The energy policy consequences of future CO_2 capture and storage technologies

Preliminary results

Dolf Gielen

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Issues

General question:

What is the energy policy relevance of CO_2 capture?

- **What method is used at IEA to assess CO_2 capture and sequestration?**
- **Where can CO_2 capture be applied?**
- **How competitive is CO_2 capture?**
- **What about the hydrogen transportation fuel link?**

IEA framework

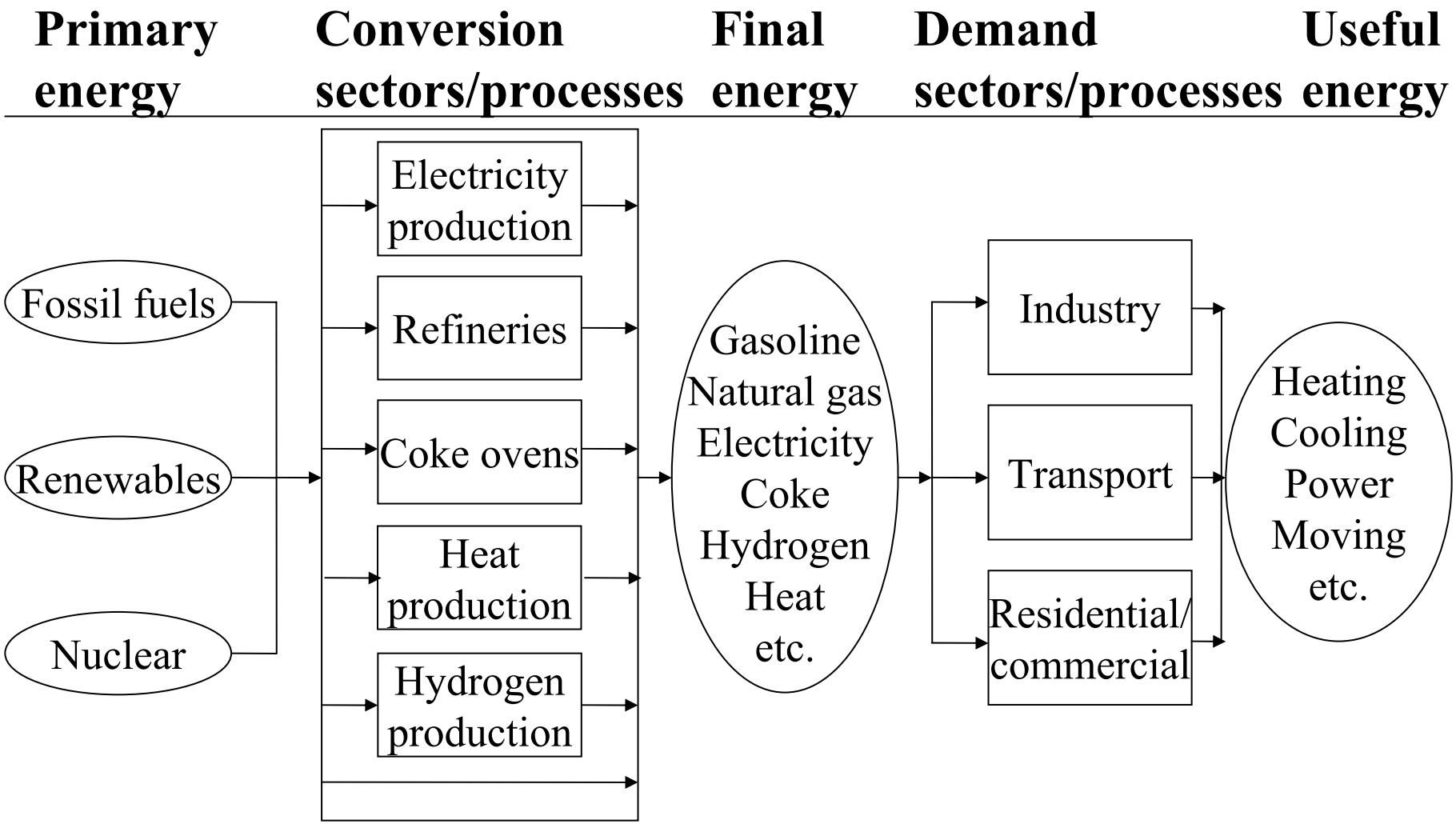
- GB request for advice October 2002
- Fossil Fuel WP ZETS initiative
- IEA GHG R&D programme
- ETP project
- *Report on capture and sequestration due in the fall of 2003*

What method is used to assess CO_2 capture and sequestration?

