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Carbon Capture and Storage vs. Energy Efficiency:

Incompatible Antagonists or Indispensable Allies?

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ECEEE 2007 Summer Study, La Colle

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Agenda

- Introduction
- CCS issues
- Activities
- Mitigation scenarios
- Conclusions

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Introduction

Coal and CCS in GERMANY

- Major domestic energy resource and power generation input
- Climate change and the low-emissions coal power station

What is Carbon Capture and Storage?

Not a new technology (EOR; EGR)

For power sector, 3 technologies under development:

- Pre combustion (**RWE, 450 MW Plant, 2014**)
- Oxyfuel (**Vattenfall, 30 MW pilot plant, 2008**)
- Post combustion (**Alstom/American Electric Power, 2011**)

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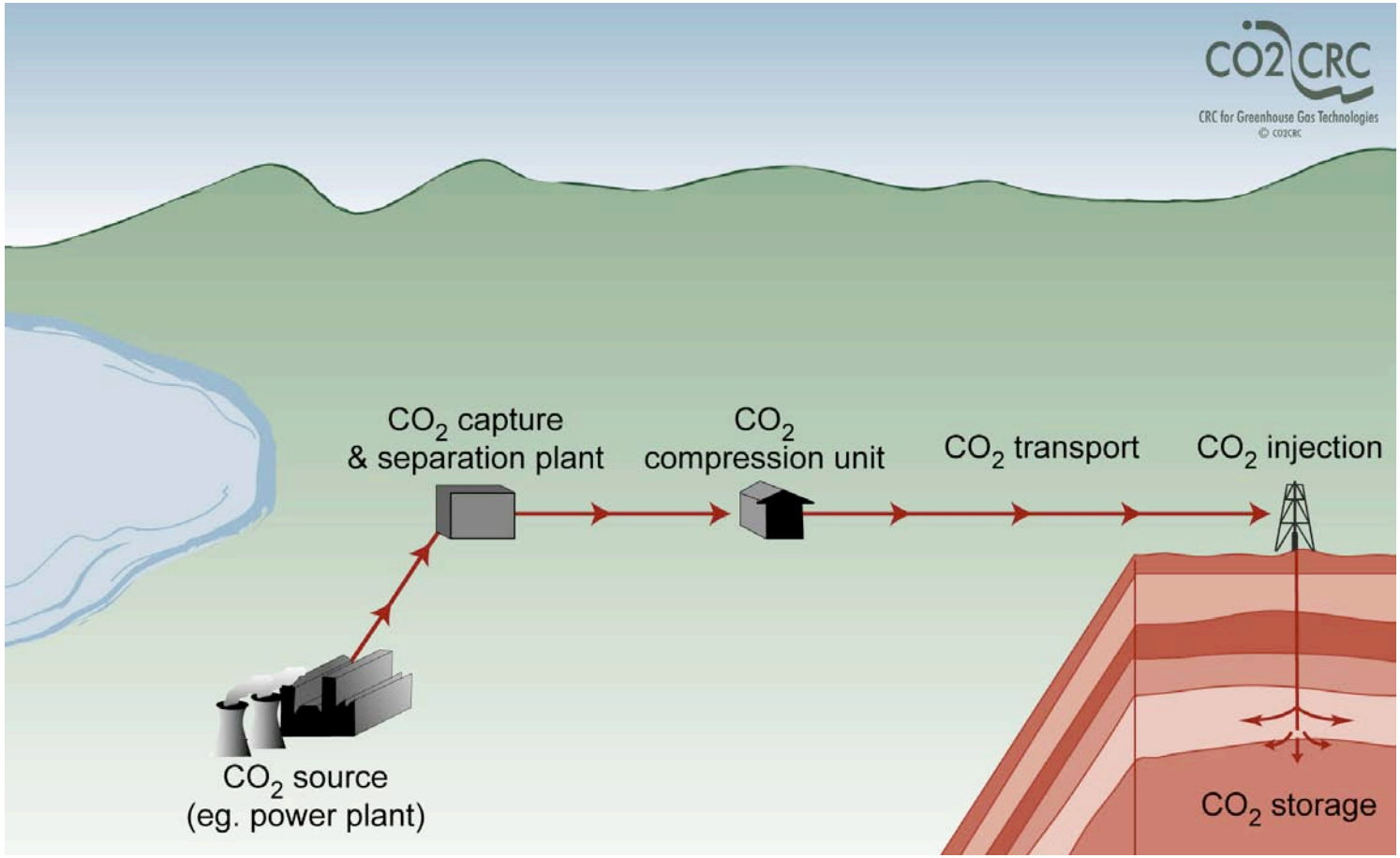
CCS process steps



Source: CO2CRC. http://www.co2crc.com.au

Issues and challenges

Economics

- Higher up-front investment
- Additional energy input (“energy penalty”)
- Economical at a CO_2 price of > 30 EUR/t

Availability and timing

- Mitigation option for large point sources
- IGCC most promising (by 2020) with economic advantages compared to retrofit, oxyfuel and NGCC
- Bridging technology: Theoretical storage capacity of 80-150 yrs (in Germany)

Environmental risks

- Leakage over time
- Geological issues (acid & other)

Issues and challenges (2)

Resulting issues and challenges

- Further R&D on open questions and risks
- Liability and other regulations (national, cross-border)
- Policy framework (carbon regime, level and intensity of R&D support…)
- Public acceptance

CCS activities in Germany and abroad

Agenda setting phase, no elaborated policy yet

- R&D networks (COORETEC, GEOTECHNOLOGIES)
- European level: ZEP technology platform (2005)
- International level: CSLF (2003)
- NGO positions formed (2005-2006)

Actors and interests

- Early drivers: Oil & gas industry, research organisations, some ministries
- Electricity and power plant industry increasingly involved
- NGO / Ministry for Environment BMU / Federal environmental office UBA rather critical, but
- No fierce opposition

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Interface of energy efficiency and CCS

- Decrease in conversion efficiency vs. efficiency
- Competition for R&D funding (also with renewables)
- Or: Complementary approaches within a mix of policies and measures?

