

***IPCC WG3 2007:
Global and Sectoral Mitigation Potentials,
Technology, and the Costs of Climate
Stabilization***

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The IPCC process for WG III

- WG I: the Science. WG II: Impacts. WG III: Mitigation.
- Three-year process 2004 to 2007
- Assessment of published literature (to December 2006)
 - 168 Lead Authors
 - 59 Authors from developing countries
 - 106 Authors from developed countries
 - 84 Contributing authors
 - 485 Expert Reviewers
- Extensive review by independent and government experts
- Summary for Policy Makers approved line-by-line by all 180 IPCC member governments (Bangkok, May 4)
- Full report and technical summary accepted without discussion

Outline

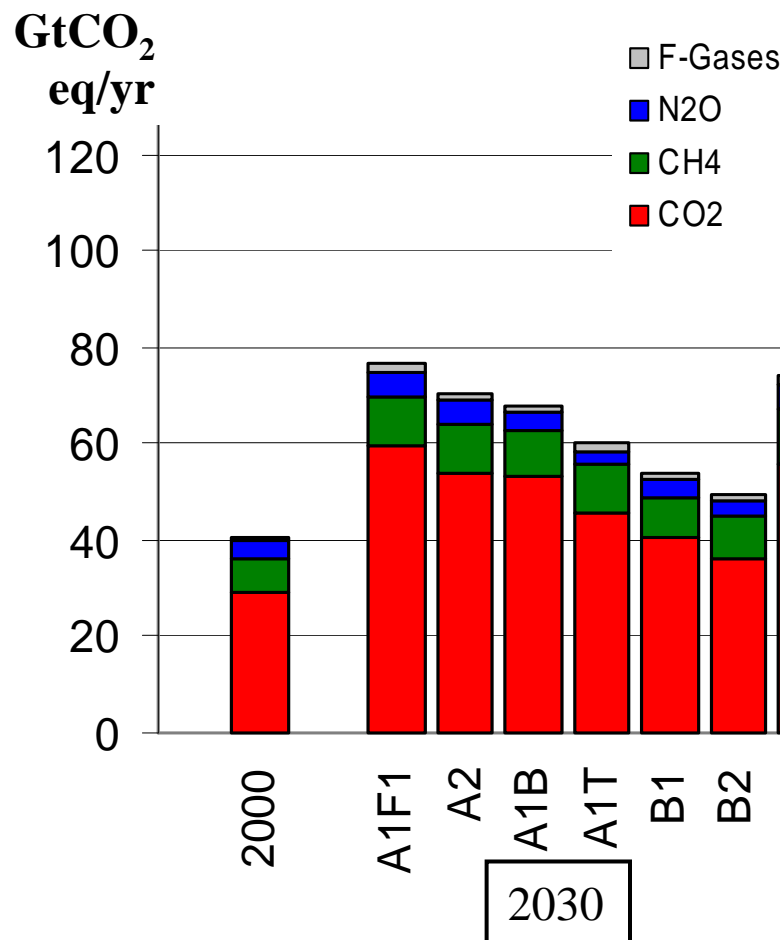
1. The problem
2. Establishing the concepts of mitigation potentials and the price of carbon
3. Economic potentials for mitigation to 2030
4. Costs of climate stabilization (and benefits)
5. The role of technological change
6. Some conclusions

Acknowledgements

This presentation has been developed from that given to the Press Conference, Bangkok, May 4, 2007, by the Co-Chairs of IPCC AR4, WG III. The text and figures in the presentation come from the WG III Summary for Policy Makers, unless otherwise stated. The comments are my own.

With current climate change mitigation policies,
and related sustainable development practices,
global GHG emissions will continue to grow
over the next few decades

- IPCC SRES scenarios:
25-90 % increase of
GHG emissions
by 2030 relative to 2000



Establishing the concept of mitigation potential

- There was a need to have a set of definitions
 - acceptable to lead authors across the WG III chapters (“bottom-up” and “top-down” approaches)
 - encompassing different economic modeling approaches (equilibrium, institutional)
 - applicable to mitigation in all countries & sectors and from one IPCC report to the next
- IPCC Third Assessment Report definitions were unclear
- Agreed: “market”, “economic”, “technical” and “physical” mitigation potentials and associated “carbon prices”

Definitions of mitigation potentials

Mitigation potential: the scale of GHG reductions that could be made, relative to emission baselines, for a given level of carbon price (expressed in cost per unit of carbon dioxide equivalent emissions avoided or reduced).

Market potential: the mitigation potential based on private costs and private discount rates, which might be expected to occur under forecast market conditions, including policies and measures in place, but with barriers limiting actual uptake.

Economic potential: the mitigation potential based on social costs and social discount rates. Direct benefits of for instance energy savings are normally included, while most external costs are generally not.

Comments on the definitions of “mitigation potential”

- The mitigation potentials are quantities
 - measured in Giga tonnes CO₂-equivalent a year (GtCO₂-eq/yr)
- They are world-wide, or for countries or sectors, and usually future
- They are defined for given carbon prices
 - expressed as \$(2000 prices) per tonne CO₂-equivalent (US\$/tCO₂-eq)
- Any positive carbon price is a “social cost”, meaning it is a price created by policies and measures
 - e.g. the EU’s emissions trading scheme
- The market potential at a zero carbon price is basically “business as usual” in the projections
 - if a country introduces a carbon tax, the effects become embodied into the market potential
- Most of the potentials discussed are economic potentials
- Four key prices have been chosen to measure economic potentials
 - Carbon prices of 0, 20, 50 and 100 US\$/tCO₂-eq

Memo: Relationship between \$50/tCO₂ and US fuel prices

		2005 base	Added cost of \$50/tCO₂	
		\$	\$	%
Crude Oil	(\$/bbl)	60	22.4	37%
Regular Gasoline	(\$/gal)	2.39	0.48	20%
Heating Oil	(\$/gal)	2.34	0.53	23%
Wellhead Natural gas	(\$/tcf)	10.17	2.73	27%
Residential Natural gas	(\$/tcf)	15.3	2.75	18%
Utility Coal	(\$/short ton)	32.6	101.4	311%
Electricity	(c/kWh)	9.6	3.23	34%

Source: Derived from Table ES.5, US CCSP, 2006, sourced in turn from Bradley et al. 1991, updated with U.S. average prices for the 4th quarter of 2005 as reported in DOE, 2006.

