target depends on the climate sensitivity

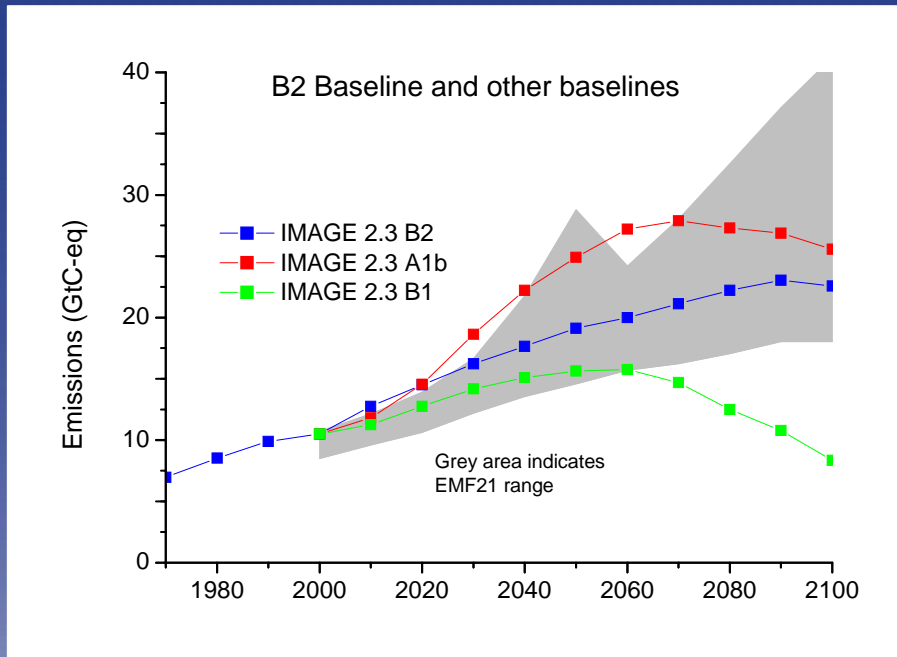
(Hare & Meinshausen, 2004)



# Definitions

- CO<sub>2</sub>-eq concentration expresses forcing of all greenhouse gasses in terms of a CO<sub>2</sub> conc. that would result in the same forcing.
- 650 ppm CO<sub>2</sub>-eq ~ 550 ppm CO<sub>2</sub>
- 550 ppm CO<sub>2</sub>-eq ~ 470 ppm CO<sub>2</sub>
- 450 ppm CO<sub>2</sub>-eq ~ 400 ppm CO<sub>2</sub>
- 400 ppm CO<sub>2</sub>-eq ~ 350 ppm CO<sub>2</sub>
  
- $1 \text{ t C} = 3.67 \text{ t CO}_2$

# Baseline – developments without climate policy



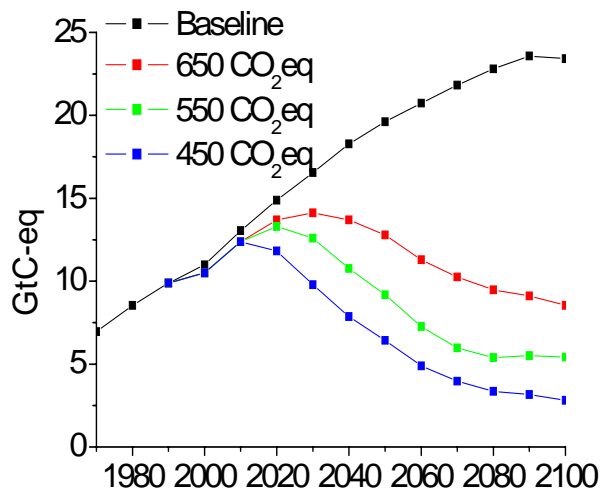
Central case B2:  
Population 2100: 9 billion (UN medium)

GDP growth: 2% per year

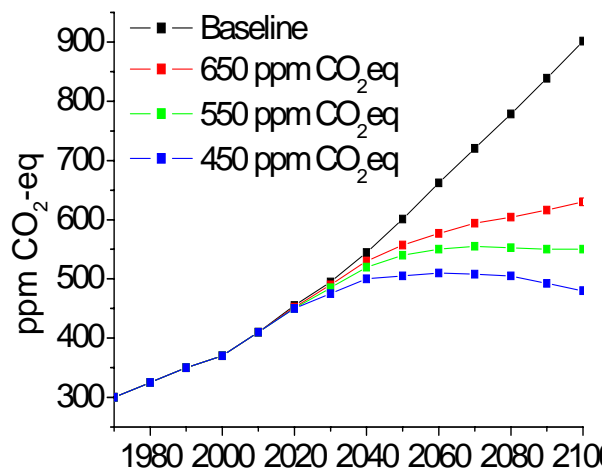
Energy: near IEA until 2030, conventional development after 2030

# Emission pathways that lead to stabilisation

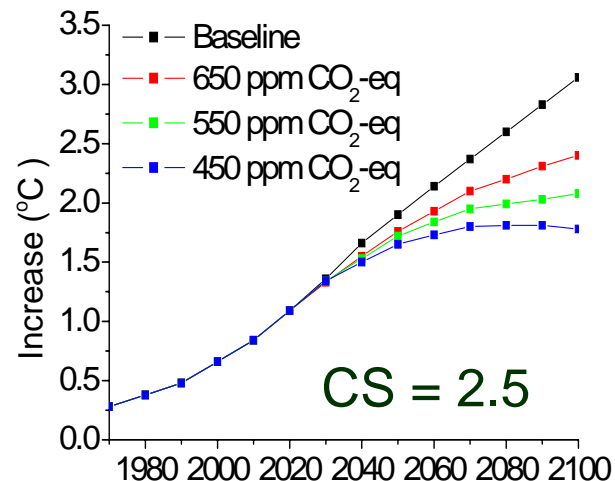
## Emissions



## Concentration



## Temperature



## Assumptions:

- B2 baseline
- reduction rate: preferably constant over time (and always < 3%/yr).
- If possibly, avoid rapid early reduction
- Stay below conc. level target (650,550) or allow minimum overshoot (450)

# Reduction options (typical values)

Energy efficiency:	300 GtC (20% improvement)
Wind/solar:	100 GtC - > 1000 GtC
Biomass:	200 GtC - 700 GtC
Nuclear:	>300 GtC
Non-CO2:	200 GtC-eq
Sinks:	20-200 GtC
CCS:	60-600 GtC
Fuel switch:	0-50 GtC
Other renewables:	>100 GtC

Cumulative reduction

650: 650 GtC

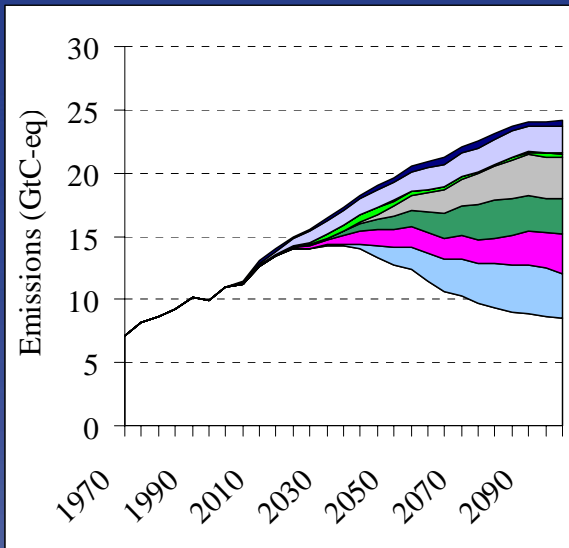
550: 850 GtC

450: 1200 GtC

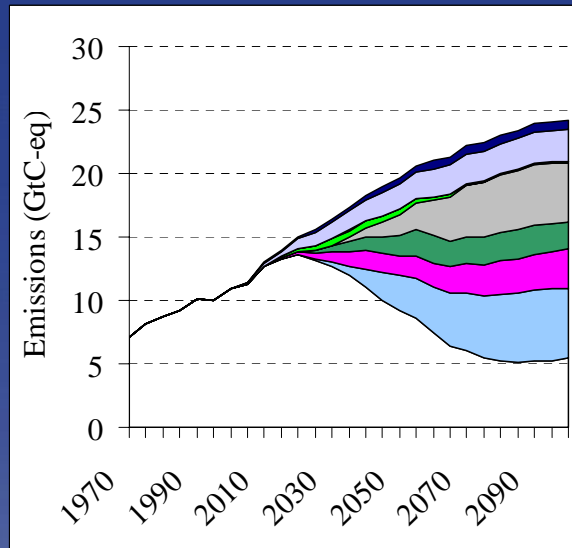
There is choice!

