ECN

Energy research Centre of the Netherlands

Costs and economics of CO_2 capture and storage

Heleen de Coninck, ECN & Princeton University

Near Zero Emissions Coal - Workshop - 5 July 2006, Beijing, China

The ACCSEPT project

Acceptance of **CO_2 C**apture and **S**torage **E**conomics, **P**olicy and **T**echnology =>**ACCSEPT**

Initiated by the European Commission (FP6 - Scientific Support for Policy):

To address **social, economic, legal and regulatory implications** of implementing CCS technology in the EU and at the world level

To **measure the social acceptance** of CCS

To **assess the costs** of CCS at the EU and world level

To **help establish guidelines and recommendations** on CCS

- in the context of the EU Emission Trading Scheme, and
- in the framework of the Carbon Sequestration Leadership Forum – CSLF

Project start: early 2006

Complete: end of 2007

Consortium: DNV (coordinator), Baker & McKenzie, ECN, IEEP, Tyndall Centre

What determines the cost of CCS?

CCS heterogeneous technology

- Costs and economics vary with source of CO_2, capture method, fuel prices, transport distance, storage type, etc.
- Different kinds of costs - US$ct/kWh, US$/tCO_2-eq

"Costs": engineering costs of a technology

- Bottom-up
- Installation-level
- Operational costs

Costs of capture-ready installations

What determines the cost of CCS?

"Economic potential": Interplay of different technologies in a market place

- Top-down least-cost modelling
- Assuming cost curves for technologies
- Technologies compete on the basis of costs

What determines the cost of CCS?

Good level of information:

- Power sector (depending on the level of development of the conversion technology (IGCC, NGCC, PC))
- Pure CO_2 streams (sources: gas processing, ammonia production, hydrogen production)

Information starting to be produced:

- Non-pure CO_2 emitting industries, such as refineries, coal to liquids facilities
- Making power plants "retrofittable" (capture-ready)

Largely unexplored:

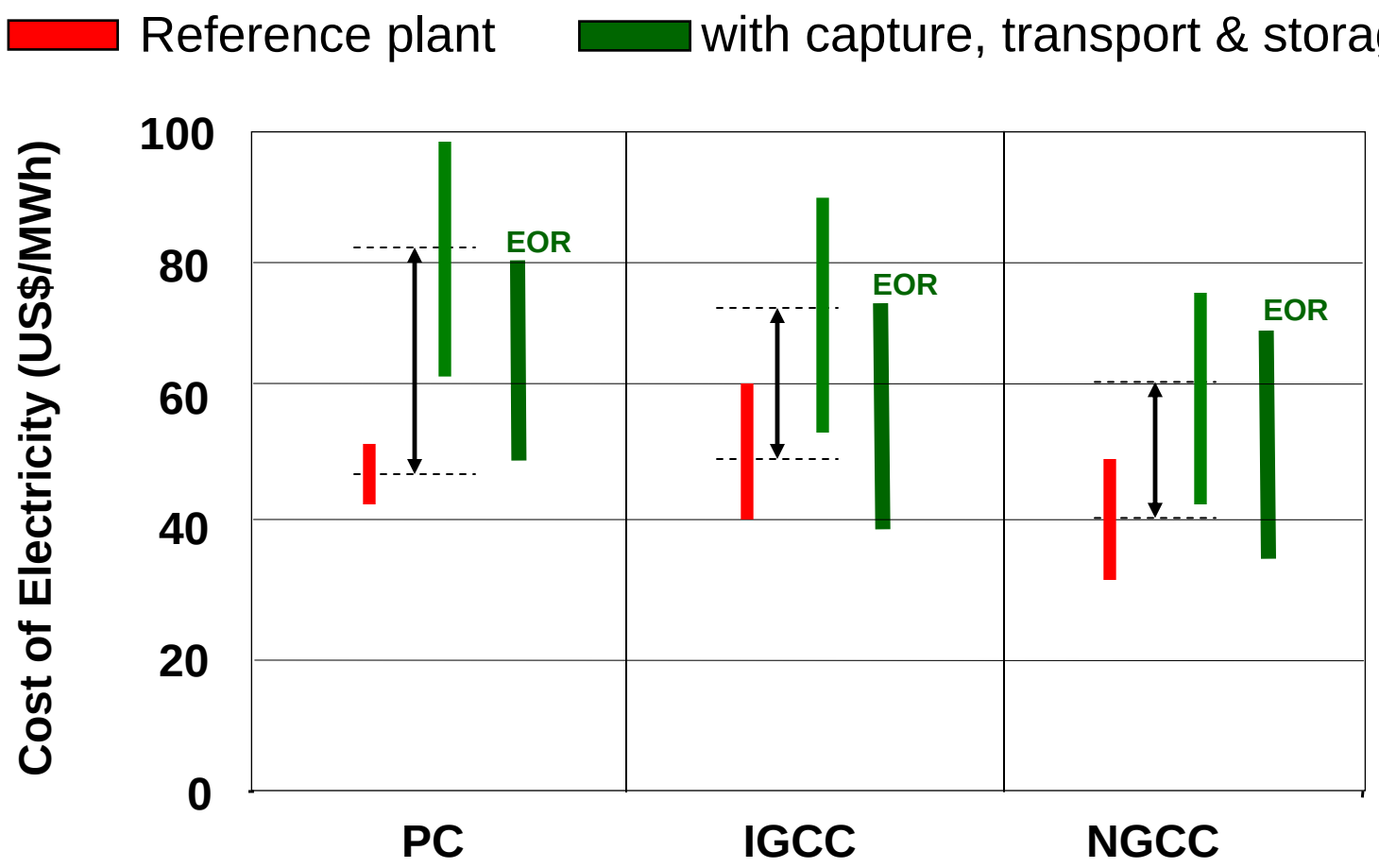
- Steel and cement industries
- Mobile sources

CCS component costs

CCS component	Cost range
Capture from a power plant	15 - 75 US$/$tCO_2$ net captured
Capture from gas processing or ammonia production	5 - 55 US$/$tCO_2$ net captured
Capture from other industrial sources	25 - 115 US$/$tCO_2$ net captured
Transport	1 - 8 US$/$tCO_2$ transported per 250km
Geological storage	0.5 - 8 US$/$tCO_2$ injected