Note: This table does not include any adjustments in producer prices due to changes in energy demands under stabilization.

A given carbon price yields a range of economic potentials

- The “bottom-up” syntheses provide ranges of economic potentials for the given carbon prices
- The “top-down” studies from economic models also provide estimates of such economic potentials from given carbon prices

Economic potential is substantial for the mitigation of global GHG emissions over the coming decades

- Estimates are from both bottom-up and top-down studies

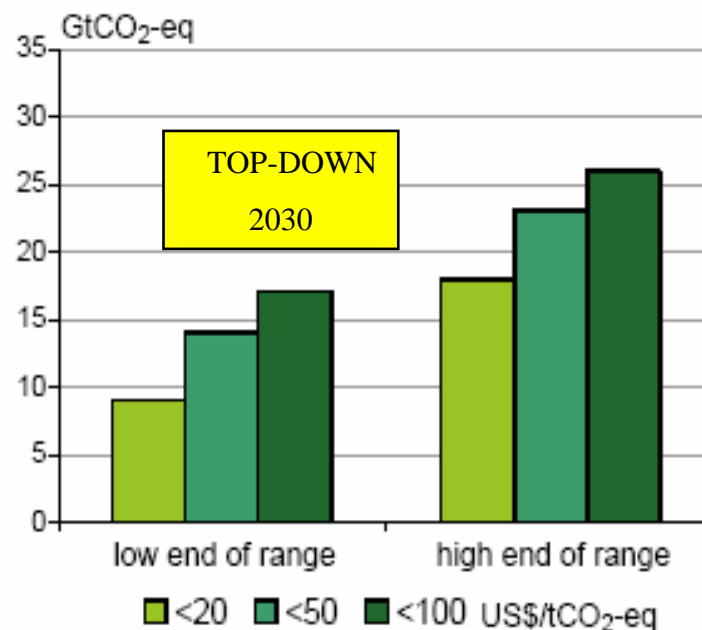
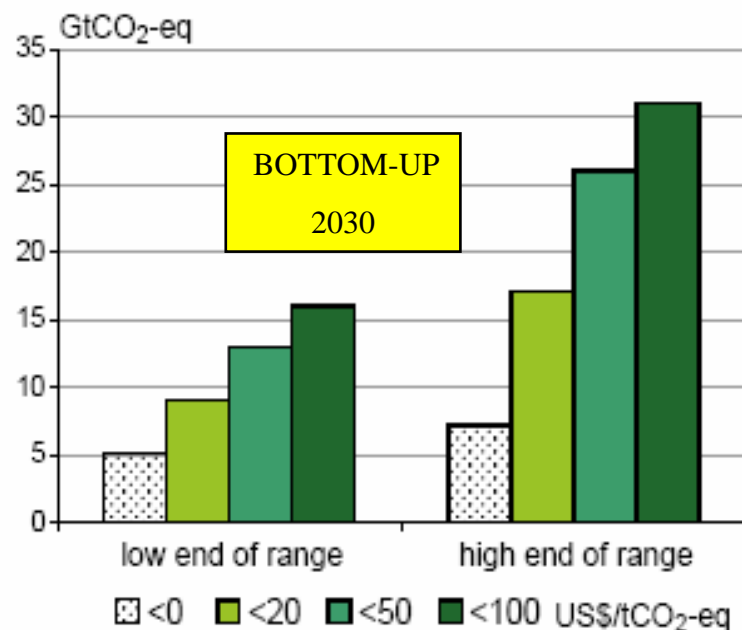


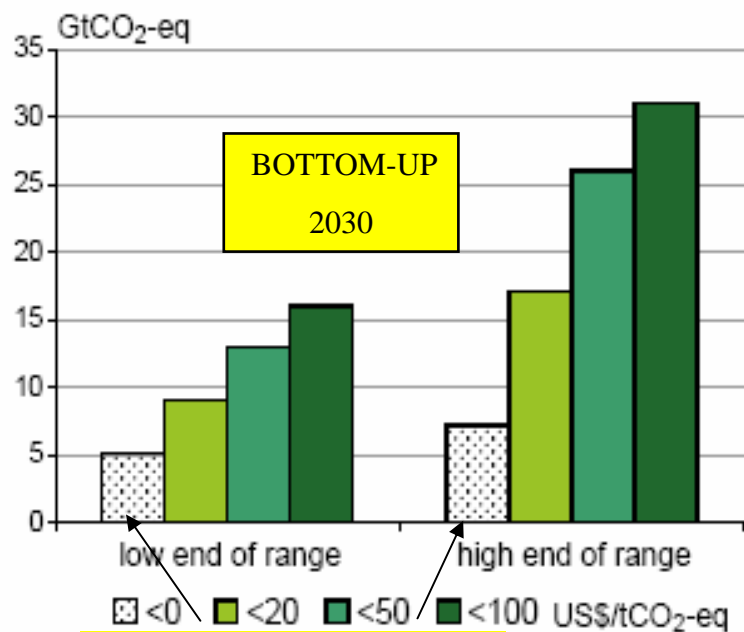
Figure SPM 5A: Global economic potential in 2030 estimated. Cost categories in US\$/tCO₂eq.

Figure SPM 5B: Global economic potential in 2030 Cost categories in US\$/tCO₂eq..