# How to get to stabilisation?

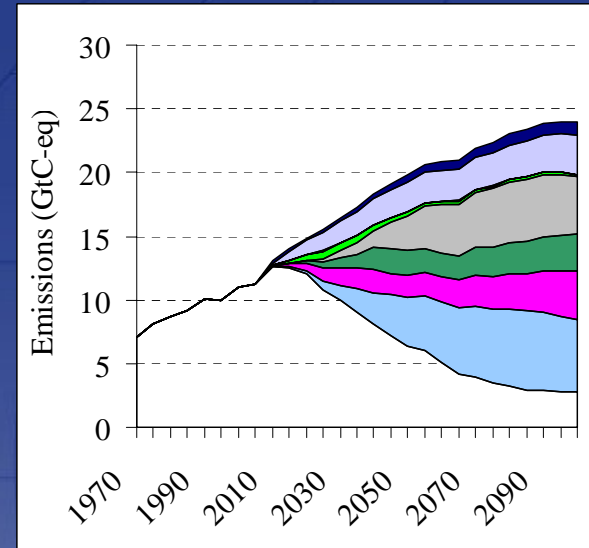
## 650 CO<sub>2</sub>-eq



## 550 CO<sub>2</sub>-eq

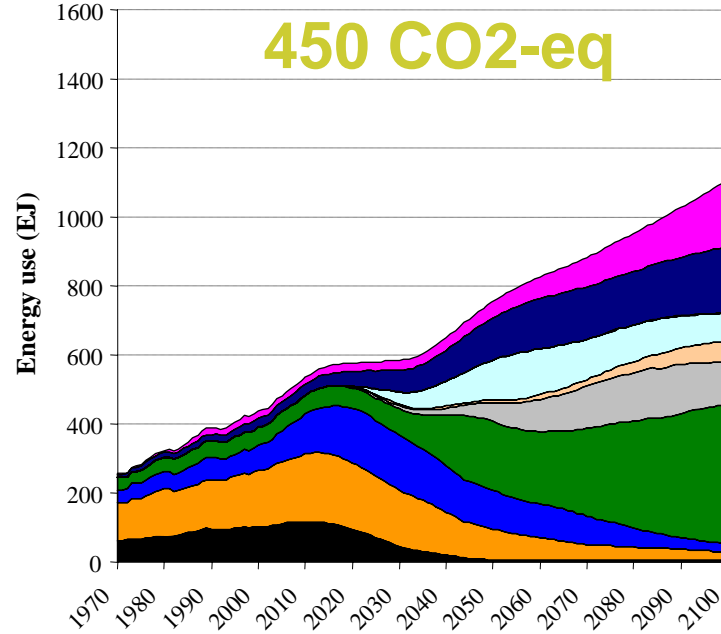
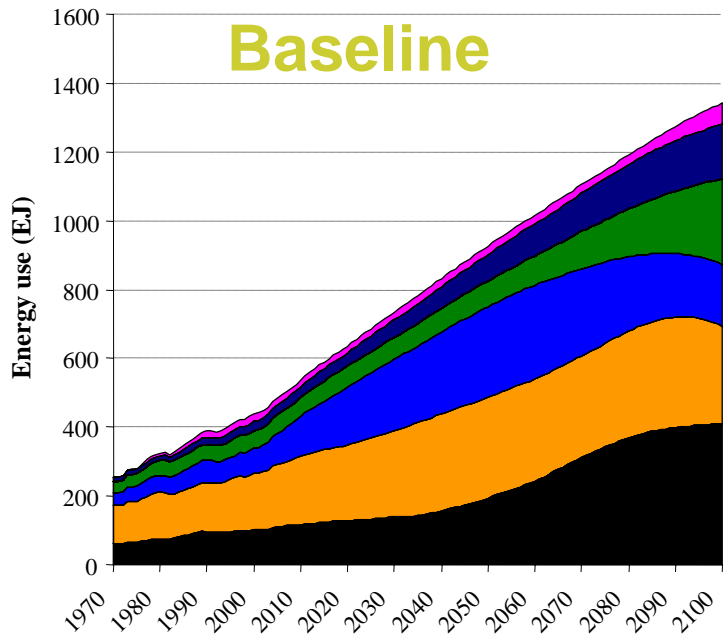


## 450 CO<sub>2</sub>-eq



- Combination of options based on technical feasibility and least cost
- Main options short term: non-CO<sub>2</sub>, fuel switch (to NG), efficiency
- Main options long term: CO<sub>2</sub> capture/storage, biofuels, nuclear/renewables, efficiency
- Large numbers of installations! (1 GtC CCS= several thousand Sleipners)

