



ECOMB

green H₂ + green CO₂ = E-MeOH

Opportunities

Sustainable fuel for Aviation and Shipping

- Easy and reliable retrofit of engines and fuel tanks
- Verified performances without losses

Challenges

COSTS / delayed ETS (EU Emission Trading System)

How can we bring down the costs for E-MeOH?

Hydrogen

CAPEX - new electrolyser technologies

OPEX - Power prices / strategic operations

Carbon dioxide from CCS

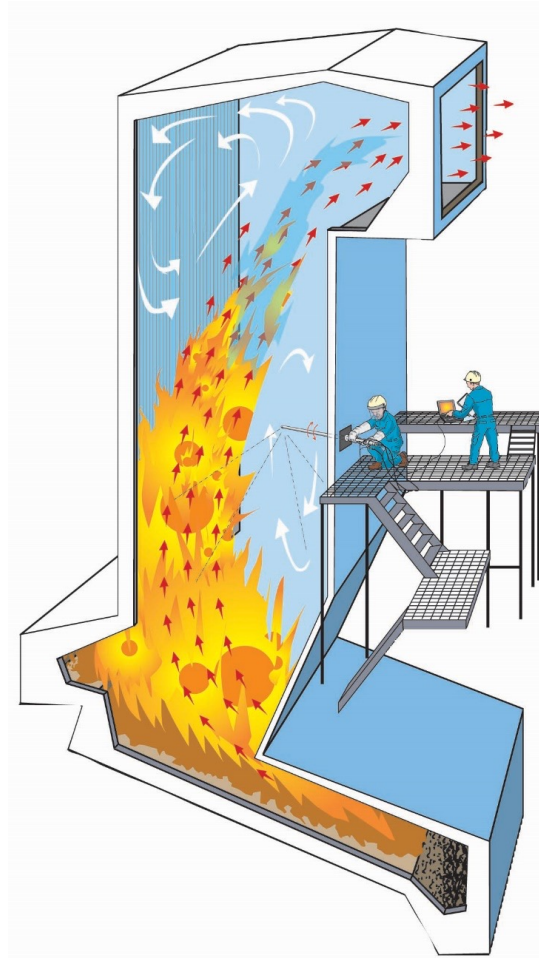
Ecotube Zero towards low cost CCS

Milestones in ECOMB history

1992	ECOMB AB was founded by Ulf Hagström och Eric Norelius
1995	First installation of an Ecotube System at the bark boiler Bäckhammars Paper Mill
1997	ECOMB become a public company, 600 new share holders
2000	First international contract, WTE plant in Coventry, UK
2004	First P.O. outside Europe, biomass boiler in Maine, USA
2011	First installation in a PF boiler, at Le Gol plant on Reunion island
2015	First contract with OEM, a new 120 MWth biomass boiler on Martinique island
2022	Ecotube Zero
2024	First Ecotube installation in Sweden for 10 years - Enköping biomass 75 MWth
2025	Ecotube DOS (Deep Oxygen Staging)

Typical Combustion Problems

- Poor mixing/laminar flue gas flow
- Uneven temperatures and gas velocities
- High NO_x
- High SNCR reagent consumption
- Frequent CO spikes
- Non utilized furnace volumes
- High ammonia slip