ETP

- Energy Technology Perspectives
- Energy systems-engineering model
- Market simulation
- Long term outlook until 2050
- Assess the role of technology in energy policy
- Account for systems effects (life cycle emissions, technology learning)

Reference Energy System (RES)



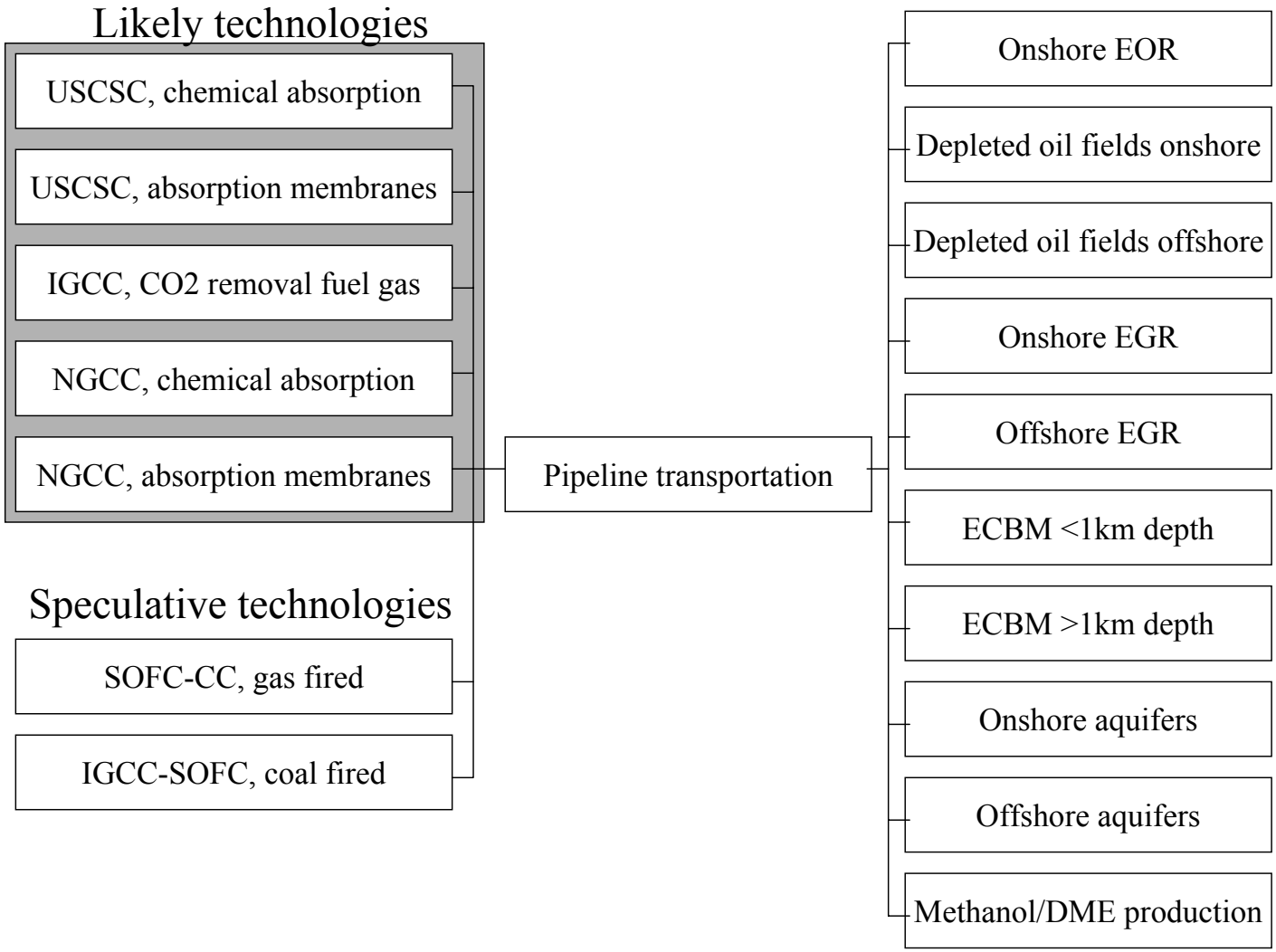
ETP database

- Global energy system, 15 regions

- One global technology database
- Region-specific constraints
- Region-specific cost index
- Region and sector specific discount rate

Where can CO_2 capture be applied?