Potential impact on future electricity system: Mitigation scenarios

- Wide range of cost estimates for CCS
- Studies including CCS as a mitigation option conclude:
  - Lower economic costs when CCS is included
  - High uncertainties on costs
  - Time of commercial availability matters
- Most studies are of bottom-up type and include detailed technology information
- They lack interaction with rest of economy, take energy demand and macroeconomic development as given
- Macroeconomic (top-down) models lack technology detail
- Attempt to combine features from both models

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Analysis with SGM Germany

- SGM Germany: computable general equilibrium model for Germany
- Embodies technology detail for electricity sector (NGCC, IGCC, and coal power with and without CCS, renewables)
- Economy-wide framework: allows interaction of sectors
- Used to analyze economic, energy and environmental effects of policy measures
  - Output adjustment
  - Structural change
  - Demand and supply efficiency changes
  - Shifts in technologies in electricity sector

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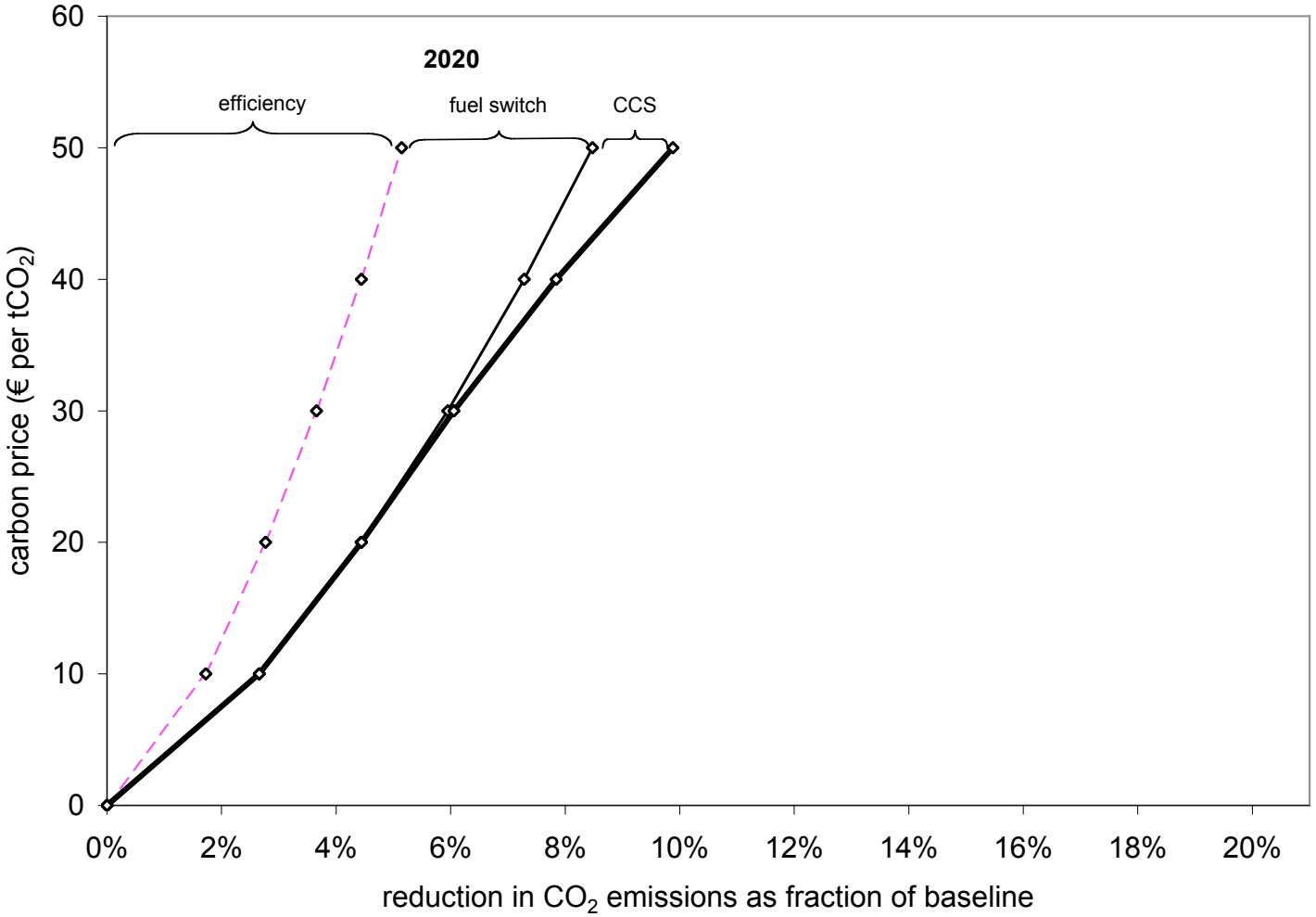
Simulated economy wide emissions reductions, Germany 2020