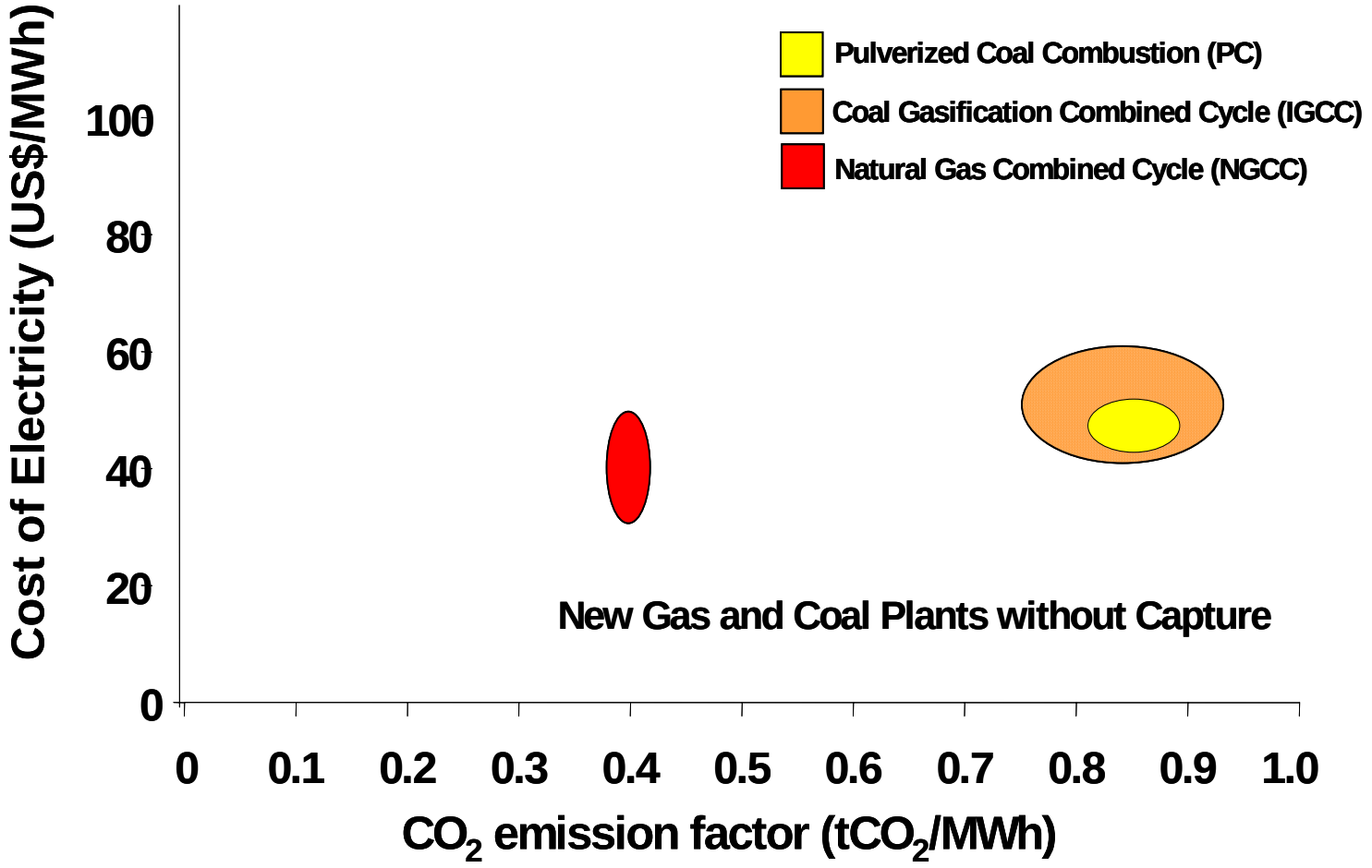
Source: IPCC Special Report on CCS, 2005