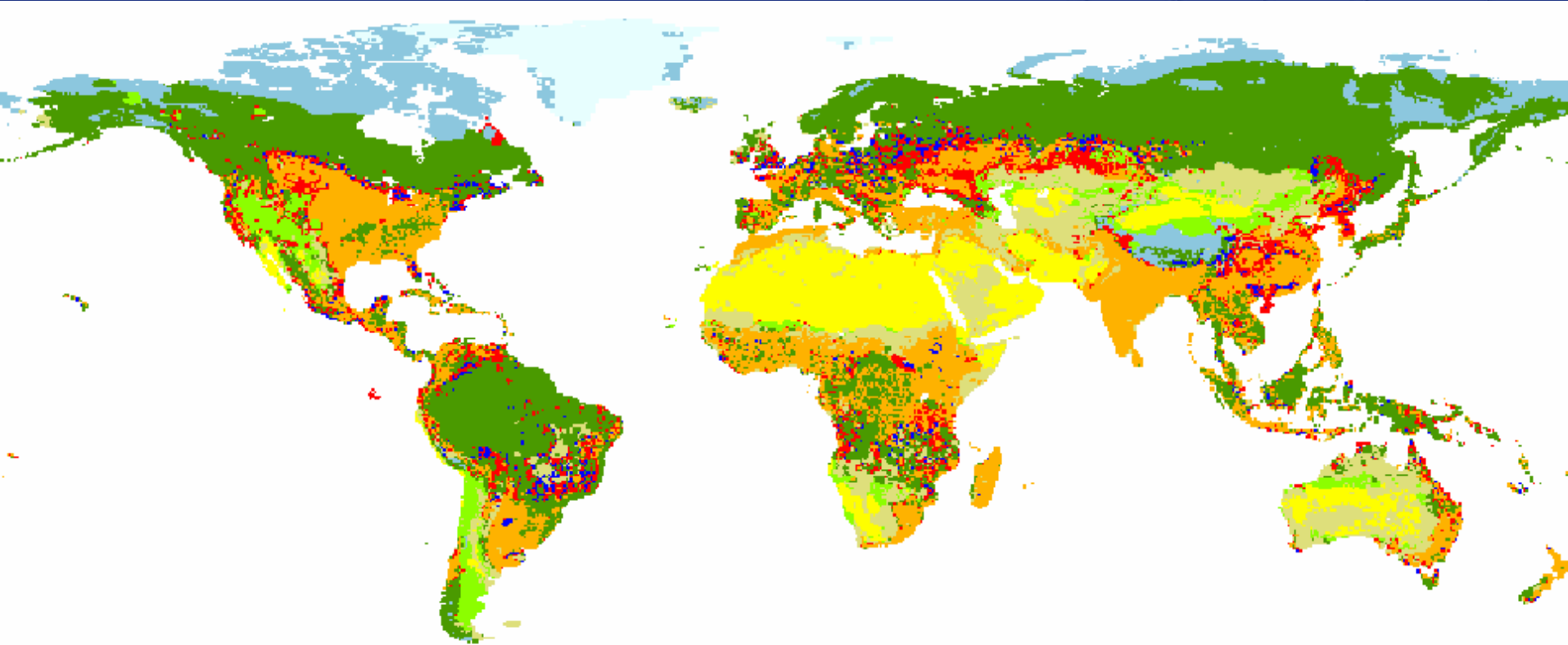
# Changes in the global energy system



- Nuclear
- Biofuels + CCS
- Oil+CCS
- Biofuels
- Oil
- Renewables
- Natural gas+CCS
- Coal+CCS
- Natural gas
- Coal

