



Carbon Capture & Storage (CCS) – supporting by carrots or sticks?

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Key questions addressed

1. What are the specifics of CCS?



2. Why do politicians promote CCS?



3. What are the sticks and carrots?



4. What are the impacts?

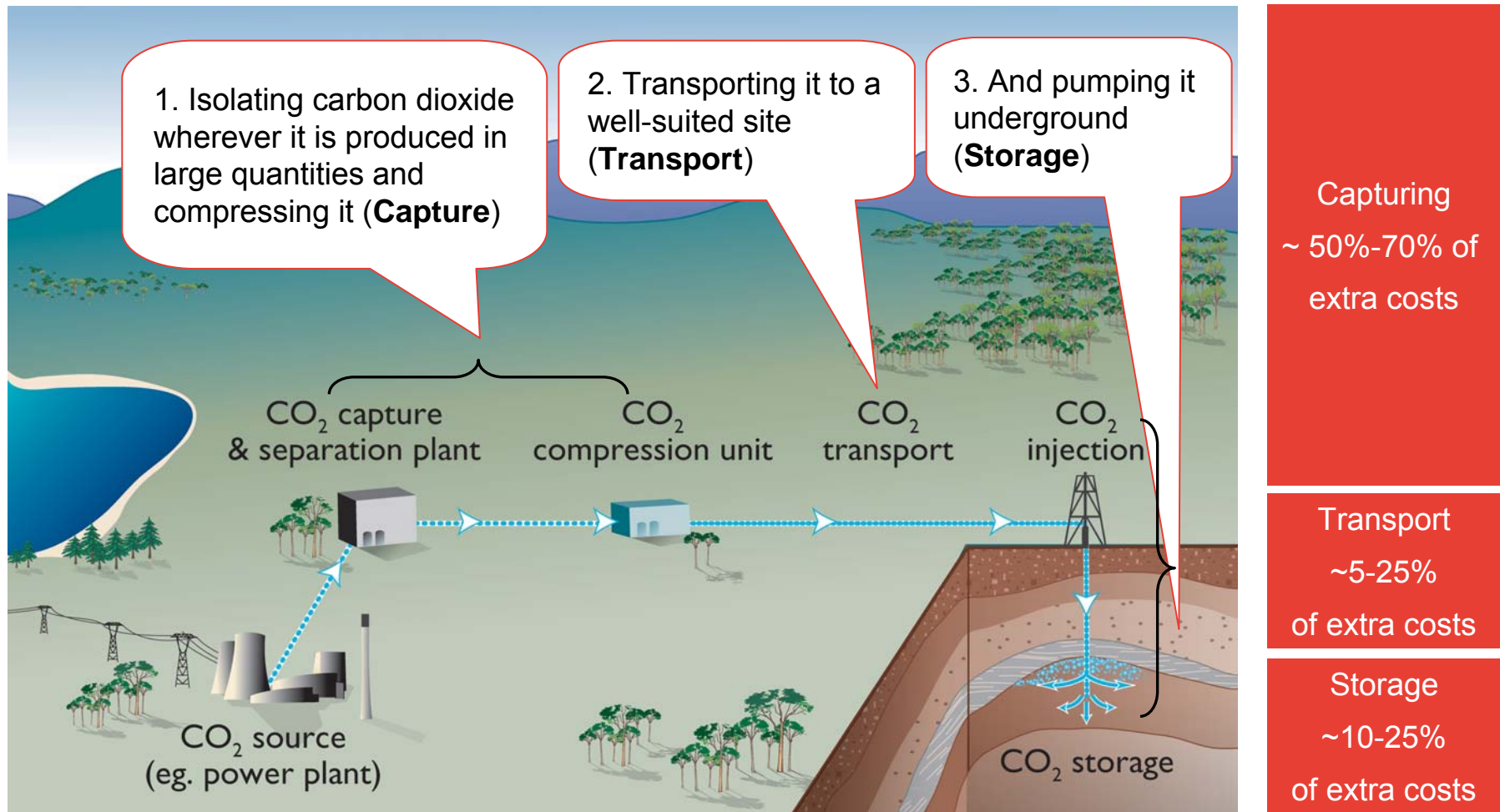
- CCS Specifics

- Policy interest

- Sticks/carrots

- Conclusions

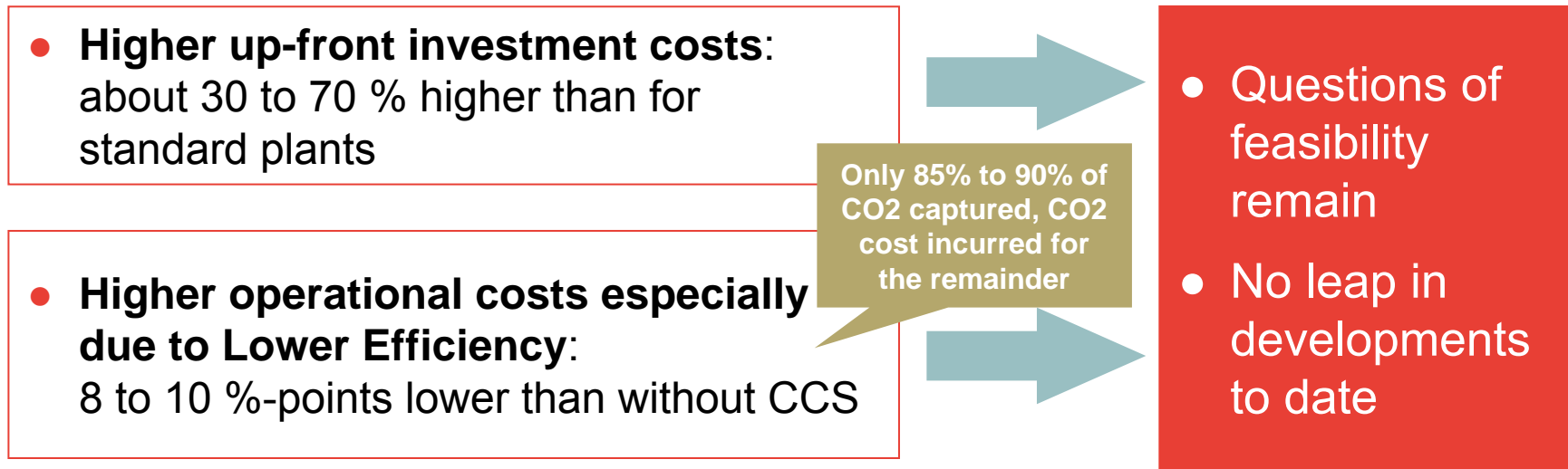
Carbon Capture and Storage (CCS) consists of...



