

Achieving lower cost negative CO₂ emissions with a new bio-CLC technology

Tomi J Lindroos
The 9th Finnish Flame Day

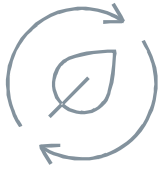


'Negative emissions' is a positive concept

Negative emissions take CO₂ out from the atmosphere.

Later on, captured emissions can be stored
underground or
used as a raw material.





Several negative emission technologies

- § Carbon sinks in forests and soils
- § Biochar
- § Bioenergy with carbon capture
- § Advanced weathering
- § Direct air capture
- § ...

The focus of this presentation

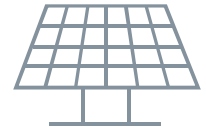
- § Carbon sinks in forests and soils
- § Biochar
- § Bioenergy with carbon capture (with bio-CLC)
- § Advanced weathering
- § Direct air capture
- § ...



Biomass Chemical-
Looping Combustion
(**bio-CLC**)

Not the first option, but not the last either

Many emission reduction options are cheaper and easier than carbon capture. Those should be used first.



On the other hand, new carbon capture technologies might emerge as relatively cheap options to mitigate CO₂ emissions.

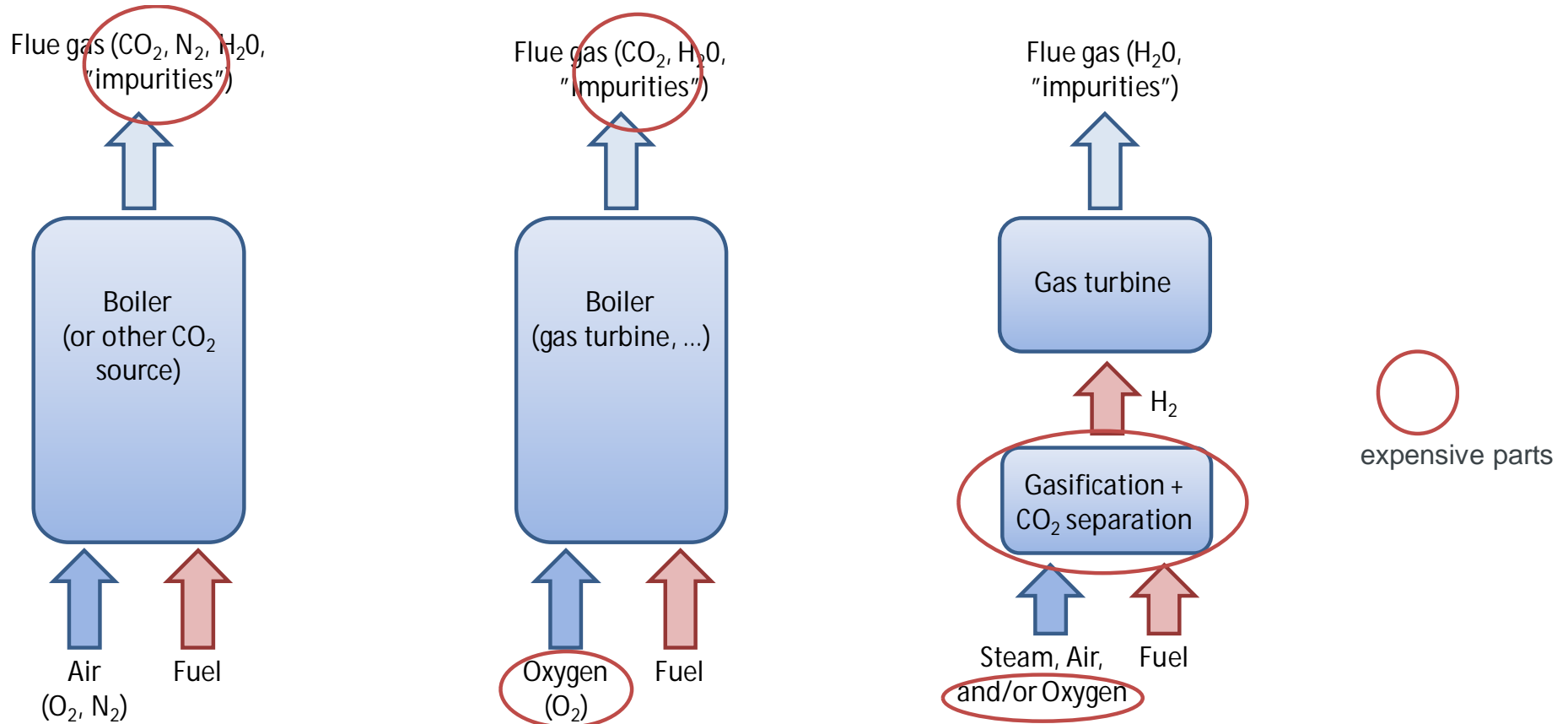
Traditional boiler

- § Established technology
- § CO₂ released to atmosphere

Flue gas (CO₂, H₂O, N₂)
+ impurities



3 conventional CCS techs for power & heat

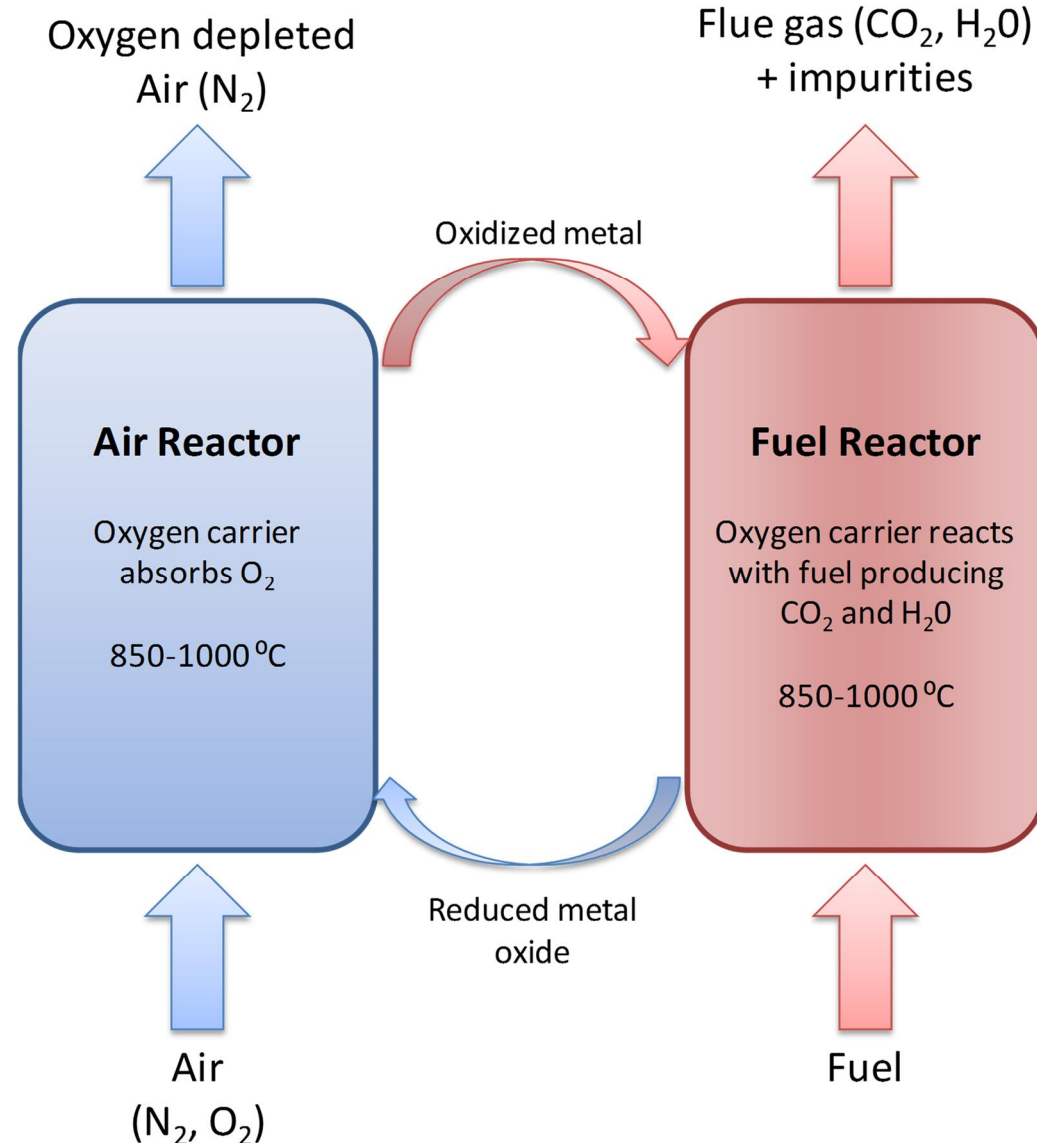


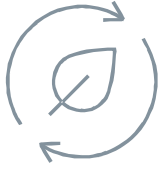
1) Post-combustion capture 2) Oxy-fuel combustion 3) Pre-combustion capture