Note: estimates do not include non-technical options such as lifestyle changes

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No-regrets options

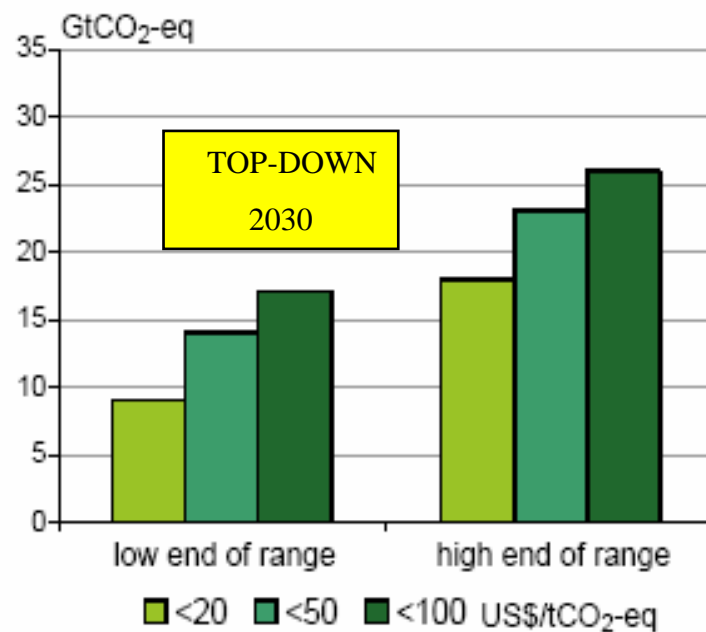


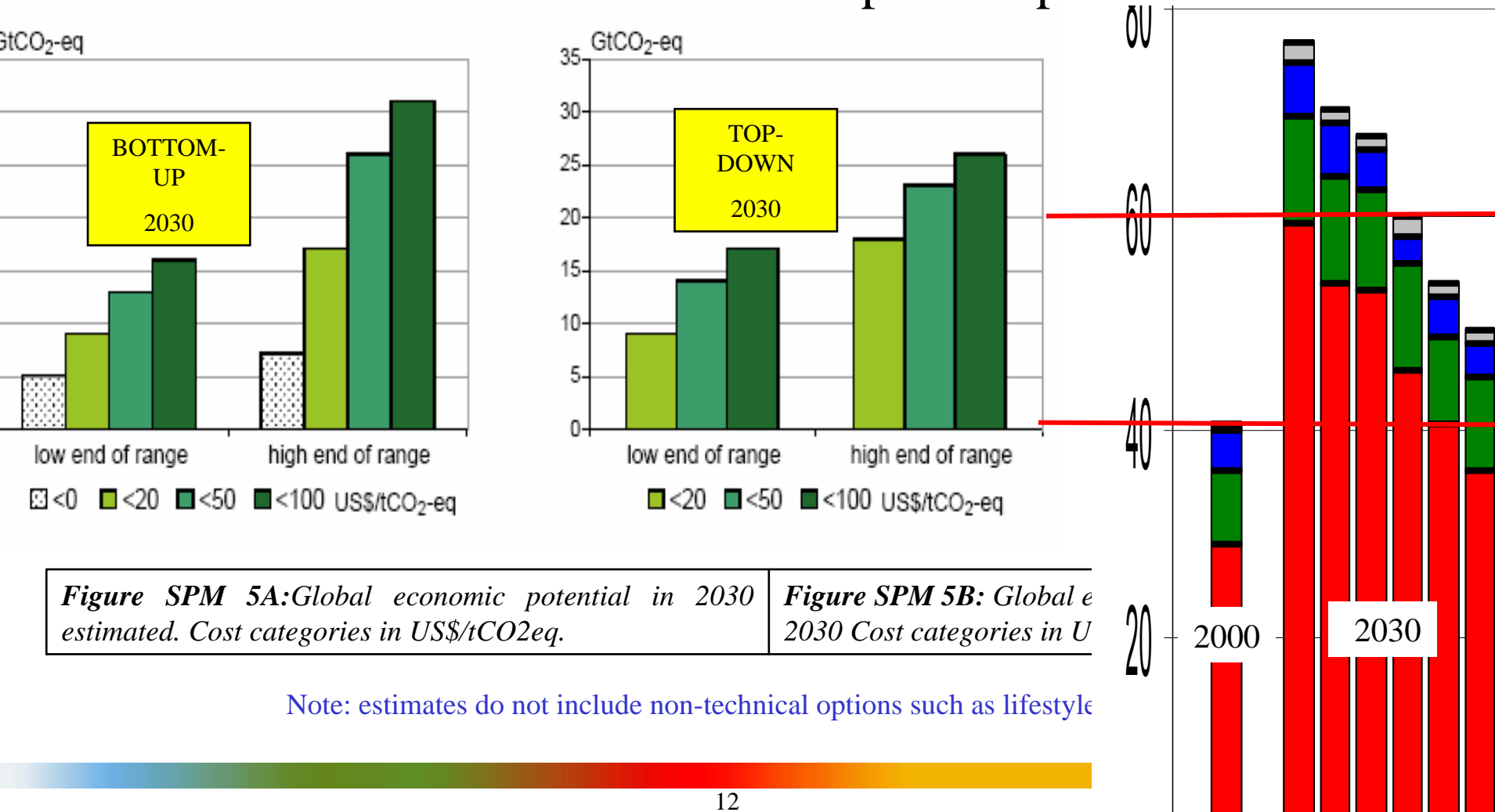
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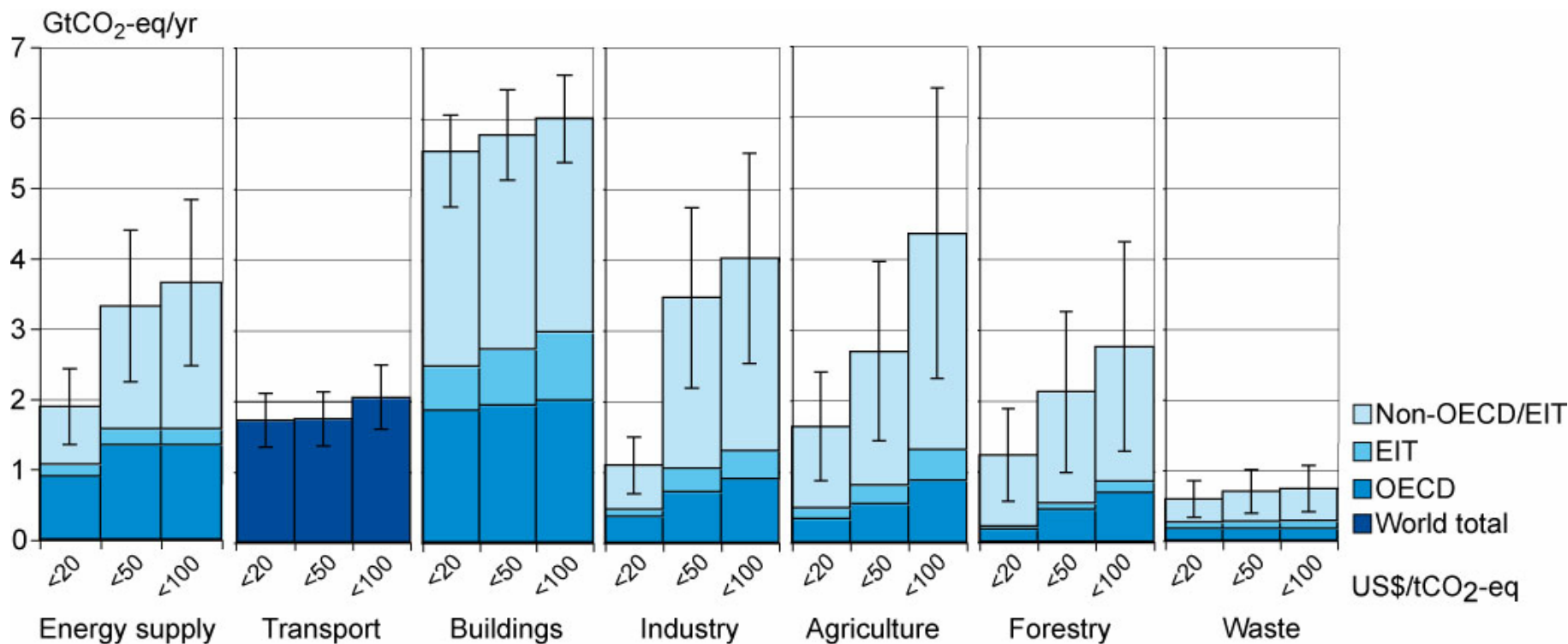
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Economic potential is substantial for the mitigation of global GHG emissions over the coming decades