The Ecotube System

**Simple retrofit installation by
Means of well-proven technique
and equipment**

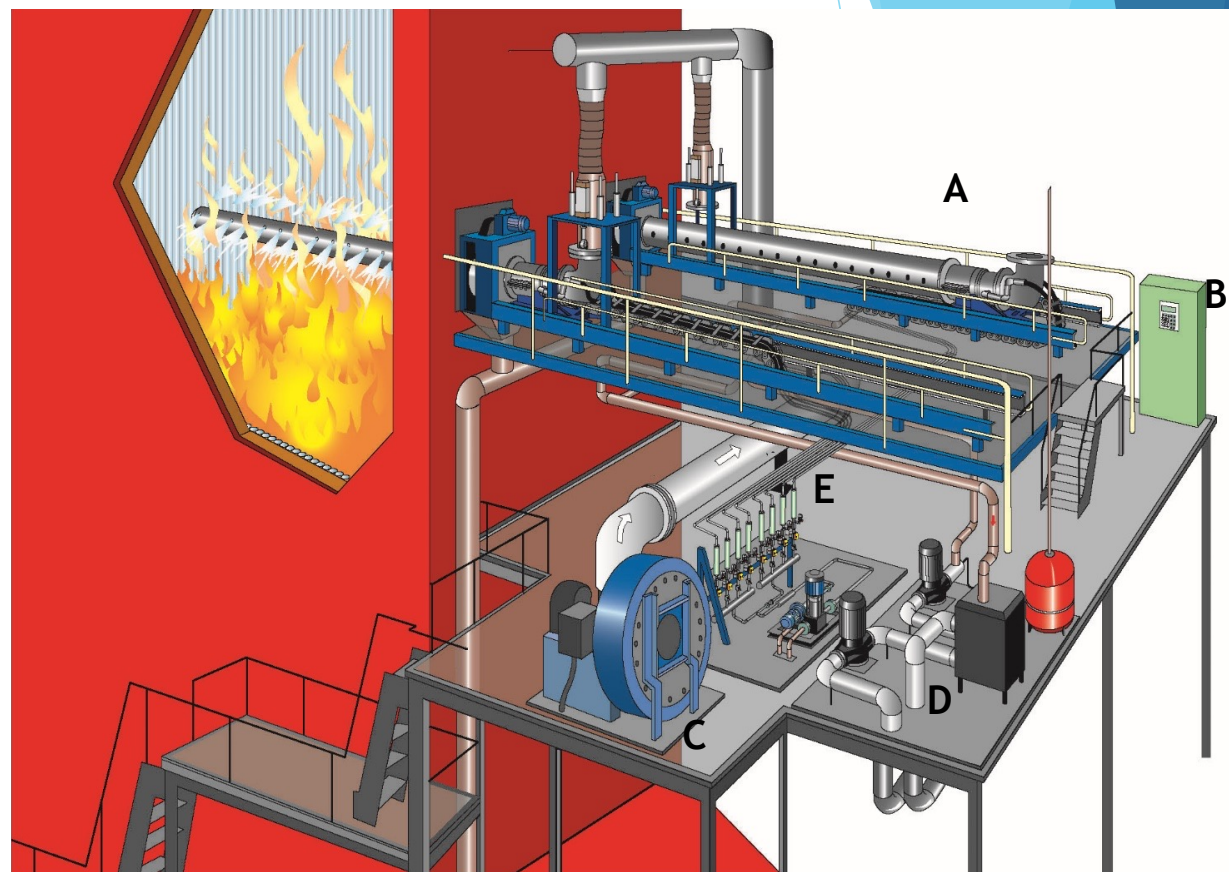
A: Ecotube Assemblies

B: Combustion Control System

C: Air Supply System

D: Cooling Water System

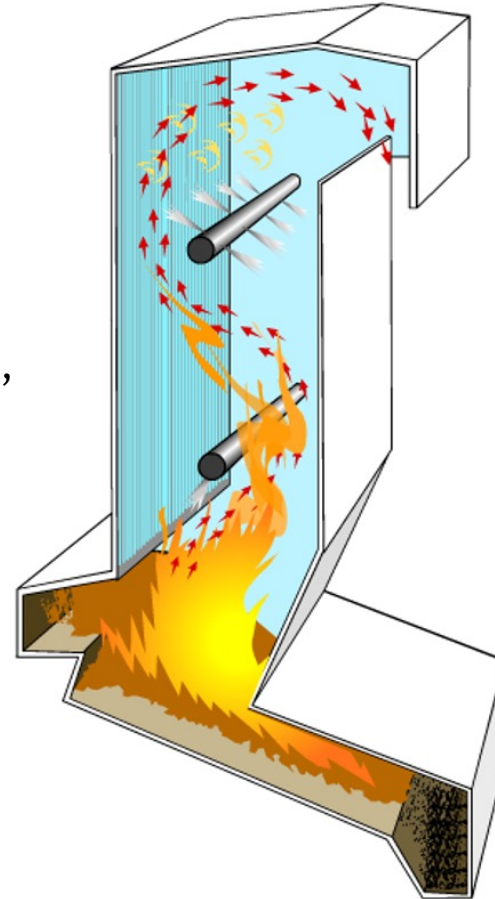
E: NH₃/Urea Supply System



Ecotubes towards low cost CCS

1. Retrofit the boiler with an Ecotube System

- Increased max load och reduced min load
- Reduced flue gas flow/excess air/O₂
- Increased output from the boiler.
The cooling system generates up to 2 MWth, depending on size and position
- Reduced NO_x/NH₃-consumption/NH₃-slip
