

Kraft lignin extraction and the recovery boiler

– Implications for boiler operation today and future visions –

Markus Engblom

Lignin Seminar Day

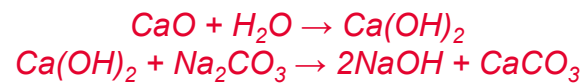
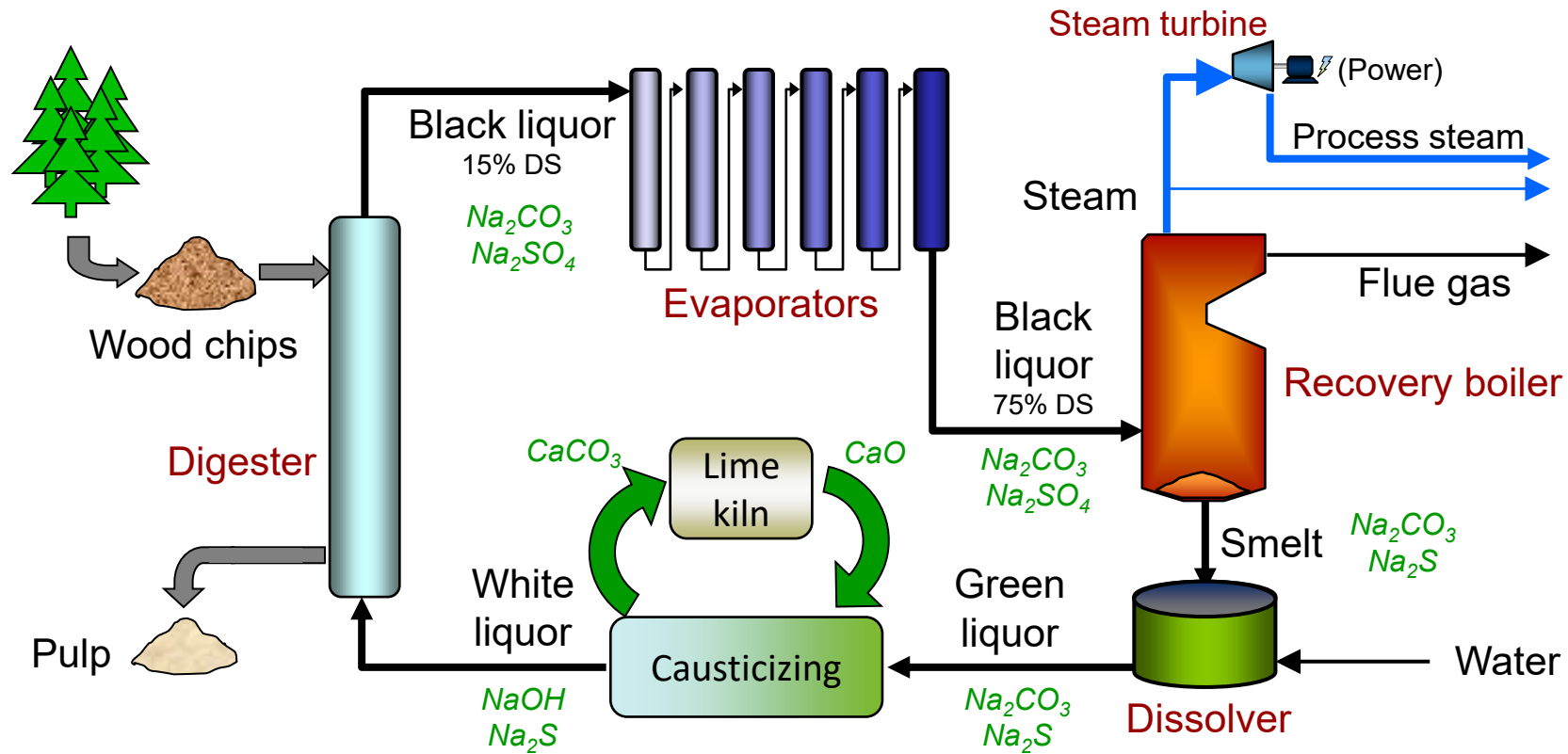
February 6, 2024

Topics

- **”Implications for boiler operation today”**
 - Important to understand how removal of lignin affects Kraft recovery boiler operation