Power generation costs with CCS



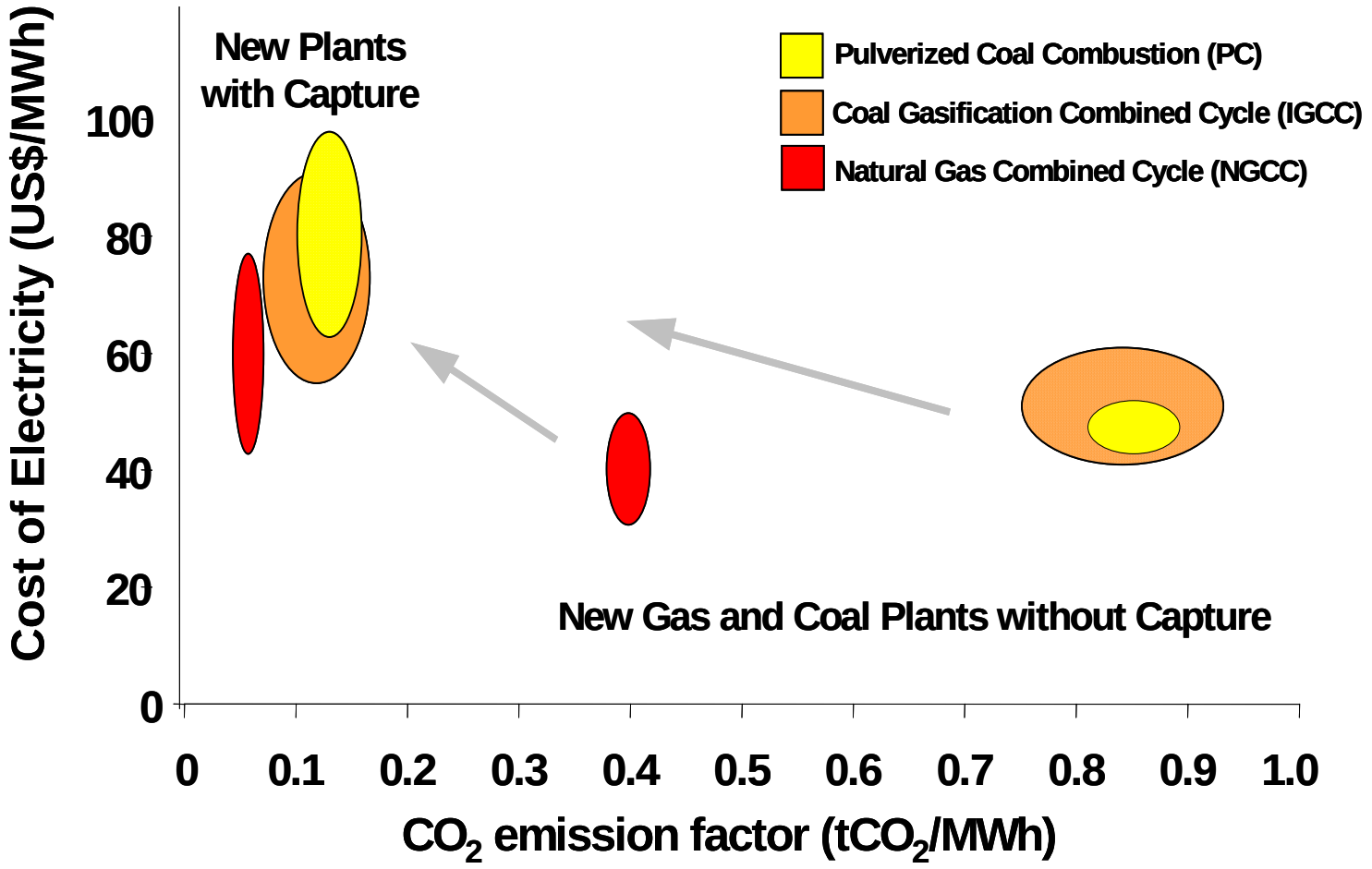
Source: IPCC Special Report on CCS, 2005

