



ASSESSMENT OF CCUS SYSTEMS INTEGRATION INTO COAL POWER PLANT IN THE CZECH REPUBLIC

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Economic assessment of CCS technologies -general assumptions



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- CCS technology integration
 - Increase CAPEX
 - Increase OPEX
 - ✓ material consumption
 - ✓ Heat and electricity consumption
 - Transport and storage CO₂ cost
- Economic effectivity of CCS technologies is a key issue for its industrial application



Input cases

- Analysed cases:
 - **Power plant with and without CCS technology**
 - 250 MWe designed power output
 - subcritical steam parameters
 - fuel = czech lignite (app. 10 MJ/kg)
 - CCS technology
 - Oxyfuel
 - » Without dryer
 - » With dryer
 - Amonnia scrubbing



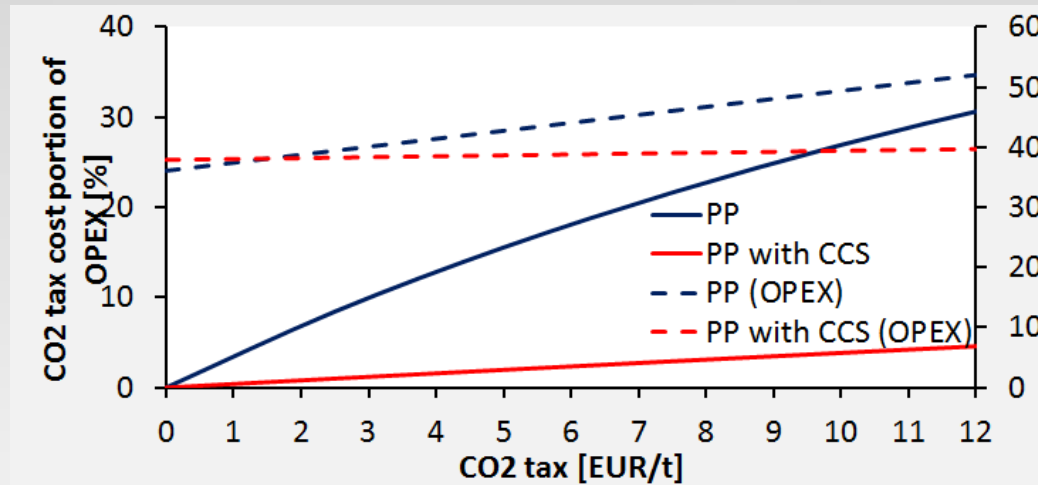
Economic input data

Parameters	Value	Unit
Annual operational time	6300	h/year
Life time of power unit	25	years
Construction time of power unit	4	year
Fuel price	360	CZK/t
Limestone price	670	CZK/t
CO ₂ tax	6	EUR/t
O&M cost coefficient	1	%
Annual rates		
fuel	4	%
chemicals (water, limestone, oxygen etc.)	2	%
CO ₂ tax	-	%
Others cost and yields	1	%
Discount rate	8	%



CAPEX and OPEX

- increase CAPEX of app. 5 billion CZK (up to 45%)
- Reduced OPEX for cases with CCS technology => CO₂ tax cost



- **Case without CCS** - 75 % OPEX consist of fuel cost (55%) and CO₂ tax cost (20%)
- **Cases with CCS** 80 % OPEX consist of fuel cost (60%) and O&M cost (20%)



COE I.+Removal Cost

Cost of electricity	PP	PP with CCS
COE without transport and storage cost [USD/MWh]	50	65 - 75
COE with transport and storage cost [USD/MWh]	50	70 - 80
Increase COE due to transport and storage cost [%]	-	9- 10%

– increase of cost of electricity (COE) up to 55%

CO ₂ removal cost in EUR/t	PP with CCS
CO ₂ removal cost (COE)	20 - 23
CO ₂ removal cost (LCOE)	25 - 28