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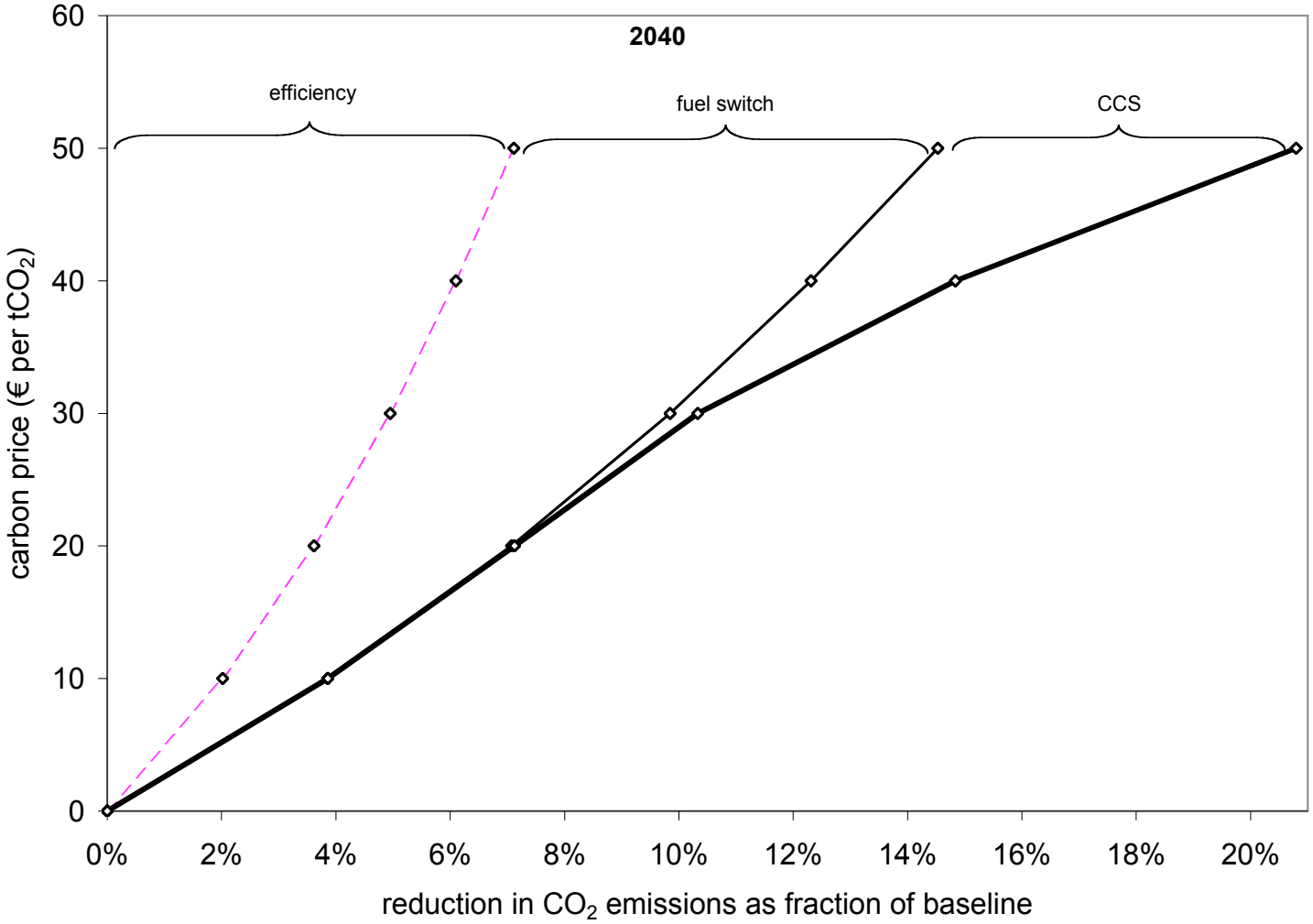
Simulated economy wide emissions reductions, Germany 2040



