CCS TECHNOLOGIES FOR COAL FIRED POWER PLANTS IN THE CZECH REPUBLIC

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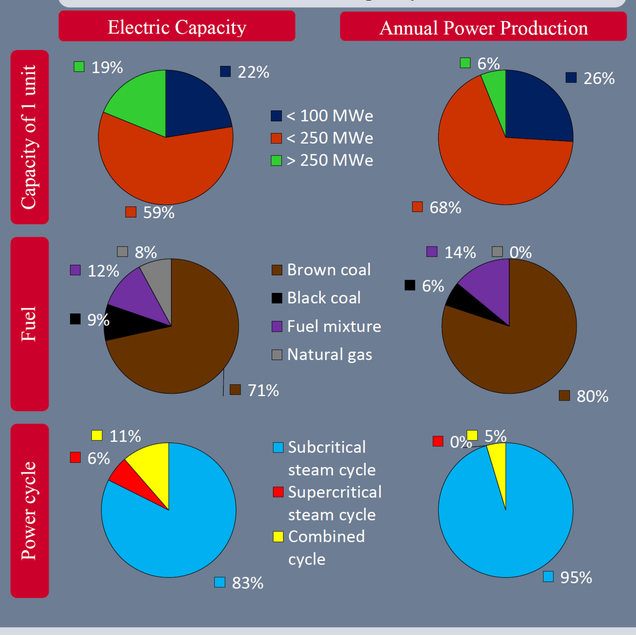
This paper shows current state and applicability of Carbon Capture and Storage (CCS) technologies with emphasis on potential deployment in Czech Republic. Two from three generally considered CCS technologies were already modelled oxyfuel-combustion and post-combustion (ammonia scrubbing). The third considered technology, pre-combustion, is being currently modelled, evaluated and we are presenting preliminary results.

ENERGY SECTOR – FOSSIL FUEL

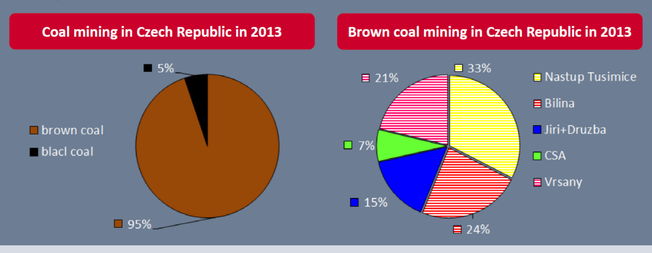
Fossil Power Plants in Czech Republic
with Installed Electric Capacity > 100 MWe



Typical fossil power plant with installed capacity in Czech Republic is:

- Steam power plant with subcritical parameters and installed capacity of one unit between 100-250 MWe
- Used fuel is Czech low rank brown coal (lignite)

Coal mining production in the Czech Republic is about 40 million tons. More than 95% of this amount is a fuel for local power plants.