CO₂ tax => 4-6 EUR/t

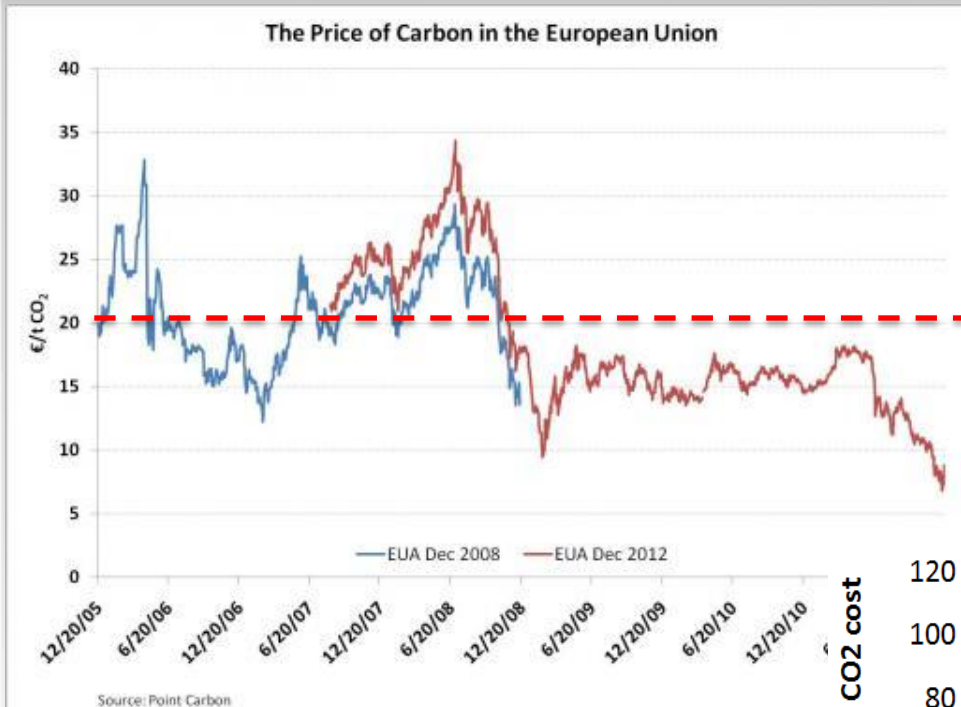
CO2 removal cost + COE => comparison with studies



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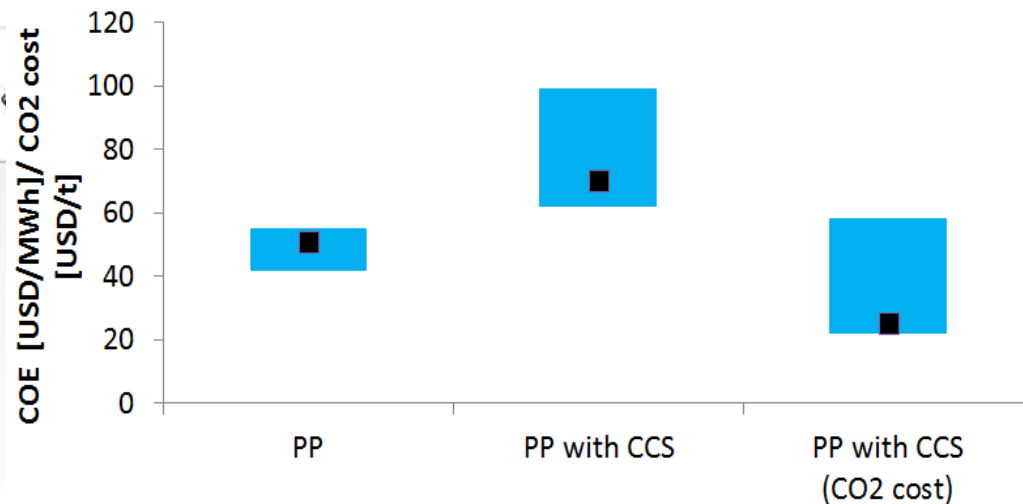


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- Removal cost = CO2 tax in 2005 and 2008