Source: Economist, March 5th 2009, CO2CRC Online Image Library

Transport & storage costs can vary significantly with site and transport distance!

...and there are major differences in cost estimates

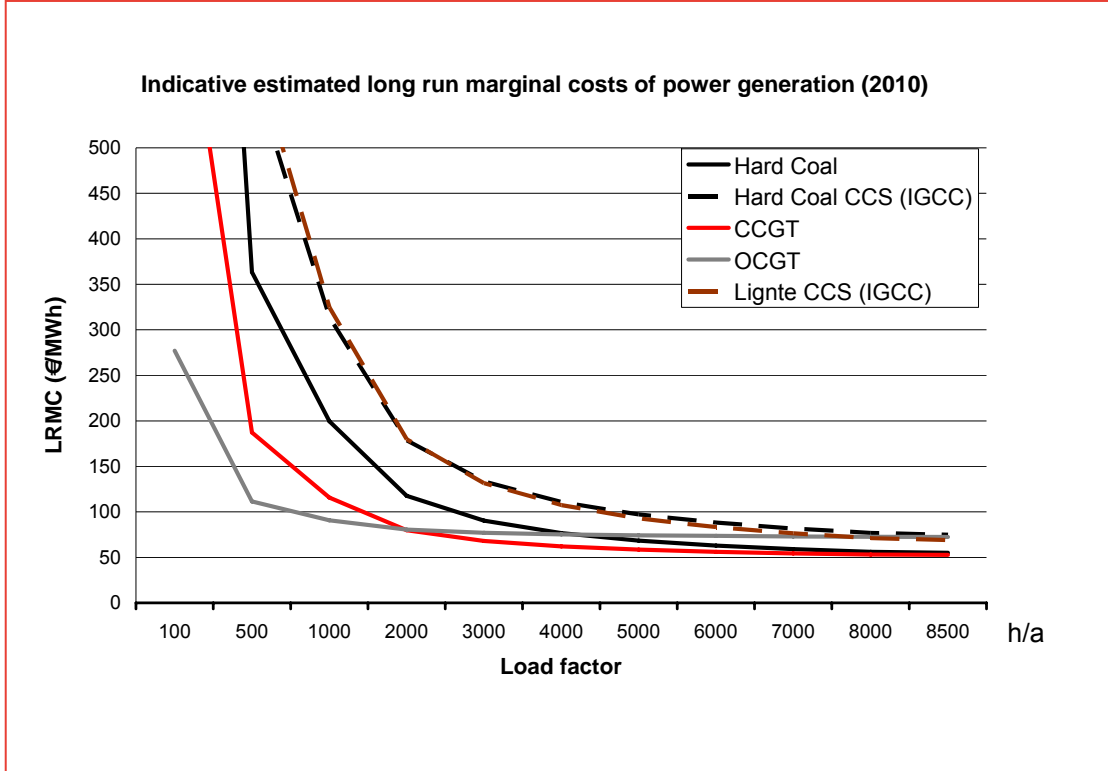


CO2 abatement costs	McKinsey Report (10/2008)	US Department of Energy Website (Sequestration Costs)	US Department of Energy Website (Capture Costs)
Current	€60-90 per t CO2	\$100-300 per t CO2	\$150 per t CO2
Future	€35-45 per t CO2 in 2030	Goal: <\$10 per t CO2 in 2015	

CCS economics still a challenge...