- Estimates are from both bottom-up and top-down studies



All sectors and regions have the potential to contribute (end-use based)



Note: estimates do not include non-technical options, such as lifestyle changes.

A given reduction in GHGs yields a range of costs and carbon prices

- Climate stabilization studies provide
 - estimates of required reductions in GHG emissions, globally by year, i.e. the required economic potentials
 - with their implications for macroeconomic costs
 - and carbon prices

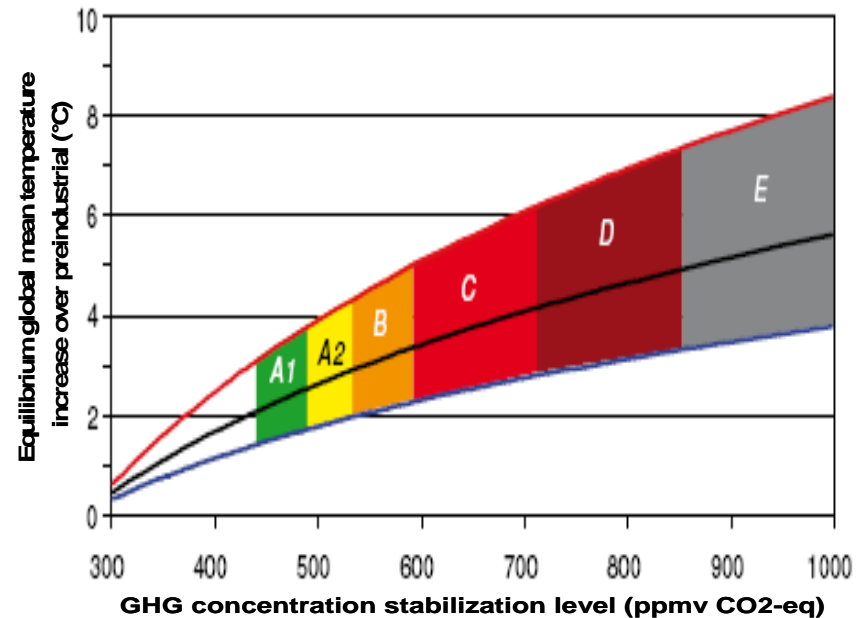
Long-term mitigation

- The lower the stabilization level, the more quickly emissions would need to peak and to decline thereafter
- Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels

Stabilization level (ppm CO ₂ -eq)	Global Mean temp. increase at equilibrium (°C)	Year CO ₂ needs to peak	% reduction in 2050 compared to 2000
445 – 490	2.0 – 2.4	2000 - 2015	-85 to -50
490 – 535	2.4 – 2.8	2000 - 2020	-60 to -30
535 – 590	2.8 – 3.2	2010 - 2030	-30 to +5
590 – 710	3.2 – 4.0	2020 - 2060	+10 to +60
710 – 855	4.0 – 4.9	2050 - 2080	+25 to +85
855 – 1130	4.9 – 6.1	2060 - 2090	+90 to +140

