

# Substitution of Fossil CO<sub>2</sub>-emitting products



# Innovation Fund Project???



- Replacing fuel in Lime Kilns with Electricity
- We have 13 mills producing Kraft Pulp
- Lime Burning is a High Temperature process (1400 C) => High quality fuels
- Today we use several different fuels
  - Heavy Fuel Oil
  - Natural Gas
  - Hydrogen
  - Wood Powder
  - Gasified Biomass
  - Pitch Oil (From Tall Oil production)
  - Lignin (out of Specifications)

# Innovation Fund Project???



- There are 2 possible process solutions on the table at the moment
- #1 Replace burner with Plasma Arc equipment operating with Pure CO<sub>2</sub>-gas
  - Still use Lime Kiln 2-4 hours process time
  - Still use multiple slaking tanks 1-2 hours process time
- #2 Make a small process chamber and slaking in steam atmosphere
  - Use Plasma Arc heat supply
  - Optimal process chamber need 1-5 minutes process time
  - Steam Slaking can be done within 10 minutes process time
  - White Liquor filtration is yet to be solved

# Innovation Fund Project???



- Lime Cycle Chemistry in a Kraft pulp Mill
  - In the lime cycle part of the mill the chemicals from the recovery boiler is “recharged” for next cycle in the pulp mill
  - Slaked Lime is reacted with the Green liquor to become White Liquor
  - $\text{Ca(OH)}_2 + \text{Na}_2\text{CO}_3 \Rightarrow \text{CaCO}_3 + \text{NaOH}$
  - The Calcium carbonate,  $\text{CaCO}_3$ , is filtered out in the white liquor filter
  - The Calcium carbonate,  $\text{CaCO}_3$ , is fed to the lime kiln and burnt to lime
  - $\text{CaCO}_3 + \text{Energy} \Rightarrow \text{CaO} + \text{CO}_2$  (biogenic)
  - The Calcium oxide, Lime,  $\text{CaO}$ , is fed into the slakers to become slaked lime
  - $\text{CaO} + \text{H}_2\text{O} \Rightarrow \text{Ca(OH)}_2$
- Total formula
  - $\text{Na}_2\text{CO}_3 + \text{Energy} + \text{H}_2\text{O} \Rightarrow 2 \text{NaOH} + \text{CO}_2$  (biogenic)

# Innovation Fund Project???



- Main benefits with electrification
  - Possible to replace Fossil fuels
  - Possible to replace High value and High quality Bio fuels
    - Make it possible to utilize those for other demanding usages – for example Transportation fuels, Chemical industry raw materials
  - Might be possible to increase capacity in Lime Kilns - yet to be proven
  - The exhaust gas is 100 % pure CO<sub>2</sub> (biogenic)
  - Possible in the future to incorporate BECCS/BECCU

# Innovation Fund Project???



- Main risks with electrification
  - Cost of electricity is unstable and heavily affected by EUA pricing
  - Availability of Plasma Arc for >8000 h continuous operation is yet to be proven
  - At the moment maximum size of a Plasma Arc burner is 6 MW
    - Needed energy input is from 20-50 MW
    - Already at 6 MW the AC/DC converter is massive
  - #2 process have great benefits from up to 80 % smaller footprint and 50% lower investment
    - But it only saves some 3-5 % of the total investment in a Kraft Pulp Mill
    - Is it worth while to do this saving if it doesn't work?
    - The rest of the 1,5 Billion € investment can't wait if it don't start
  - Physical properties of the Lime might give problems in the subsequent process equipments => Operational risk

# Innovation Fund Project???

## Project in relation to Innovation Fund

- Several parts needs yet to be developed – Mainly by other companies
- First installation would probably be an add-on to an existing lime kiln to do de-bottlenecking Or to reuse old lime kiln with Plasma Arc burners, mainly for developing process
- Some kind of direct subsidy is need to support technology developing companies
- To convince our company management to enter the risk we could benefit with funding to reach lower cost if failing
- We have 13 Kraft Pulp Mills emission from Lime Kilns in the range of 1 Mton of CO<sub>2</sub>-e from the fuel and another 0,5 Mton of CO<sub>2</sub>-e from the Calcium carbonate, Total EU-wide potential is at least 5 times larger
- No comparison between different investments is done
- At the moment no comment on how the funding should look like

# Innovation Fund Project???

## Project in relation to Innovation Fund



- We should benefit from support on Indirect effects from the ETS on electricity pricing in Sweden
- When we implement BECCS/BECCU there ought to be some mechanism that give some financial benefits from negative emissions
  - Today you can't even deduct it from your fossil emissions if you don't produce PCC
  - And if you don't have any fossil emissions what then??
- BECCS is of course dependent of regulations regarding CCS
  - Export possibilities
  - Infrastructure
  - Legal issues
- ETS product Benchmark for Kraft Pulp should not be impacted as this is a technique that needs the possible income from sales of EUA in the global market in coemption with mills in Canada, US, Brazil, Indonesia and other non-EU countries