Conclusions

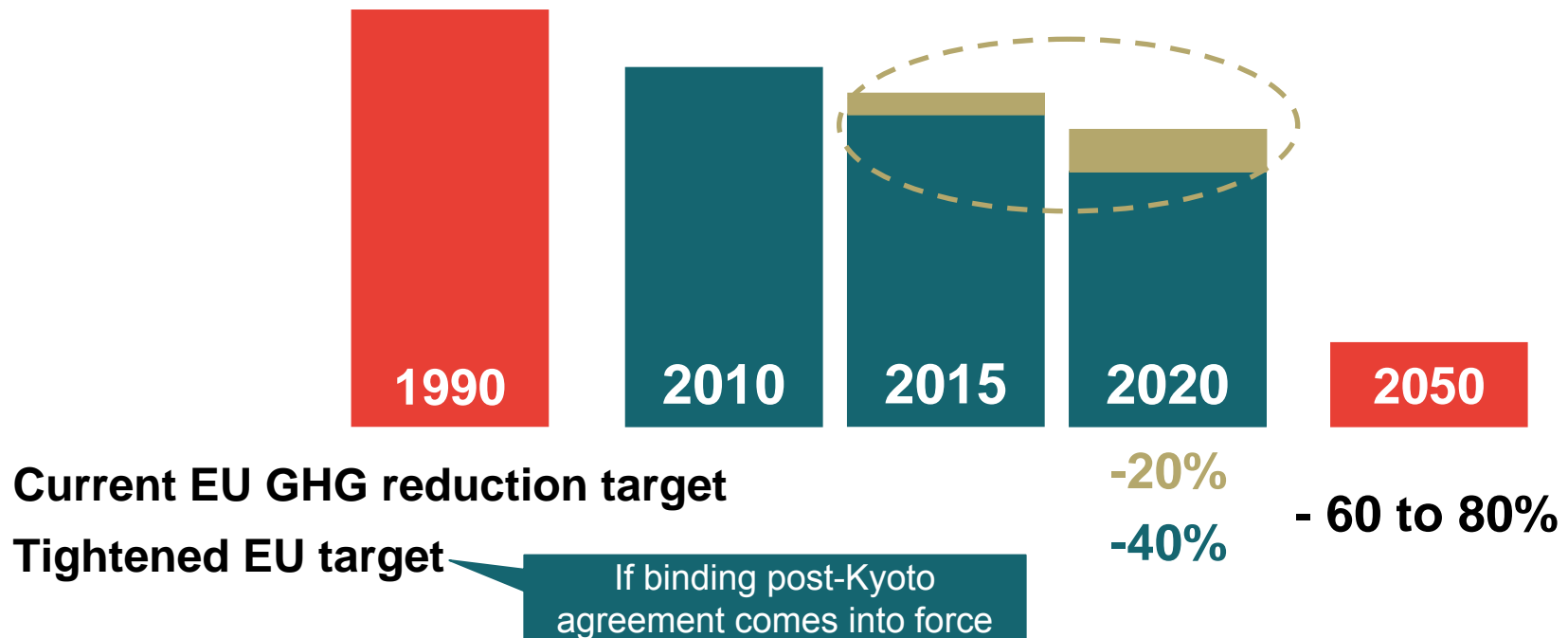
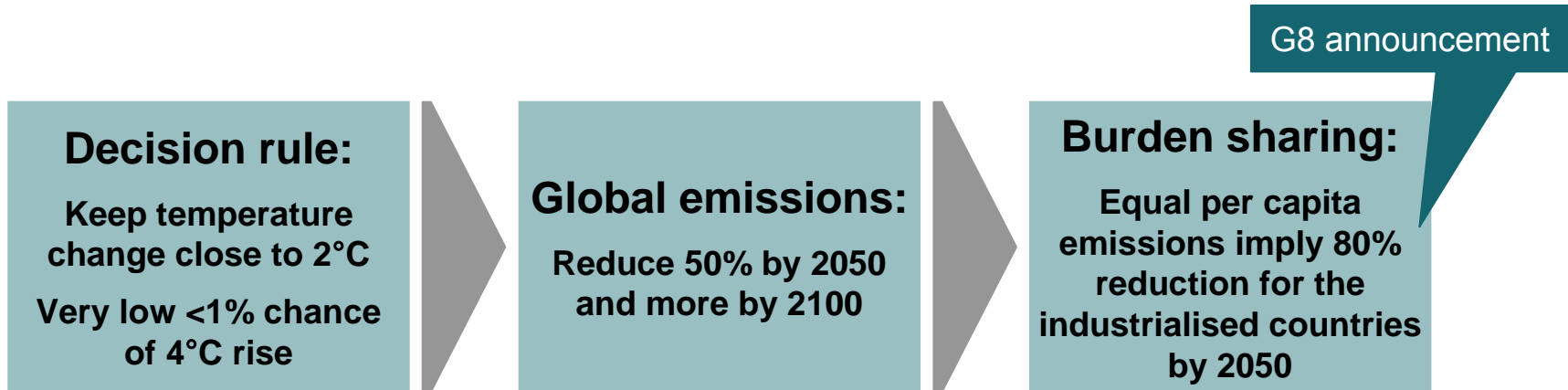
- CCS currently not viable based on costs
- Extra-cost depend on fuel and investment costs and CO2 saving
- Specific CO2 abatement costs
 - lower for coal than for gas
 - lower for lignite than gas
- If built, CCS should be for baseload generation
 - High fixed costs
 - Lower variable costs than the corresponding conventional plants (thanks to CO2 saving)