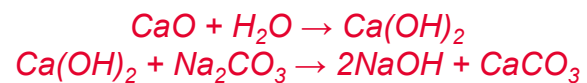
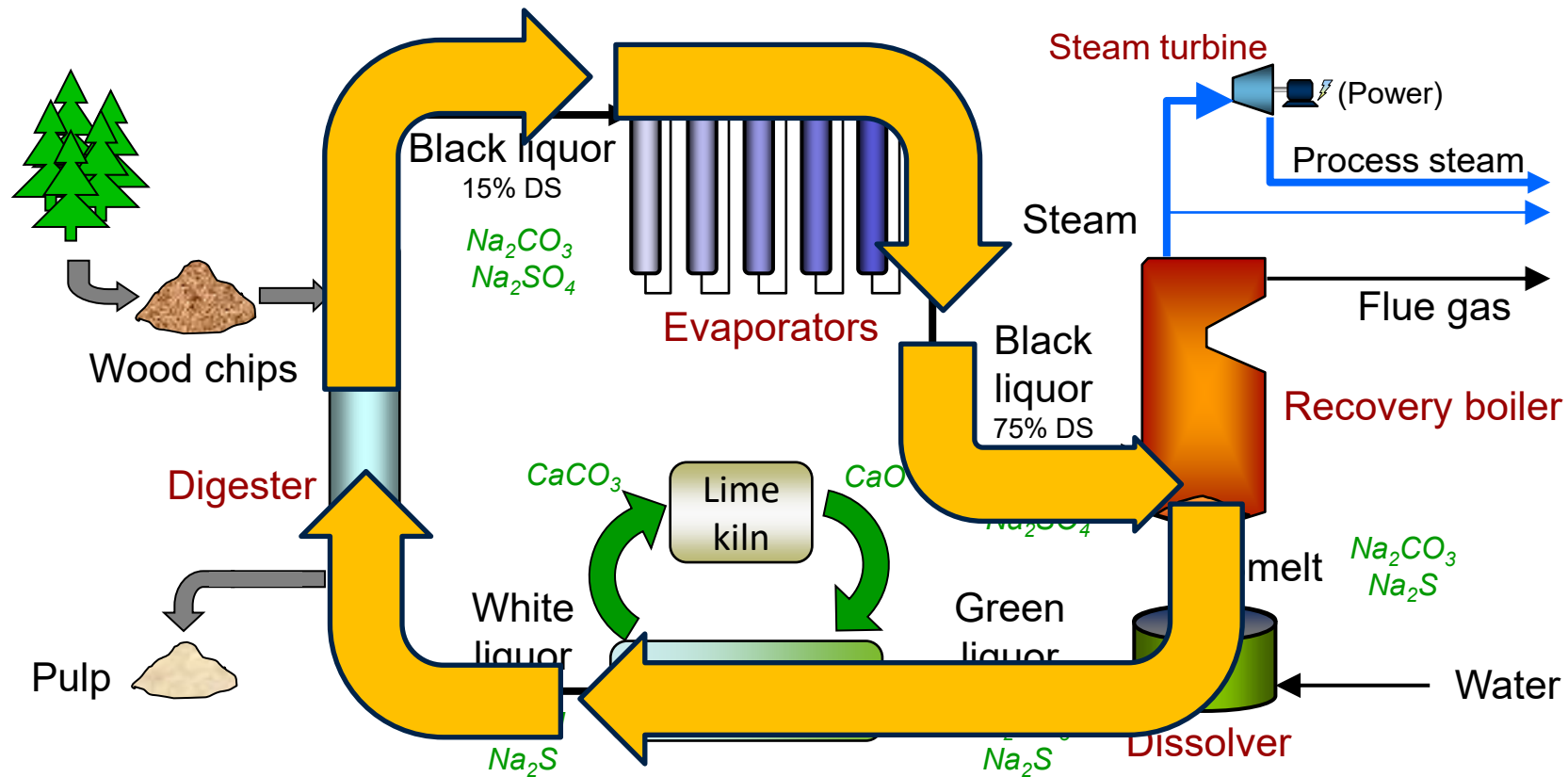
- **”Future visions”**
 - Oxy-Kraft recovery boiler

