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Reduction of greenhouse gases emission by post combustion capture

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How can one capture CO2 ?

- CO_2 capture is already ***an industrial technology,*** used today notably to process natural gas. It is commonly called on in the manufacture of fertilizers, in the food-processing industry and in the energy sector (the oil and gas industry).
- The main problem is generally the low concentration of CO2 in the flue gas.
- It would be out of the question to seek to compress the CO2 for storage, from the standpoint of both energy and storage capacity.
- Separation methods are thus required so as to trap CO2 preferentially.
- Three main categories are recognized:
  - post-combustion capture,
  - oxy-fuel combustion capture, and
  - pre-combustion capture.

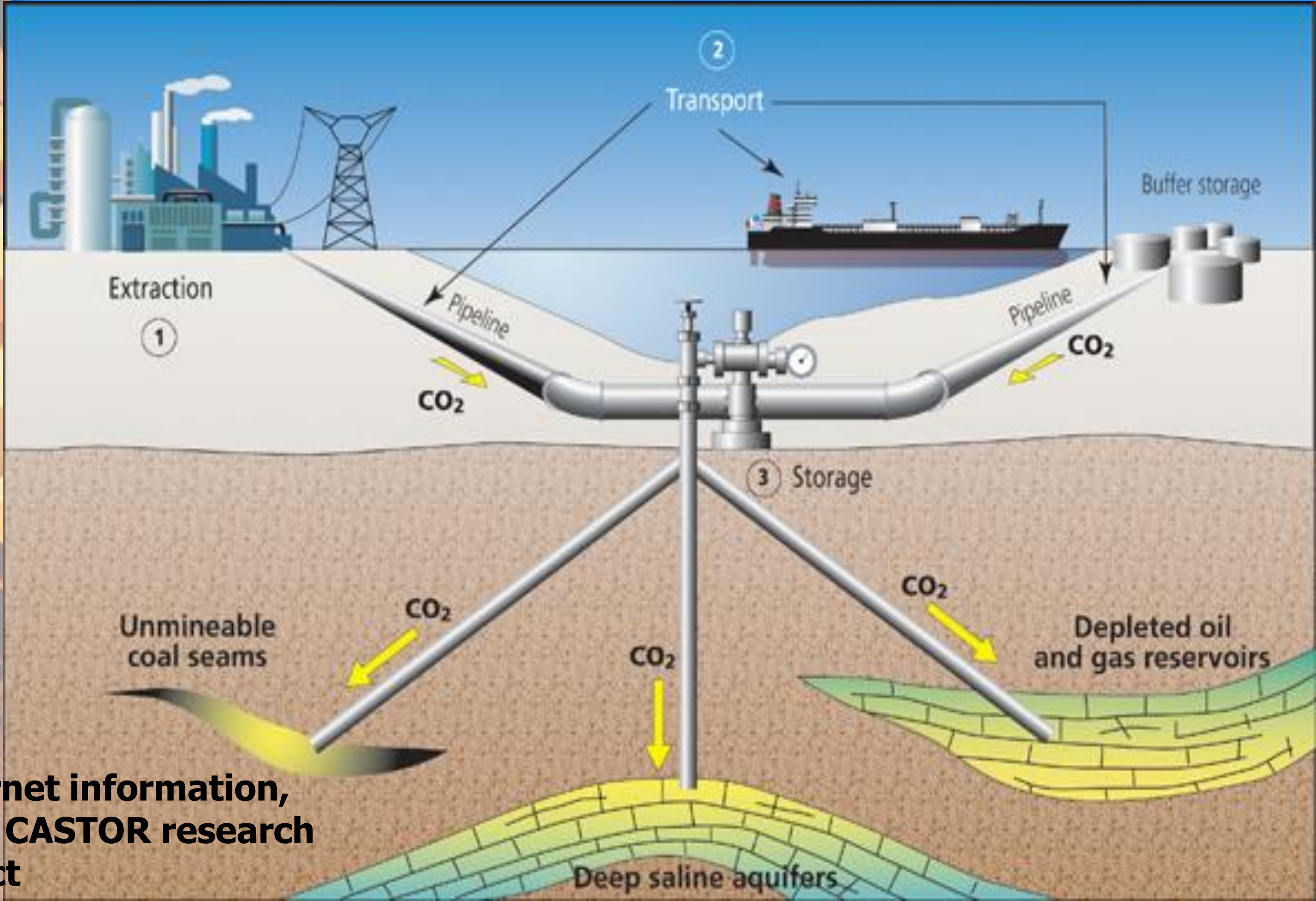
•Internet information, 2006, CASTOR research project

Post-combustion capture

- Post-combustion capture is designed to extract the CO2 that is diluted in the combustion flue gas. It can be integrated into existing facilities without demanding any major modifications. The most common process is CO2 capture by solvents, generally amines.
- **This is the capture process tested in Elsam power plant (Esbjerg) for Castor pilot.**
- Other processes are under consideration involving the *calcium cycle and cryogenic separation*. The former consists in quicklime-based capture that yields limestone; this is then heated, thereby releasing CO2 and producing quicklime again for recycling. The cryogenic process is based on solidifying CO2 by frosting to separate it out.