- Key Assumptions
 - CO2 price 12.50 €/t
 - Coal price: 105 \$/t (Cif ARA)
 - Gas price (GCV): 19 €/MWh (NGC)
 - Exchange rate: 1.40 \$/€
 - No subsidisation of CCS plant

- Specifics
- Policy interest
- Sticks/carrots
- Conclusions

Global CO2 targets drive political interest in CCS...

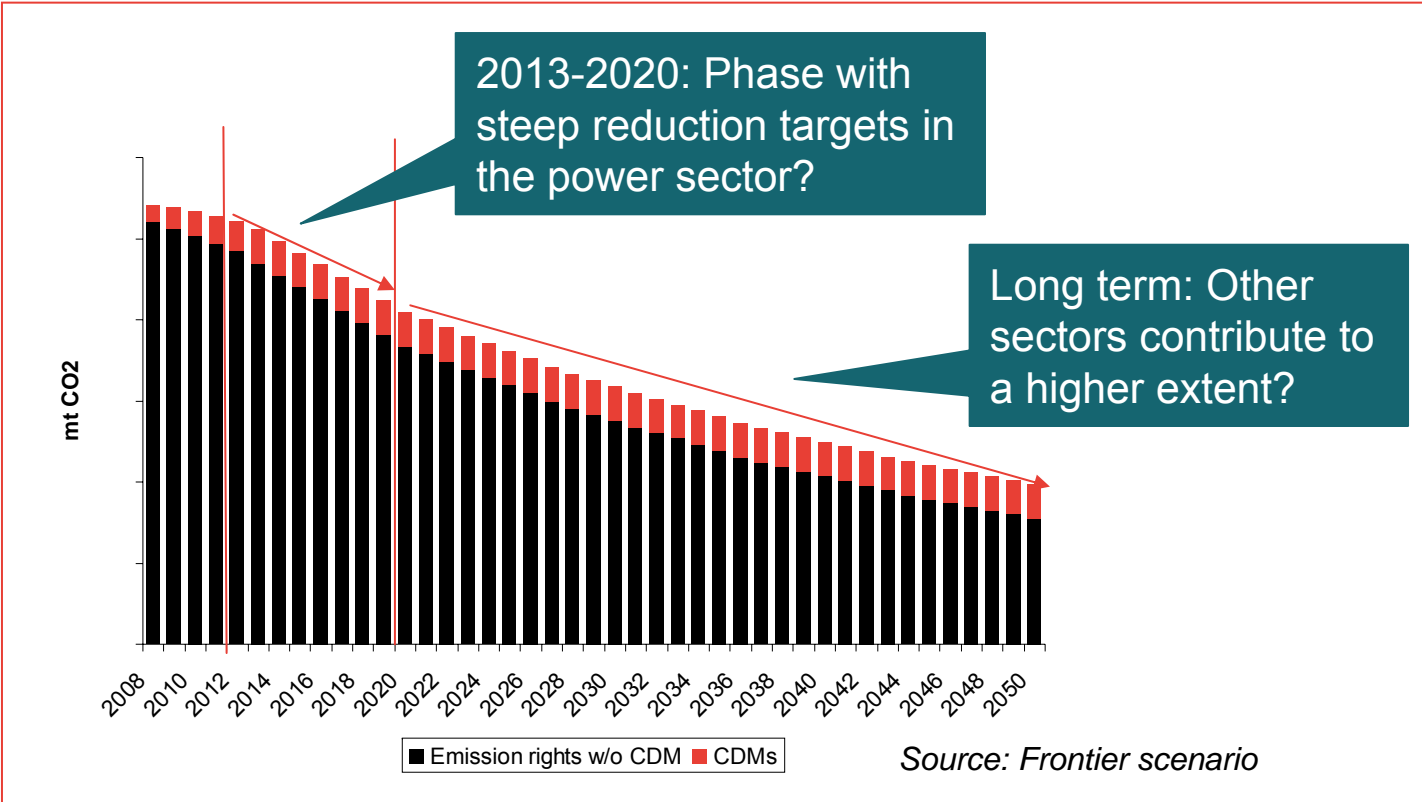


Global CO2 targets drive emission allowances in EU ETS

Targets of EU ETS

- **Reduction of GHG emissions in the EU ETS until 2020**
 - -21% without „post Kyoto“ agreement compared to 2005
 - Higher if „post Kyoto“ agreement comes into force

