Energy research Centre of the Netherlands

CCS in the EU: Environmental impacts

Heleen de Coninck

EEA meeting, Copenhagen: July 4th, 2008

Energy research Centre of the Netherlands

- Develop technologies for a sustainable energy system, and bring them to the market
- Ca. 700 scientific staff, in Petten and Amsterdam
- Technological research but also Policy Studies
- Work on CCS: IPCC Special report on CCS, ACCSEPT project, Consultant for European Commission on CCS Directive and impact assessment

Why is CCS so important?

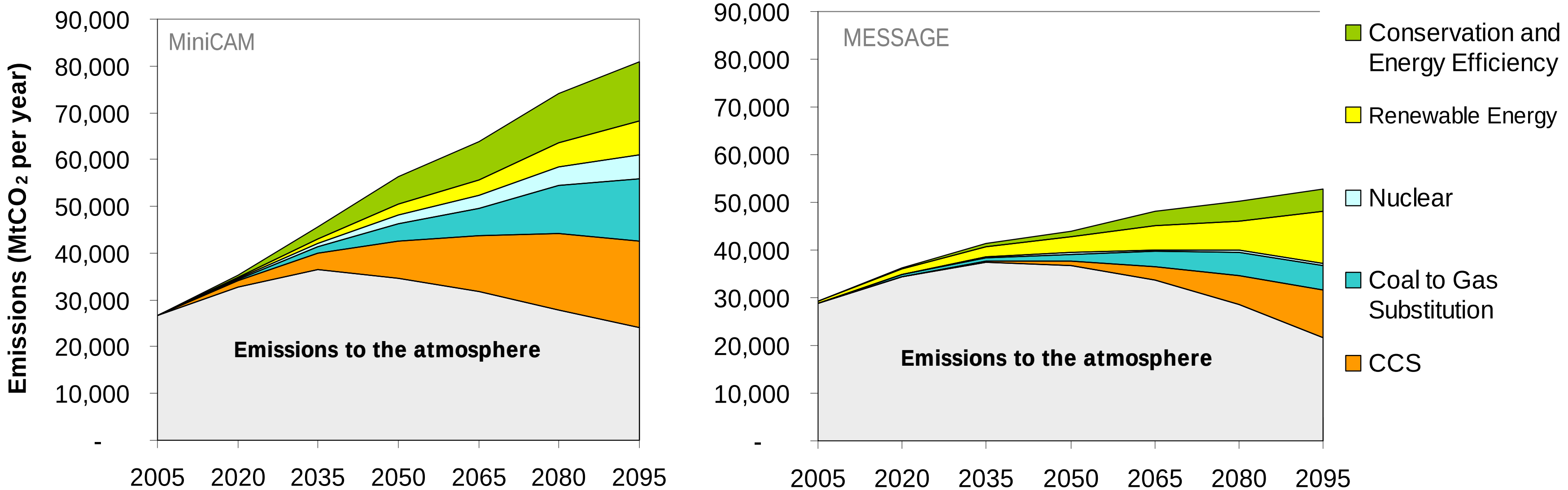
Non-controversial:

- Makes stabilisation cheaper
- Makes stabilisation consistent with energy security
- Allows continued use of cheap fossil fuels (important for development in emerging economies)