- Reduced CO and LOI (Loss Of Ignition)
- Reduced carry over/fly-ash



Typical performance improvements

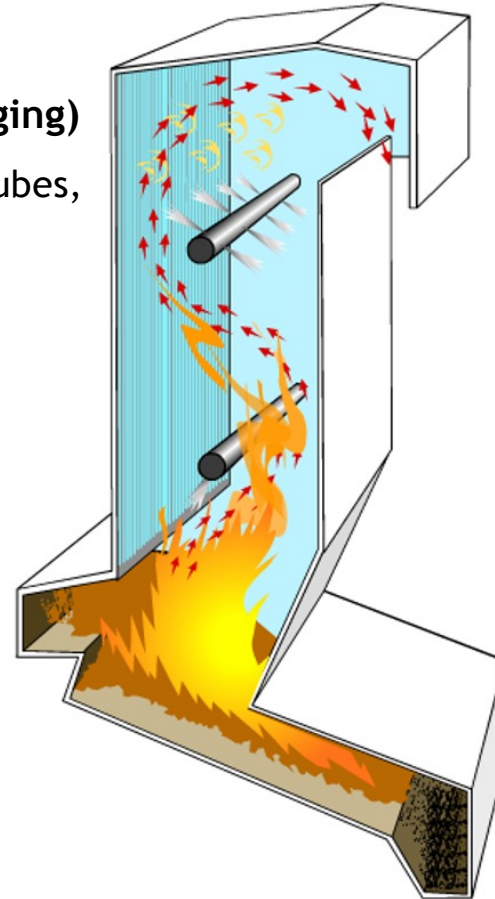
Parameter	Typical improvements
Thermal efficiency/fuel costs	+0,5 - 1,5 %
Increased max load (power / steam)	+5 - 15 %
Increased throughput (waste)	+5 - 15 %
Reduced carry-over / fly-ash	-25 - 35 %
Reduced NH ₃ -consumption	-20 - 70 %
NO _x -reduction for NO_x <80 mg/Nm³	-50 - 75 %
CO-improvement	Reduced and more stable
Wear&Tear and fouling	
Corrosion issues related to high NH ₃ -slip	
Possibilities to burn cheaper fuels (with high moisture content)	
Reduced costs for condensate cleaning	