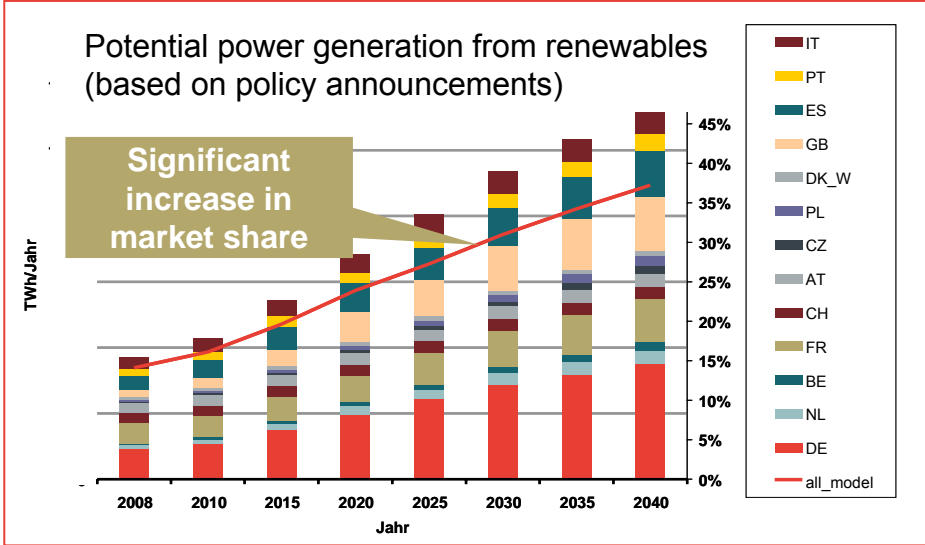
Potential CO2 reduction path (EU, power sector)



CCS can be essential for reaching targets

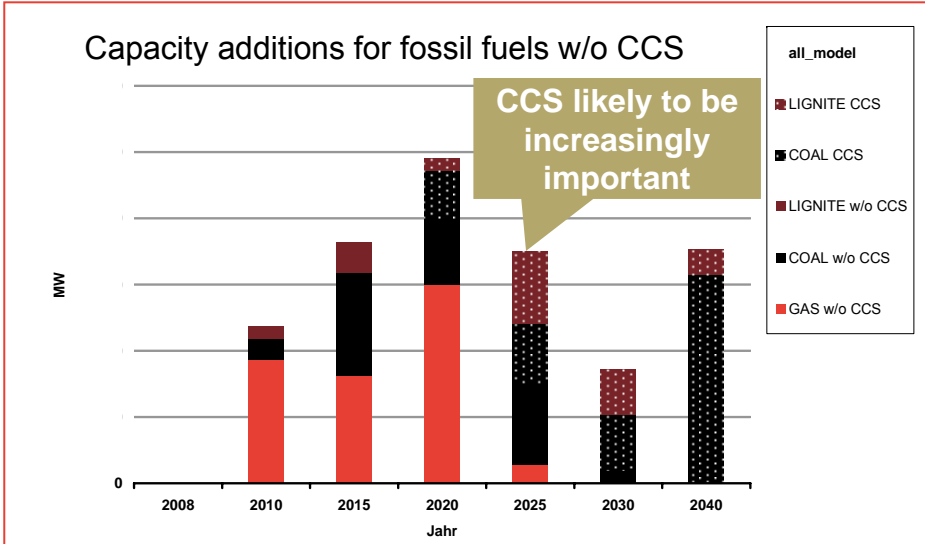
Back stop technologies...

- ...for low carbon power generation (plus energy saving) in the long term essential for reaching CO2 targets
- Backstop technologies can be e.g.
 - Renewables
 - Nuclear
 - CCS



CCS...

- ...expected not to be commercially available before 2020-25
- However, after 2020/2025, CCS can be crucial for CO2 abatement
- Otherwise more nuclear (policy constraints) or more REN (costs?) needed - or non-compliance with targets