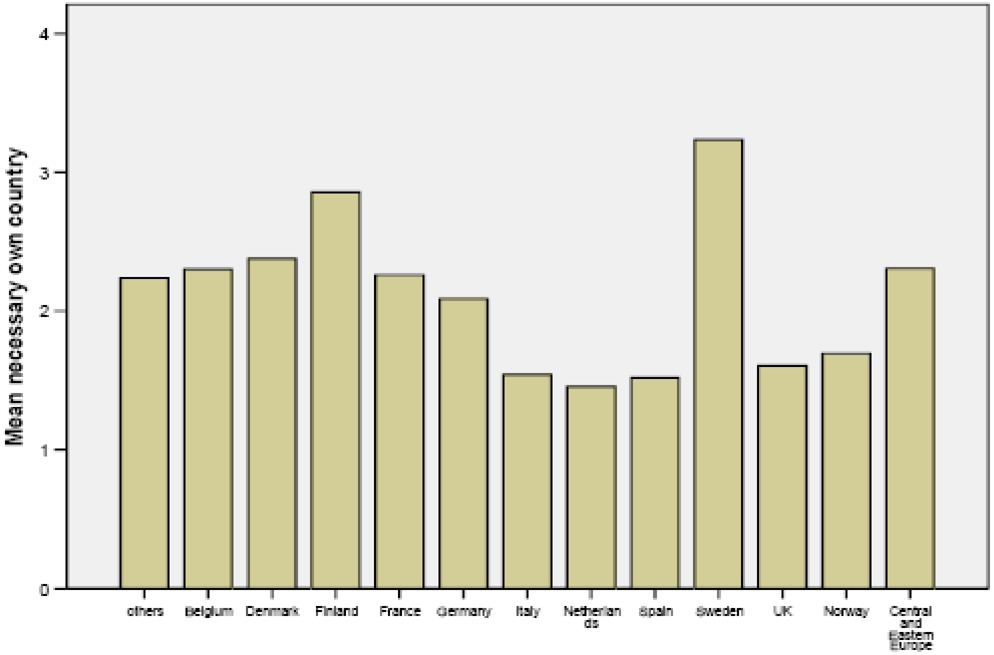
Slightly more controversial

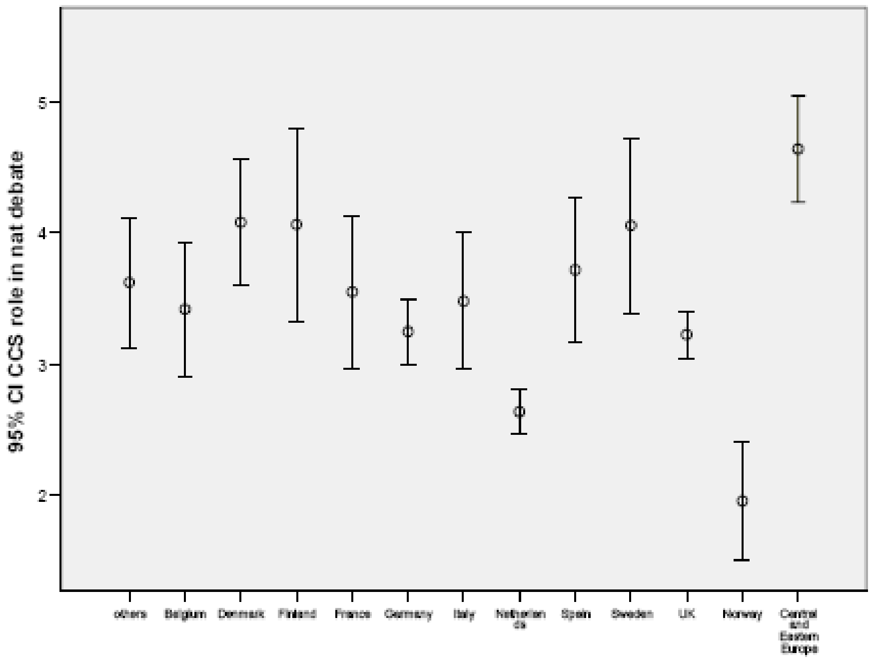
- Makes the fossil fuel industry part of the solution
- Some NGOs: Keeps nuclear at distance

Why is CCS so important?



Stakeholder perception: the ACCSEPT project





Most interest in Norway, UK, Netherlands, Germany, Italy

Risks: global and local

CCS risks

Global risks

Climate risks, impact on energy efficiency and renewables

ETS

Local risks

Water, health and safety, other emissions, biodiversity, waste, …

Directive on geological storage of CO_2

Overview of the project reported

Technical support to EC DG Environment

- Overview of legal gaps and obstacles for CCS
- Recommendations for legal framework for CCS
- Assessment of incentive policy options
- Environmental and economic impact assessment
- Legal drafting: “CCS Directive”

Deployment scenarios by NTUA/ICIS (PRIMES model); storage capacity by TNO

Deployment of CCS in the EU - scenarios

PRIMES model: bottom-up cost optimisation model; runs 2000-2030, including endogenous learning

- Option 0: No CCS enabling policy at EU level; reduction of GHG emissions by 20% in 2020 and 20% renewables; CCS not eligible in the EU-ETS
  - Carbon price: 22 €/tCO_2-eq
- Option 1: Option 0, and enable CCS under the ETS
- Option 2: Option 1, and mandate CCS from 2020 onwards, on a) new coal; b) new coal&gas; c) new coal + retrofit; d) new coal&gas, and retrofit