Power generation and carbon mitigation costs of CCS



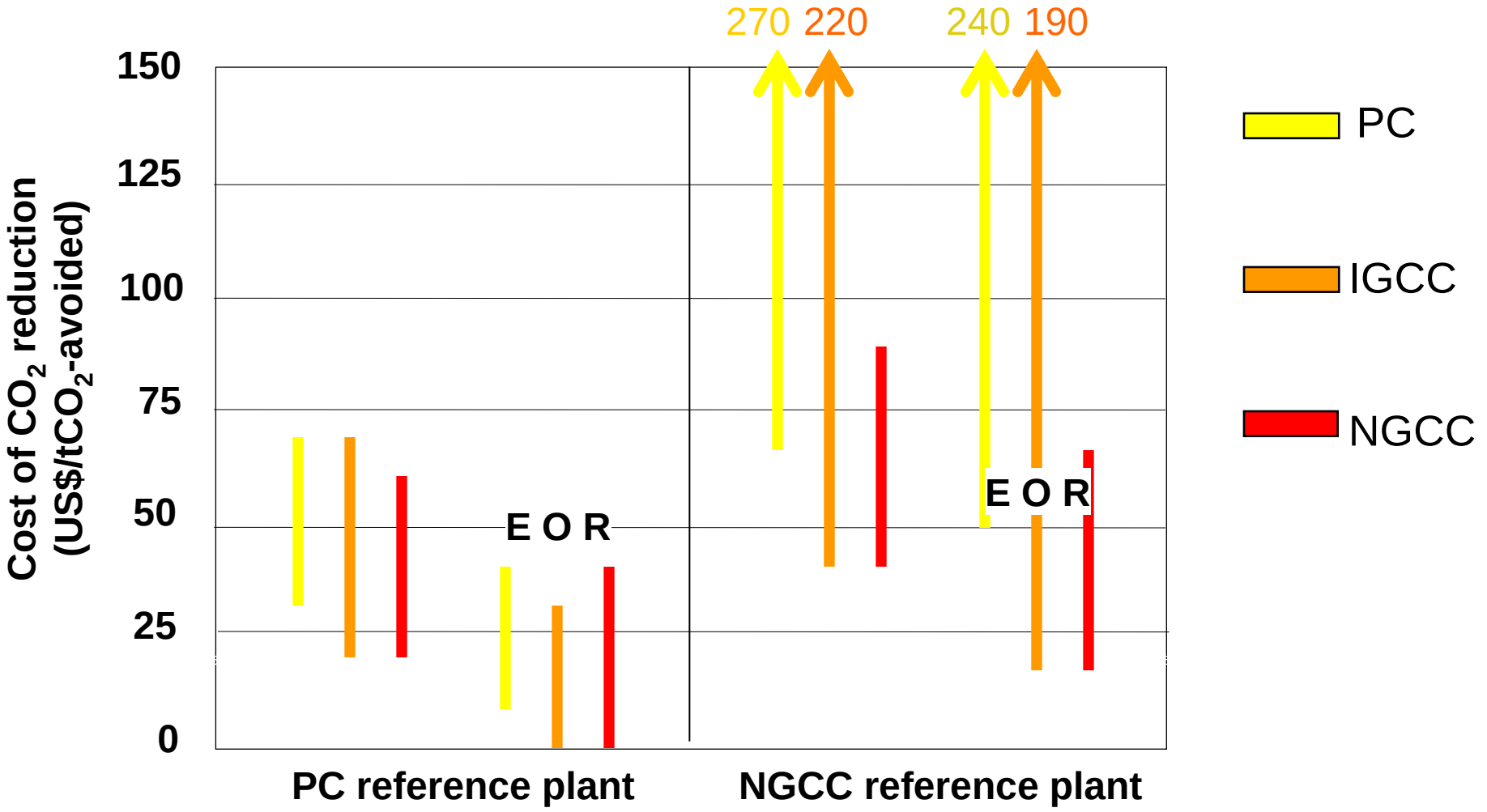
Source: IPCC Special Report on CCS, 2005