MODEL INPUT DATA

Study input data

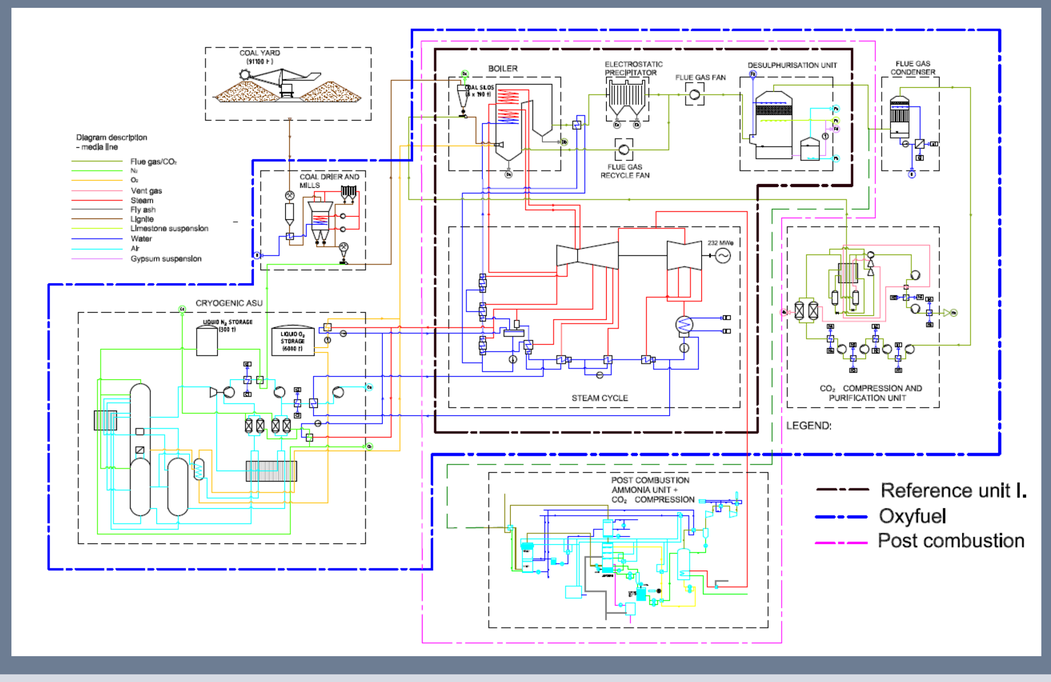
- Lignite Power Plant with
  - 250 MWe Installed capacity
  - parameters steam and fuel shown in table

CCS systems	Oxyfuel	Post combustion	Pre-combustion
Power cycle	steam power plant with subcritical parameters (575℃/580℃,18.3/3,6 MPa)		Integrated gasification combined cycle
Fuel			
LHV	8,5 - 10 MJ/kg		~ 15 MJ/kg
Wr	~ 31%		~ 27%
Ad	~ 41%		~ 18%
S	~ 3%		~ 1.7%

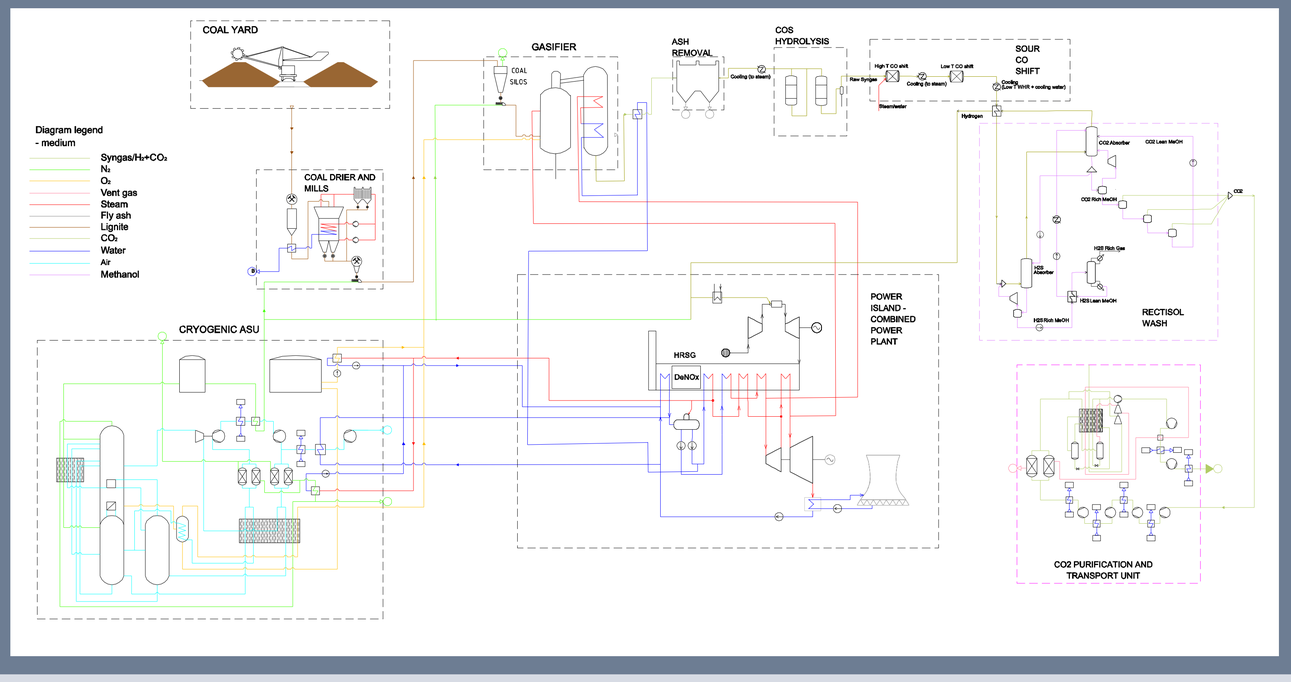
- CO2 capture factor = 90%, transport as a gas, storage in aquifer
- Capture technology in level for industrial application