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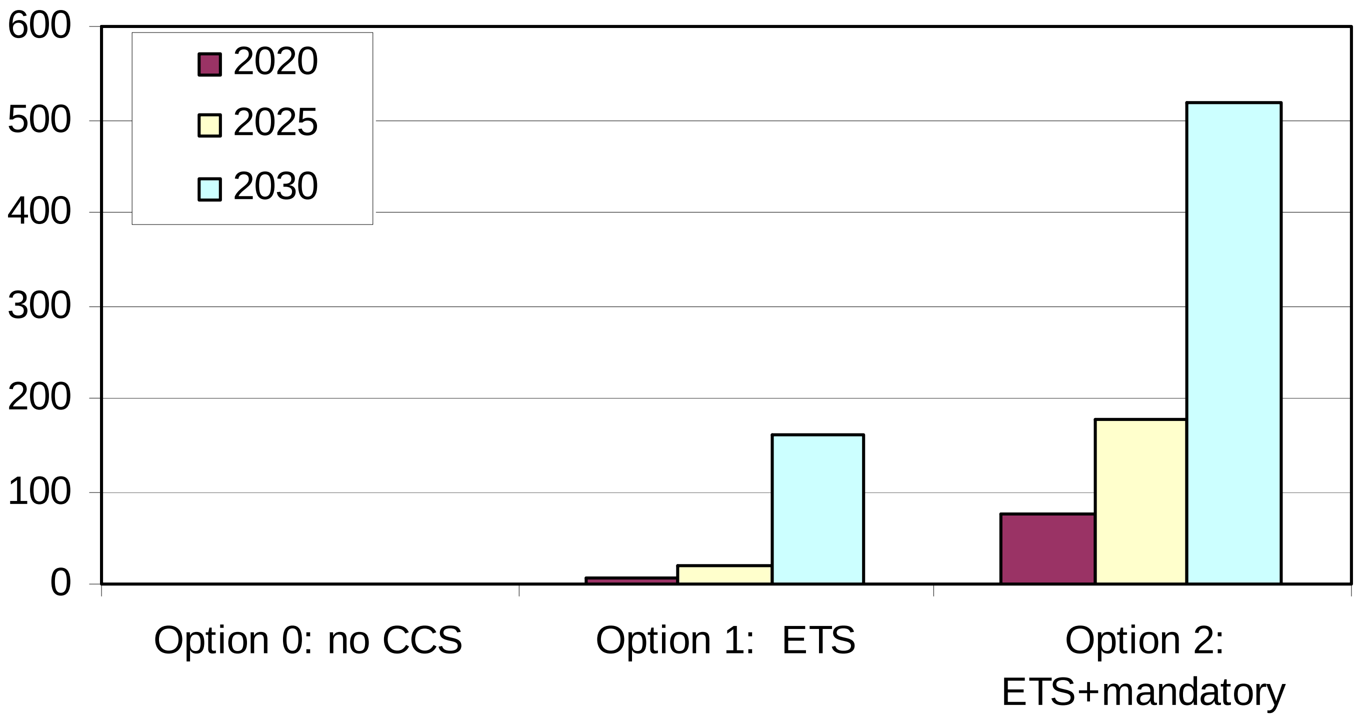
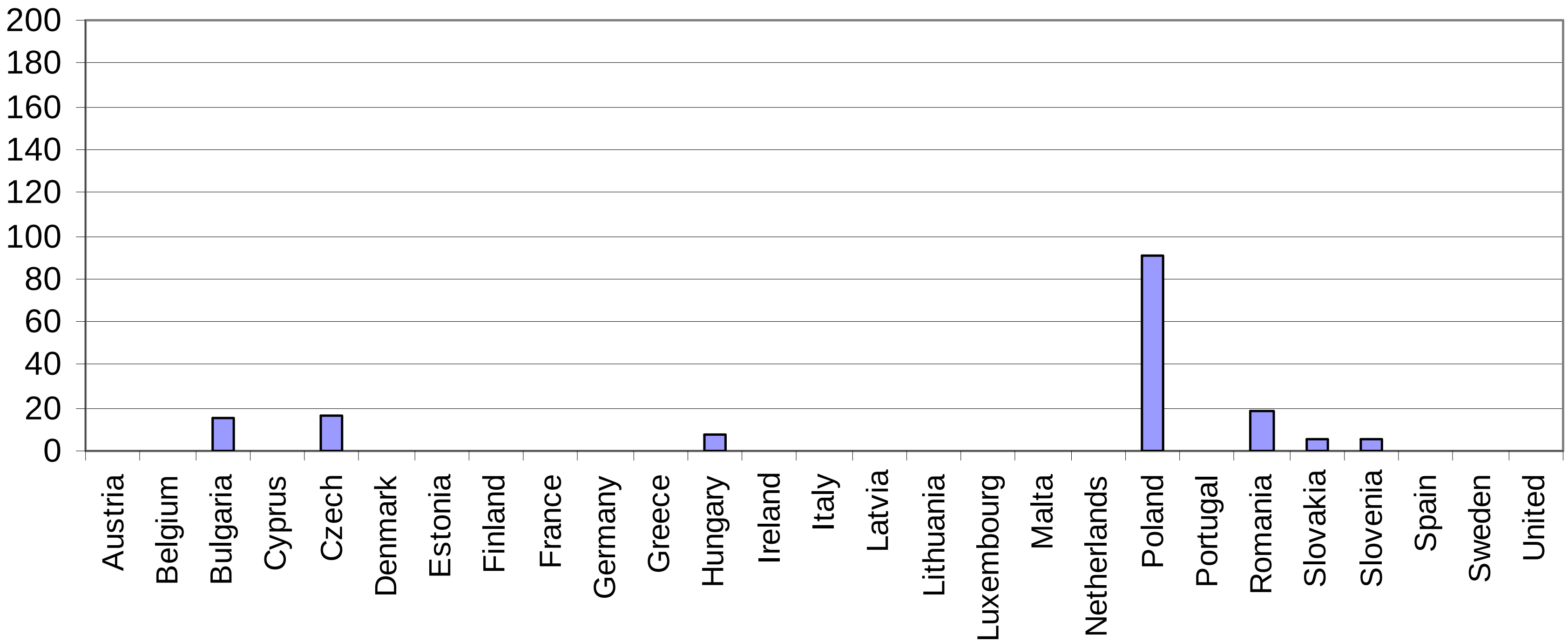
Total CCS deployment