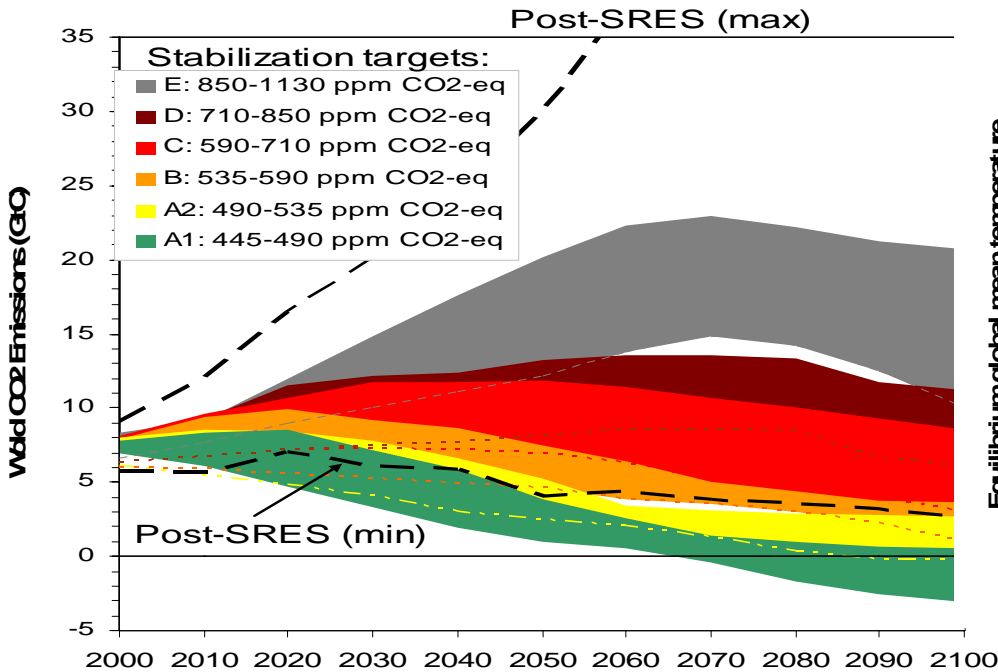
The key question: can “dangerous anthropogenic climate change” be avoided?

- EU interpretation: keep global mean temperature increase at less than 2 degrees above pre-industrial level

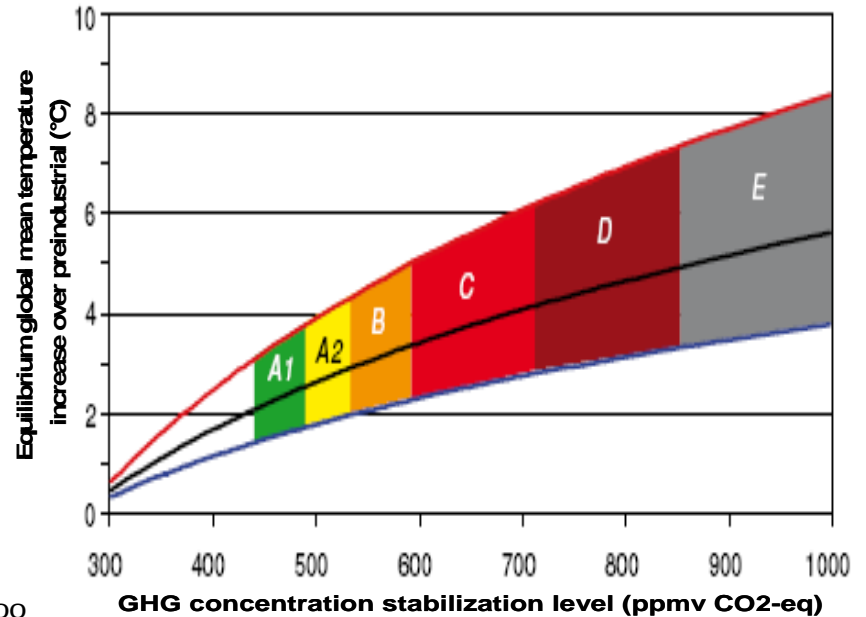


The lower the stabilisation level, the earlier global emissions have to go down

Global CO₂ in GtC



Mean temperatures °C



Multigas and CO₂ only studies combined

What are the macro-economic costs in 2030 for different stabilization levels?

Stabilization levels (ppm CO ₂ -eq)	Median GDP reduction [1] (%)	Range of GDP reduction [2] (%)	Reduction of average annual GDP growth rates [3] (percentage points)
590-710	0.2	-0.6 – 1.2	< 0.06
535-590	0.6	0.2 – 2.5	<0.1
445-535 [4]	Not available	< 3	< 0.12

[1] This is global GDP based market exchange rates.

[2] The median and the 10th and 90th percentile range of the analyzed data are given.