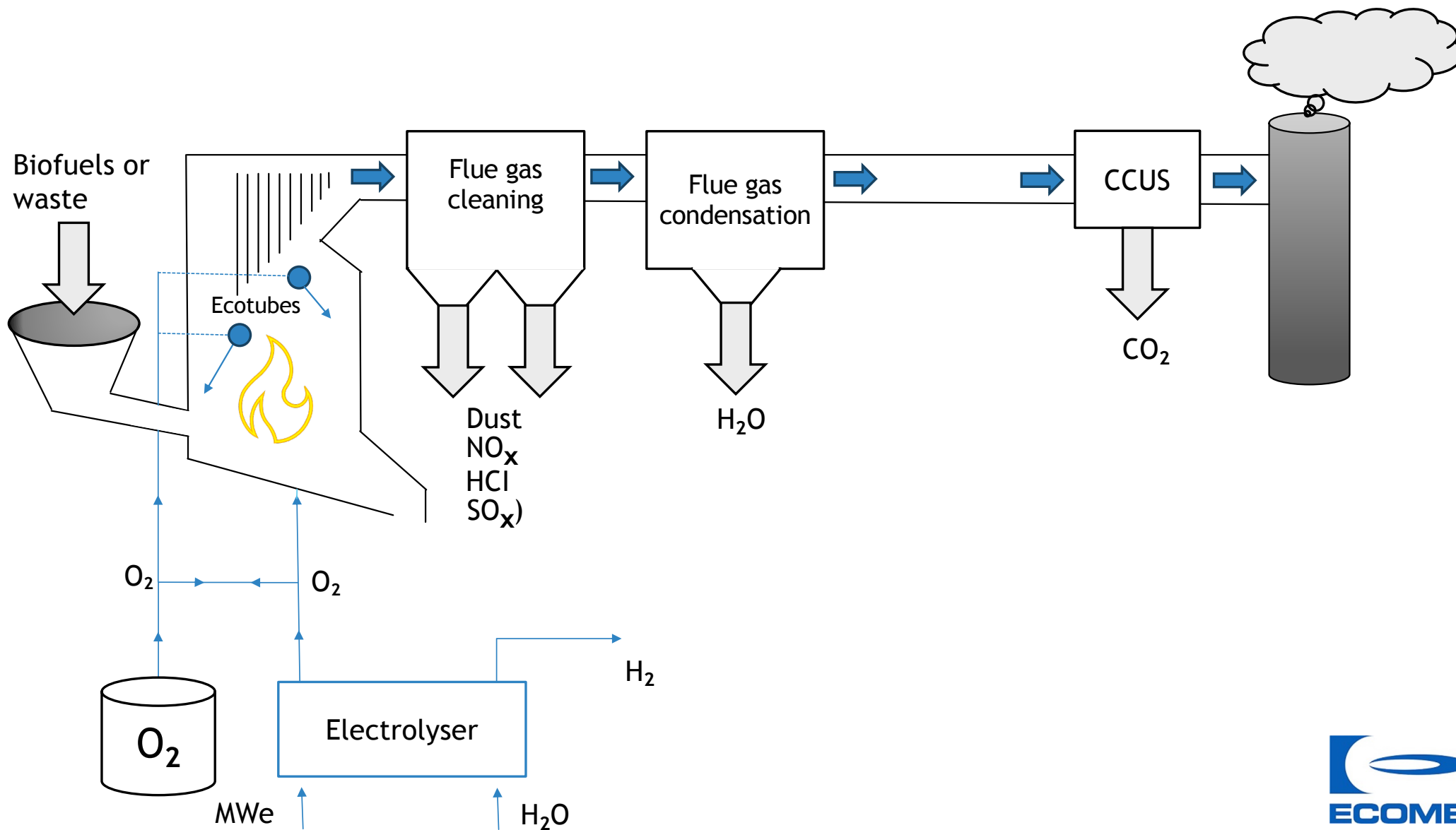
*Average performance improvements
based upon 34 installations of
the Ecotube System*

Ecotubes towards low cost CCS

2. Conversion to Ecotube DOS (Deep Oxygen Staging)

- Utilise moderate flows of oxygen for the Ecotubes, local electrolyzers, down to 100 kg O₂/h
- The same advantages as under 1, but further increased performance improvements