New challenger: Bio-CLC

Targets:

- § 100% CO₂ capture rate
- § Considerably smaller energy penalty and additional costs than in conventional CCS

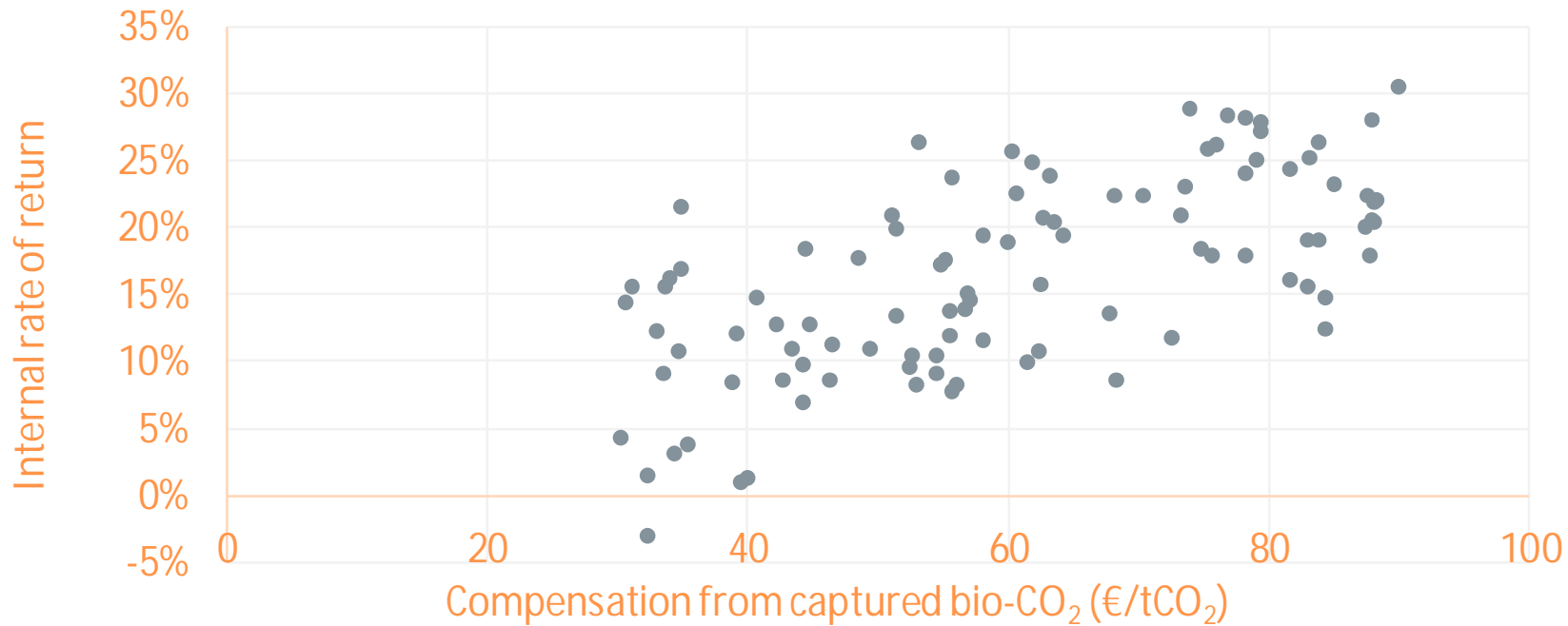




Demonstrated technology

- § ~20 MW_{th} district heating boiler in Gothenburg, Sweden
- § 50-100 kW pilot plants in Finland, Sweden, and Norway
- § Large scale demonstration plant is the obvious next target

Breakeven could be around 30-40 €/tCO₂



Thank you!

More info:

[http://www.nordicenergy.org/
flagship/negative-co2/](http://www.nordicenergy.org/flagship/negative-co2/)

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