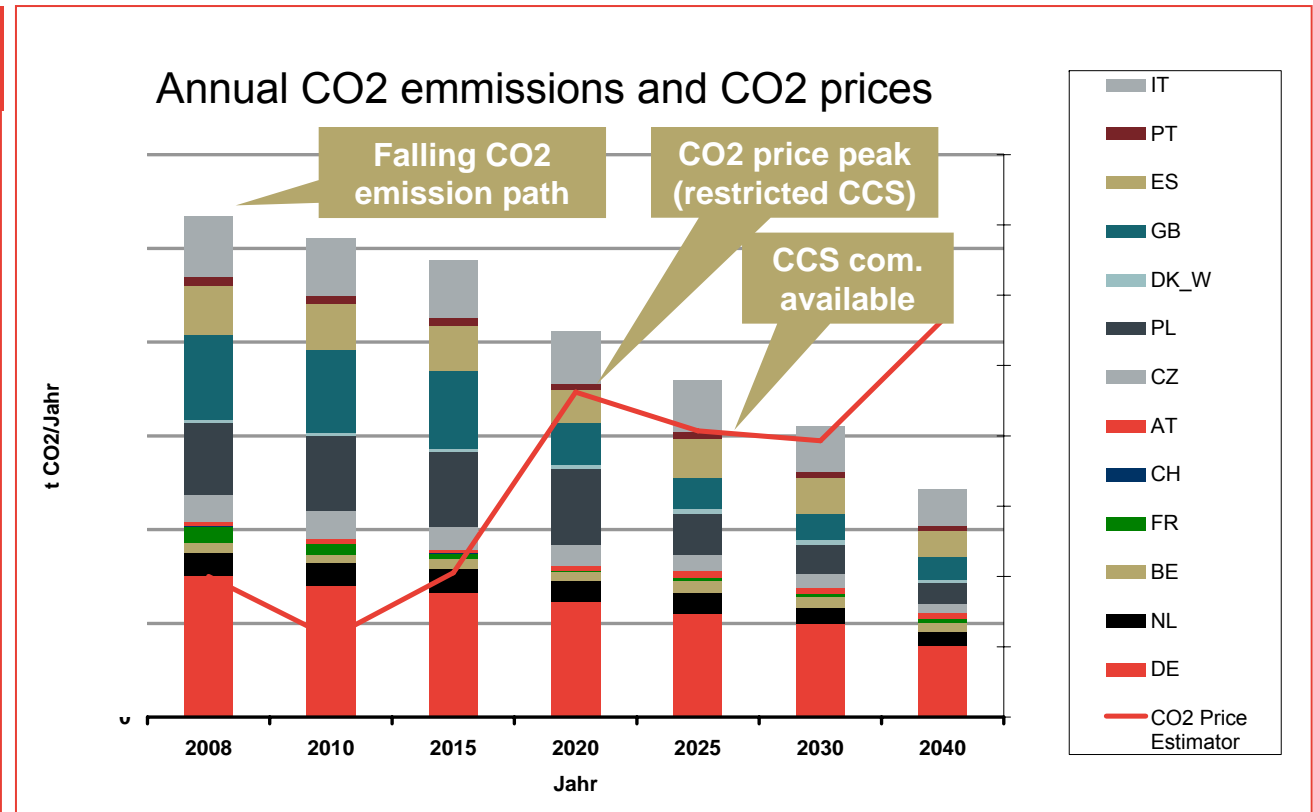


Source: Frontier assumptions and model simulations

CCS may also have a limiting impact on CO2 prices and power prices

CCS...

- ...may be able to limit CO2 and power prices after 2020-25
- CCS can become important especially if
 - REN integration turns out to be costly or technically difficult
 - Nuclear production is politically limited



CCS as an „insurance“ against exploding CO2 prices

Promotion of CCS has an option value... but are there really market failures?

R&D phase

- High risks and high upfront costs
 - Technology and costs still unproven
 - But: Is this a reason for public promotion?
- External effects / public goods character leads to free-ridership
 - Test of political acceptance
 - Test of public acceptance
 - Test of technical feasibility
 - Test of large scale costs

Commercial phase

- CO2 price reflects the economic benefit of CO2 abatement
 - CO2 prices reflect emission constraints
 - Benefit for CCS if stored CO2 is not subject to allowance requirements
- Market failure only if CO2 market is not working effectively e.g.
 - Politically driven CO2 price caps
 - Uncertain policy framework

Focus in the political discussion

- Specifics
- Policy interest
- Sticks/carrots
- Conclusions

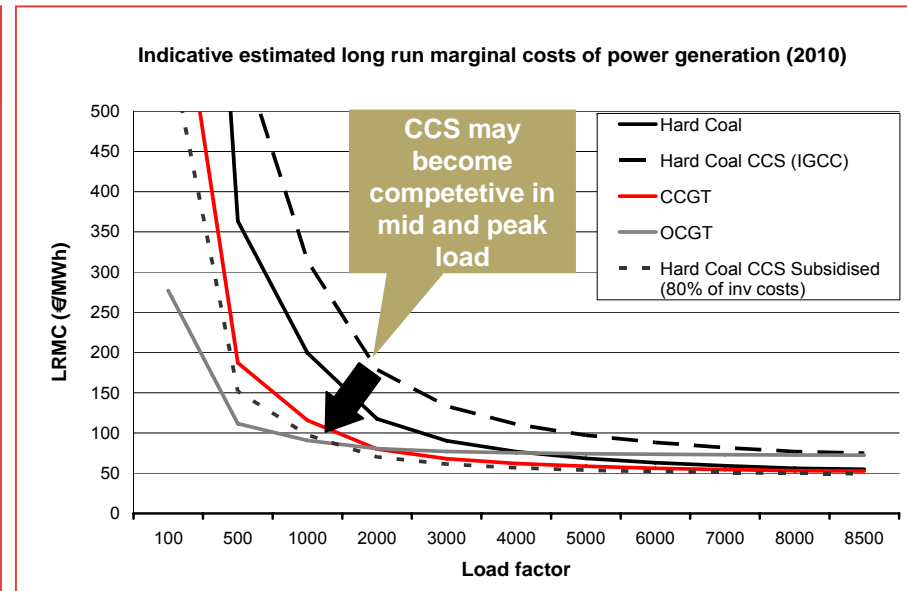
Policy can choose between sticks and carrots to promote CCS