Kraft process

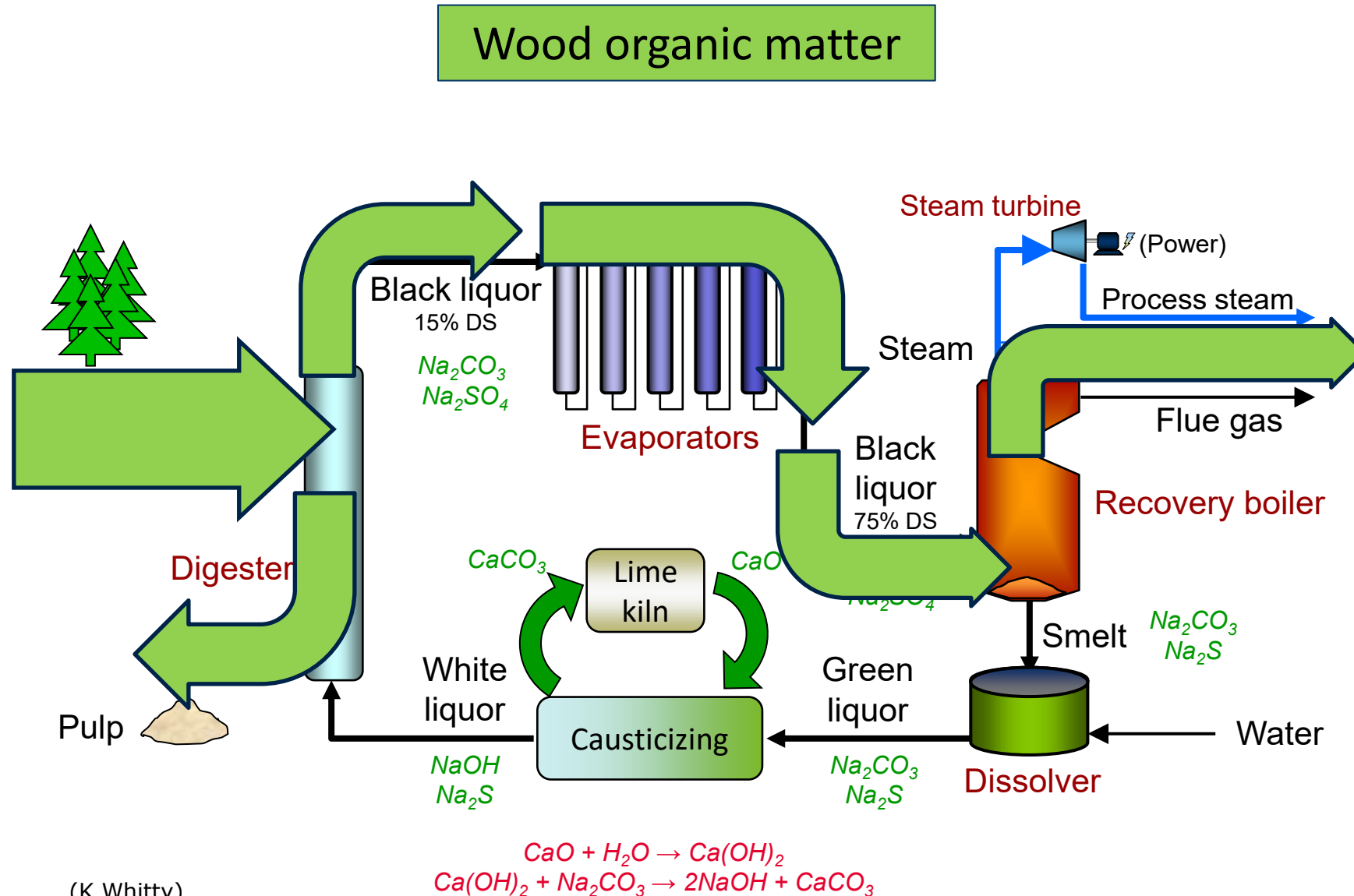


Kraft process – chemicals recovery cycle

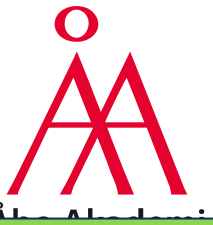