Country-specific CCS deployment: Option 1



Total in 2030: 161 $MtCO_2$

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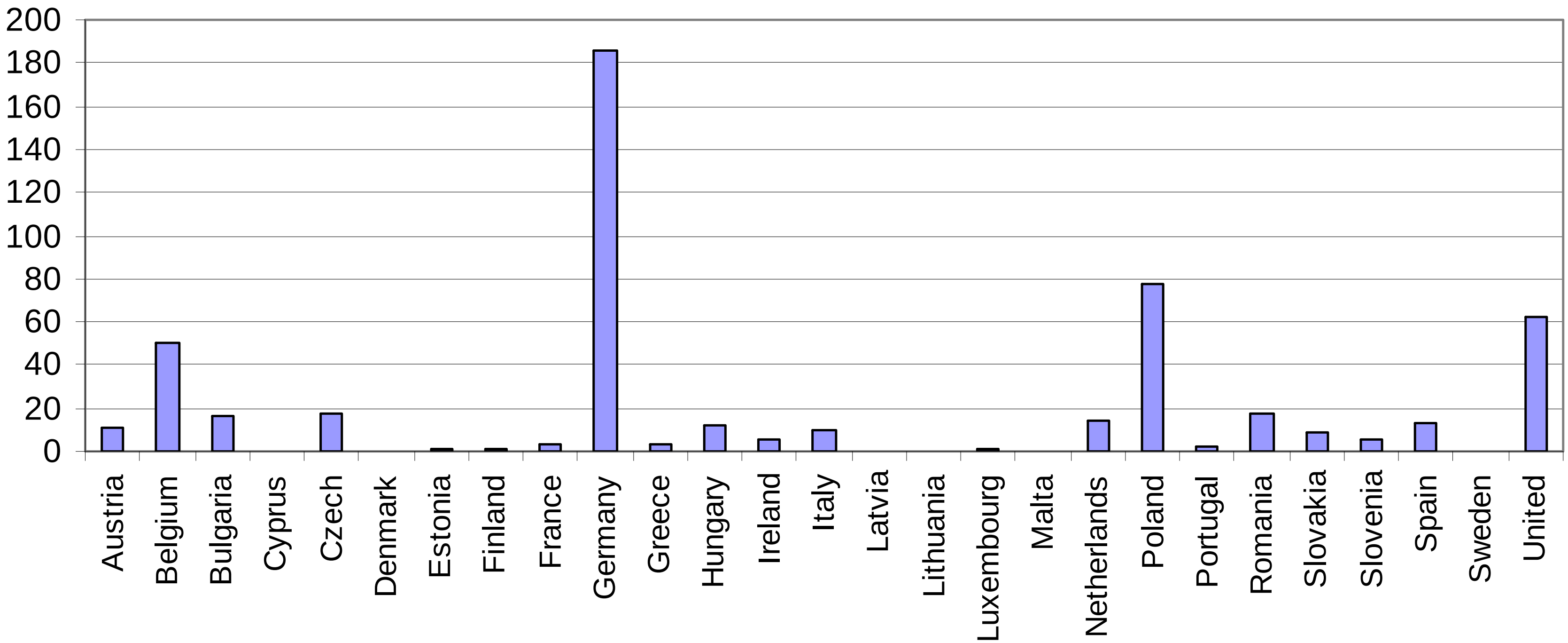
Country-specific CCS deployment: Option 2