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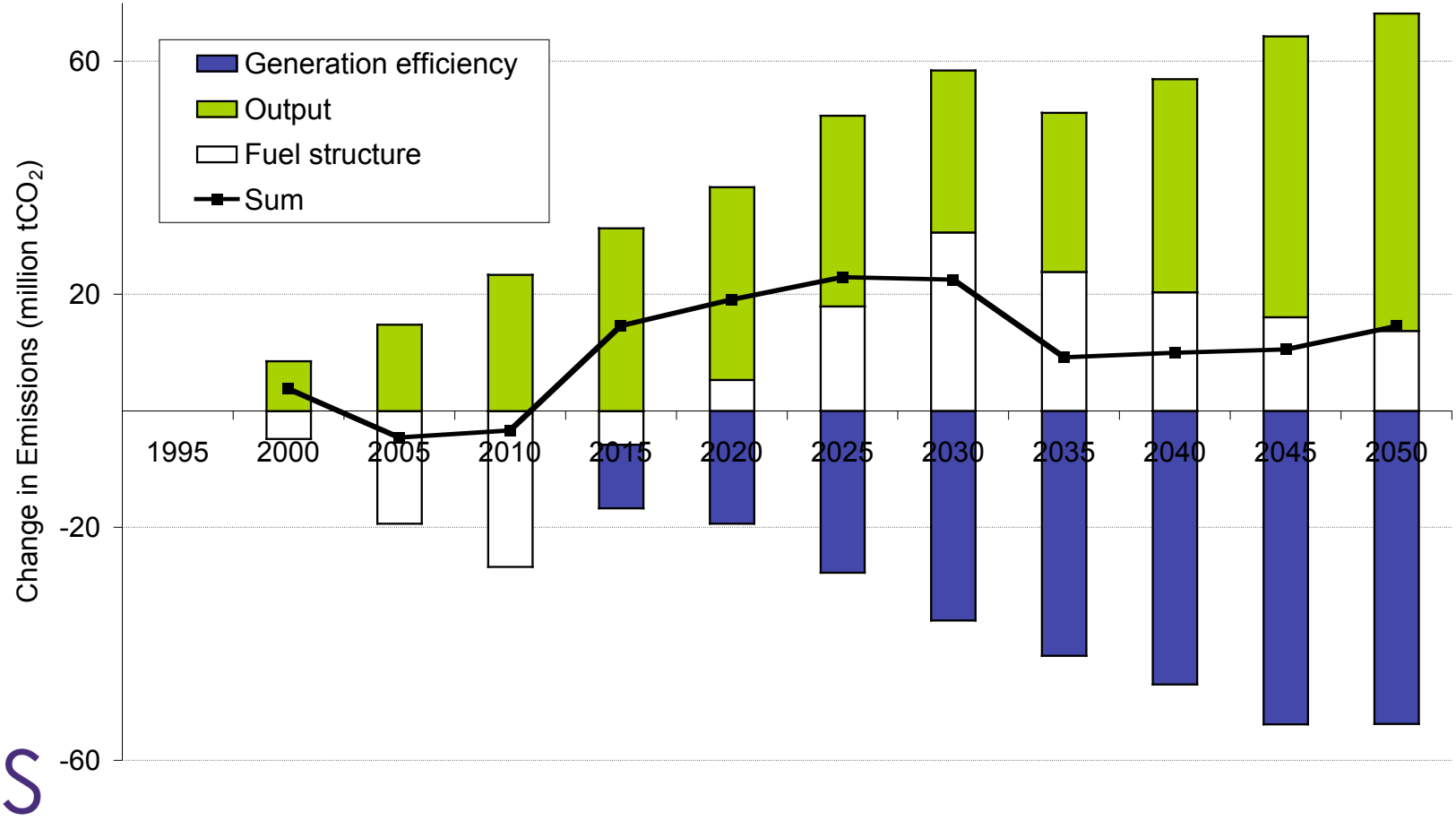
Electricity sector decomposition over time (baseline)



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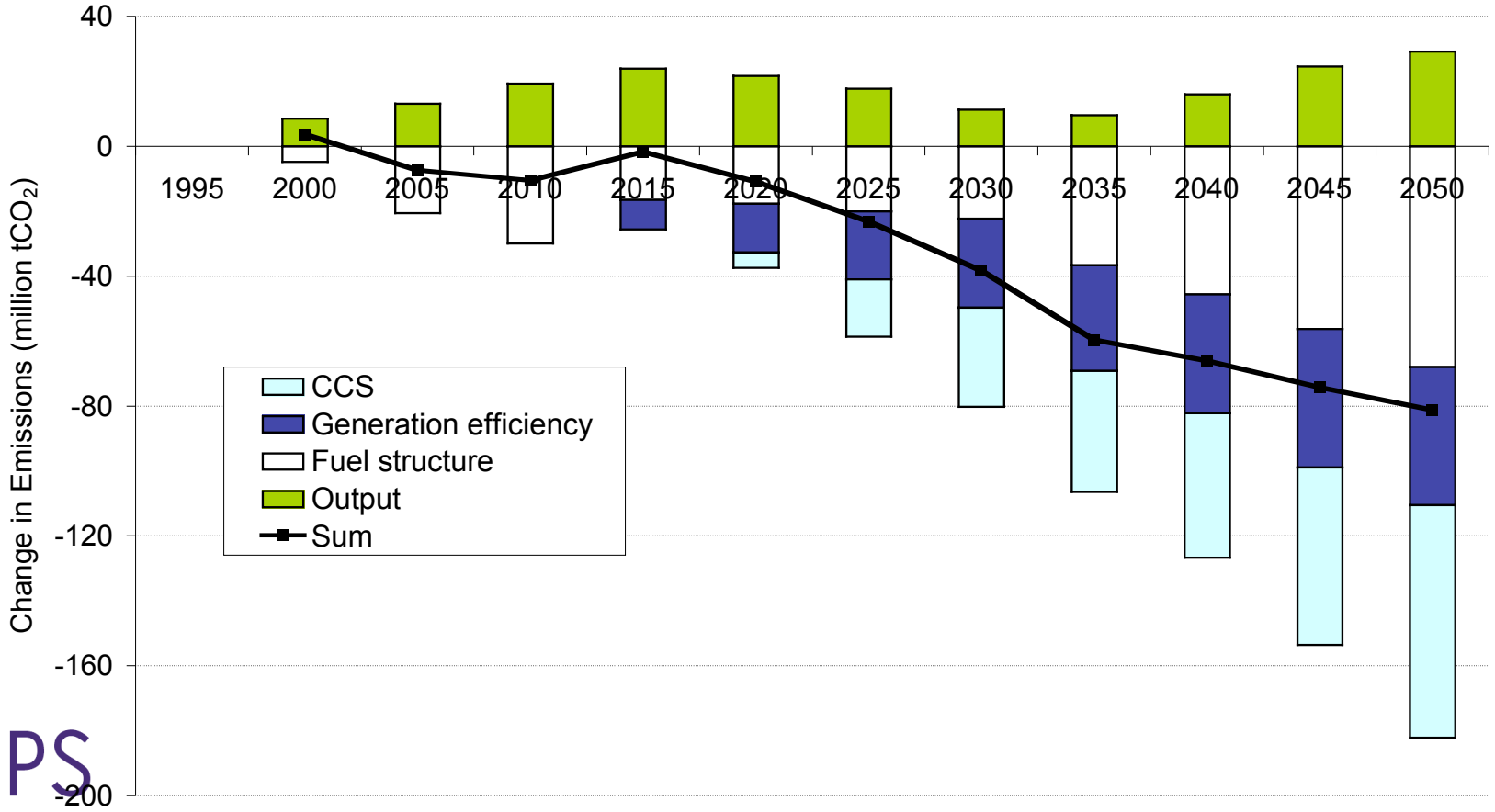
Electricity sector decomposition over time (step wise CO_2 policy)