DESIGNED SYSTEMS

OXYFUEL AND POST COMBUSTION (AMMONIA SCRUBBING)



PRE-COMBUSTION – RECTISOL WASH



RESULTS, UPGRADING AND CONCLUSIONS

RESULTS

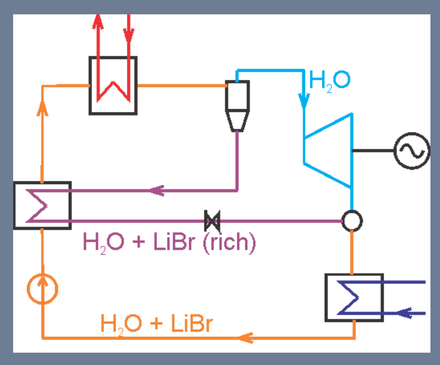
Parameters	Reference plant I.	Post combustion Ammonia scrubbing	Oxyfuel	Reference plant II.	Pre-combustion – Rectisol wash
Net efficiency [%]	38.9%	28.2%	31.2%	44.7%	32.1%
COE [USD/MWh]	50	75	70	65	94.5
Investment cost [USD]	600 mil.	900 mil.	950 mil.	742 mil.	1110 mil.
Removal cost [USD/t]	-	29	26	-	35

- Efficiency penalty for oxy- and post-combustion from low LHV lignite is unrealistically high for application, production loss would need to be replaced by new plants
- No market for CO2 and low CO2 tax limit real application
- Potential to partly offset efficiency penalty by waste heat recovery

POTENTIAL OF LOW T WASTE HEAT RECOVERY IN PRE-COMBUSTION

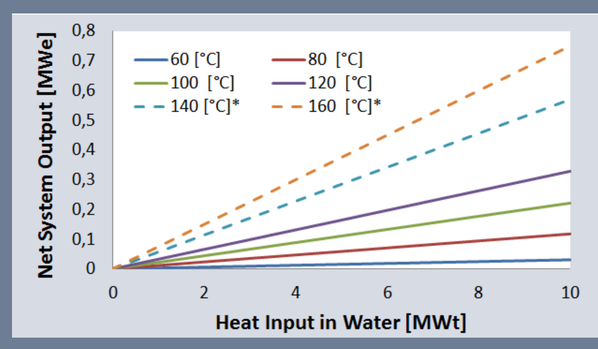
Cycles for low temperature heat utlization:

- ORC (T>120°C)
- Absorption Power Cycle (T<120°C)
  - H2O-LiBr solution, diagram shown in picture on the right side
  - At 100°C net efficiency of whole system (including heat rejection) 2.2%, exergy efficiency 19.5%



The fundamentals potential and parameters of available waste heat and utilization process for pre-combustion CCS system is shown in table and graph below

System	Medium	T [°C]
ASU - Intercooling	Water	80-180
CO2 – Intercooling	Water	70-200
Gas last stage cooling	Water	~130
WGS cooling	Water	~140
Solvent distillation	Not in Rectisol,	
Coal dryer vapour	Air+Vap	~100
Flue gas "super-bottoming"	Flue gas	~100



Utilizing 50 MWt of 100°C can provide additional 1.1 MWe ~ 0.1 % of CCS system efficiency. Initial estimates of all heat <200°C utilization show potential up to approximately 5 MWe ~ 0.6 % of CCS system efficiency.

ACKNOWLEDGMENT

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Information about project NF-CZ08-OV-1-003-2015

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