norden

Top-level Research Initiative

WP4 - CO_2 capture

Industrial case studies

Consortium Day 2015, Oslo

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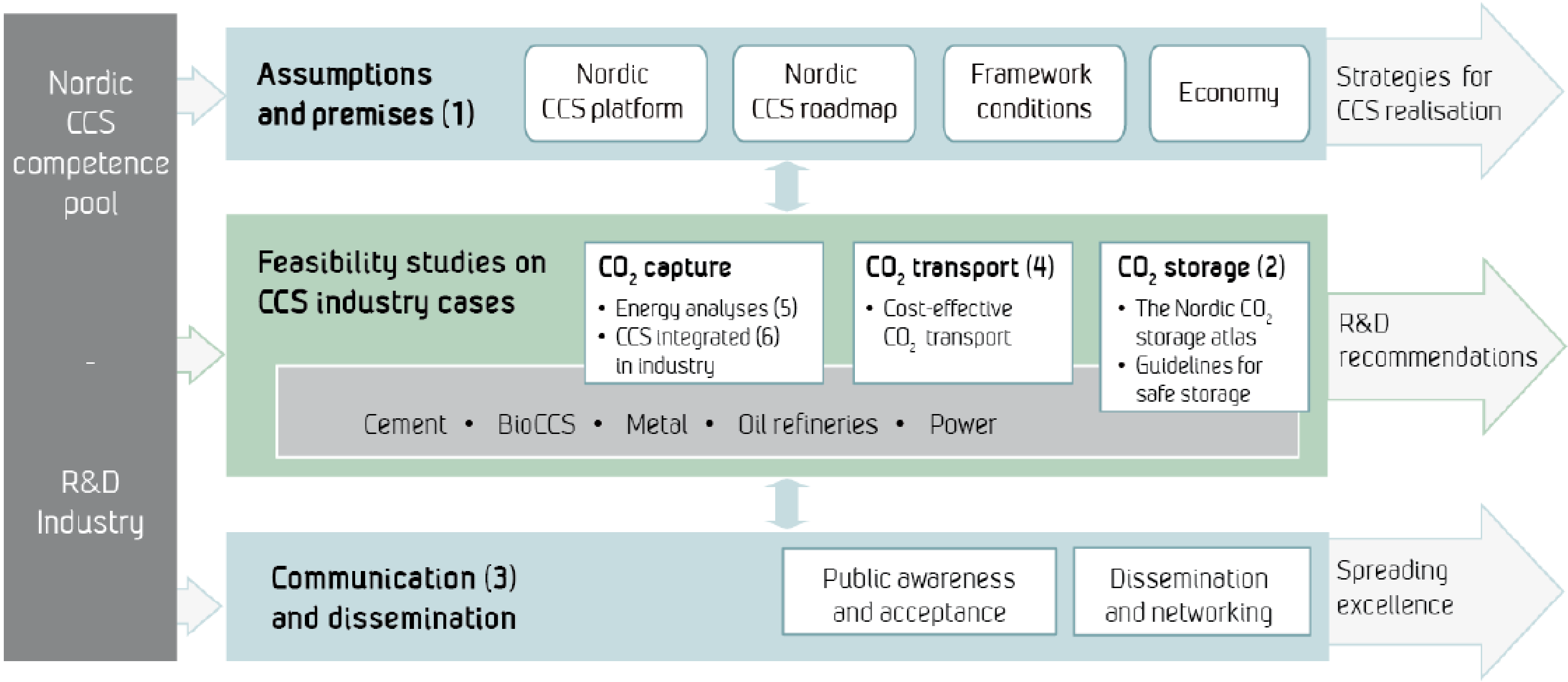
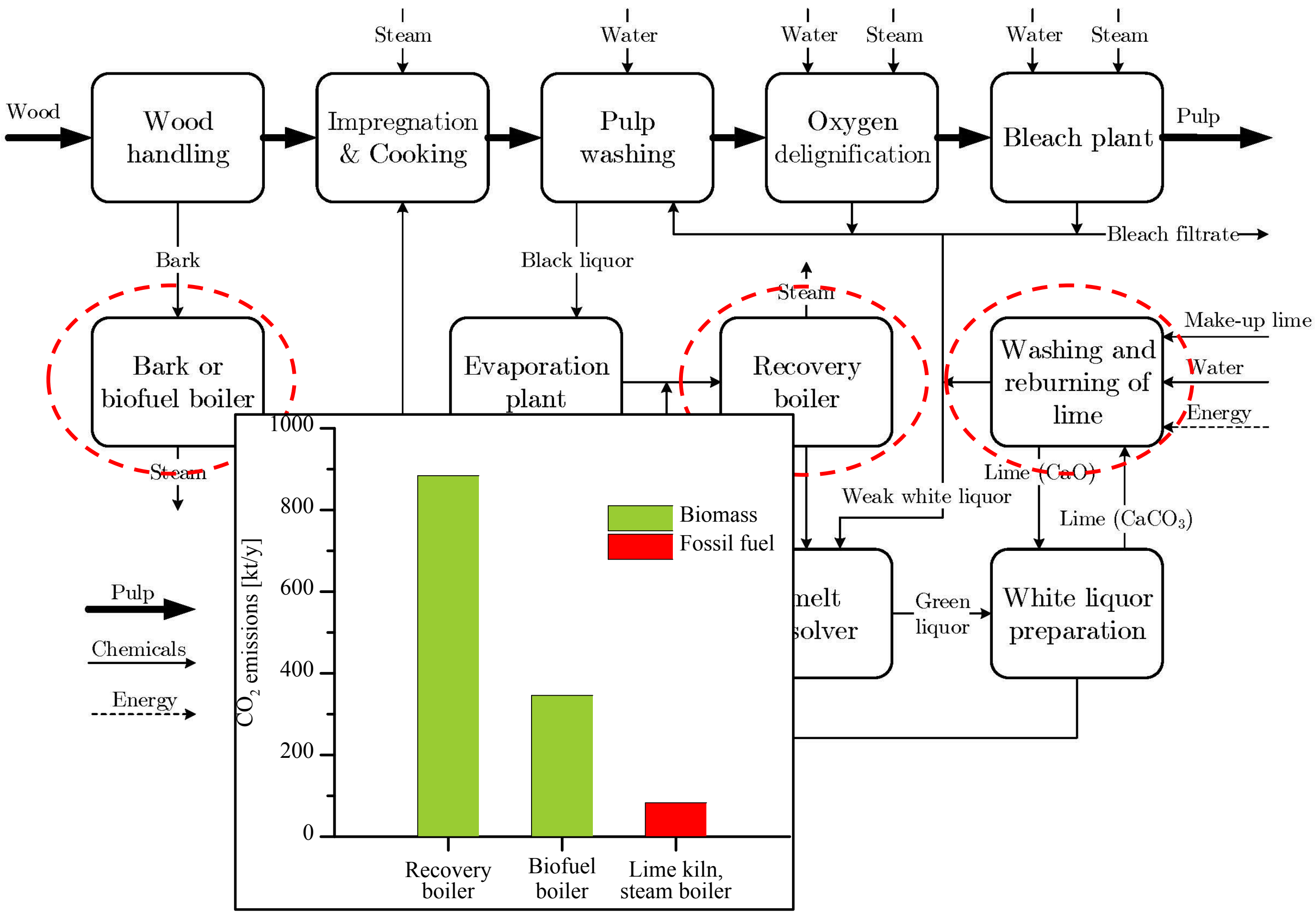
The NORDICCS Concept