**Biofuel, nuclear, renewables already in baseline!**

# Land use pattern in 450 ppm CO<sub>2</sub>-eq mitigation scenario (2100)



Forests  
Grass  
Desert

Ice  
Tundra

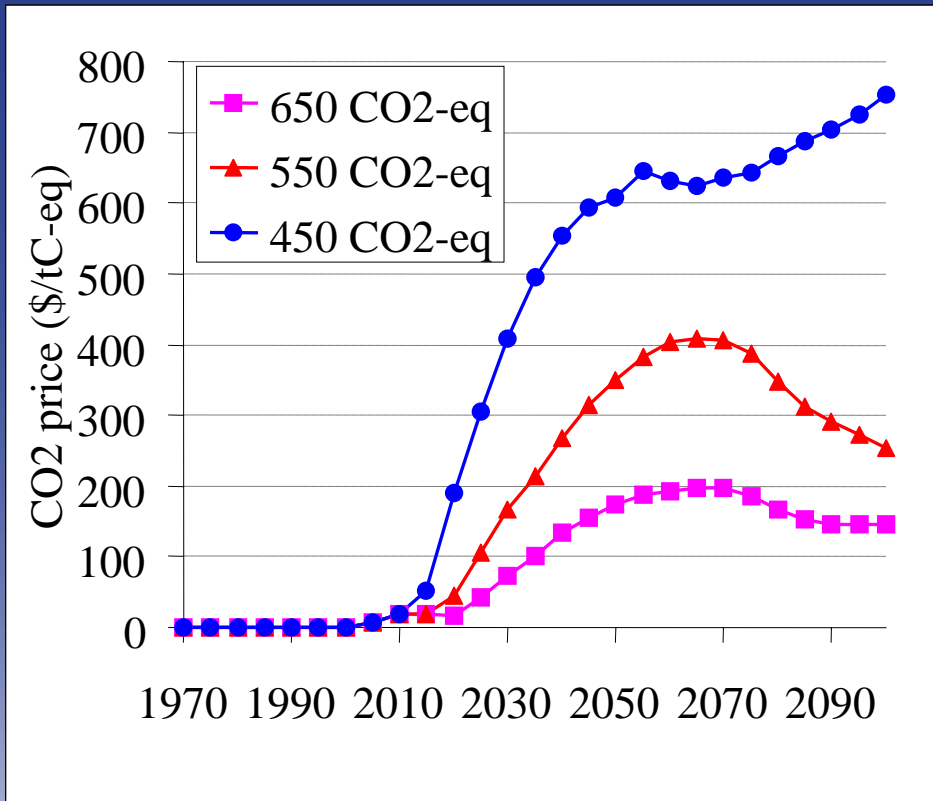
Agriculture  
Ext. grassland

Bio-energy  
C-plantation

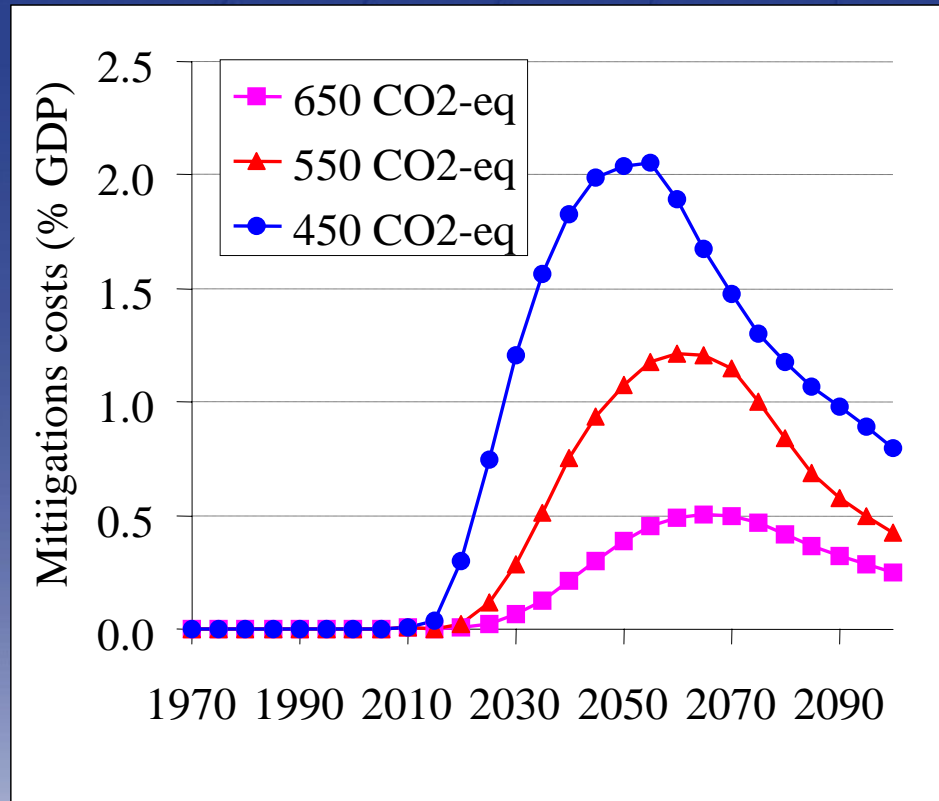
IMAGE results, MNP, 2006

# Costs of stabilisation

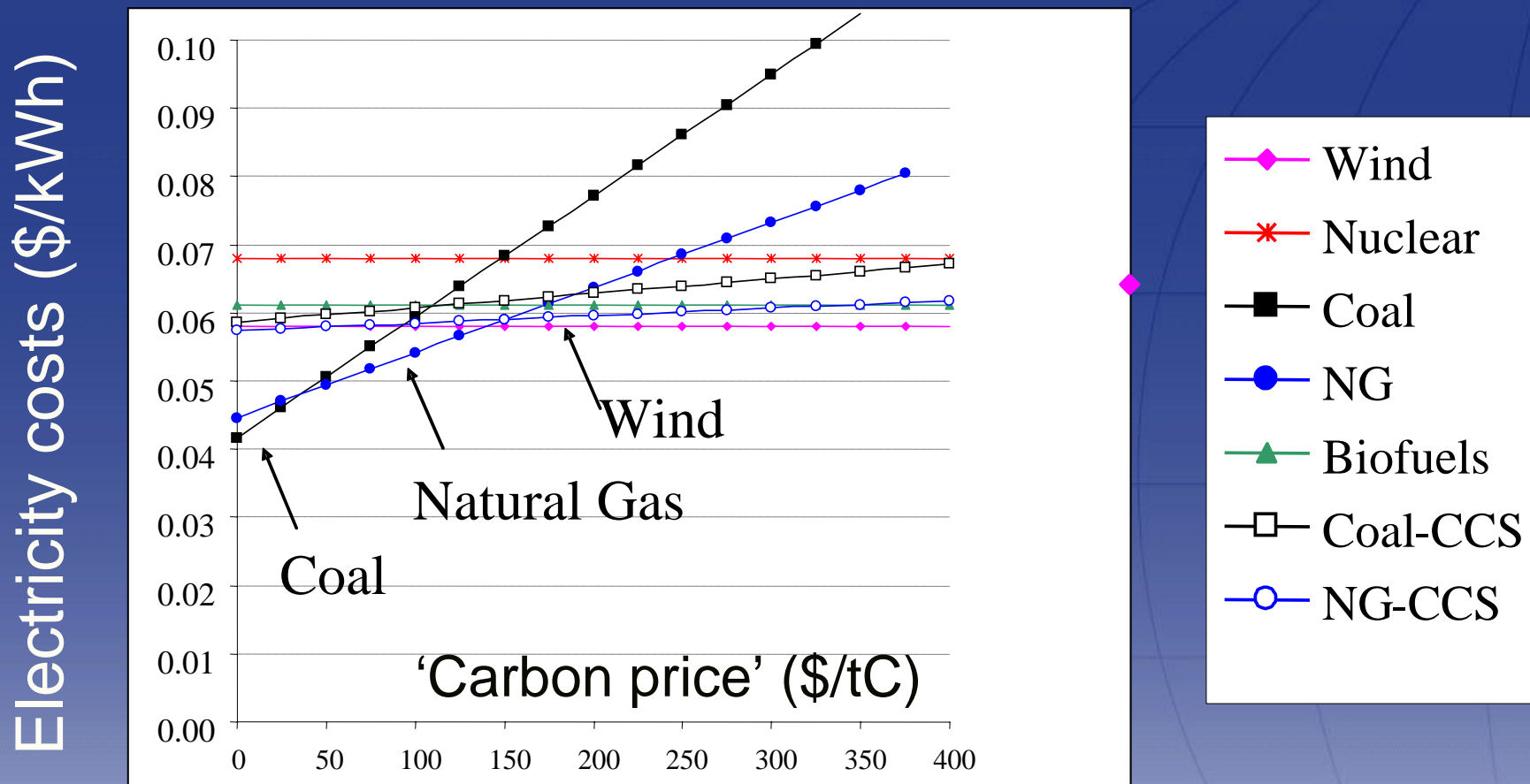