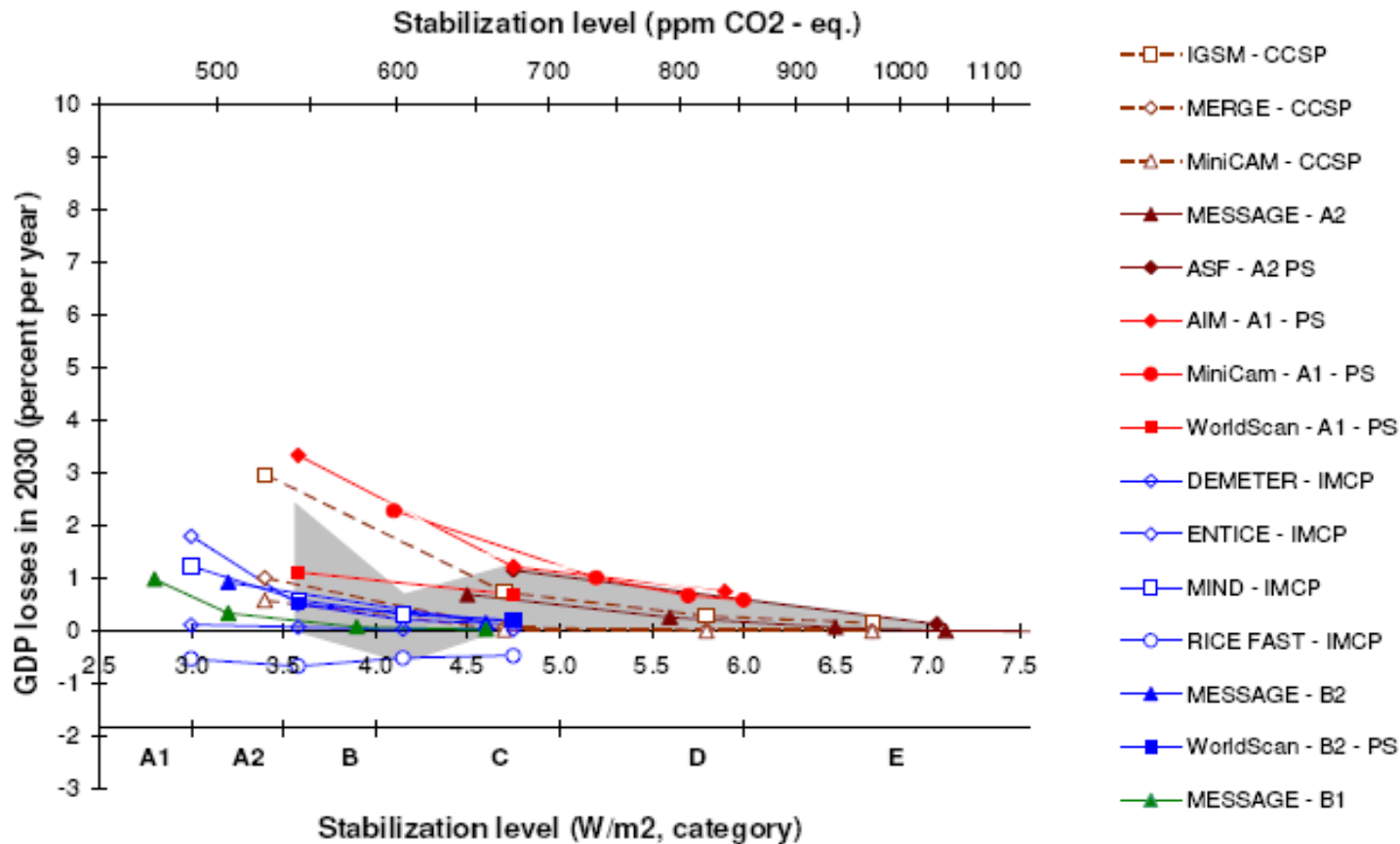
[3] The calculation of the reduction of the annual growth rate is based on the average reduction during the period till 2030 that would result in the indicated GDP decrease in 2030.

[4] **The number of studies that report GDP results is relatively small and they generally use low baselines.**

These net costs and ranges come for modeling studies that assume efficient markets etc. They do not include net environmental and other co-benefits, which can be substantial.

3% maximum global cost by 2030 in context

Most studies for stringent stabilization (categories A1 and A2) show costs less than 3% →



Source: IPCC AR4, WG III Report 2007, Chapter 3, Figure 3.25 (a)

The importance of a “price of carbon”

- Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes
 - Such policies could include economic instruments, government funding and regulation
- For stabilisation at around 550 ppm CO₂eq carbon prices should reach 20-80 US\$/tCO₂eq by 2030 (\$5-65 if more technological change is induced by policies, i.e. ITC)
 - At these carbon prices large shifts of investments into low carbon technologies can be expected

The role of technology policies (1)

- Deployment of low-GHG emission technologies and RD&D would be required for achieving stabilization targets and cost reduction.
- The lower the stabilization levels, especially those of 550 ppm CO₂-eq or lower, the greater the need for more efficient RD&D efforts and investment in new technologies during the next few decades.
- Government support through financial contributions, tax credits, standard setting and market creation is important for effective technology development, innovation and deployment.
- Memo:
 - Government funding for most energy research programmes has been flat or declining for nearly two decades (even after the UNFCCC came into force); now about half of 1980 level.