<https://econfix.wordpress.com/tag/eu-ets/>



Options to improve economic efficiency of CCS technology integration



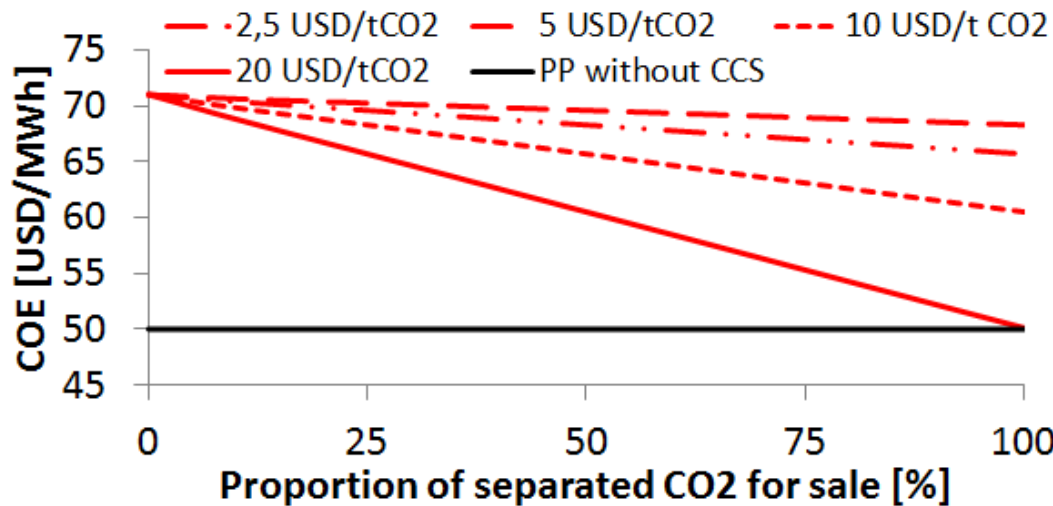
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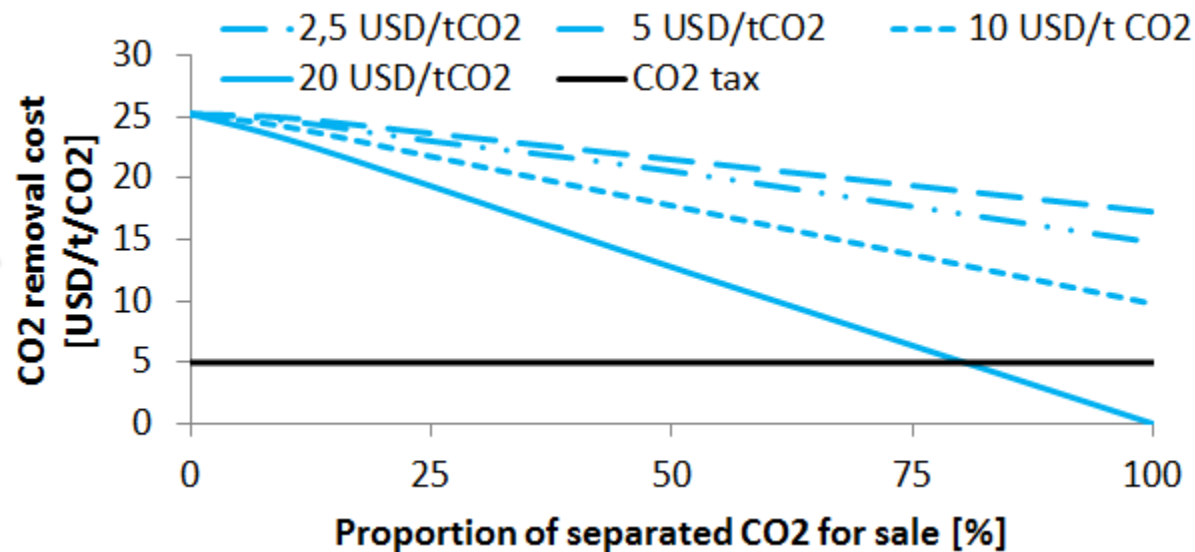
- Generally, the possibilities can be divided into:
 - technical
 - Economic
 - Technical Options => to reducing energy consumption:
 - extensive - reducing the energy consumption of existing technologies
 - intense - the search for new methods of separation
 - Economic opportunities / incentives that could streamline CCS include:
 - reducing the capital intensity of CCS
 - the possibility of producing and selling another product
 - **exploring the possibilities for the use of separated carbon dioxide**