## CO2 price



## Abatement costs (%GDP)



# Low carbon power and the price of carbon

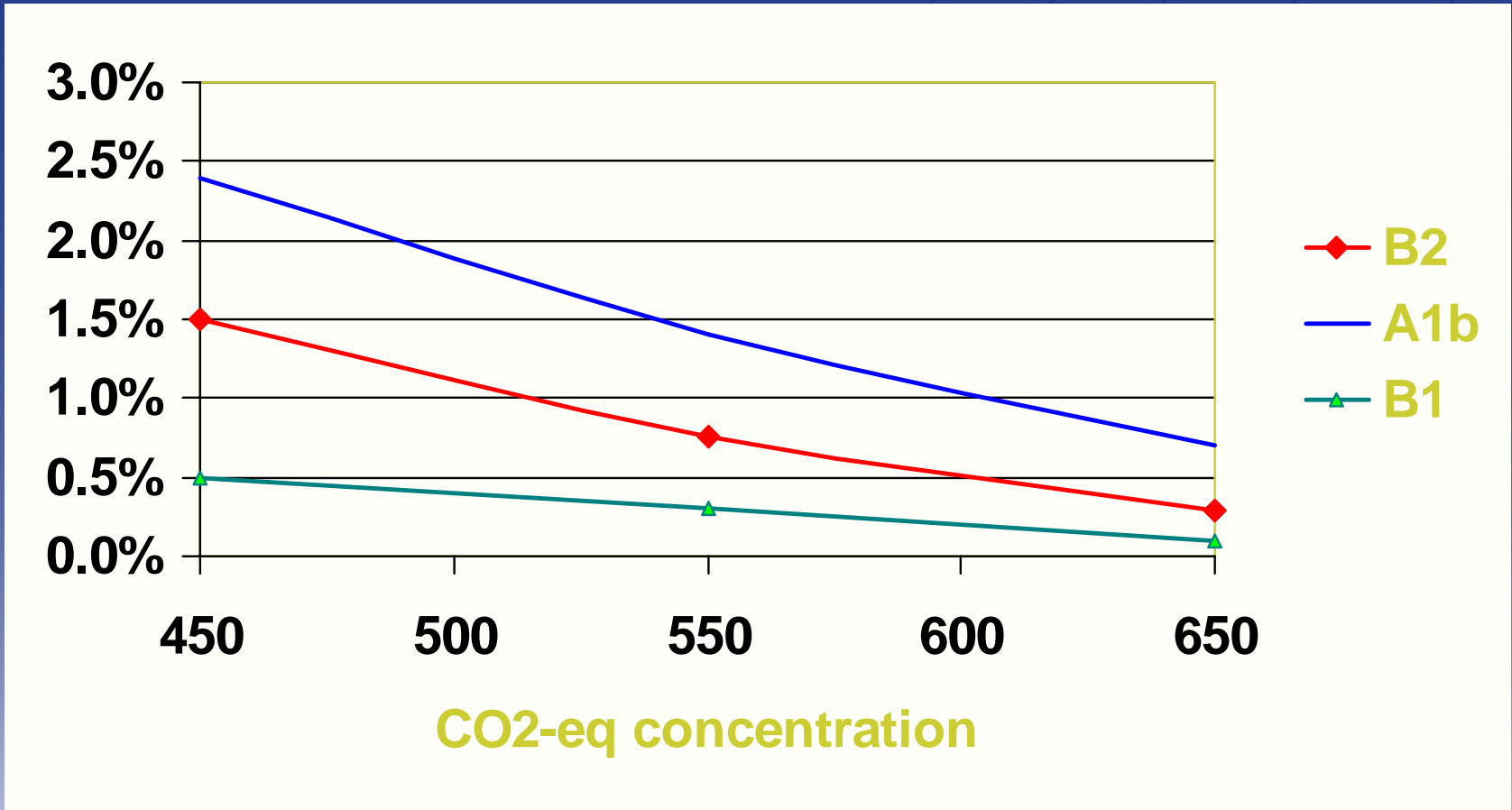


## Western Europe, 2025

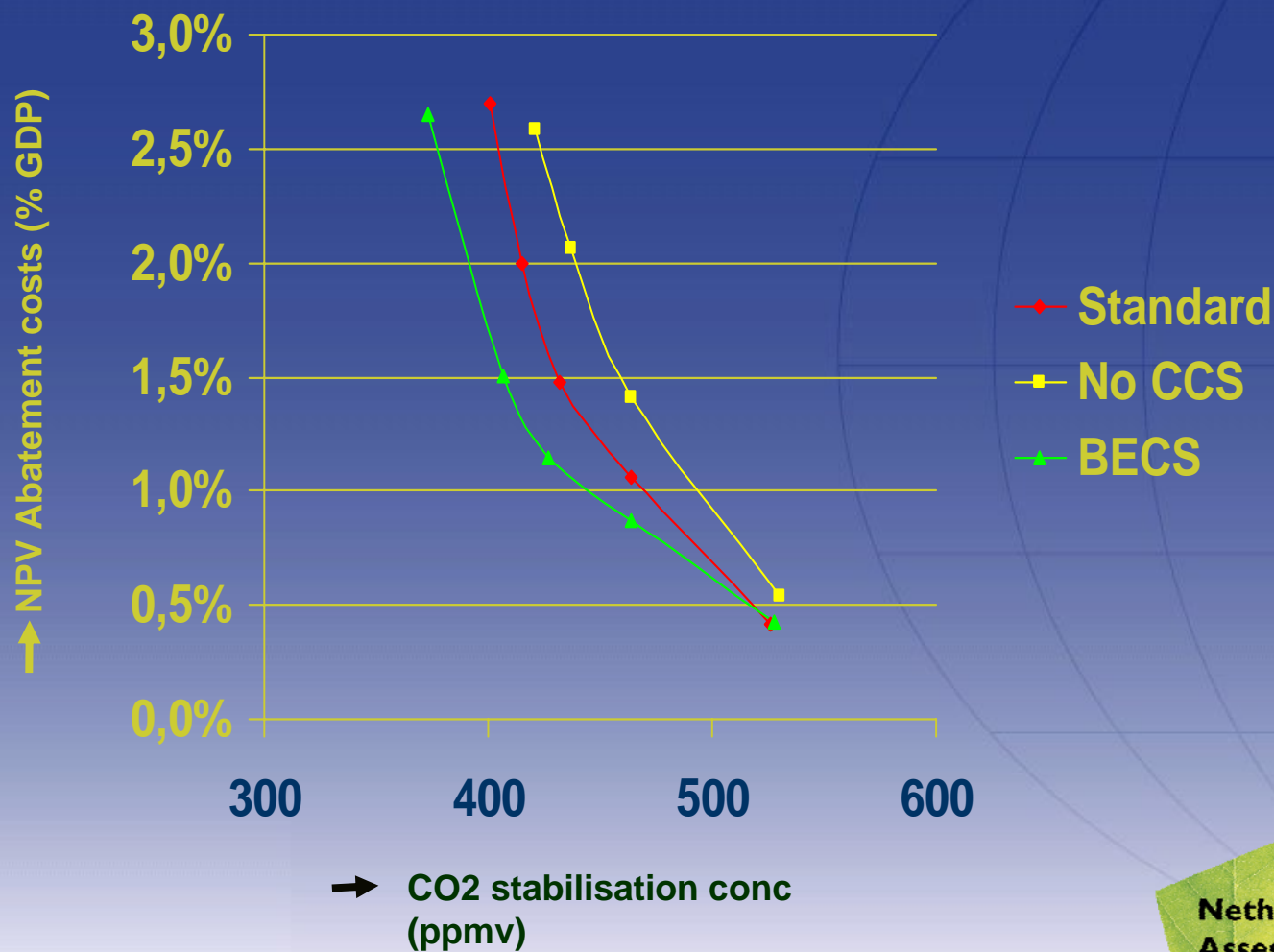
Van Vuuren, van Ruijven, De Vries, Hendriks. Reducing CO<sub>2</sub> emissions in the electric power sector.

# Baseline just as important for costs as stabilisation level

Net present value of mitigation costs (% of GDP)  
(5 % discount rate)