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Conclusions

- It is likely that CCS will come (retrofit unlikely though)
- Stringent and reliable CO_2 policy is important
- Given uncertainties and storage constraint CCS may serve as bridging technology
- Timing matters
- CCS no magic bullet, unlike perhaps energy efficiency
- CCS and energy efficiency can both contribute to emissions reduction, given high enough CO_2 price
- CCS more important in the relation to renewable energy and nuclear power

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Thank you

Your comments are welcome!

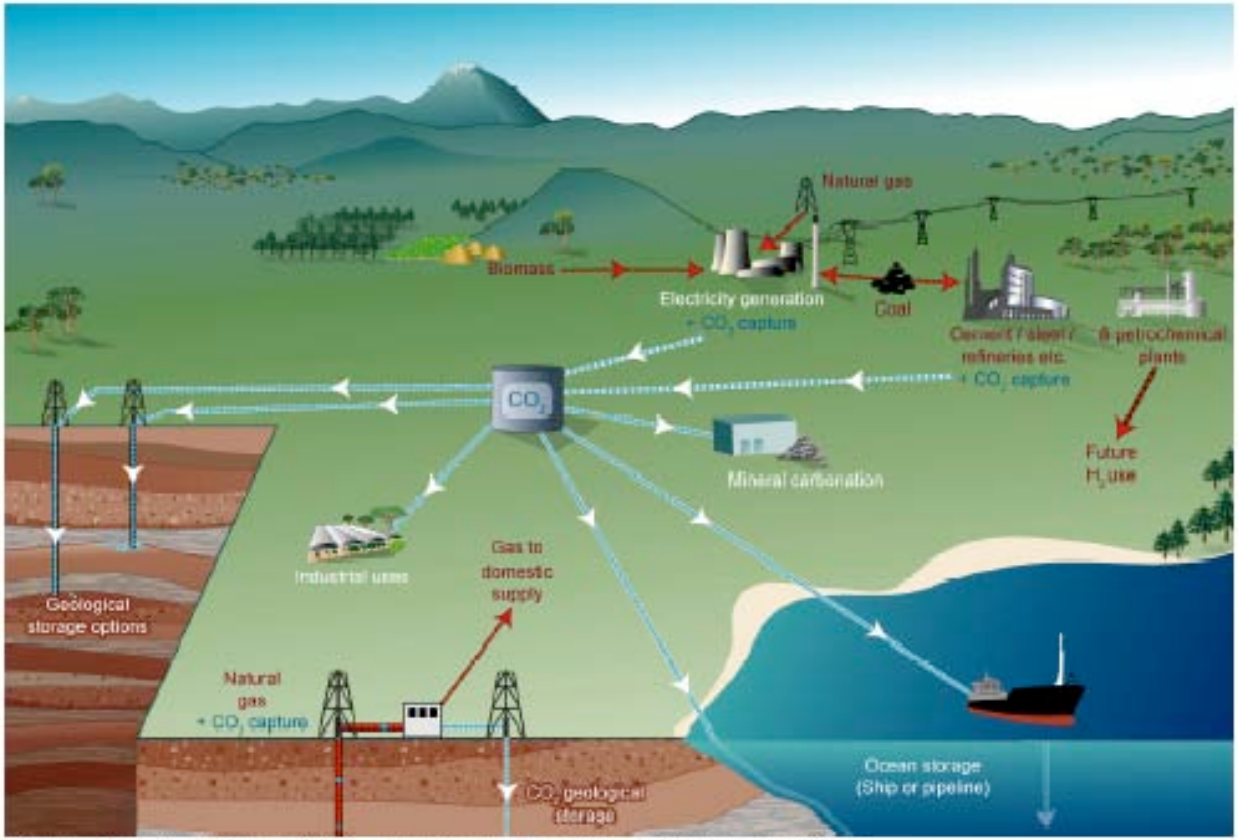

Figure P.1 *Overview of CO_2 capture, transport, and storage options*
Source: IPCC, 2005.