Total in 2030: 517 $MtCO_2$

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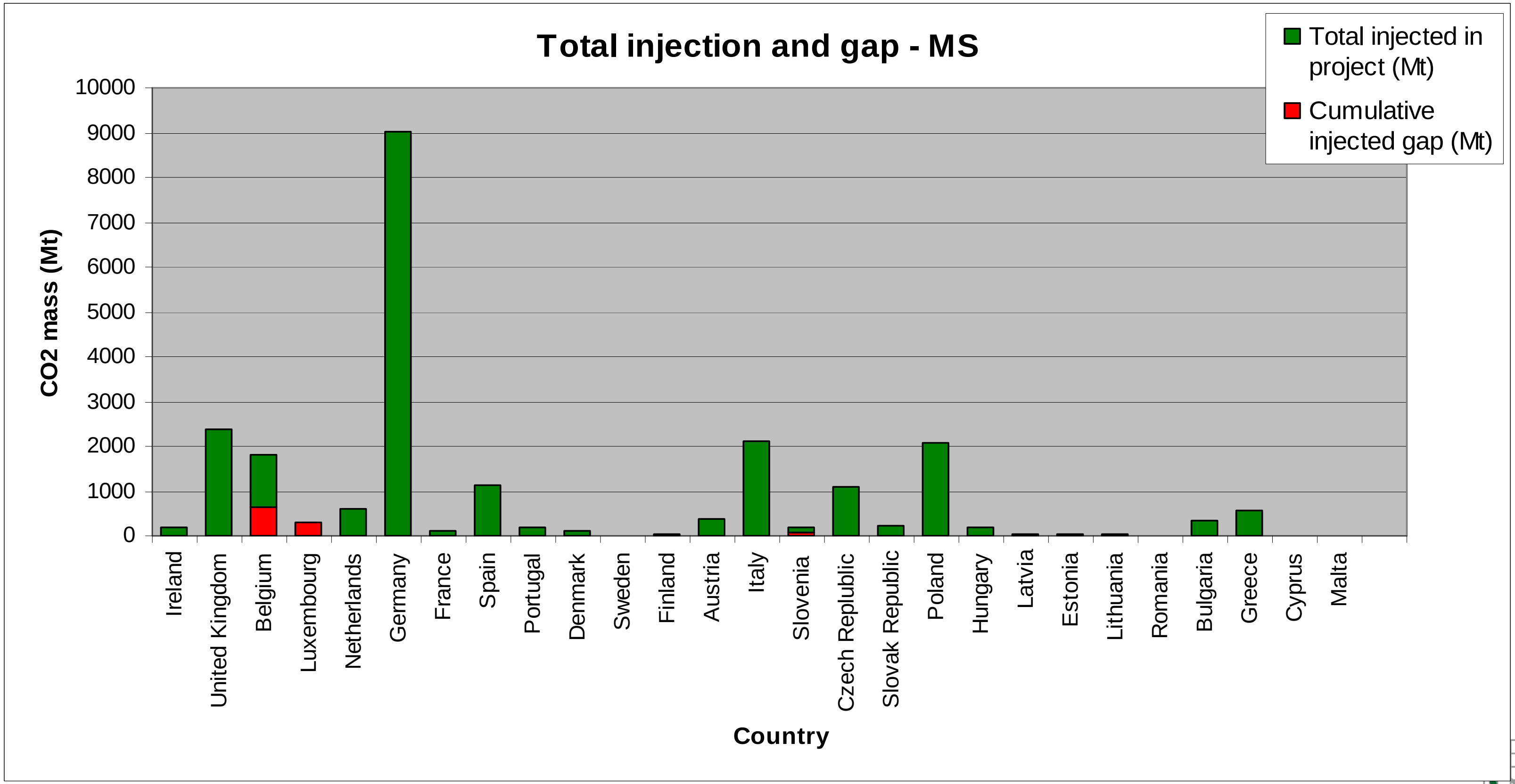
Is there enough storage capacity?