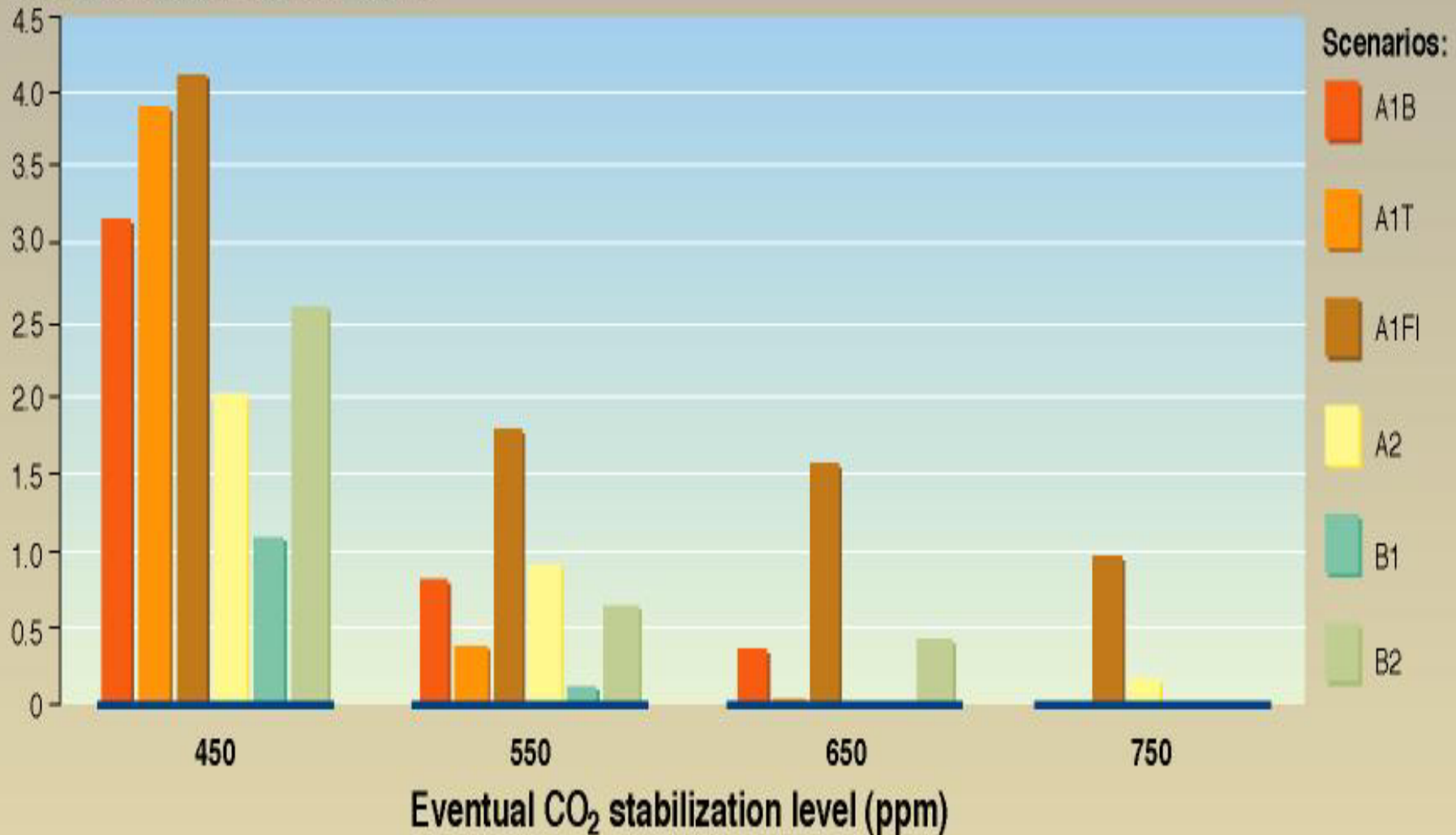


# Adding Bio-energy with CCS lowers cost (baseline: SRES-IMAGE-B2)



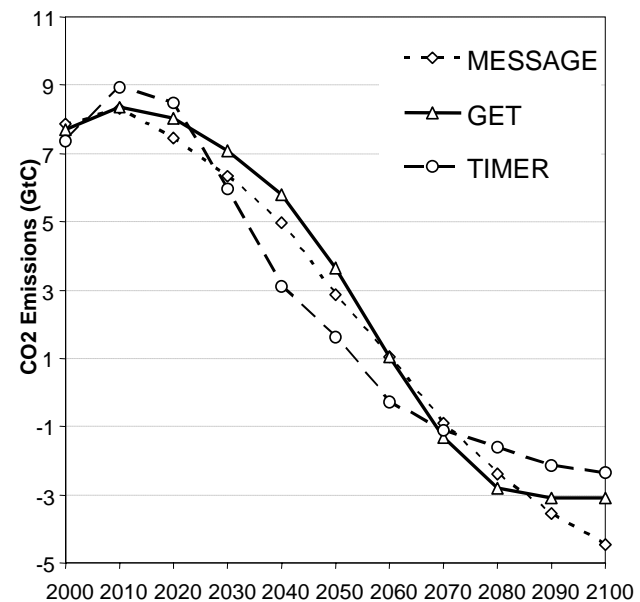
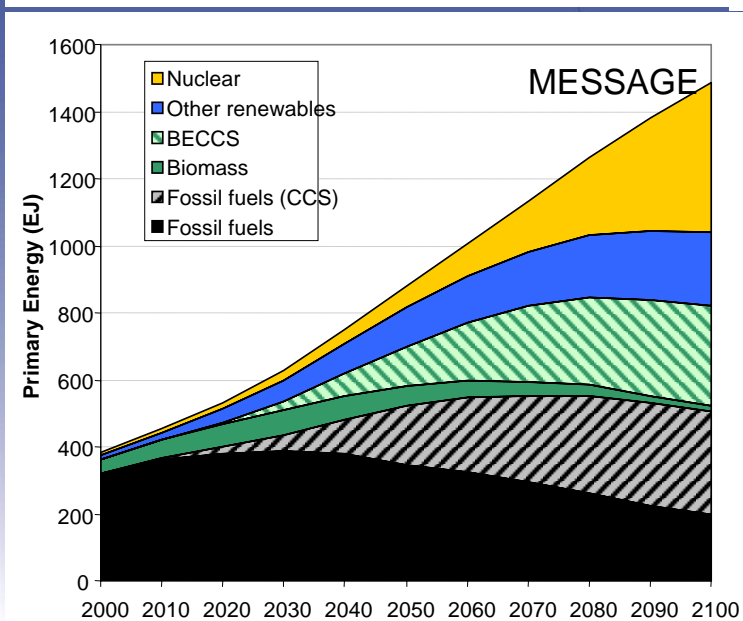
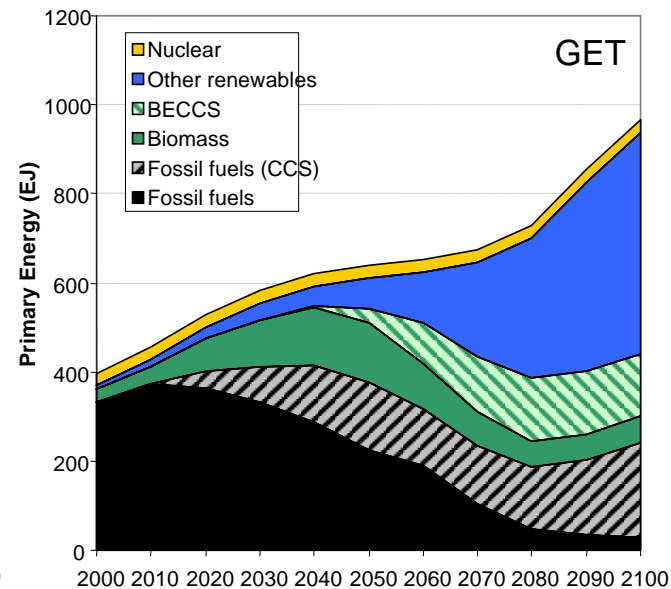
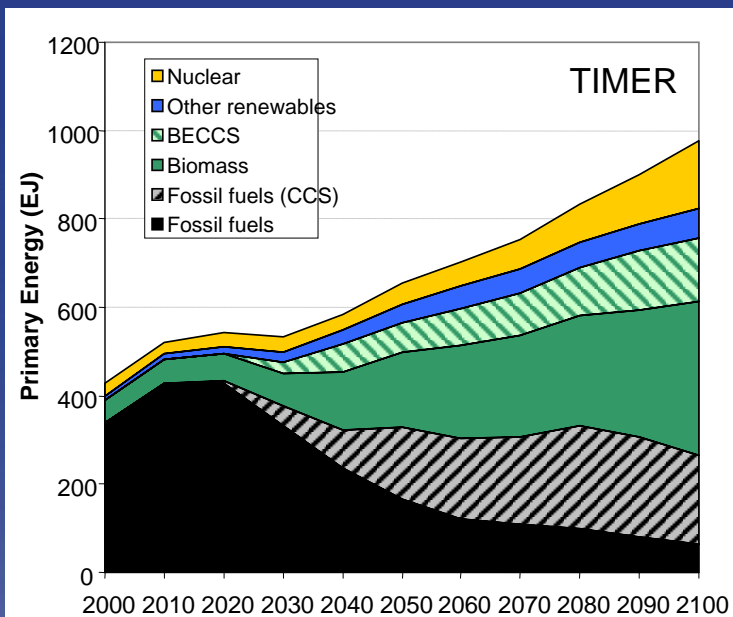
# Costs: 2050 Global GDP reduction for various CO<sub>2</sub> stabilisation levels and baselines