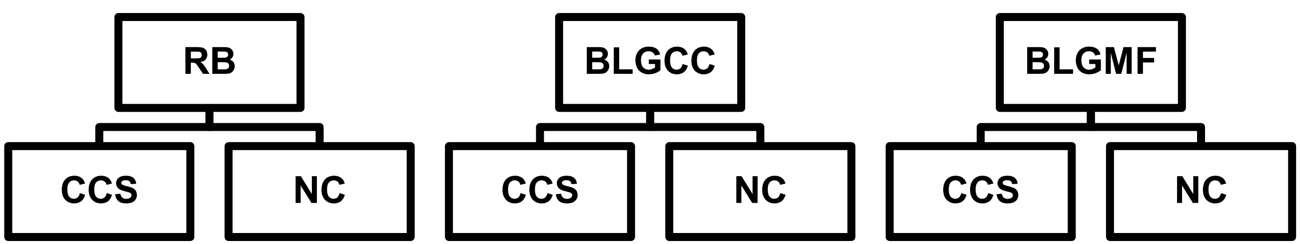
Case study example: BioCCS - Pulp&Paper

The pulp mill

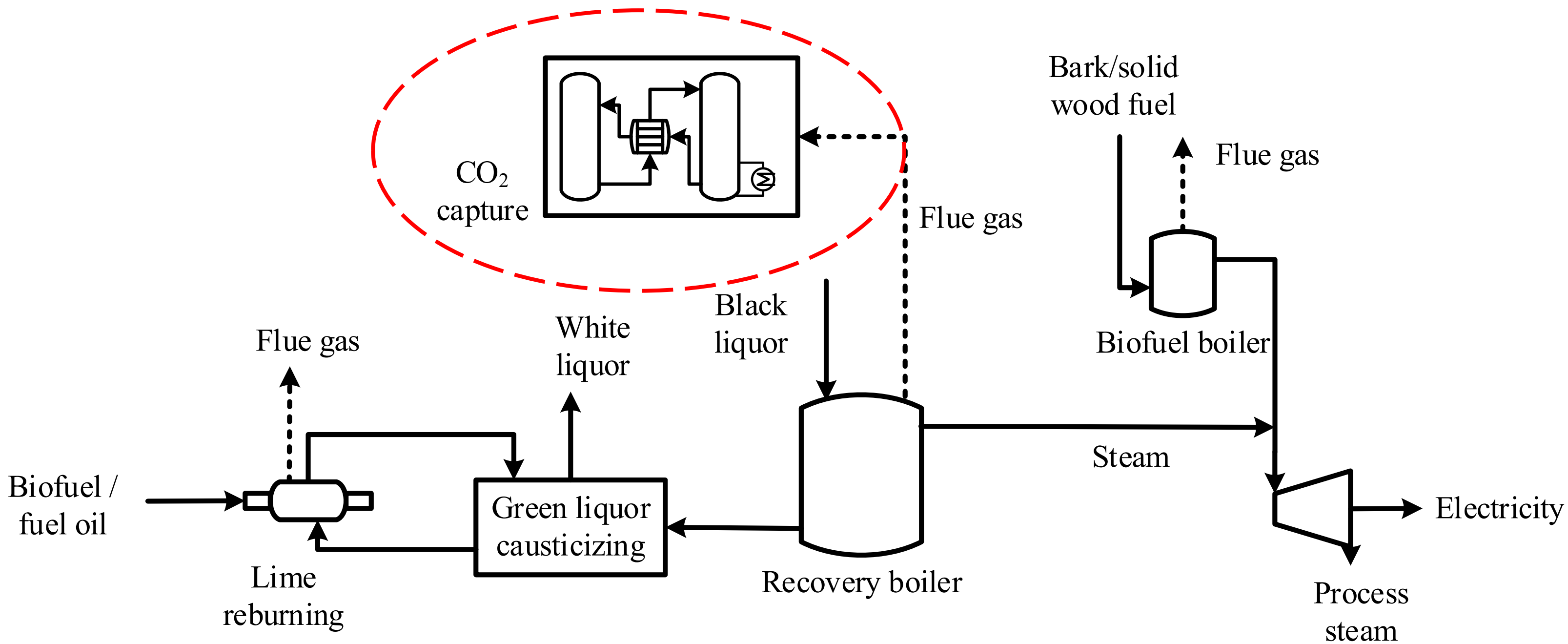


Investigated scenarios

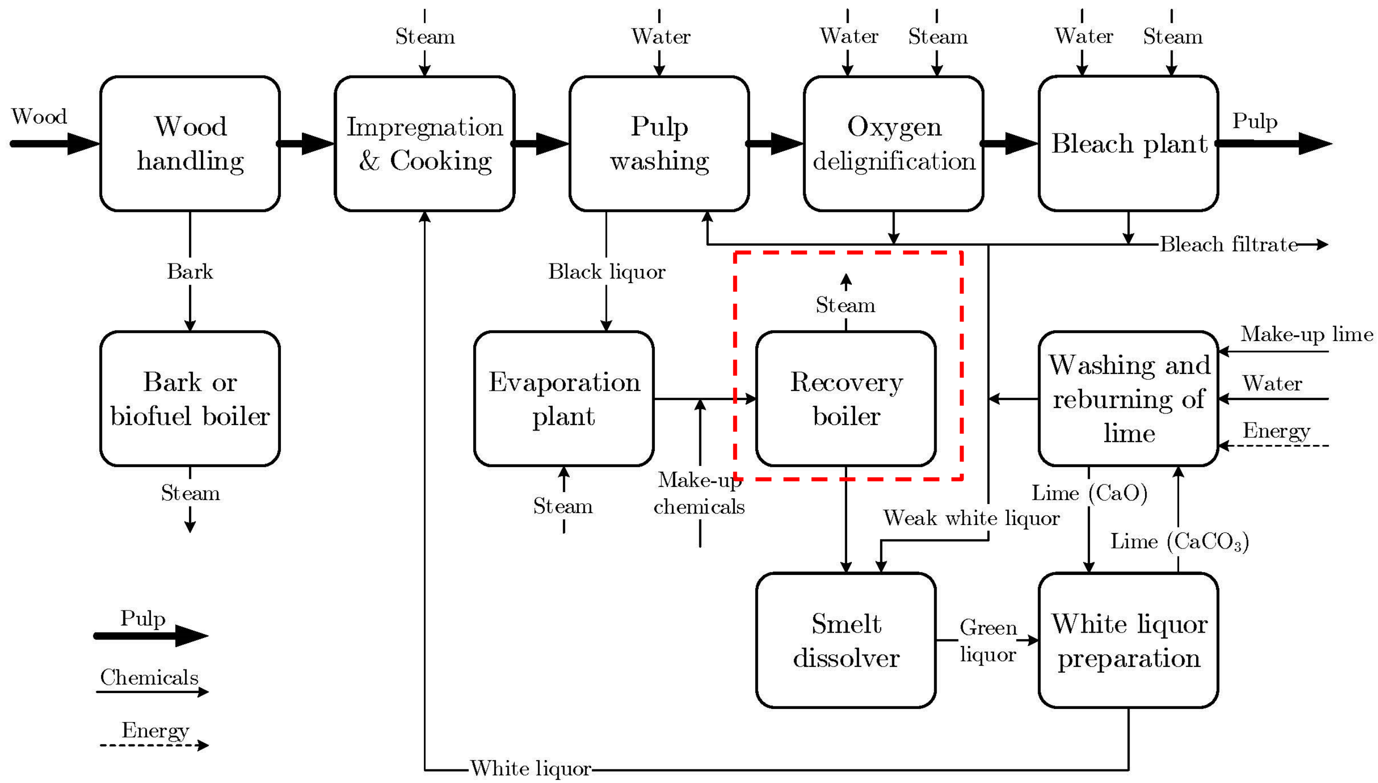
Scenario	Recovery system	Additional product	Capture technology	Capture technology
RB	Recovery boiler	n/a	Post-combustion	MEA
BLGCC	Black liquor gasification	Electricity	Pre-combustion	Selexol
BLGMF	Black liquor gasification	DME	Pre-combustion	Rectisol