Pulping chemicals



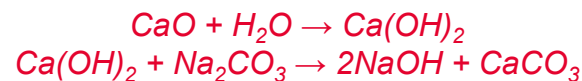
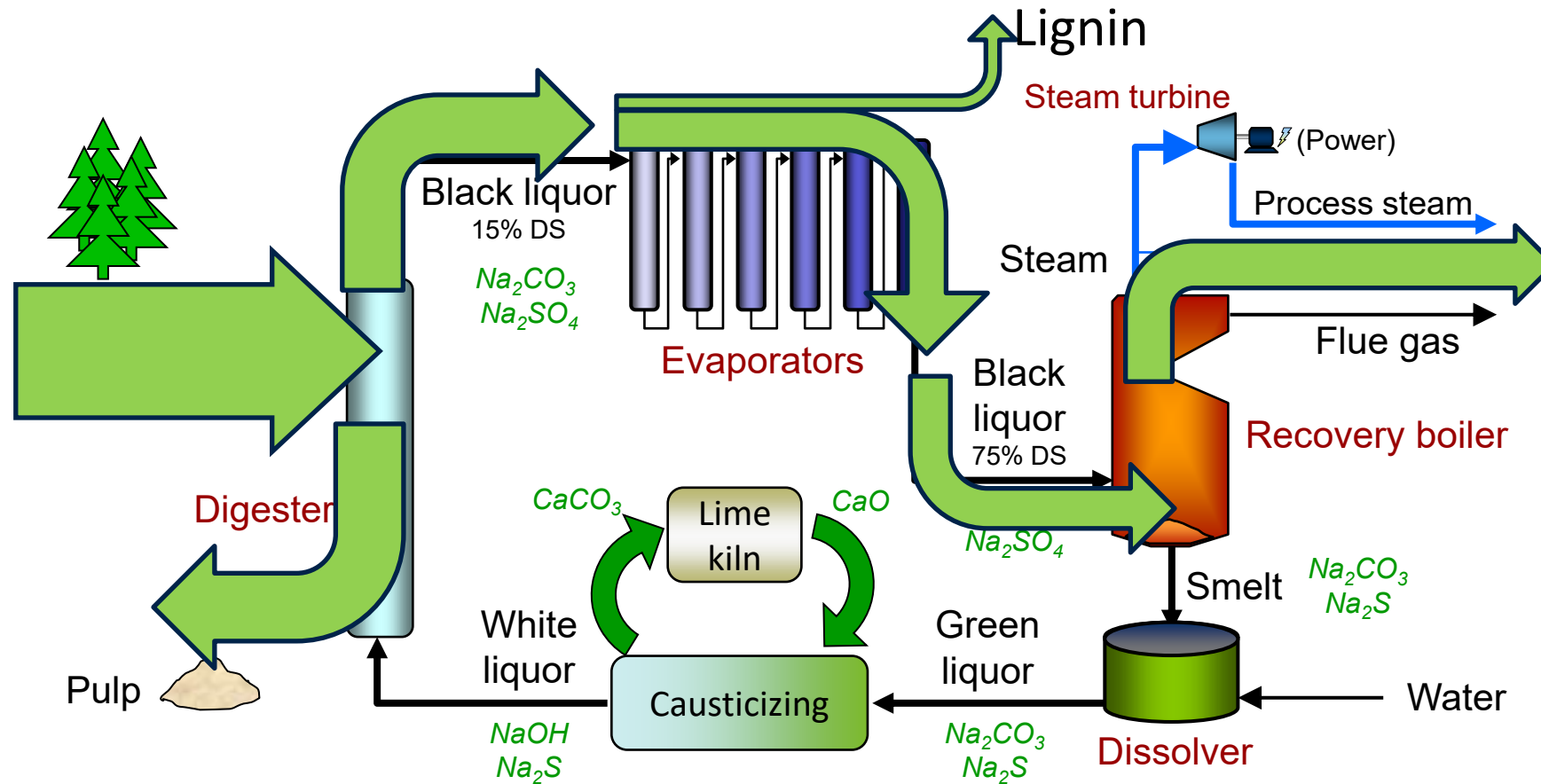
Kraft process – wood organic matter