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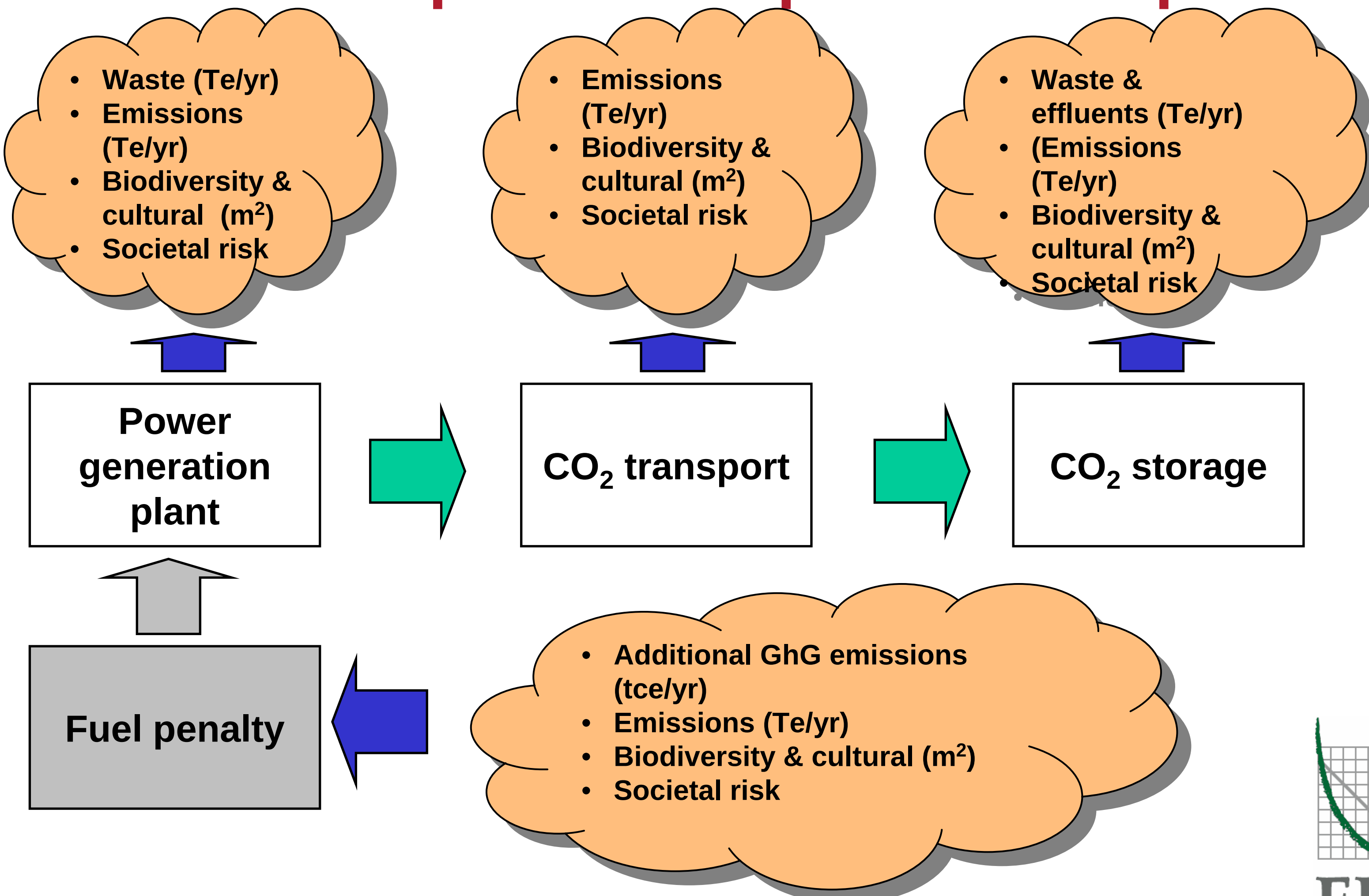
Economic impact of CCS in the EU