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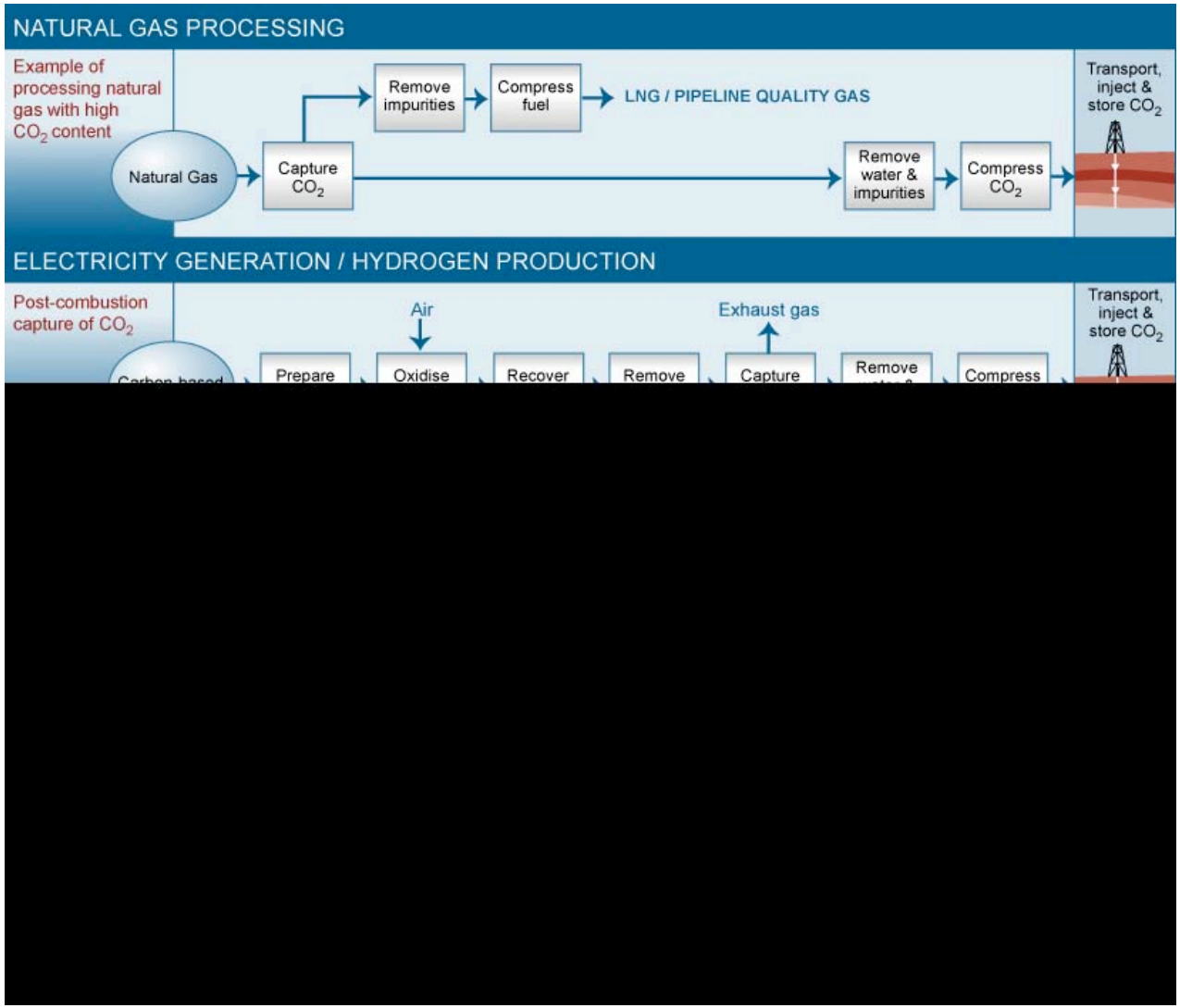
CO_2 capture process: Different options