Kraft process and lignin removal



Wood organic matter – with lignin removal, material flow into recovery boiler decreases



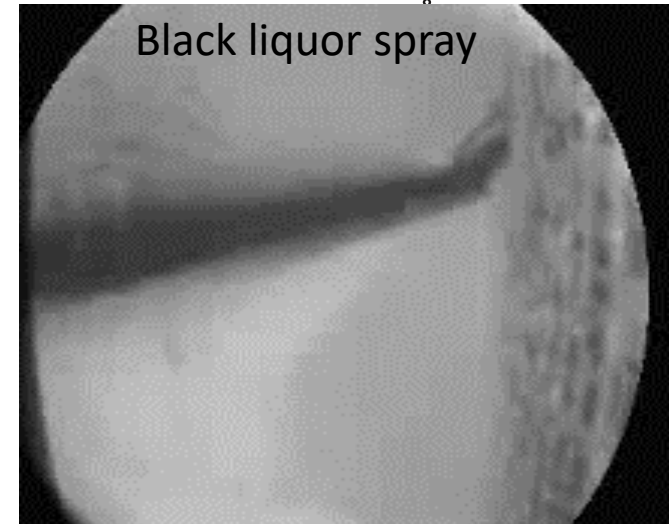
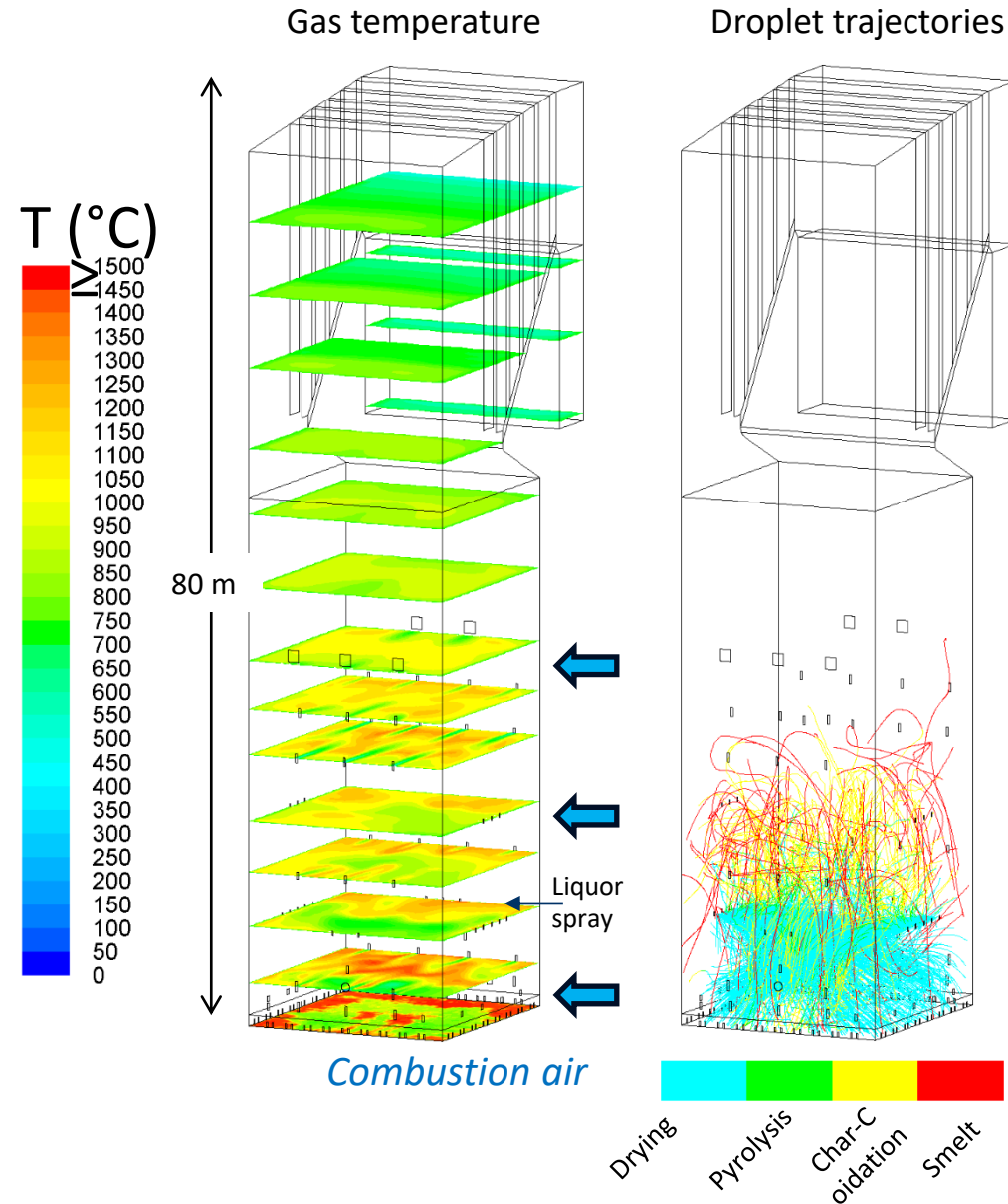
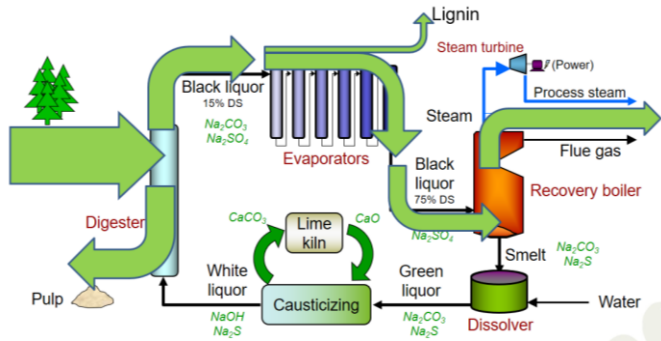
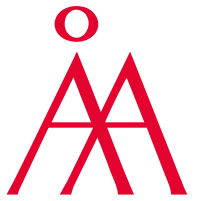
Pulp mill and Lignin removal (1/2)

- Black liquor lignin removal – mill benefits
 - Deload recovery boiler
 - Increase pulp production
 - Valuable side-product / biorefinery
 - ...
- Lignin removal – Currently implemented at mills only to limited extent

Pulp mill and Lignin removal (2/2)

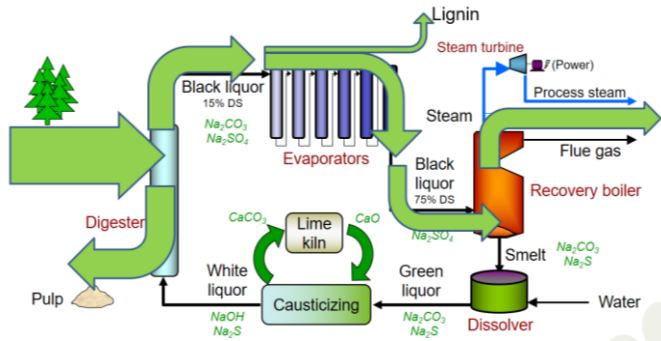
- Reasons for not implementing lignin removal
 - Recovery boiler / mill energy balance
 - Mill strategy / market,...
 - **Lack of RB operational experience**
 - **Unclear how much lignin removal impacts boiler operation ?**