Economic benefit of CO₂ utilization

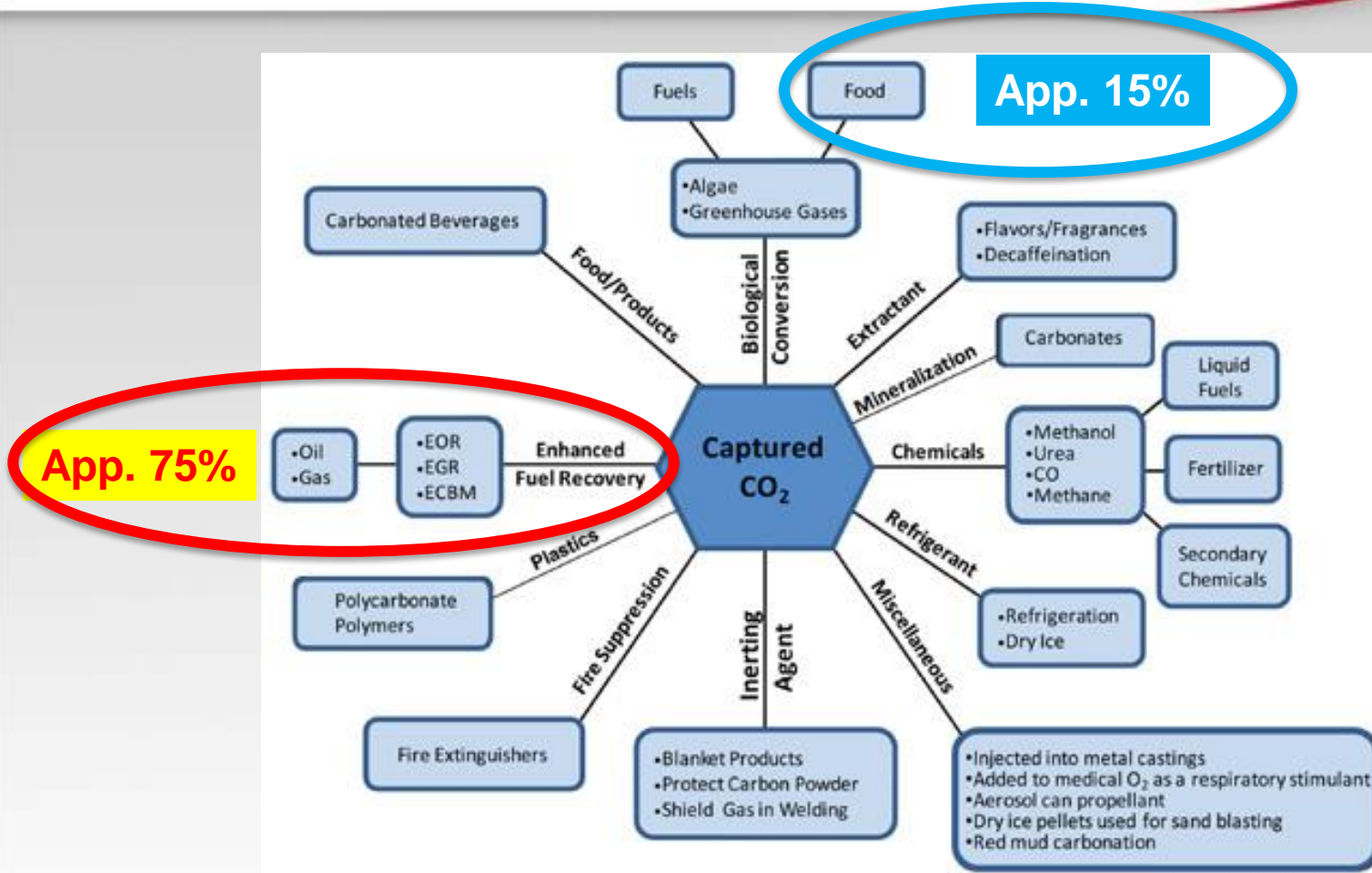


Influence of sale of captured CO₂ to electricity price

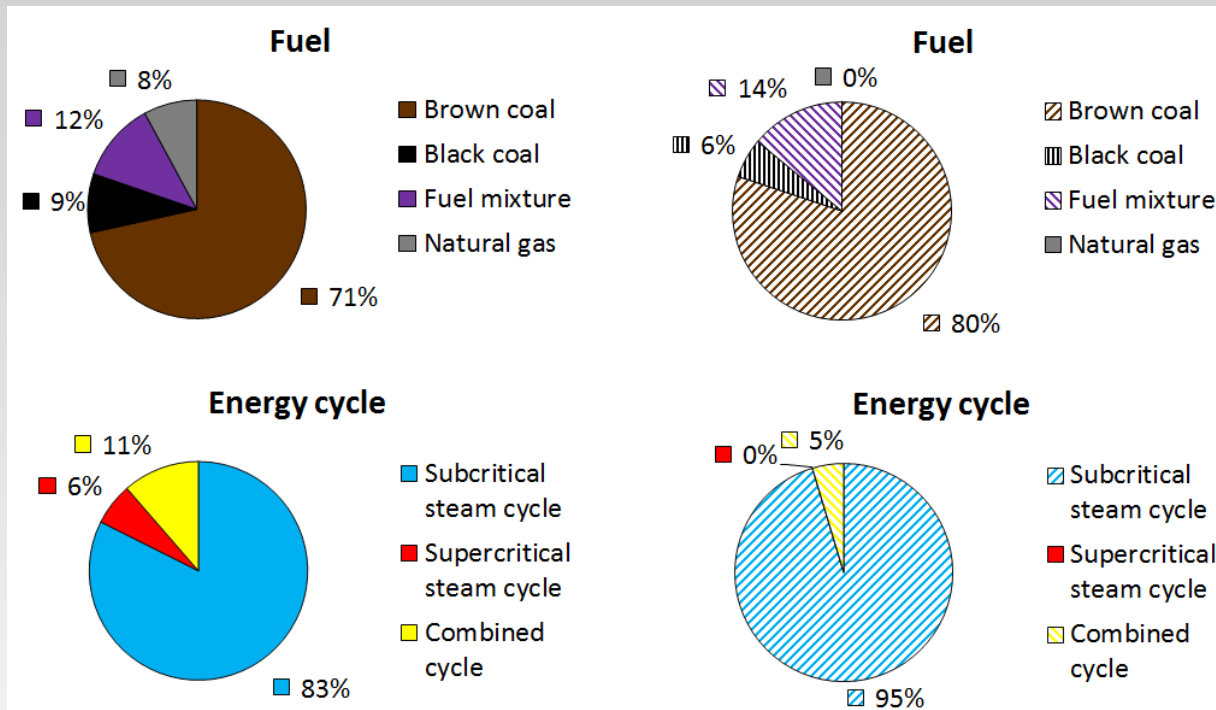
Influence of sale of captured CO₂ to CO₂ removal cost



CO2 utilization - possibilities



Fossil power plant in Czech Republic



- 49 TWh electricity production from fossil fuel in 2011
- App. **48 mill. tune of CO₂** was avoided in 2011

CO₂ utilization in Beer production



- Approximately Beer contains 5 grams CO₂ per liter
 - For case
 - 100 % utilization of captured CO₂ from fossil fuel power plants in Czech Republic for beer production industry respond
 - annual production of beer in the amount of 86.4 mill. hecto liter
 - real annual production of beer was the amount of 19 mill. hecto liter in 2013, it is means that Beer production industry has a potential for max. 20 % utilization of captured CO₂ in ideal case



- **Increase production and consumption beer about 450 %**
- **Search / Creation / Bussiness (Research) for new unconventional possibilities for the use of CO₂**



THANK YOU FOR YOU ATTENTION