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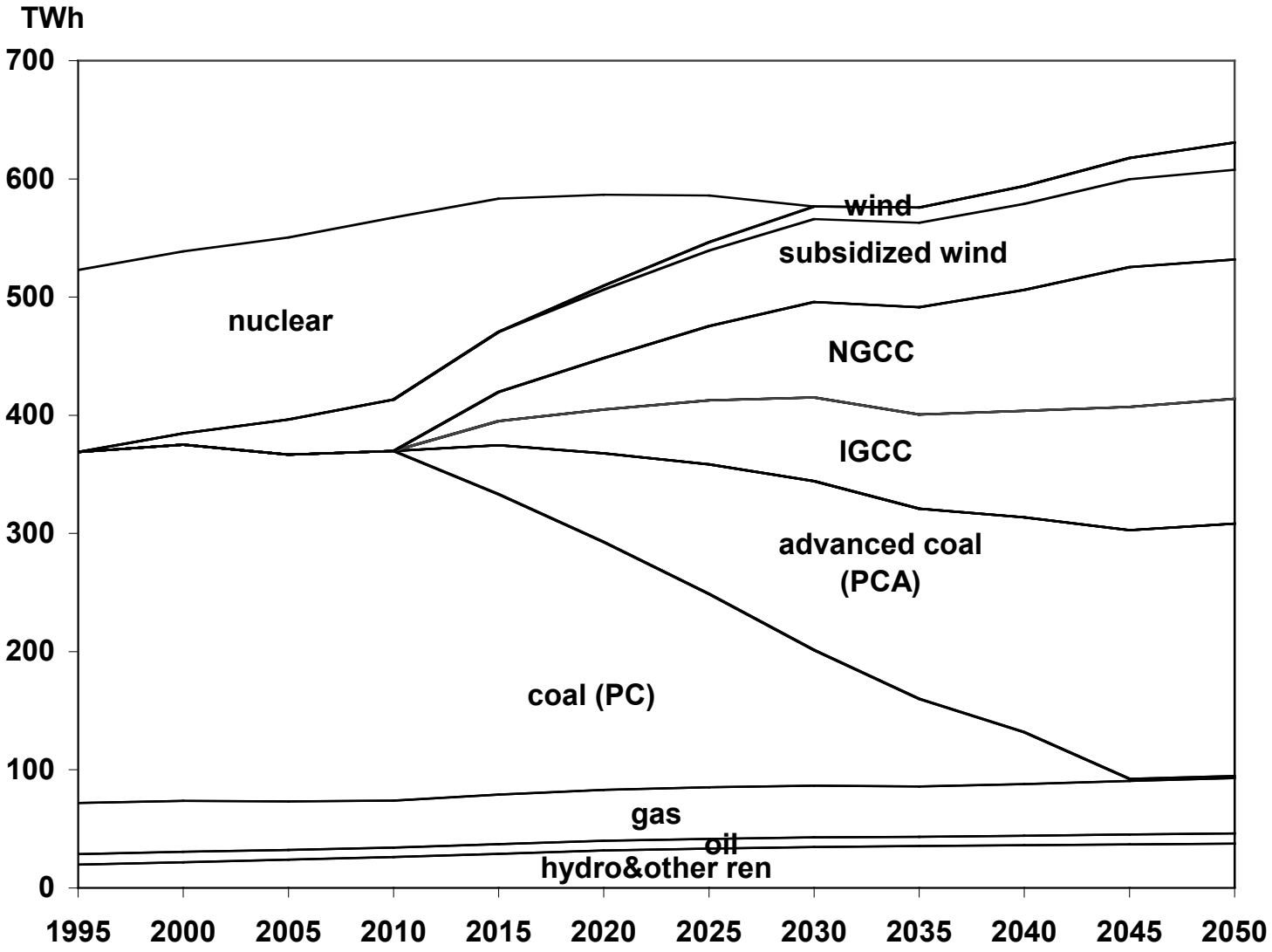
SGM Results: Baseline electricity generation



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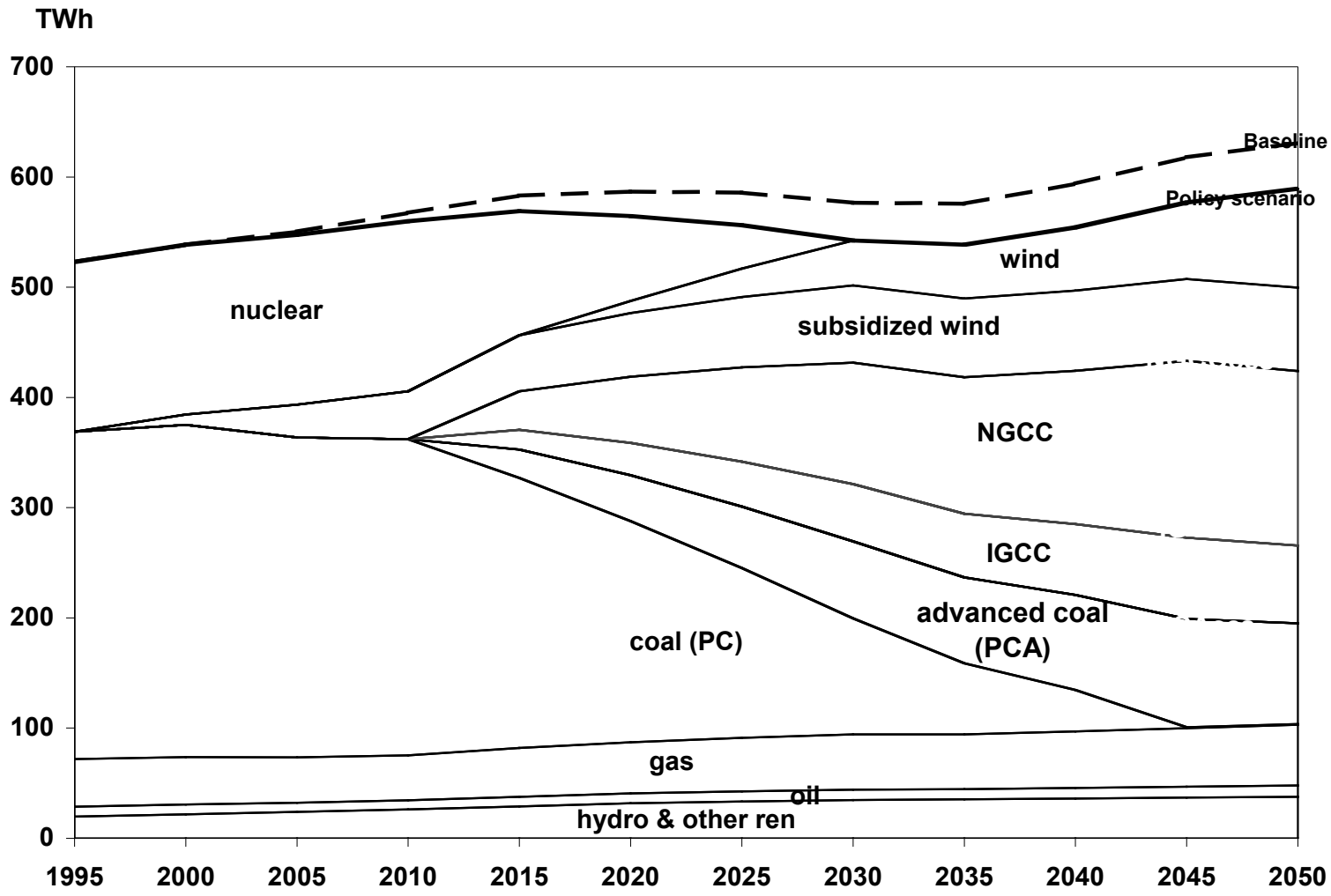
Electricity sector results – stepwise increase of CO2 price, without CCS