ETP database
Electricity sector model strcture



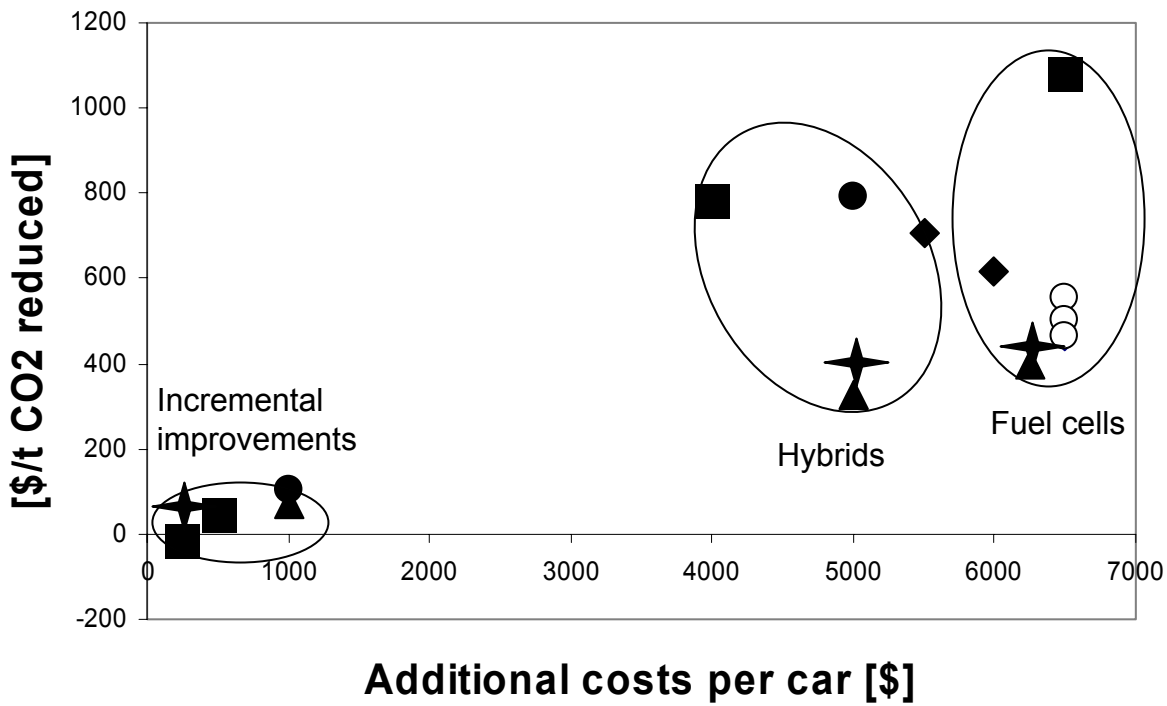
ETP database
Electricity sector CO_2 capture
10% discount rate
Coal 1.5$/GJ; Gas 3 $/GJ

Fuel + type	Starting year	El. eff [%]	El. eff. loss [%]	Ele costs [Mills/kWh]	CO_2 capture costs [$/t CO_2]
Coal steam cycle – CA	2010	31	-12	51.0	24
Coal steam cycle – membranes +CA	2020	36	-8	46.3	21
Coal IGCC – Selexol	2010	38	-8	52.3	20
Coal IGCC – Selexol	2020	45	-5	45.6	18
Coal IGCC – SOFC	2035	56	-4	49.0	13
Gas CC – be CA	2010	47	-9	36.8	29
Gas CC – fe Selexol	2020	50	-8	36.8	35
Gas CC + SOFC	2030	66	-4	39.2	28

Upstream capture

- Hydrogen production
- Refineries - Flexicoking
- FT synthesis from coal and gas
- Tar sand processing

Hydrogen and other transportation sector options



Gasoline
Diesel
Methanol/DME
Natural gas
Hydrogen
Ethanol from lignocellulose

Manufacturing industry (so far not considered in the model)

- Blast furnaces (1 Gt CO2)
- Cement kilns (1 Gt CO2)
- Ammonia (0.15 Gt CO2)
- Industrial furnaces