Recovery boiler with PCC

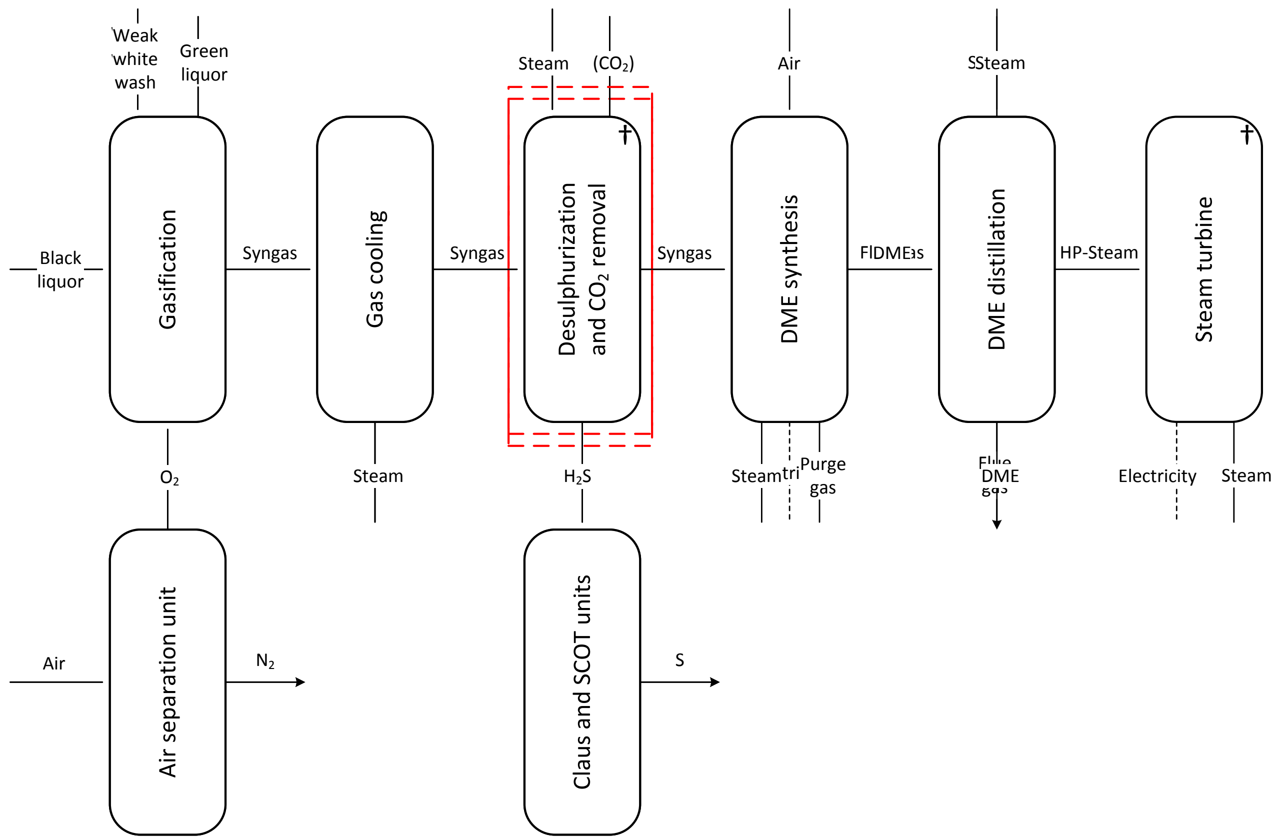


Black Liquor Gasification



Black Liquor Gasification

- BLG combined cycle (BLGCC)
- BLG with motor fuel production (BLGMF)



Results summary

Utility [kJ/kg CO_2 captured]	**RB**	**BLGCC**	**BLGMF**
Steam	3760	0	0
Cooling water	4460	1130	370
Electricity	360	1110	220
Net reduction potential [ktCO_2/year]	715	318	393
Specific CO_2 capture cost [€/tCO_2]	46	48	9

Östrand pulp mill, Sweden

- Three scenarios of future development scenarios in the pulp mill were investigated:
  - Continued use of the conventional recovery boiler
  - Black Liquor Gasification (BLG) with electricity production
  - BLG with motor fuel production

- Pulp and paper industry could be a suitable future candidate for BECCS (Bio-Energy with Carbon Capture and Storage)

- Implementation of CO_2 capture in connection with BLG technology requires relatively low additional utility and specific capture cost, compared with conventional post-combustion capture

Fictive integrated steel mill, Finland

- Concept studied: Modifying blast furnace (BF) and replacing gas boiler with GTCC
  - Increased Pulverized Coal Injection and reduced coke consumption in BF = higher BF top gas heating value
  - Replacing power plant gas boiler with high-efficiency low-BTU gas turbine combined cycle
  - WGS + CCS (MEA and Selexol)

- Main results:
  - Up to 80% reduction in CO_2 emissions from power plant
  - 2 – 2.5 times increase in power output possible (depending on process configuration and CO_2 capture method)

Norcem cement plant, Brevik, Norway

- Concept studied: Implementation of MEA based post-combustion and oxyfuel-combustion CO_2 capture

- Main results:
  - Approx. 22% of the heat requirement can be covered with waste heat.
  - For oxyfuel-combustion, the rate of air in-leakage should be kept to a minimum to ensure effective CO_2 capture. Capture rates in the range of 88-96%.

Preem Refinery, Lysekil, Sweden

- Concept studied: Partial CO_2-capture with focus on the steam methane-reforming (SMR), the fluid catalytic cracker and a combined stack (mainly gas heaters)
  - Post-combustion with MEA and ammonia was investigated

- Main results:
  - 25% of plant emissions may be captured from the SMR alone and at more than 10% lower specific heat requirement than the plant average
  - Around 20% of the heat requirement for capture from SMR can be covered with waste heat

Hellisheiði geothermal power plant, Iceland

- Concept studied: Various process alternatives for H_2S and CO_2 separation from volatile components (CH_4, N_2, H_2).
  - Water wash (reference); MDEA absorption; Low-temperature separation; MDEA/Low-temperature hybrid

- Main results:
  - Water wash was found to be the most energy-efficient process (cold water available and no need for thermal stripping of the water stream)
  - The different alternatives give very different product outputs
    - Pressure and purity of H_2S and CO_2 streams; for some cases H_2

WP4 concluding remarks

- Applying carbon capture technologies can be technically feasible for a broad set of process conditions

- Specific process conditions are important → strong influence on the choice of capture technology
  - Considerable savings in capture cost possible by considering specific process and site conditions as well as possible industrial process developments