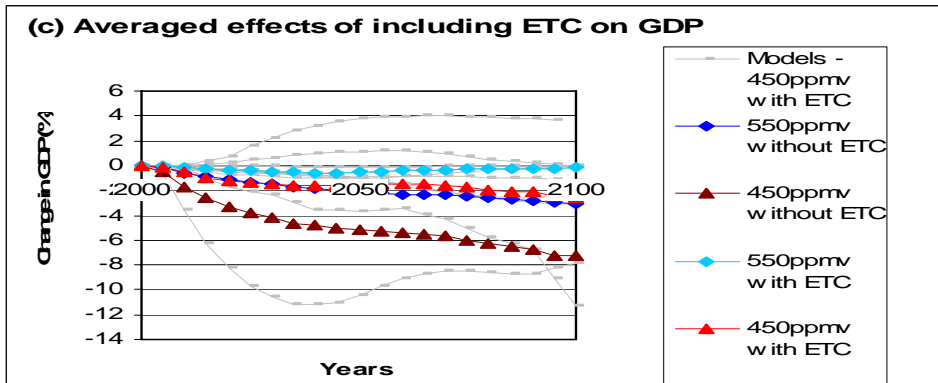
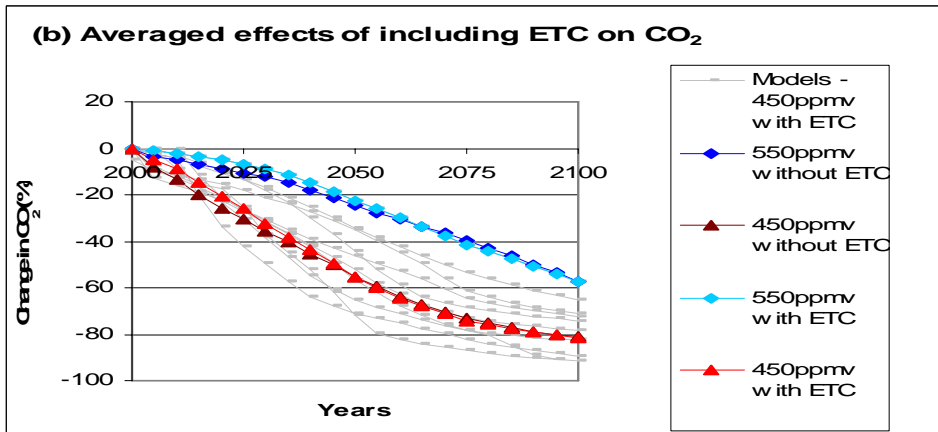
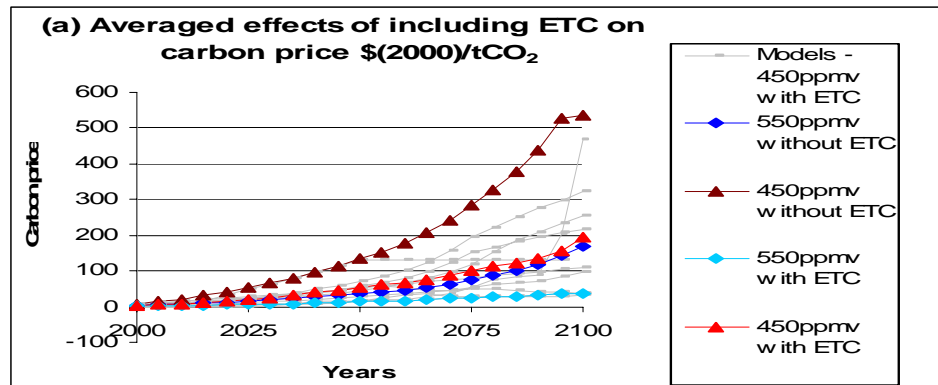
The role of technology policies (2)

- Third to Fourth Assessment report
 - “remarkable progress has been achieved in applying approaches based on induced technological change to stabilisation studies; however, conceptual issues remain” (SPM, p. 28) (EMF19, IMCP)
 - technology is now responsive to carbon prices in many models
- In the models that adopt these approaches, projected costs for a given stabilization level are reduced
 - the reductions are greater at lower stabilisation levels.
- Although most models show GDP losses, some show GDP gains
 - because they assume that baselines are non-optimal and mitigation policies improve market efficiencies
 - or they assume that more technological change may be induced by mitigation policies.

Average effects of including endogenous technological change: 9 models

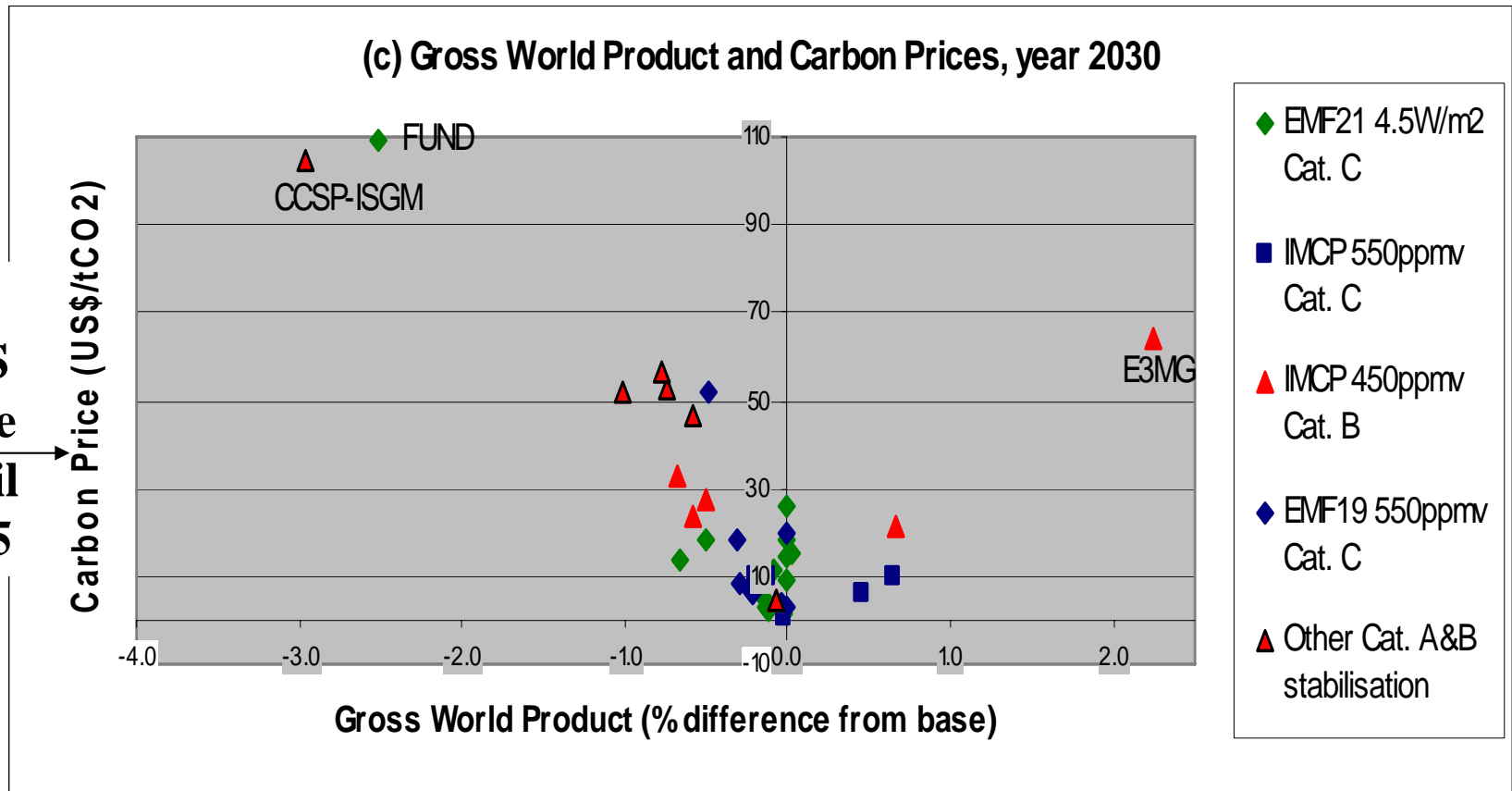
Averaged effects of including ETC on carbon tax rates, CO₂ emissions and GDP: 9 global models 2000-2100 for the 450 ppm and 550 ppm CO₂ only stabilisation scenarios