Lignin removal – recovery boiler operation



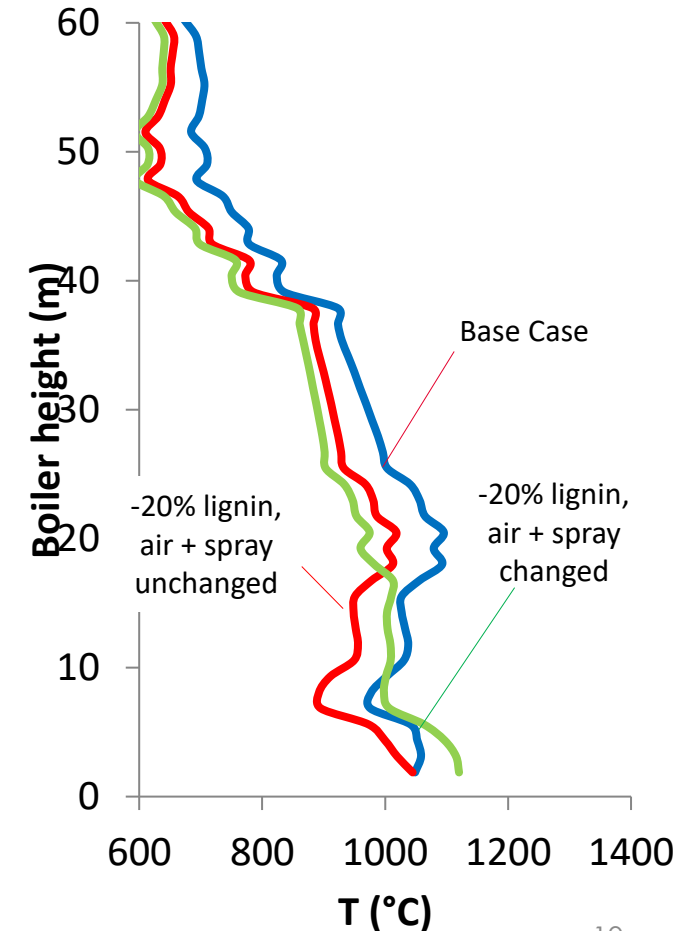
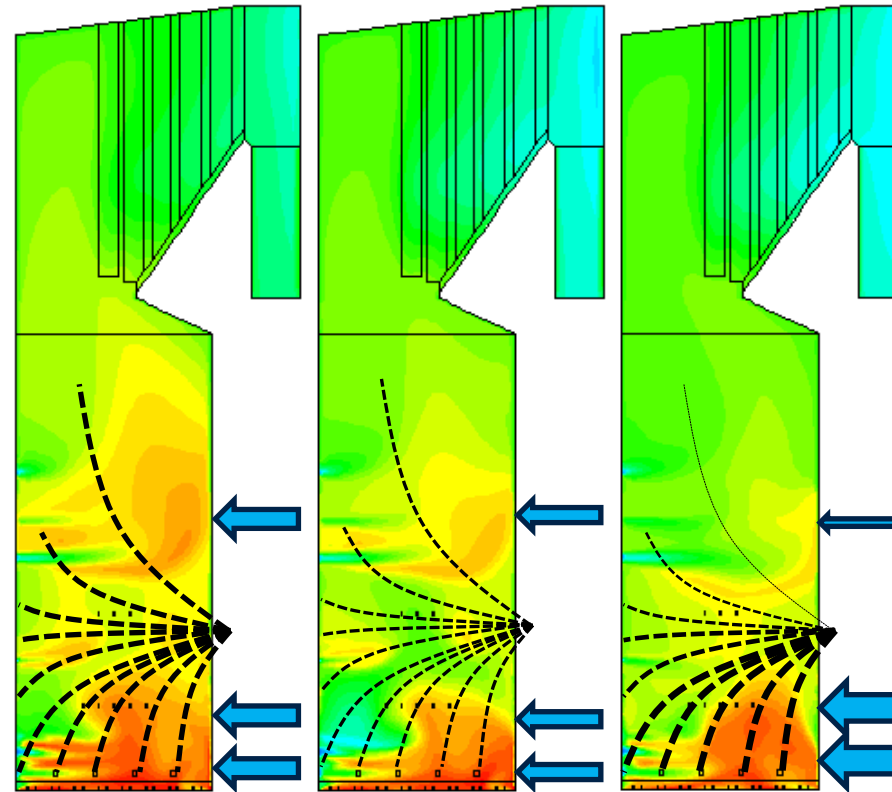
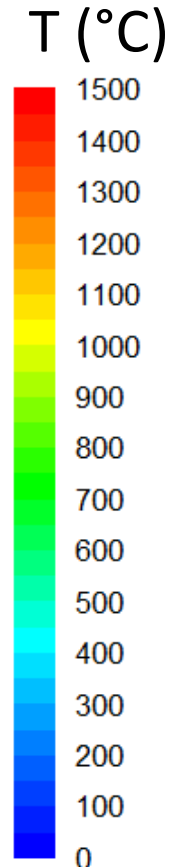
- With lignin removal less char carbon to lower furnace
 - Temperature decreases
 - Char bed & Chemicals recovery
- → Changes in boiler operation needed in order to compensate
- → More of the liquor and combustion air delivered to the lower furnace

Lignin removal – recovery boiler operation



Original liquor

20% reduced lignin



- With lignin removal less char carbon to lower furnace
 - Temperature decreases
 - Char bed & Chemicals recovery
- → Changes in boiler operation needed in order to compensate
- → More of the liquor and combustion air delivered to the lower furnace
- **The magnitude of the boiler operation changes appear feasible even in an existing boiler (20% lignin removal)**