	Schemes	Examples
Carrots	<p>1 Subsidisation schemes</p> <ul style="list-style-type: none"> □ Upfront lump sum payment (fixed mn€) □ Capacity payment to generators per kW (upfront or per year) □ Payments based on electricity production (per kWh) □ Payments based on avoided CO2 emissions (per avoided t CO2) 	<ul style="list-style-type: none"> ● Schemes on EU level and in some EU member states (e.g. UK)
Sticks	<p>2 Obligatory CCS e.g. from 2020/2025</p> <ul style="list-style-type: none"> □ Only new plants vs. retrofit of old plants □ Only coal vs. all fossil fuels 	<ul style="list-style-type: none"> ● Currently discussion about CCS readiness for new plants

Lump sum support vs. output oriented support

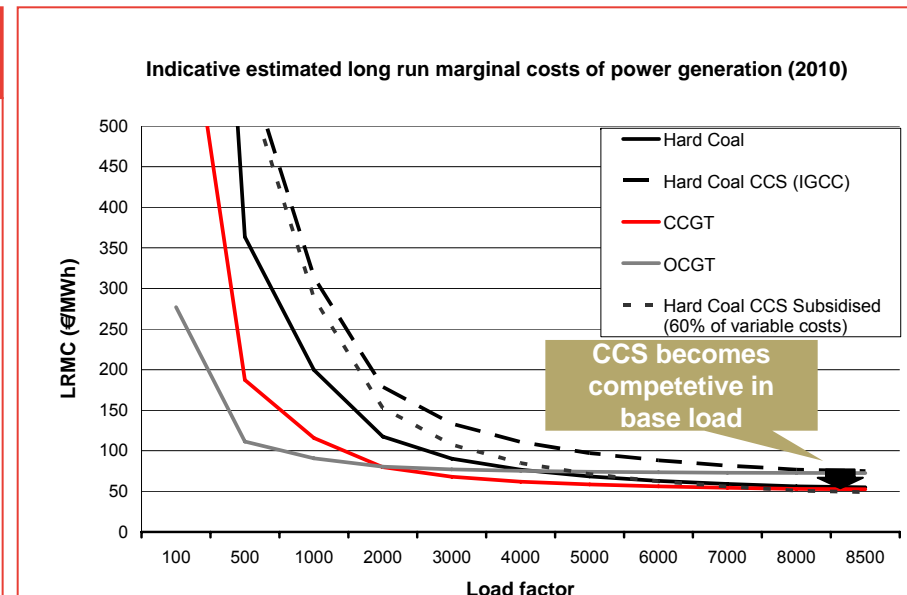
Lump sum & capacity payments

- Current support schemes for demonstration plants focus on lump sum payments or capacity payments (upfront)
- Risk that CCS plants would currently be used as mid or peak load (current CO2 price too low)
- Also less incentive to favour a technology with significant CO2 benefits



Energy related payments

- Energy or output orientated schemes would improve the competitiveness especially in base load
- Higher load factors of CCS than without support
- Also less incentive to favour a technology with significant CO2 benefits



How would markets and market participants be affected by obligatory CCS (e.g. from 2020)?

		What is covered?		
		New coal plants	+ old coal plants	+ new gas plants
Politics		<ul style="list-style-type: none"> • “Cheaper” than “carrots” 		
	Generators	<ul style="list-style-type: none"> • Higher incentive for R&D if early announcement of obligation 		
Potentially less investment in coal		Potential shut down of old plants	No investment in new gas plants?	
Markets		Power	<ul style="list-style-type: none"> • Unambiguous <ul style="list-style-type: none"> □ higher costs for fossil fuelled power plants - but which plant is „at the margin“ regarding LRMC in the reference case? □ Lower CO2 prices (?) and impact on fuel prices (?) 	
	CO2	<ul style="list-style-type: none"> • No impact on emissions if CO2 caps are not adjusted downwards – otherwise only CO2 prices fall • Dirigistic approach – risk of lower efficiency of CO2 abatement • Would the CO2-market (EU ETS) still make sense? 		

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Conclusions

Role of EU ETS

- **Rely on the EU ETS!**
EU ETS can set the right incentives in the long term
 - Requirement: no political intervention into CO2 prices
 - CCS would compete with other „back-stop“ technologies

R&D subsidies

- **Develop the R&D option**
Market failure may justify support in the short/medium term
- **Select an appropriate support scheme!**
Avoid capital grants (may be acceptable for single projects)

CCS obligation?