•**Internet information, 2006, CASTOR research project**

Main options for the transport and geological storage of CO_2



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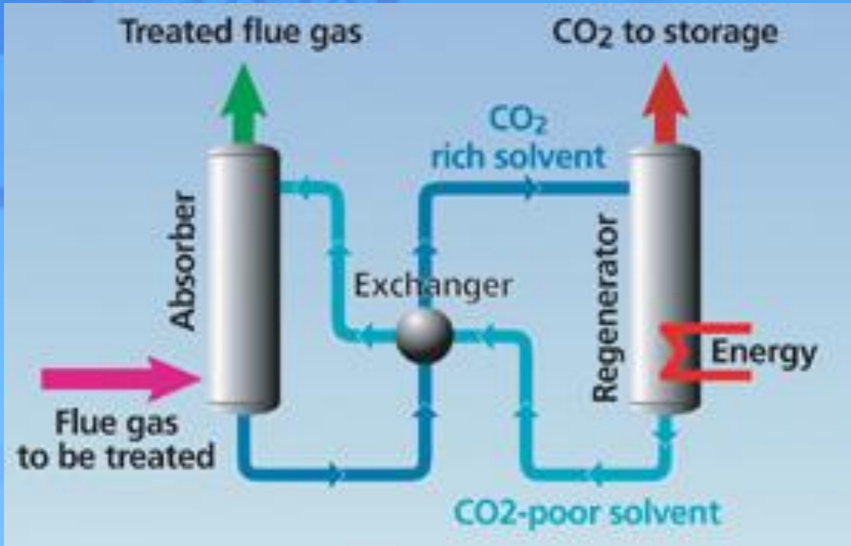
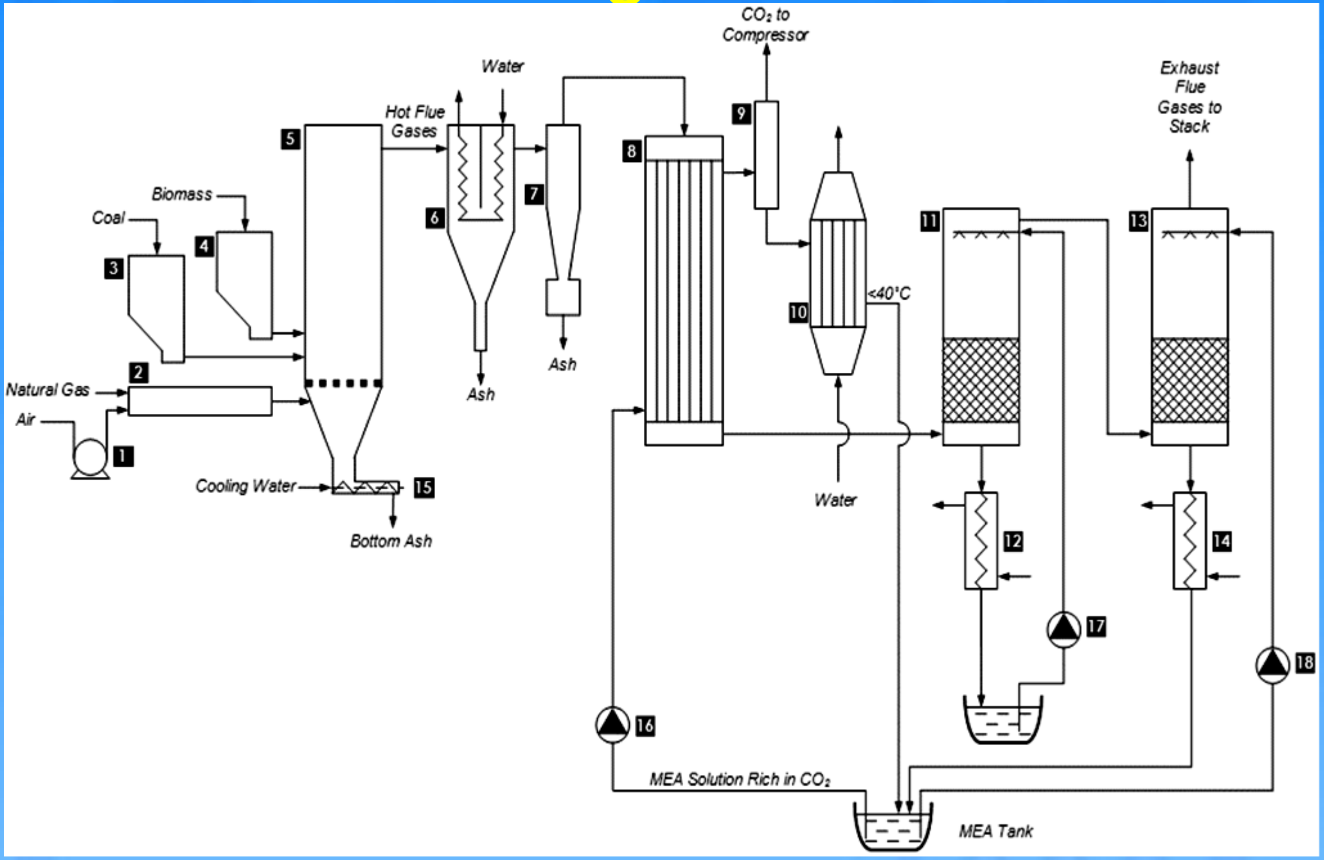
Capture CO_2 by absorption