Off-gas composition in iron production

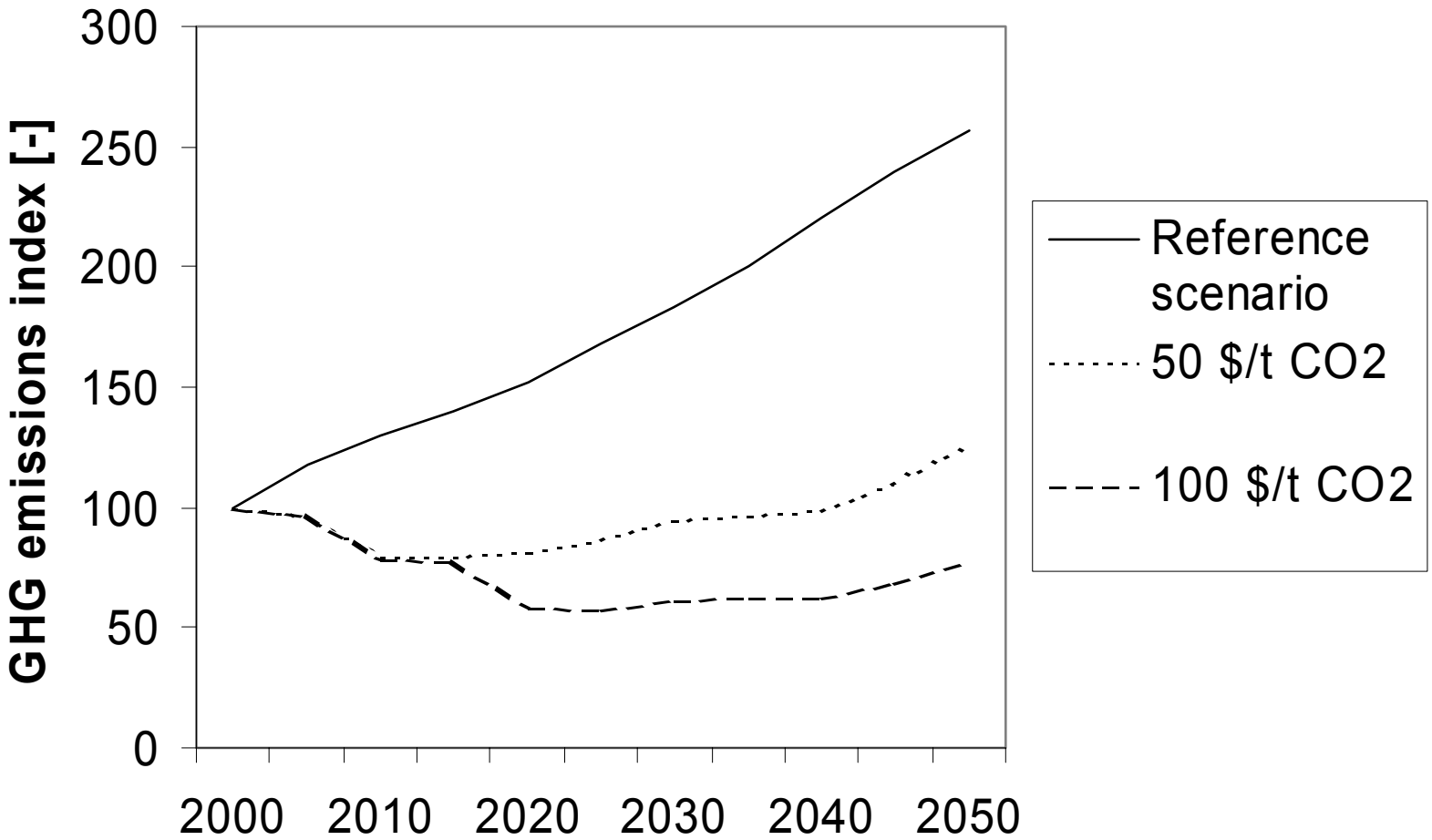
Component [mol %]	Shell gasifier	Coal fired power plant	Conventional blast furnace	Corex
CO_2	1	13	20	24
CO	64	0	21	44
Other	35	87	59	32

How competitive is CO_2 capture?