Percentage reduction relative to baseline



Source: IPCC TAR Working Group III

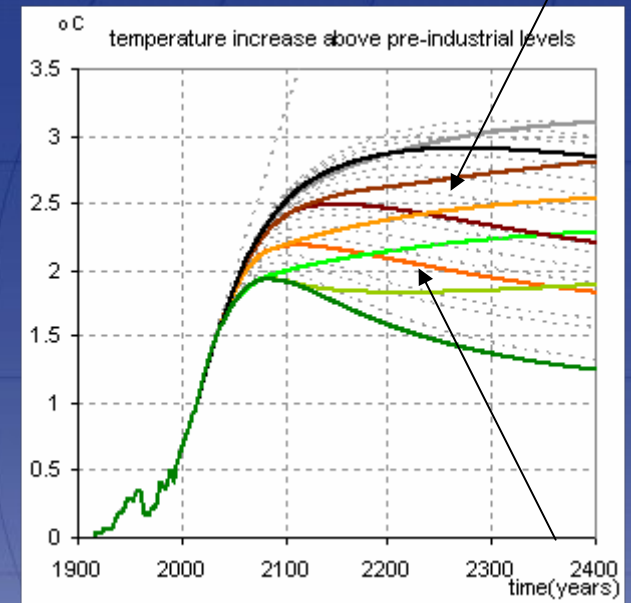
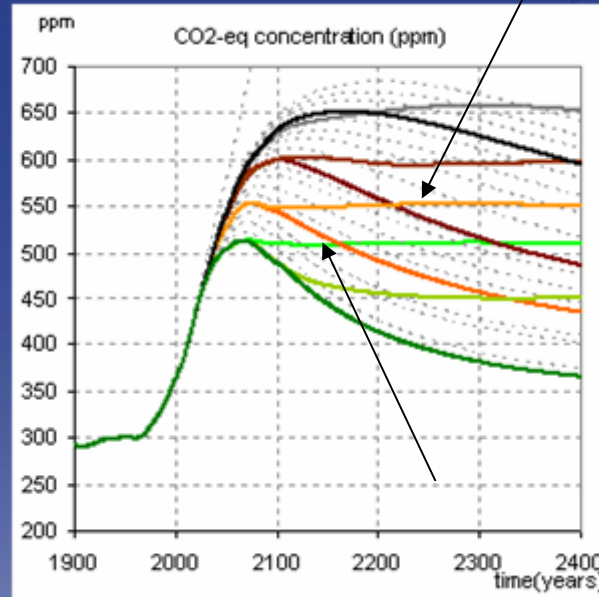
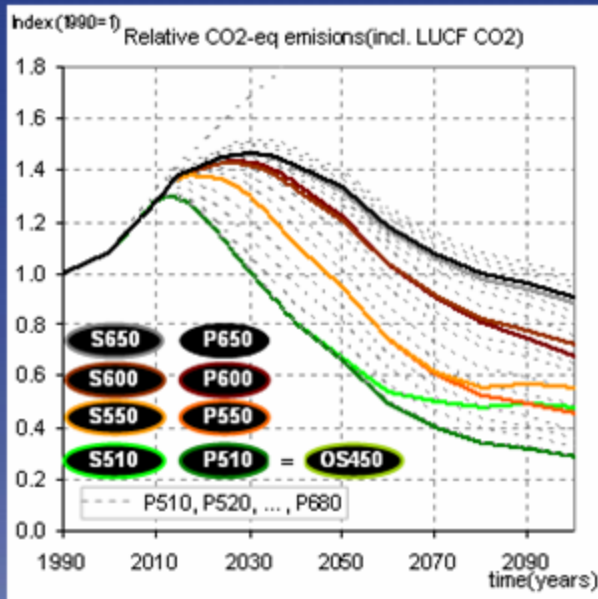
# Different models give different portfolios



# Peaking scenarios can reduce climate impacts

CO<sub>2</sub>-eq conc

Temp. increase



S550: 2.8°C; P550 2.2°C

# Regional costs and allocation regimes

## 1. Multi-Stage approach:

- Participation in stages:

1. No commitments

2. E.g. Moderate reduction

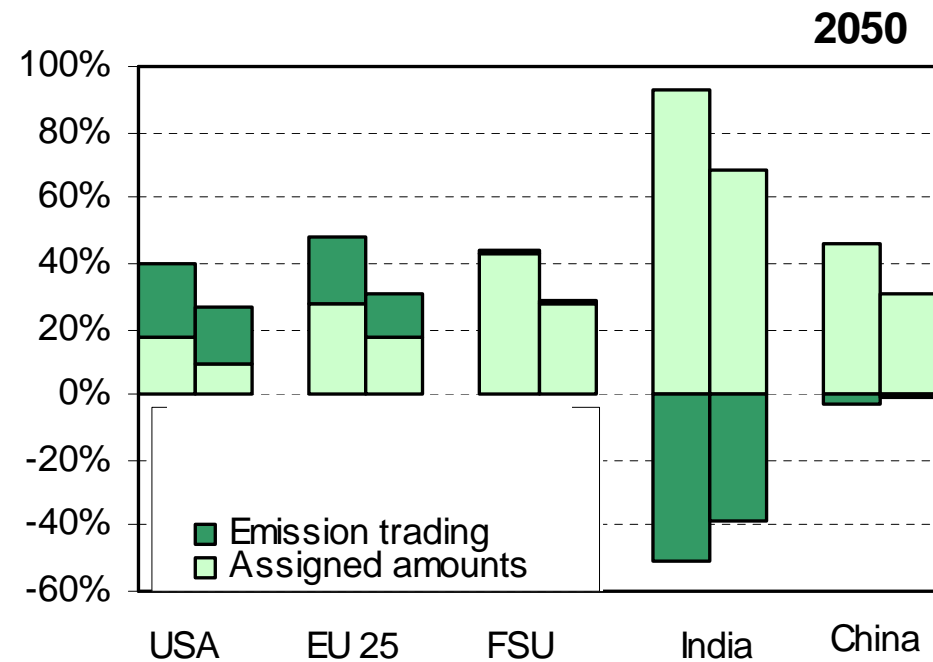
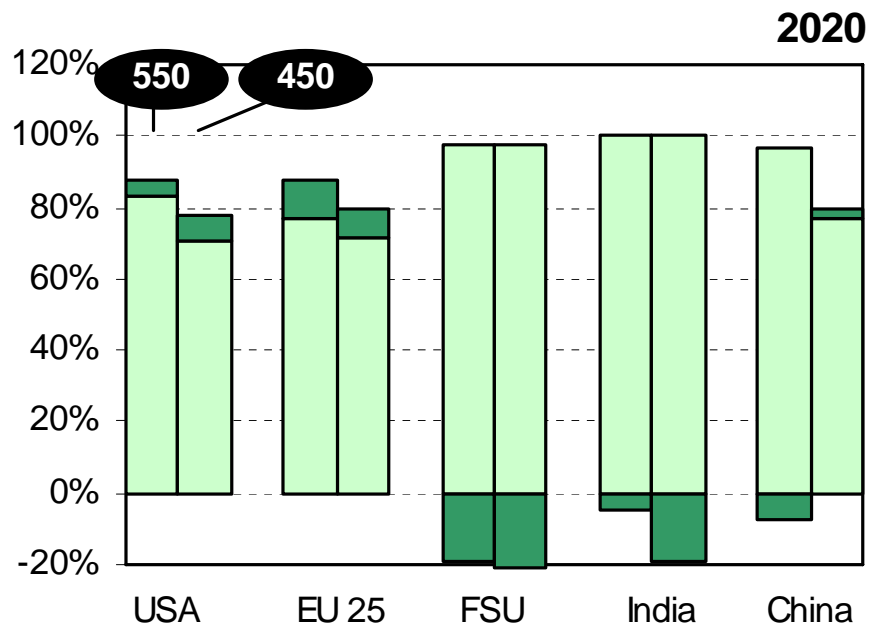
3. Reduction

- Countries “graduate” to a next stage, if threshold is passed, e.g. combination E/cap and GDP/cap