Power generation and carbon mitigation costs of CCS



Source: IPCC Special Report on CCS, 2005

Carbon mitigation costs of CCS

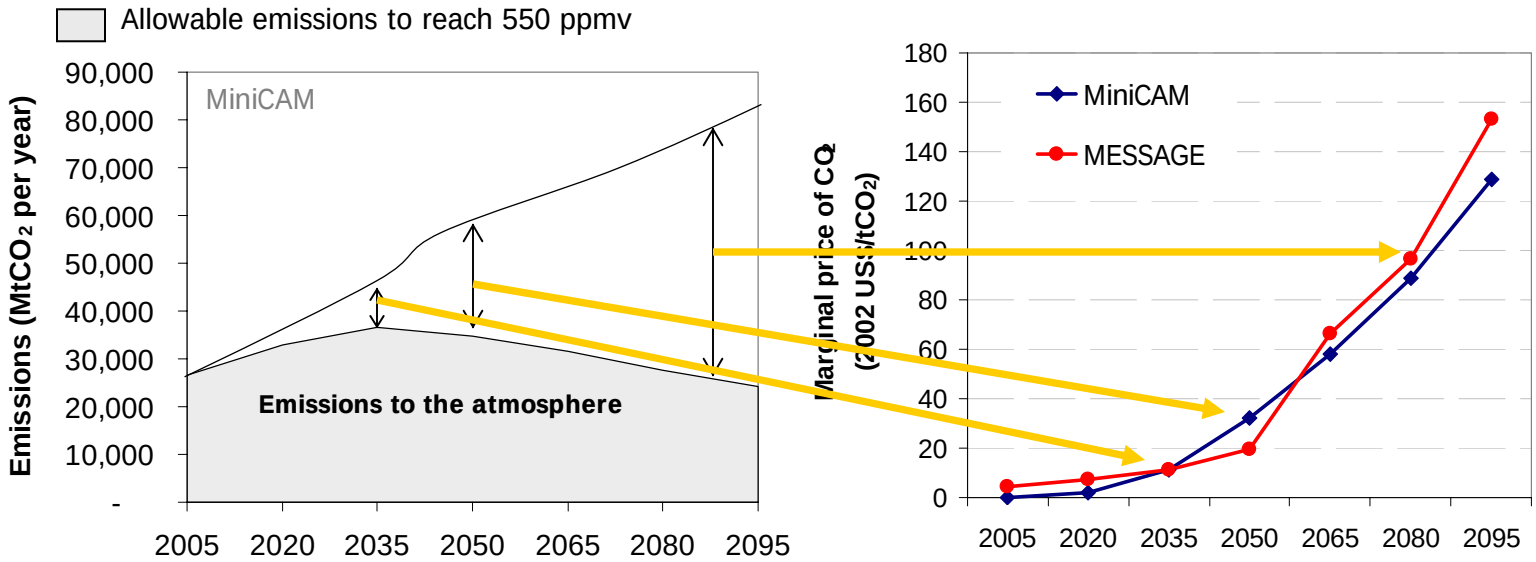


Source: IPCC Special Report on CCS, 2005

Economic potential

How much of the technical potential for CCS would be used if CCS would compete for market share in the mitigation market?