1. The pilot unit captures CO2 in the flue gases emitted by the co-combustion: it is a "post-combustion" capture.
2. The flue gases to be treated are directed to an absorber, where they are mixed with a solvent. Having more affinity with the CO2 molecules than with the other components of the flue gases (in particular nitrogen), the solvent captures the CO2 (the solvent is "enriched") and the other molecules are discharged from the absorber (treated flue gases). Nearly 90 % of the CO2 in the flue gases is trapped by the solvent.
3. The CO2-rich solvent is then fed to a regenerator. The device is heated to 120°C in order to break the bonds between the CO2 and the solvent. The CO2 is then isolated and transported to its storage place. The solvent, restored to its initial form ("CO2-poor" solvent), is reinjected into the absorber with the flue gases to be treated.



Facility for the CO_2 Separation and Capture Process from the co-combustion flue gases



1. Air Fan, 2. Combustion Air Pre-Heater, 3. Coal Feed, 4. Biomass Feed, 5. Combustion Chamber, 6. Heat Exchanger Flue Gas-to-Water, 7. Cyclone, 8. De sorption Tower, 9. CO2 Separation Unit, 10. Cooler, 11. Scrubber, 12. Liquid Cooler, 13. CO2 Absorption Tower, 14. Liquid Cooler, 15. Bottom Ash Cooling Screw, , 16., 17., 18. Pumps.

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Photo of the CO_2 capture facility

Results

t_{ga}	O_2	CO	CO_2	NO	NO_x	SO_2
[°C]	[%]	ppm	[%]	ppm	ppm	ppm
FG BEFORE DESORPTION						
265.80	11.11	557	8.48	160	168	498
241.80	6.14	419	12.74	121	127	1172
FG AFTER ABSORBER						
52.40	18.74	815	1.94	48	51	27
49.30	19.23	1477	1.51	27	29	4

Conclusions versus CO_2

- **The process represents a near-term, low-risk and low-cost, sustainable, renewable energy option that promises reduction in CO_2, NO_x and SO_2, and other social benefits.**
- **In order to generate a total CO_2 lean global process by CO_2 absorption (through scrubbing with monomethanolamine-amine MEA), the CO_2 emission might be also reduced and controlled, of course by paying the price for the supplementary technology.**
- **The cost of conventional processes for CO_2 capture in the flue gases of large industrial facilities, already operational, in particular in Japan, is estimated at between €50 and €60 per tonne of CO_2. The Elsam industrial pilot is expected to halve the cost per tonne of CO_2 avoided, €20 - €30.**

Possibility of financial gain from CO_2 reduction

- The proposed technology is therefore a sustainable, interim mechanism for meeting commitments to the Kyoto Protocol.
- There are three major environmental markets from which co-firing facilities in EU Member States could potentially benefit:
  - EU Emissions Trading Scheme (EU ETS),
  - National Green Energy Schemes (Green Certificates),
  - National Energy Efficiency Schemes (e.g. Combined Heat &Power markets).