



Impurities management in an Oxy-Combustion Power Plant

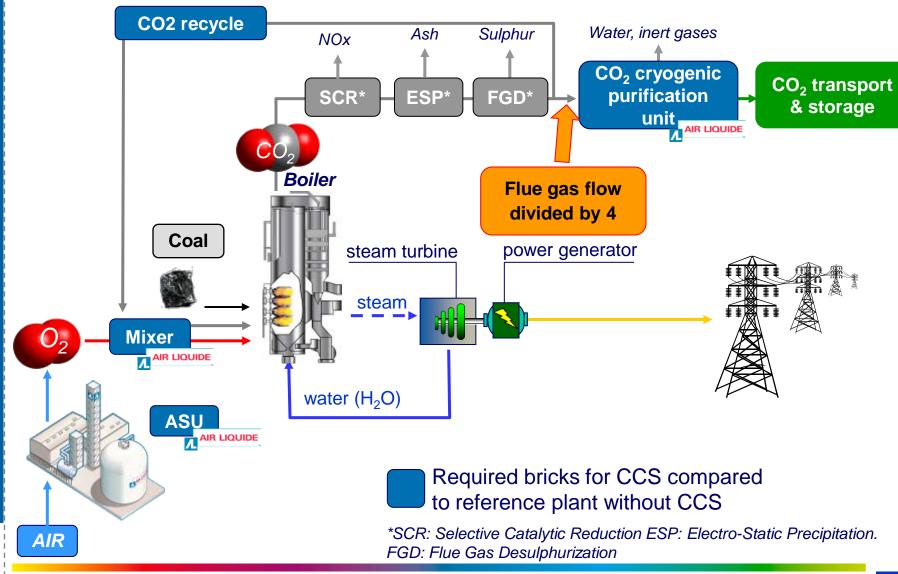
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Key advantages of oxycombustion: efficiency



and near zero emissions





What is the best way to manage the impurities in order to maximize these advantages i.e. efficiency and zero emissions?

What are the impurities?



- Coming from coal
 - √ H₂O
 - ✓ PM
 - ✓ SOx
 - ✓ Hg
 - → HCI, HF
- Coming from oxygen
 - ✓ O2
 - ✓ N2
 - ✓ Ar
- Coming from coal and oxygen
 - ✓ NOx
 - \vee N₂O
 - ✓ CO

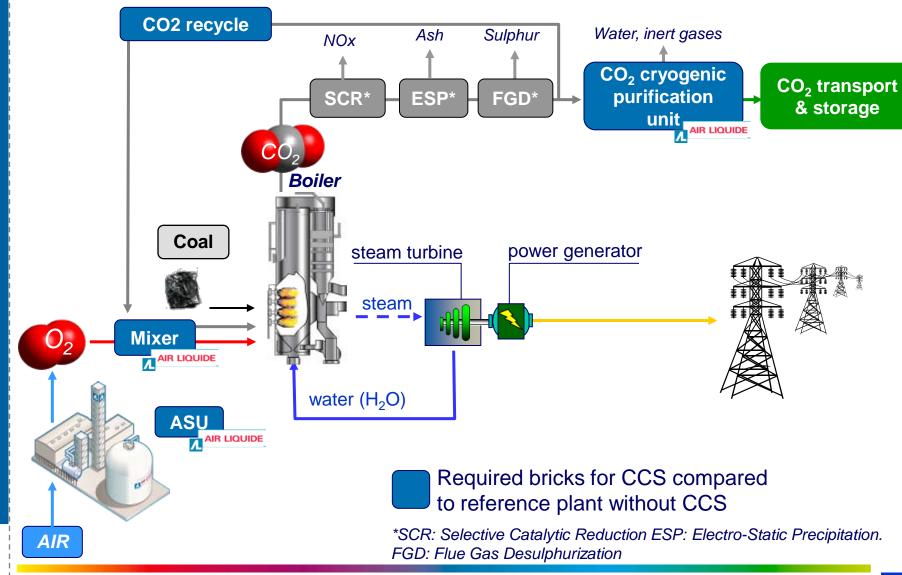
What are the locations to manage impurities?



- Air Separation Unit (ASU)
- Coal handling and preparation
- Boiler
- Environmental Island
- CO₂ Compression and Purification Unit (CO₂ CPU)

AIR LIQUIDE

Two distinct functions: de-concentration of the recycle loop and emission control



What are the locations to manage impurities?



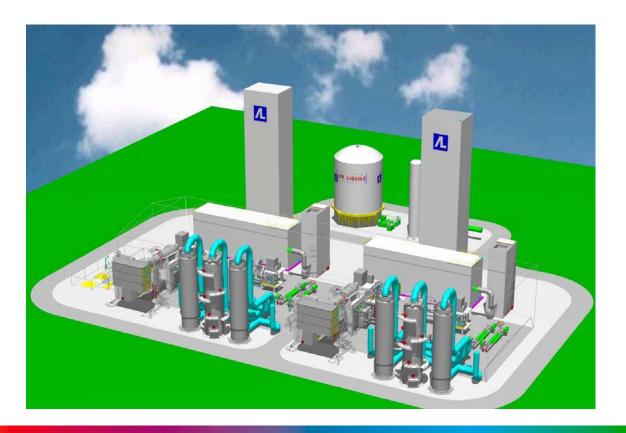
	PM	H ₂ O	SOx	NOx	HCI HF	Hg	N ₂ Ar	O ₂	СО
ASU				✓			✓		
Coal handling & preparation	✓	✓	✓			✓			
Boiler			✓	✓				✓	✓
Environmental Island	√	✓	✓	✓	✓	√			
CO ₂ CPU	√	✓	✓	✓	✓	✓	✓	√	✓