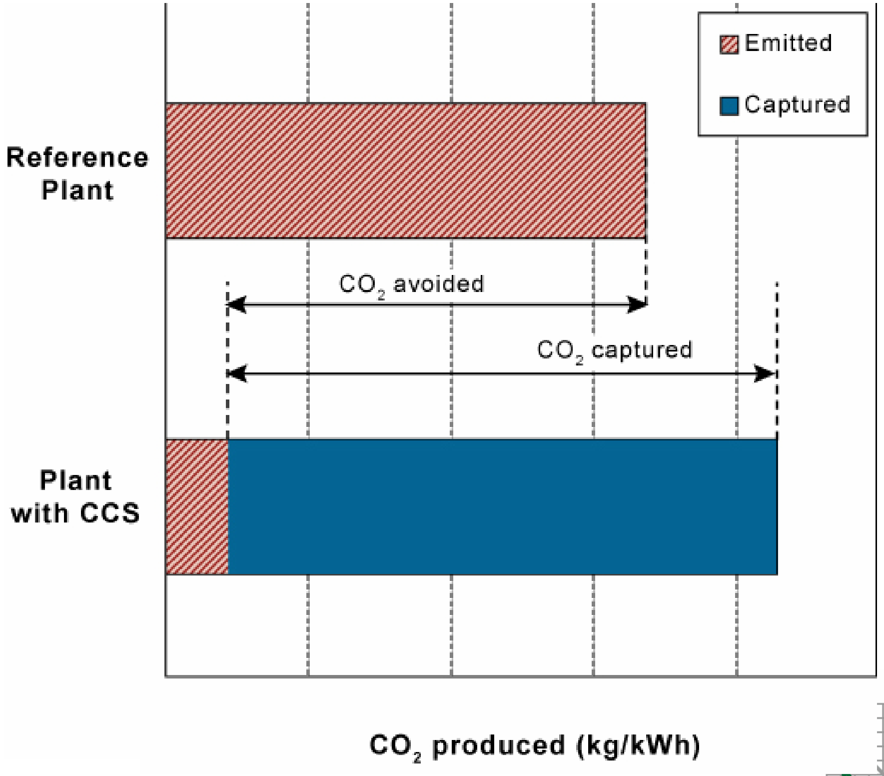
- Reducing emissions without CCS eligible in the ETS can be up to 40% more costly
- Mandating CCS is more expensive, but the costs depend on the scenario.
- Mandate on new coal+gas and retrofit leads to large extra costs (€ 12.6 billion per year) and a significant shift in country-specific deployment
- Economics depend (a.o.) on availability of storage sites nearby, and therefore on transport and storage cost