## 2. C&C regime:

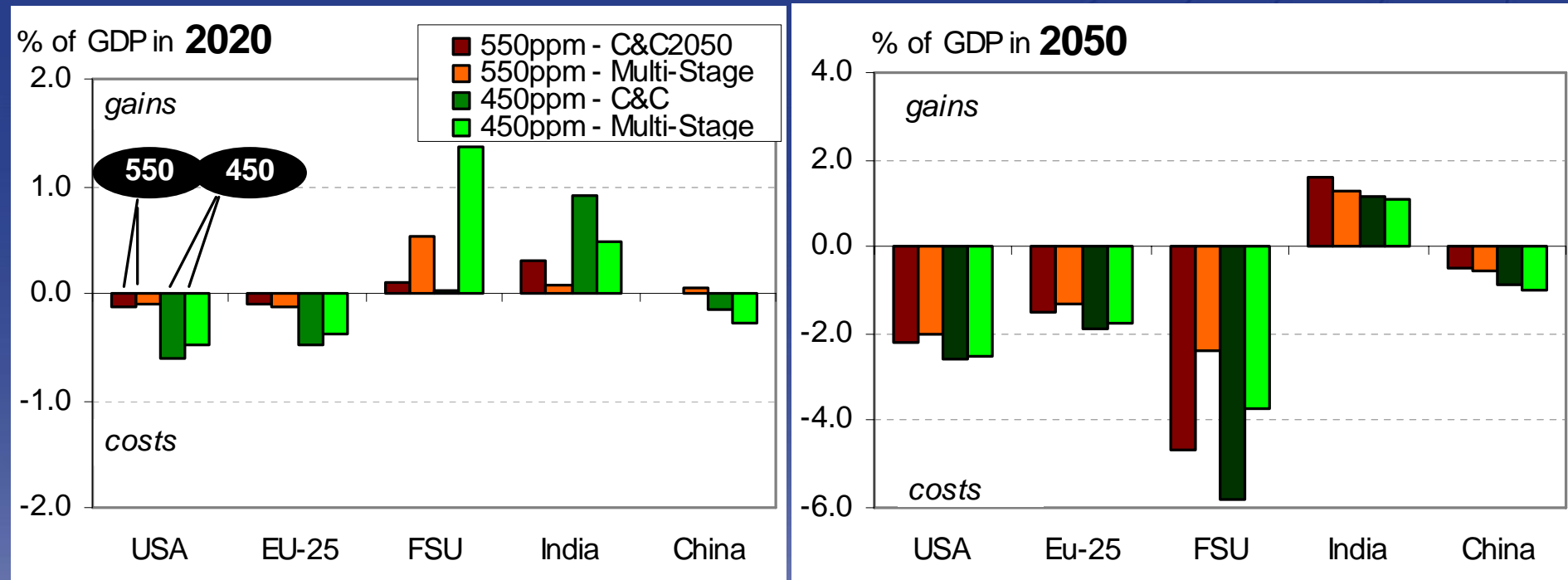
- per capita emissions converge in 2050

# Regional emission allocations under Multi-Stage and effect of emissions trading



100% = baseline

# Regional abatement costs under 450 and 550 ppm CO<sub>2</sub>-eq stabilisation

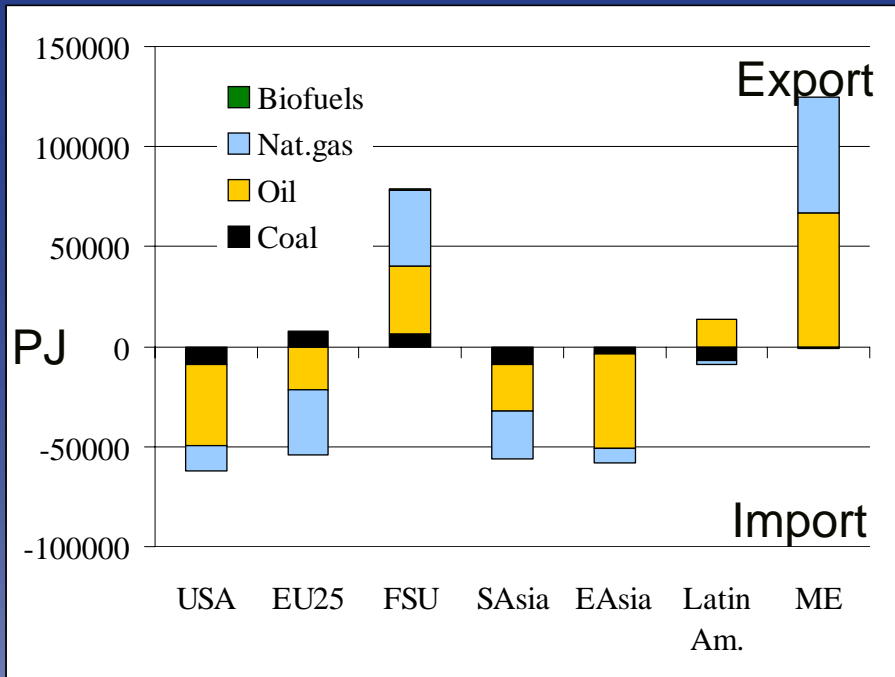


## Costs depend on:

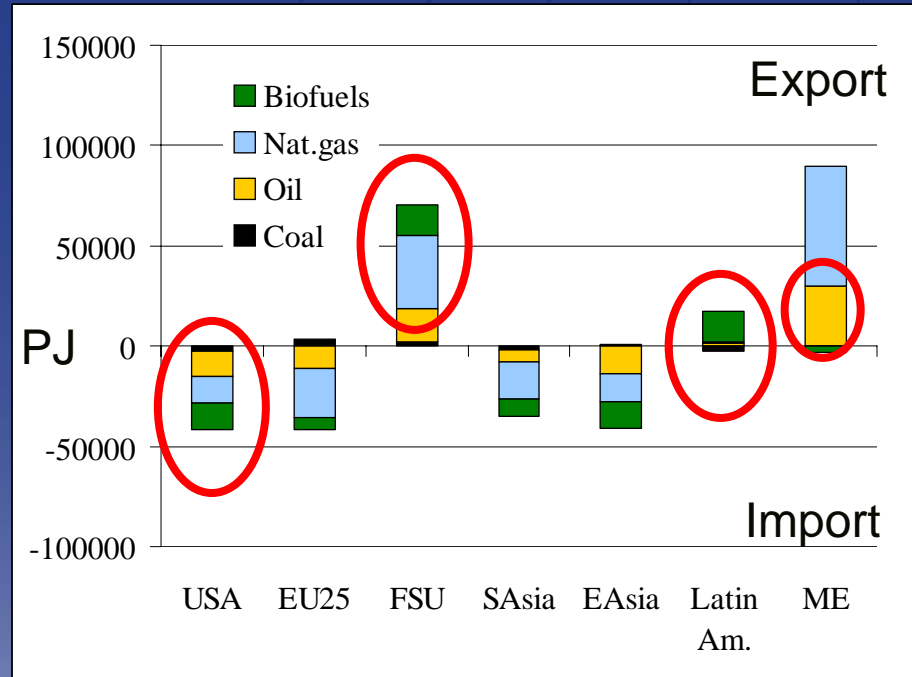
- Stabilisation target
- Regional baseline developments and mitigation potentials
- Participation and emission trading/JI/CDM
- Allocation of emission allowances

# Changes in energy trade (2050 situation)

## Baseline



## 450 CO<sub>2</sub>-eq



- Fossil fuel exporting regions: reduced coal and oil exports
- Fossil fuel importing regions: reduced energy imports; shift to biofuel
- Some fossil fuel exporters compensate with biomass

# Making development more sustainable can go hand-in-hand with low level stabilisation

- Avoided damages from climate change
- Improved energy security
- Lower energy costs
- Reduced air pollution and health costs
- Creating employment locally through efficiency, domestic renewable energy and other mitigation actions
- Export potential for bio-energy
- Better public transport
- .....

# Summary

- ☞ Staying below 2 degrees global mean warming >> stabilisation around 450 ppm CO2 equivalent
- ☞ Concentration can go above 450 ppmv for some time
- ☞ Peaking scenarios can lead to lower temperatures
- ☞ Low-level stabilisation does not require totally new technologies (e.g. nuclear fusion)
- ☞ There are no magic bullets: a portfolio of technology options is needed; there is choice, but excluding options will increase costs
- ☞ Emission trading, optimal timing and strong technology development, diffusion and transfer are essential to control abatement costs
- ☞ Regional costs depend more on baseline and stabilisation target than on allocation regime
- ☞ A big problem for low-level stabilisation is overcoming the many political (e.g. equitable allocation!), social and behavioural barriers to implementing mitigation options
- ☞ Sustainable development objectives (employment, energy security, health, food security, etc) and low level stabilisation can go hand-in-hand

**Thank you for your attention**

**see**

**<http://www.mnp.nl/en/publications/2006/index.html>**