Ramp-up of large-scale CCS infrastructure in Europe

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Aim

To investigate the relevance of CCS and to classify cost for transport and storage of CO2 for each individual EU member state (MS). Emphasis on power plant clusters, ownership concentration, source-sink distance and onshore storage potential.
The cost category for each MS is used as input in a techno-economic modeling to evaluate the future electricity supply system in Europe (see parallell paper by Odenberger et al., at this conference).
Based on the modeling results, a detailed CO2 transportation and storage infrastructure for Germany and UK is given and issues related to the ramp-up of such infrastructure is discussed.

Relevance and cost classification of CCS in EU member states

	GHG emissions Base Year	GHG Emissions 2006	CO2 Power & Heat[1]	Storage Capacity[2]	Identified Sites	Plant	Ownership	Approx distance[3]	Storage Cost	
	Mt CO2 eqv	Mt CO2 eqv	Share 2006, %	Mt CO2	Onshore/Offshore	Clusters	Concentration	Source-sink, km	Classification	CCS Relevance
Austria	79.0	91.1	13.2	500	Onshore	Yes	Fair	0-280	2	Moderate
Belgium	145.7	137.0	16.5	100	Onshore	Yes	Considerable	40-100	1	Moderate
Bulgaria	132.6	71.3	38.4	825	Onshore[4]	Yes	Considerable	0-170	1	Good
Cyprus	6.0	10.0	36.5	0	na	Yes	Considerable	na	3	Poor
Czech Rep	194.2	148.2	36.8	3 190	Onshore	Yes	Fair	10-60	1	Good
Denmark	69.3	70.5	38.1	18 007	Onshore & Offshore	Copenhagen	Considerable	0-120	1	Good
Estonia	42.6	18.9	60.6	0	na	Yes	Considerable	250-400 plus	3	Poor
Finland	71.0	80.3	36.6	0	na	Helsinki	Fair	370-1000	3	Poor
France	563.9	541.3	8.7	1 850	Onshore	Yes	Fair	0-240	2	Moderate
Germany	1 232.4	1 004.8	32.8	14 879-30 879	Onshore[4]	Yes	Considerable	20-450	1	Good
Greece	107.0	133.1	38.3	2 228	Onshore & Offshore	Yes	Considerable	30-240	1	Good
Hungary	115.4	78.6	22.2	5 648	Onshore	No	Poor	60-130	1	Good
Ireland	55.6	69.8	20.7	455	Offshore	Yes	Considerable	30-150	1	Good
Italy	516.9	567.9	21.4	2 417	Onshore & Offshore	Yes	Considerable	0-150	1	Good
Latvia	25.9	11.6	17.4	300	Onshore	No	Considerable	70-170	1	Good
Lithuania	49.4	23.2	16.1	18	Onshore	No	Considerable	250-530	3	Poor
Luxemb	13.2	13.3	11.0	0	na	No	Considerable	80 plus	2	Good
Malta	2.2	3.2	62.1	0	na	Yes	Considerable	na	3	Poor
Netherlands	213.0	207.5	23.8	11 255	Onshore & Offshore	Yes	Considerable	0-200	1	Good
Poland	563.4	400.5	44.0	4 794	Onshore	Yes	Fair	0-220	1	Good
Portugal	60.1	83.2	23.5	0	Onshore & Offshore	Lissabon	Considerable	0-100	2	Moderate
Romania	278.2	156.7	31.1	5 500	Onshore	Yes	Considerable	0-100	1	Good
Slovakia	72.1	48.9	16.8	1486	Onshore	No	Considerable	0-80	1	Good
Slovenia	20.4	20.6	30.8	149	Onshore	No	Poor	0-50	1	Moderate
Spain	289.8	433.3	23.4	43266	Onshore	Yes	Poor	0-300	2	Good
Sweden	72.2	65.7	12.4	1610	Offshore	No	Poor	25-310	3	Poor
UK	776.3	652.3	28.3	30352	Offshore[4]	Yes	Poor	60-480	2	Good
SUM EU	**5 767.8**	**5 142.8**	**26.8**	**148 829-164 829**	**Onshore & Offshore**					

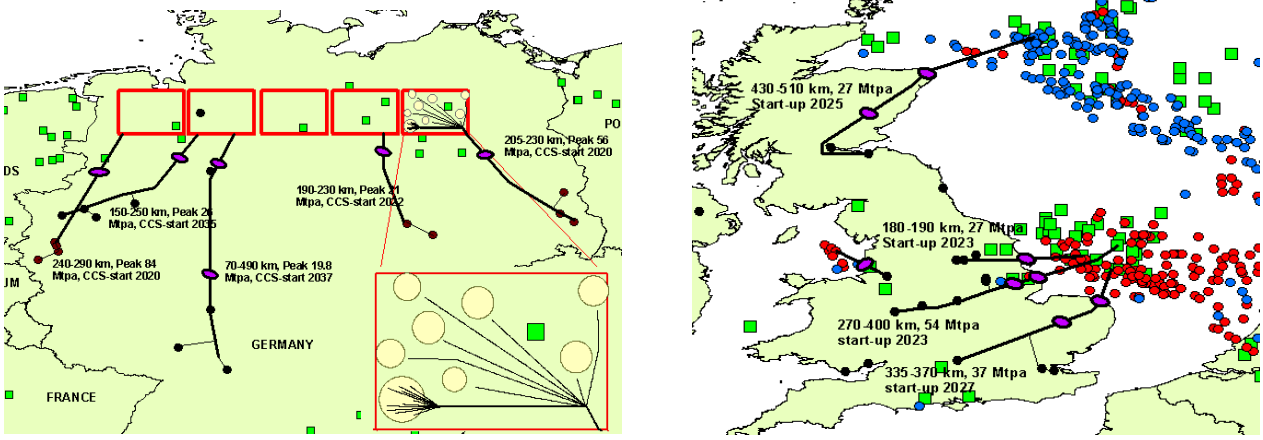
[1] Power and Heat refers to Public Power and Heat generation corresponding to source category 1A1a as defined by UNFCCC

[2] Storage potential refers to those figures that have been publicly announced as of October 2008 involving various degrees of accuracy. Also, investigations are ongoing within several MS to raise the accuracy and/or to identify new potential structures.

[3] Distance source-sink refers to straight line distance, a "real life" pipeline will necessarily be considerably longer

[4] Storage potential includes 4 Mt offshore potential in Bulgaria, 65 Mt offshore potential in Germany and 302 Mt onshore potential in UK

Centralised CCS infrastructure for the electricity sector in Germany (left) and UK (right)



Summary

- An overall assessment of the prospects for CCS in the European power sector is presented.
- Most MS have suitable subsurface reservoirs and large clusters of emission sources along with considerable national or regional concentration of plant ownership, factors that may facilitate the ramp-up of a bulk CCS infrastructure.
- CCS plants are likely to be located on existing plant sites and CO2 pipeline trajectories to follow existing trajectories for natural gas pipelines.
- A key issue will be the phasing out of existing plants versus phasing in of new CCS plants.
- Some 5.2 Gt CO2 is being captured and stored in Germany between 2020 and 2050 and 3.7 Gt in the UK.
- Require CCS infrastructure investments: between € 6.1 and € 7.8 billion in Germany, between € 6.7 and € 10.1 billion in the UK, depending on reservoir injectivity. Specific costs for transport and storage range between € 3.4 and € 4.4 per ton CO2 in Germany and between € 5.4 and € 8.1 in the UK.
- Lignite only abundant resource within Europe that can provide competitively priced base-load power. Lignite for power with CCS could potentially improve energy security considerably within the union.

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