Source: IPCC WG3 Report, 2007, Figure 11.9



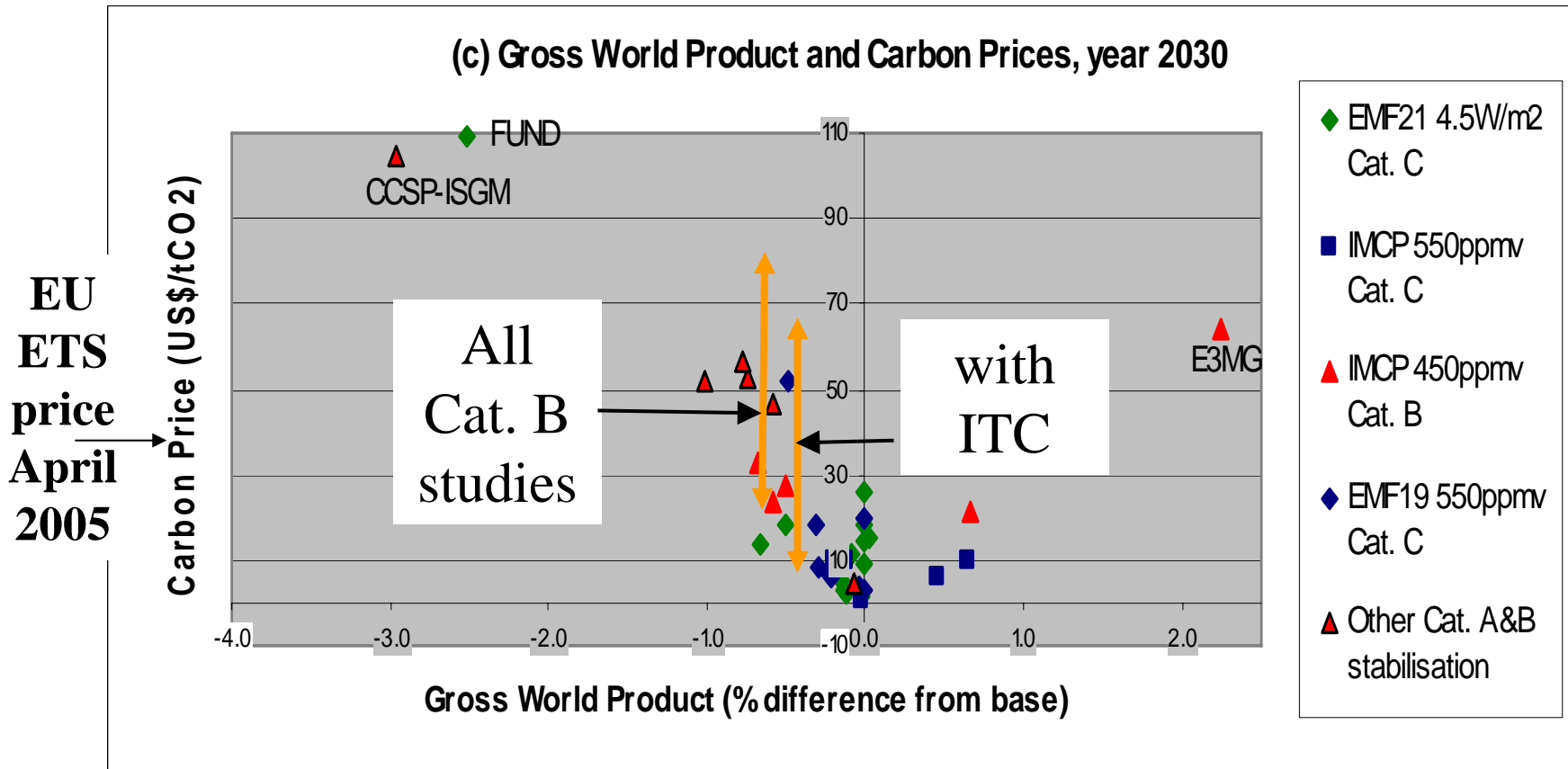
Macro-economic costs by 2030 in relation to carbon prices

EU
ETS
price
April
2005



Source: IPCC AR4, WG III Report 2007, Chapter 11, Figure 11.7

Macro-economic costs by 2030 in relation to carbon prices



Source: IPCC AR4, WG III Report 2007, Chapter 11, Figure 11.7

Conclusions:

an interpretation of the outcome

- We, collectively, may be able to reduce the risks of warming, but action is urgent for low-cost options avoiding “dangerous” global warming of more than 2°C
- There are uncertainties, particularly of the costs and means of effective action, but the way forward is clear
- The 3% overall economic cost is the top end of a wide range that includes substantial benefits
- The Fourth IPCC assessment report marks a turning point in understanding about technology-economy interaction by both the scientific community and governments

The Summary for Policy Makers , the Technical Summary and the full Report (subject to editing) can be downloaded from

www.mnp.nl/ipcc

Further information:

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