2 impurities are key for their impact on LCOE (CAPEX and OPEX): H₂O and SOx

Air Separation Unit



- High purity oxygen (99.5% O₂, 0.5% Ar) can increase specific energy consumption of Air Separation Unit by more than 30%
- Therefore low oxygen purity (96.5% O₂, 3% Ar, 0.5% N₂) is the preferred solution including impact on CPU design



Coal handling and preparation



- Coal drying (for sub-bituminous and lignite) provides a triple efficiency advantage:
 - 1. Less water is vaporized in the boiler
- + specifically in oxycombustion:
 - 2. Flow to CPU is reduced and consequently the associated heat loss
 - 3. Indirect firing considerably reduces the primary flow:
 - it is not anymore necessary to condensate water from this significant amount of flue gas in order to avoid condensation in the pulverizers
 - possible additional efficiency of more than 1 percentage point HHV
- Coal preparation could also have an impact on sulfur, PM and Hg

Boiler



SOx:

- ✓ In oxycombustion, it may be necessary to deconcentrate the recycle loop as soon as the coal suphur content is above approximately 1%
- ✓ It is preferable not to introduce H₂O for desulphurization
- Therefore, dry desulphurization (e.g. furnace sorbent injection) is likely to be the best solution
- O₂: excess O₂ is a key parameter in oxycombustion as it impacts the size and power consumption of the ASU and of the CPU
- NOx : NO₂ purge from CPU could be reburnt in the boiler for NOx reduction

Environmental island



- Particulate Matter needs to be removed on the overall flue gas to deconcentrate the recycle loop; high temperature solutions (350°C versus 150°C) needs to be developed to improve HHV efficiency; otherwise, recycle flue gas has to be cooled down and reheated
- H₂O: if indirect firing is chosen, flue gas condensation together with HF/HCl removal will be part of CO₂ CPU
- SOx: SDA and wet FGD penalize the efficiency of the plant; dry desulfurization options could also be considered
- NOx: SCR is not required as CO₂ CPU efficiently removes NOx at a low cost
- Hg: CO₂ CPU will manage Hg more efficiently

CO₂ CPU



- PM: in order to avoid fouling management, a high efficiency filtration system should be considered as an option
- H₂O: flue gas condensation and adsorption (at low or high pressure) are the solutions
- SOx: several options could be considered such as SO₂ cosequestration, H₂SO4 or liquid SO₂ production
- NOx can be purged as NO₂ and reburnt in the boiler
- HF/HCI : removed in the flue gas condenser
- Hg: guard bed or Hg tolerant components
- CO: catalytic oxydation is an option



What are the **best** locations to manage impurities?

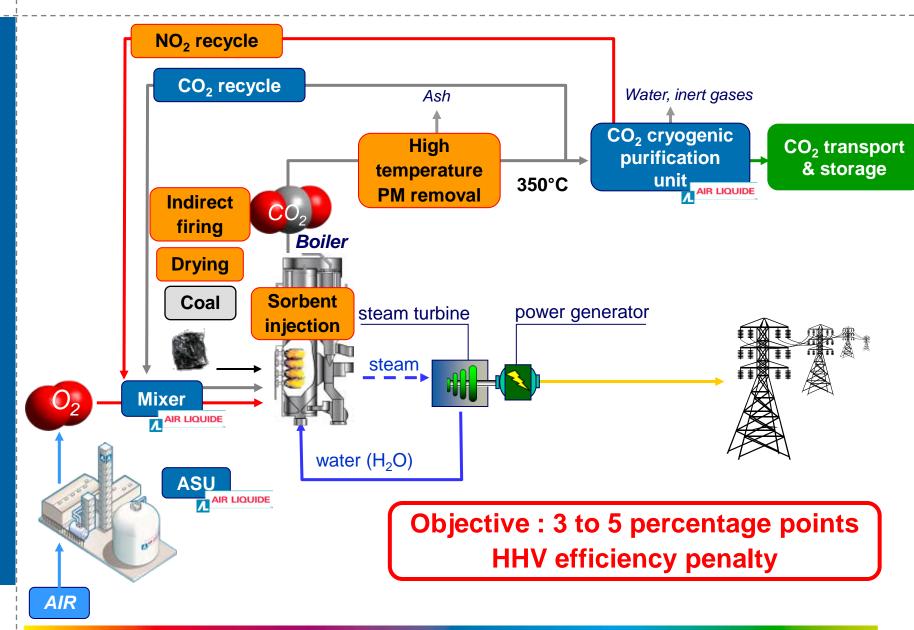


	PM	H ₂ O	SOx	NOx	HCI HF	Hg	N ₂ Ar	O ₂	СО
ASU				✓			✓		
Coal handling & preparation	√	\bigcirc	✓			√			
Boiler			\bigcirc	\bigcirc				\bigcirc	\bigcirc
Environmental Island	\bigcirc	✓	✓	✓	√	✓			
CO ₂ CPU		\bigcirc		\bigcirc	\bigcirc		\bigcirc	\bigcirc	\(\lambda

- Environmental island functions could be significantly reduced
- CO₂ CPU becomes the main emission control equipment

Oxycombustion power plant of the future









THANK YOU FOR YOUR ATTENTION

Contact

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