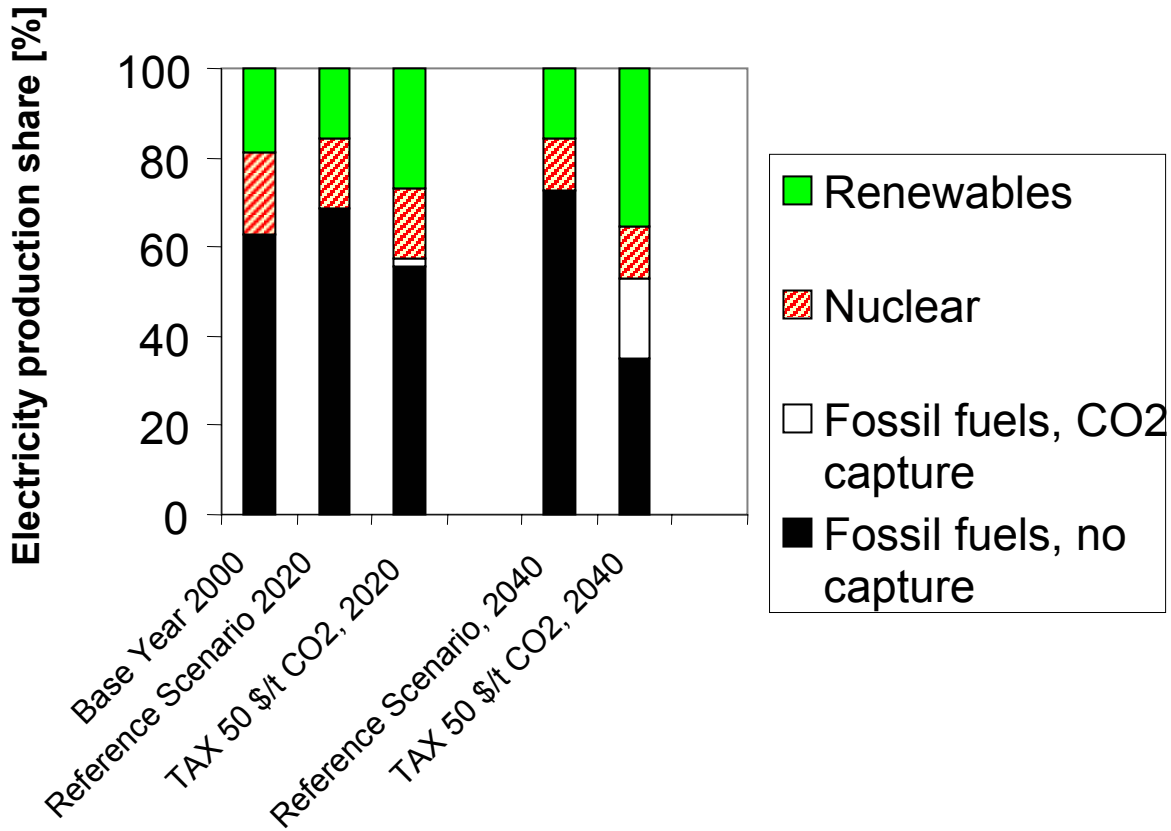
ETP scenario runs

- Reference scenario (no new policy)
- CO_2 tax increasing to 50-100 $/t CO_2 in 2015-2020
- Sensitivity analysis Fuel Cell Vehicles (FCV) +500$ compared to ICE