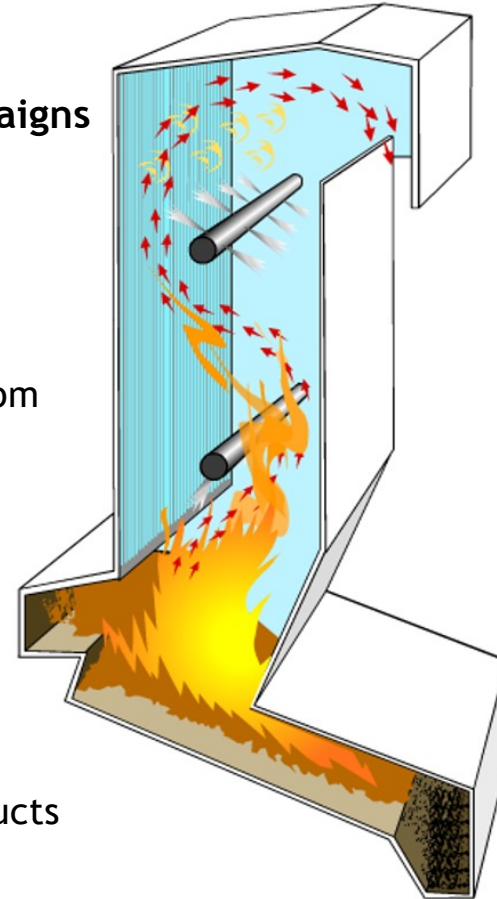


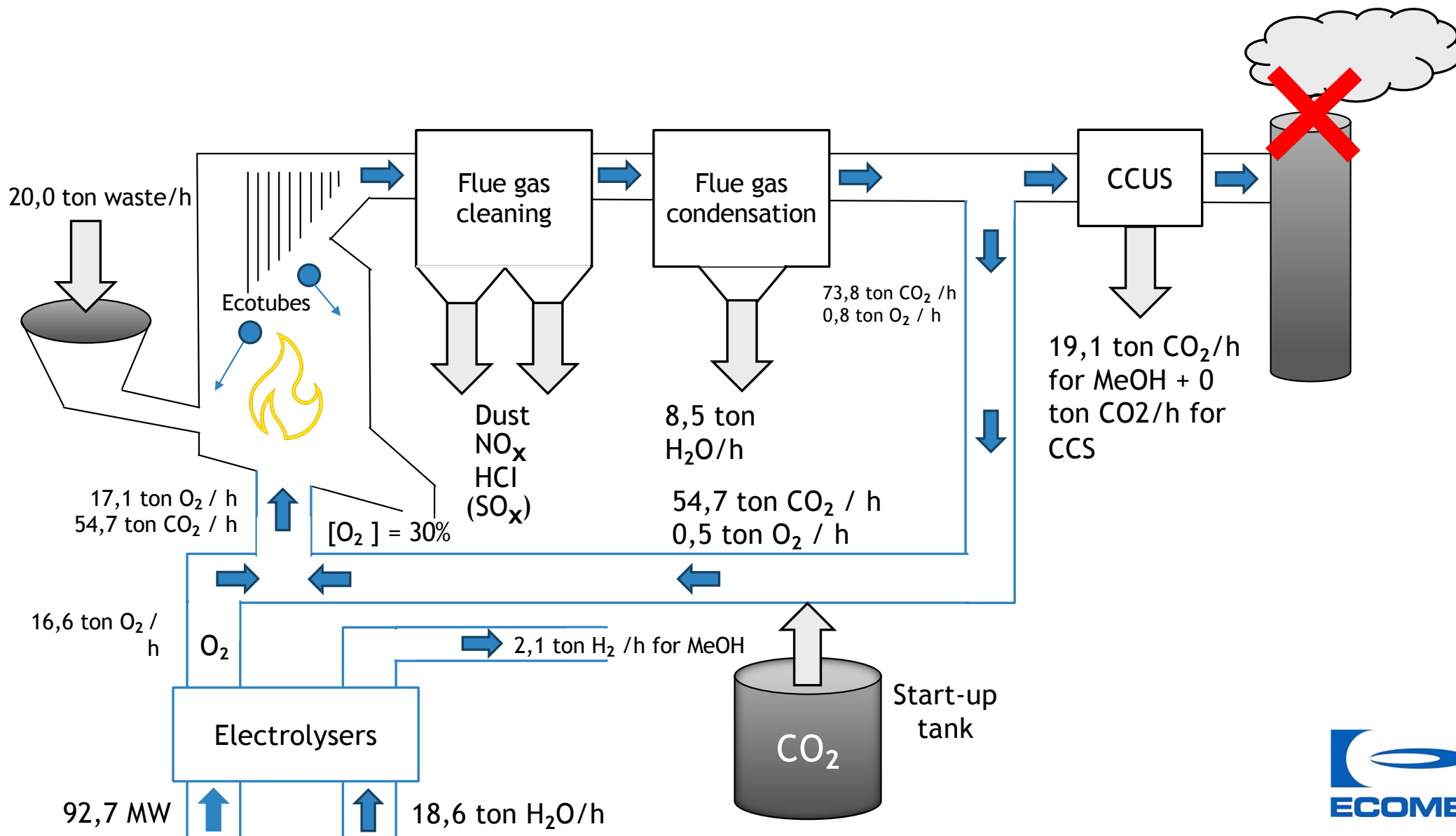


Ecotubes towards low cost CCS

3. Add flue gas recirculation and carry out campaigns with Ecotube Zero and Oxyfuel

- Quick and safe change of combustion mode between "air combustion" (as of today) and Oxyfuel combustion with Ecotube Zero. O₂ from temporary solution/tank etc.
- Verify leakages / Tramp air in the boiler and flue gas ducts and its consequences
- Verify new heat balance in the boiler.
- Determin optimum flows of recirculating flue gas to primary-, secondary- and tertiary air ducts