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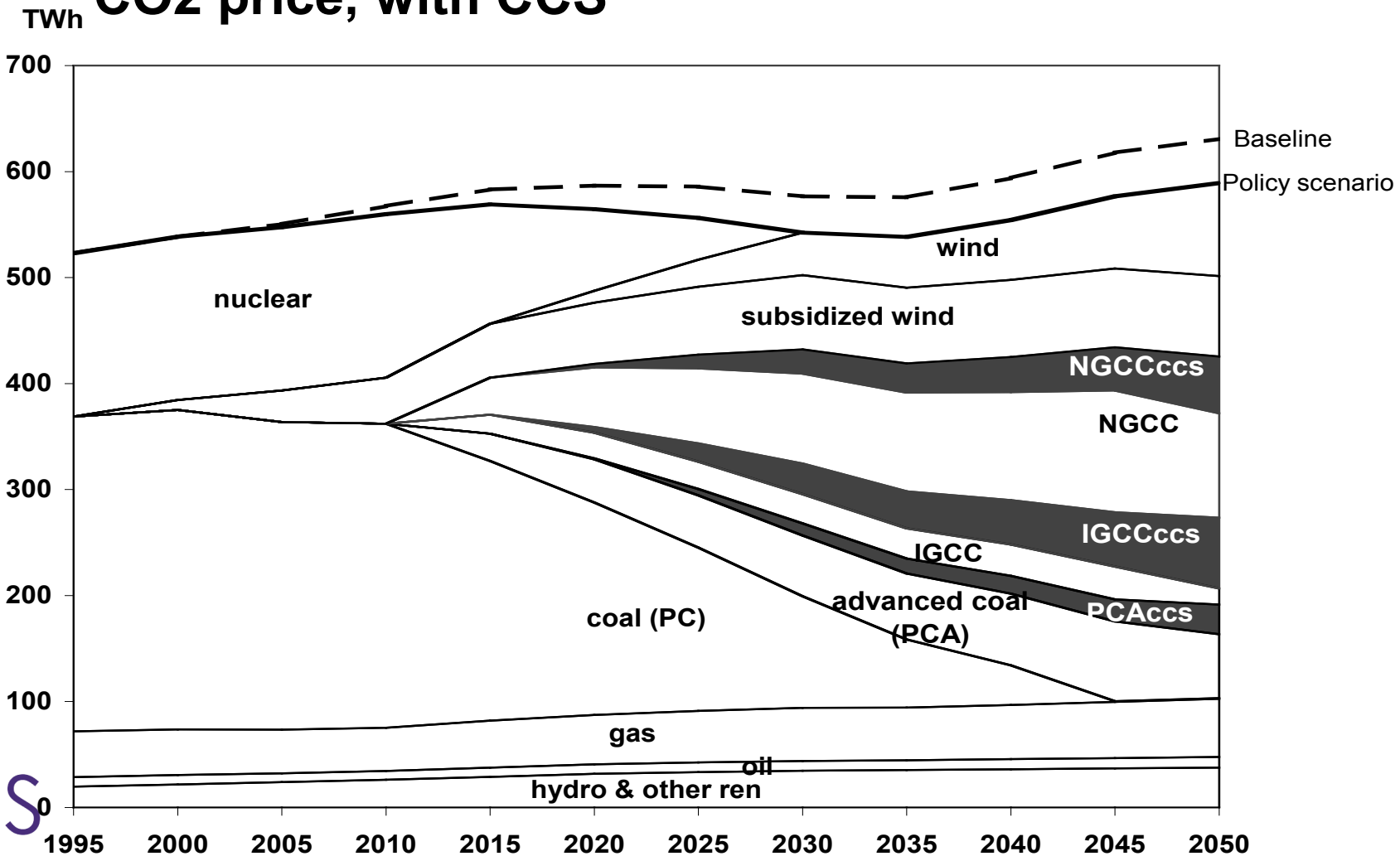

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