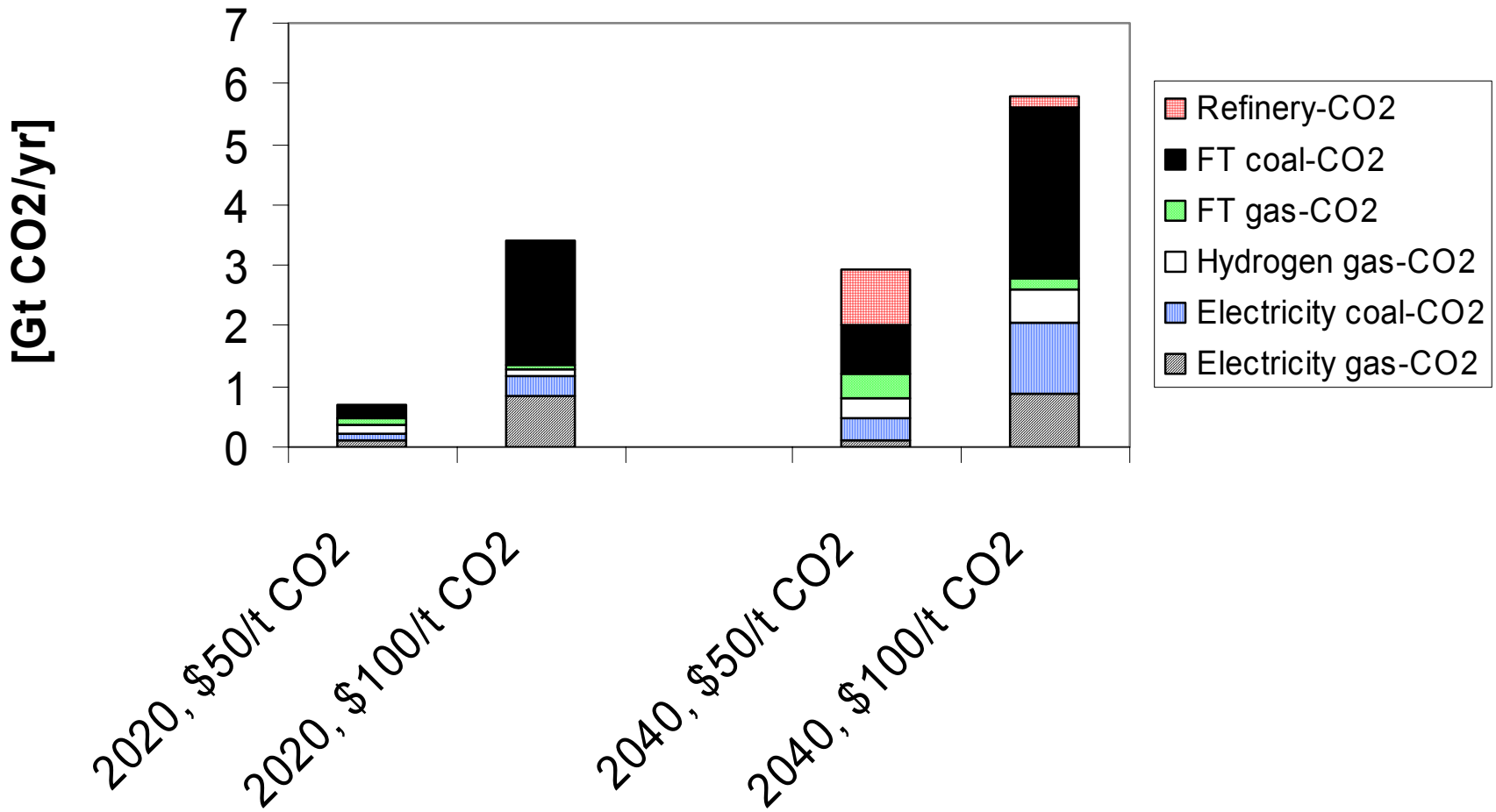
ETP results: GHG emissions



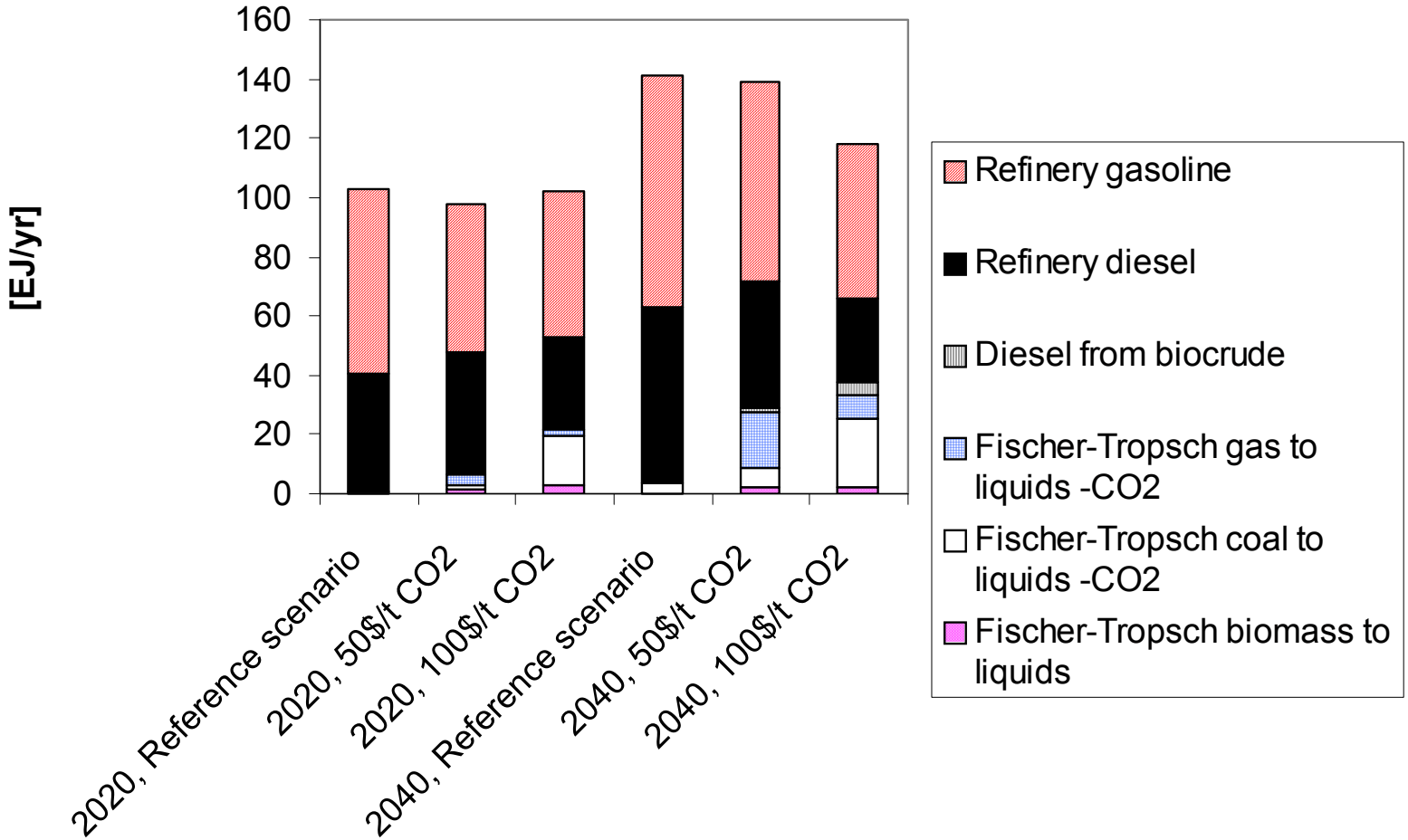
ETP results: Electricity production, Global