Topics

- **"Implications for boiler operation today"**
 - Important to understand how removal of lignin affects Kraft recovery boiler operation
 - 200 Mt/y BLDS → 35% is lignin → 20% lignin recovery → 14 Mt lignin/y
- "Future visions"
 - Oxy-Kraft recovery boiler

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Oxy-Kraft recovery boiler

- 2024-2026
- Clean Energy Transition Partnership –project
 - The CETPartnership aims to empower the clean energy transition and contribute to the EU’s goal of becoming the first climate-neutral continent by 2050, by pooling national and regional RDTI funding for a broad variety of technologies and system solutions required to make the transition.
- Åbo Akademi University, Finland (coordinator)
- KTH Royal Institute of Technology, Sweden
- University of Zaragoza, Spain
- ANDRITZ Oy, Finland
- International Paper Inc., USA
- Valmet Technologies Oy, Finland
- Valmet Ab, Sweden



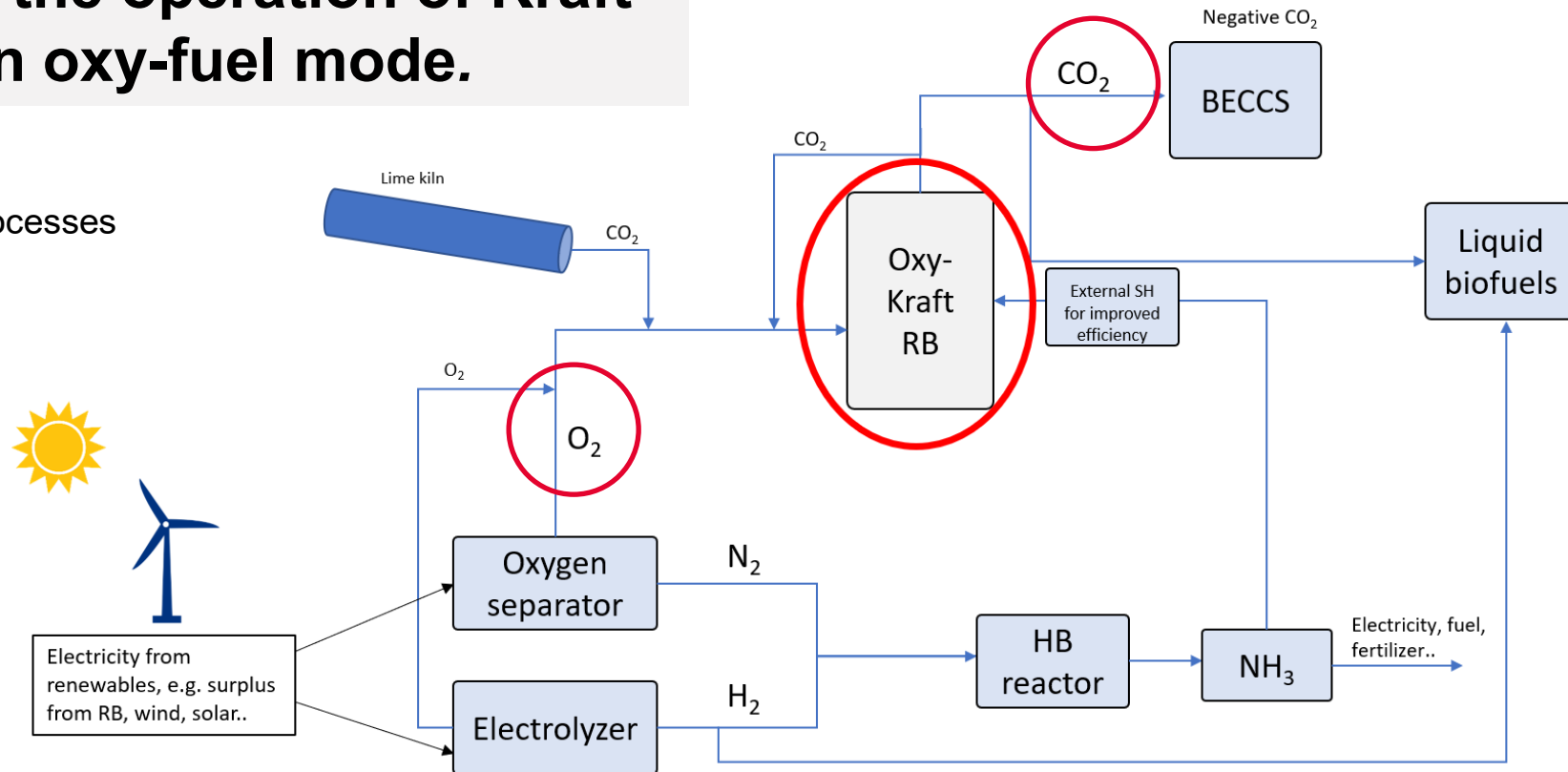
<https://blogs2.abo.fi/oxykraft/>

Oxy-Kraft recovery boiler and integrated green technologies

Objective: Enable the operation of Kraft recovery boilers in oxy-fuel mode.