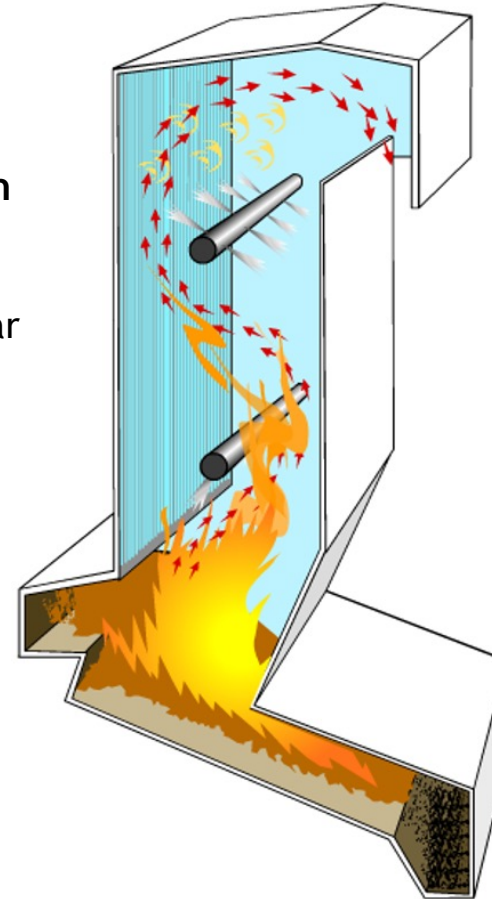




Ecotubes towards low cost CCS

4. A complete conversion to Ecotube Zero and Oxyfuel, including permanent oxygen production

- Final decision of oxygen production, such as electrolyzers connected to wind turbines, solar cells or nuclear power plants
- A CCUS plant designed for min flue gas flow and high CO₂ concentration (over 85 vol-% instead of max 15 vol-%)
- Shut down stack (only "evacuation" of air gases)



Ecotubes at Enköpings Energi (75 MWth) 2025