ETP results: Global CO_2 capture

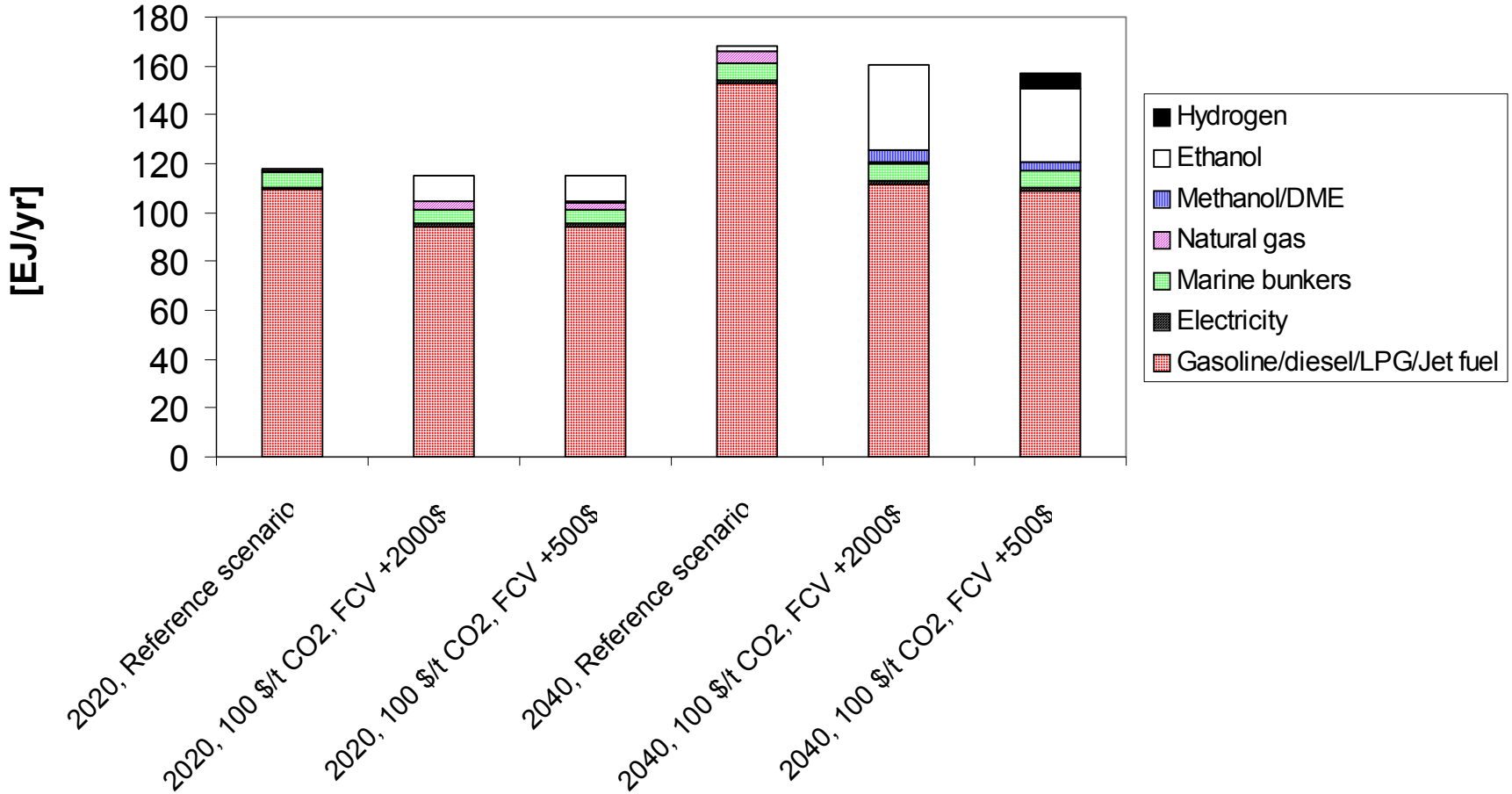


Gasoline and diesel supply

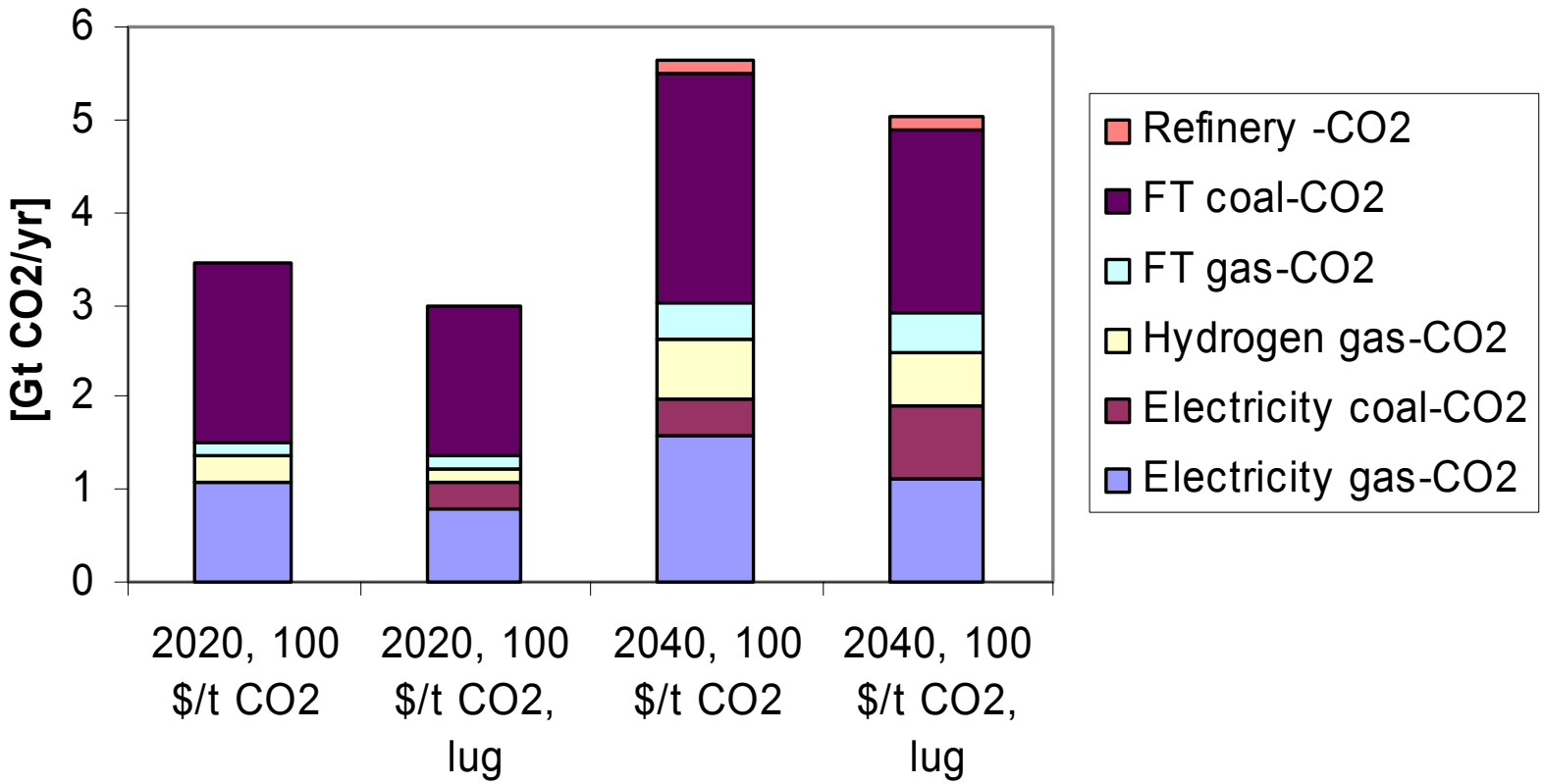


What about the hydrogen link?

ETP results: transportation fuels



Conclusions

- CO_2 capture can be an important term strategy to reduce emissions;
- However technology development alone is insufficient, policy incentives are required;
- A significant potential for capture exists outside the electricity sector;
- Hydrogen transportation fuel in combination with CO_2 capture seems costly (but has security benefits).

Sensitivity Analysis
Low Unconventional Gas (LUG) availability