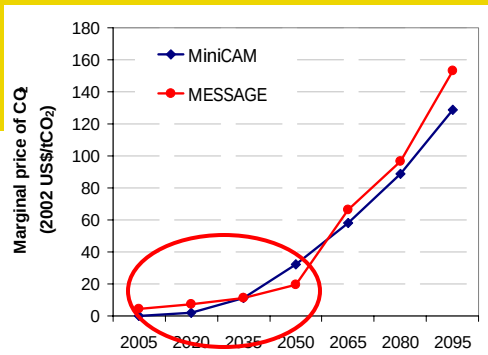
Optimisation on the lowest carbon price

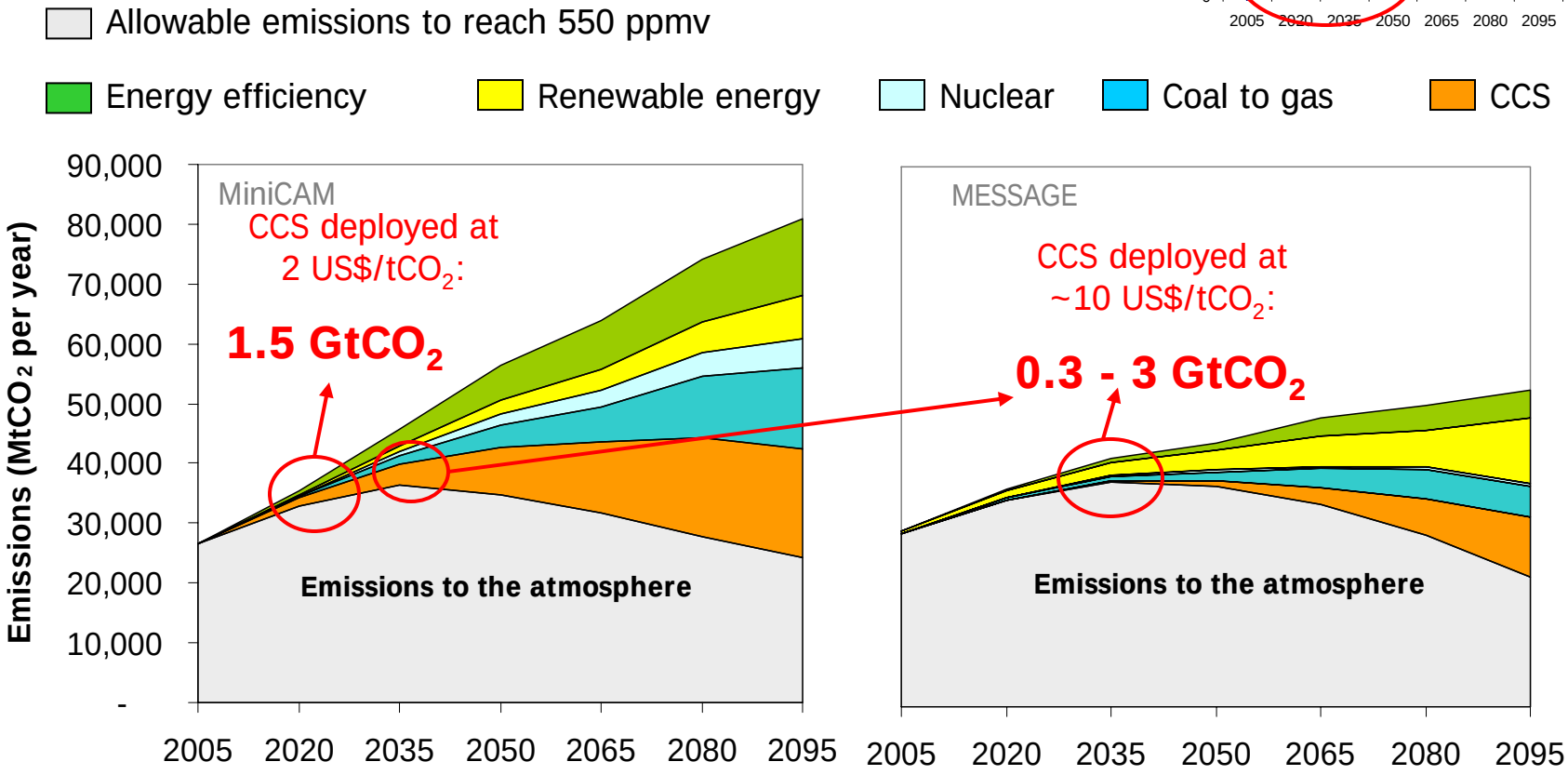


Renewables, energy efficiency, nuclear, etc. compete

Source: IPCC Special Report on CCS, 2005

Economic potential





Cumulatively: 220 - 2200 $GtCO_2$ CCS used

Including CCS in the portfolio decreases overall mitigation costs with 30%

Source: IPCC Special Report on CCS, 2005

To summarise…

Capture costs main component, largest cost reduction potential

Power sector costs well-known

But:

- Important questions for costs of capture-ready power plants remain, and experience is still limited
- Costs of industrial applications less clear
- CDM and carbon prices not yet high enough

Including CCS in the portfolio decreases overall mitigation costs with 30%; CCS deployment 220 - 2200 $GtCO_2$ over 21st century

But:

- Low cost assumptions may have resulted in an overestimation of the role of CCS

Thank you

IPCC Special Report on CO_2 capture and storage: www.ipcc.ch

ACCSEPT project: www.accsept.org

Energy research Centre of the Netherlands: www.ecn.nl

Princeton University: www.princeton.edu

More information: deconinck@ecn.nl