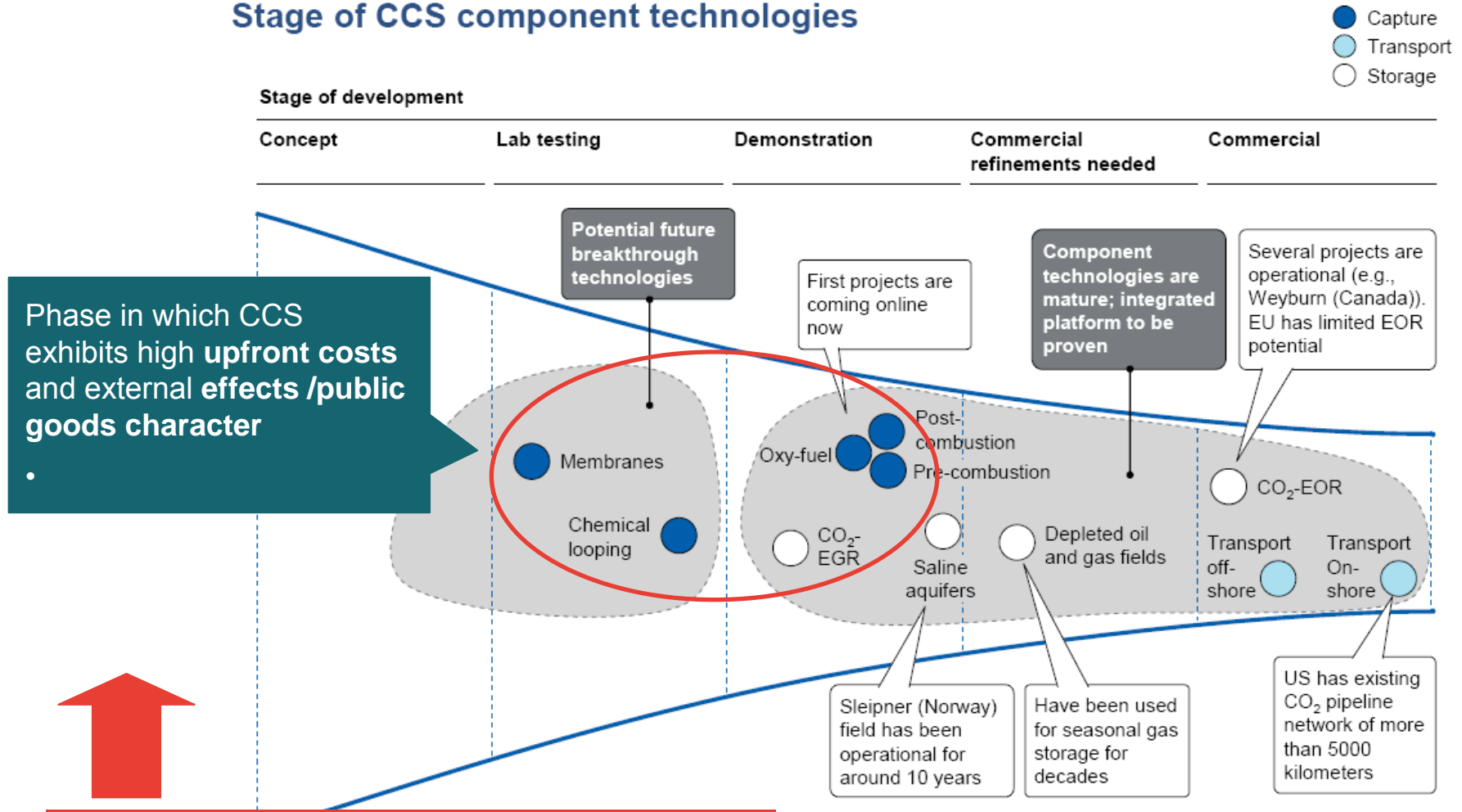
- **Be careful with CCS obligation!**
Risk of reduced efficiency of CO2 abatement
- **Use the EU ETS instead!**
Maintain competition among abatement technologies

Appendix



CCS will only be technically and commercially available if further developed

Stage of CCS component technologies



Major argument for political promotion

Source: McKinsey Report, 2008

The EU currently discusses carrots for pilots

EU ETS directive

- 300 million CO2 emission allowances for funding of clean energy demonstration projects including CCS projects.
- Allowances will be made available until 31 December 2015
- Still open as to how the funding will be split between CCS projects and other clean energy technologies (REN)

Financial stimulus package

Carbon Capture and Storage Projects

Country	Project	Envisaged Community Contribution	Capacity	Capture Technology	Storage Concept
Germany	Hürth	€180m	450 MW	IGCC	Saline Aquifer
	Janschwalde		500 MW	Oxyfuel	Oil/Gas Fields
Netherlands	Eemshaven	€180m	1200 MW	IGCC	Oil/Gas Fields
	Rotterdam		1080 MW	PC	Oil/Gas Fields
	Rotterdam		800 MW	PC	Oil/Gas Fields
Poland	Belchatow	€180m	858 MW	PC	Saline Aquifer
Spain	Compostilla (Leon)	€180m	500 MW	Oxyfuel	Saline Aquifer
United Kingdom	Kingsnorth	€180m	800 MW	PC	Oil/Gas Fields
	Longannet		3390 MW	PC	Saline Aquifer
	Tilbury		1600 MW	PC	Oil/Gas Fields
	Hatfield (Yorkshire)		900 MW	IGCC	Oil/Gas Fields
Italy	Porto Tolle	€100m	660 MW	PC	?
France	Florange	€50m	Transport of CO2 from Industrial installation (steel plant) to underground storage (Saline Aquifer)		

Source: EU Commission



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