=> integration of energy-related systems and processes

- Bioenergy with carbon capture and storage (BECCS).
- Bioenergy with carbon capture and use (BECCU).
- Integrated electrolysis with green H₂ and O₂ production.
- Integrated production of liquid biofuels from green CO₂ and H₂.
- Integrated green ammonia production and liquid biofuels.



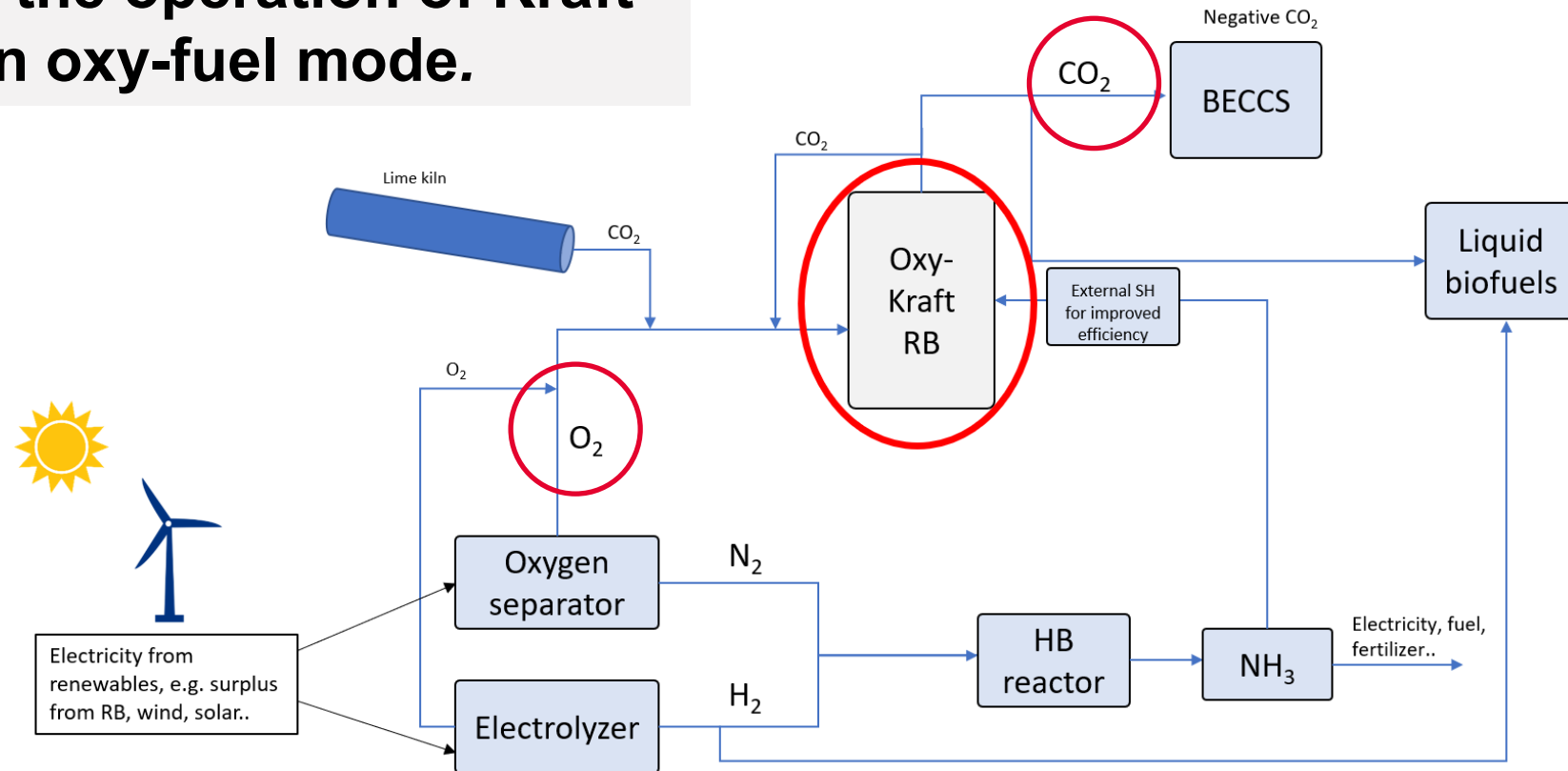
Oxy-Kraft recovery boiler and integrated green technologies

Objective: Enable the operation of Kraft recovery boilers in oxy-fuel mode.

Potential implication for lignin removal

- Combustion using oxidizer without N_2 increases the furnace (adiabatic) temperature significantly
- Can be used to compensate decrease in furnace adiabatic temperature due to lignin removal

→ **Might support higher levels of lignin removal from black liquor**



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- **”Future visions”**
 - Oxy-Kraft recovery boiler → potential to increase lignin removal
 - Other changes and additions to the traditional Kraft mill