Environmental impacts: components/outputs



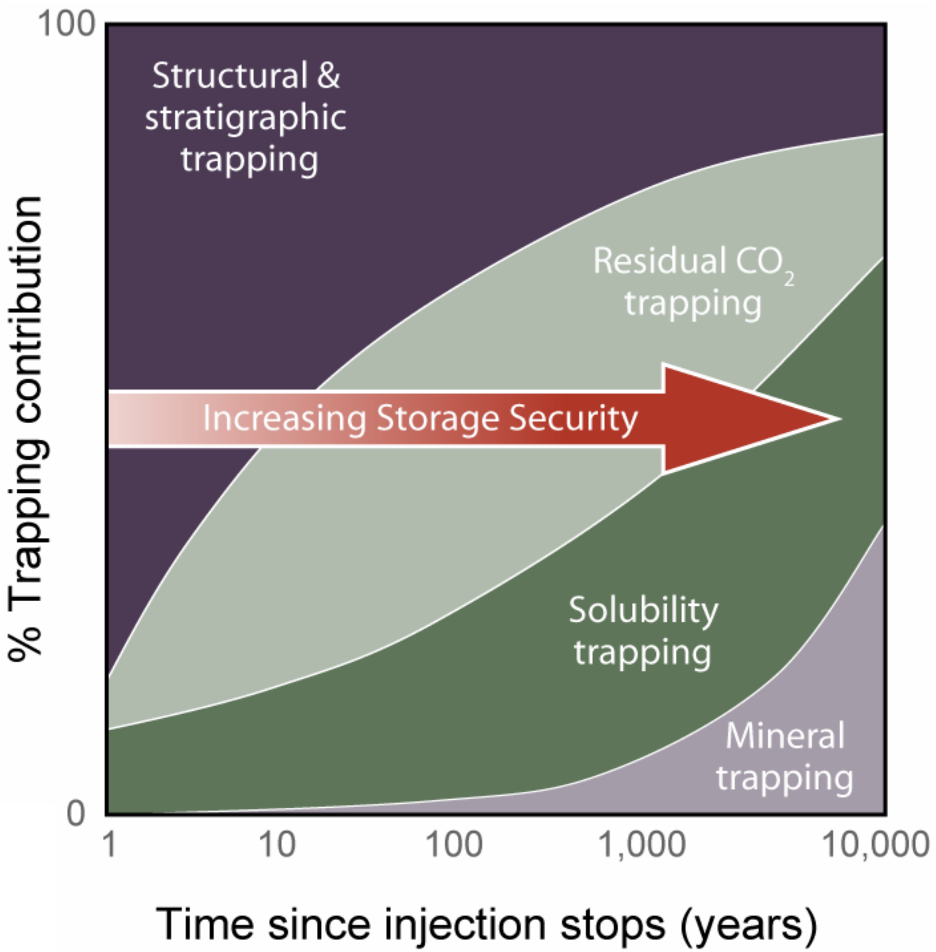
Additional energy use

- Additional energy use
  - 10 - 40% (for same output)
- Capture efficiency:
  - 85 - 95%
- Net CO_2 reduction:
  - 80 - 90%
- Assuming safe storage
- Not taking into account upstream emissions



Storage security

- No real examples, but deduced from natural analogues and geological operations
- Site selection
  - Site characterisation
  - Geological monitoring
- Regulatory system
  - Monitoring
  - Remediation
  - Liability transfer



Scope and assumptions

- Define incremental impact with respect to conventional generation
- Scope of assessment (as per earlier slide):
  - accidental risk to people (referred to as societal risk);
  - greenhouse gas (GHG) emissions;
  - other emissions to atmosphere (NO_X, SO_2, etc);
  - wastes and effluents;
  - geology and hydrogeology;
  - biodiversity;
  - cultural (land-use, landscape, heritage);
  - employment generation
- Major assumptions:
  - Clean coal techs $\Rightarrow$ no new societal risk
  - 10% CO_2 in air $\Rightarrow$ fatal dose
  - No geological system failure (non-engineered) $\Rightarrow$ Assumed that regulatory framework ensure good selection
  - Releases offshore $\Rightarrow$ no public risk
  - Onshore/offshore split $\Rightarrow$ source-sink matched

Societal Risk (1)

	2015		2020		2025		2030	
	Op1	Op2	Op1	Op2	Op1	Op2	Op1	Op2
Fatalities (person/yr)	**-**	**-**	**<1**	**<5**	**<1**	**<10**	**<5**	**<10**
Accidental releases of CO_2 (kt CO_2 /yr)	**-**	**-**	**127**	**686**	**172**	**822**	**305**	**962**
% of total captured	**-**	**-**	**0.16**	**0.16**	**0.15**	**0.15**	**0.16**	**0.15**

- **Based on conservative release scenarios and average population densities**

Societal Risk (2)

- Assumes no new risks from clean coal/capture technology
- Based on 10% lethal concentration in air
- Reducing lethal concentration to 7% leads to <20 fatalities a year in 2030 for Option 2 (deepest deployment)
- Comparison with natural gas tricky as different hazard (fires, dispersion) and risk characteristics
- CO_2 pipelines potentially more onerous per km
- Absolute scale (30,000 km vs 110,000 km) means overall risk is lower

Biodiversity & cultural impacts

- Some very minor landtake associated with CO_2 capture plant deployment
- Pipeline corridors could lead to bigger landtake – 30,000 km * 20m = 600 km²
- Leaks of CO_2 from pipelines and storage could impact; soil & groundwater acidification, ocean acidification, asphyxiation of flora and fauna
- Regulatory framework designed to manage down this risk
- Risk of inaction could be equivalent if atmospheric CO_2 levels continue to rise

Summary/conclusions

- Societal risks posed by CCS are comparable with other technology and can be considered low
- Conservative assumptions lead to hazard broadly similar to natural gas pipelines (although absolute risk much lower)
- Rough indication of certainties:

	Estimated impacts	Uncertainty
Capture	Low	Low
Transport	High	Low
Storage	Low	High

THANK YOU

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With thanks to Paul Zakkour, ERM Energy & Climate Change

Note: these results and views present those compiled by the authors and do not necessarily represent finalised EU policy information.