

# Utilisation of co-Produced Oxygen from Electrolysis to Enable Deep Decarbonisation

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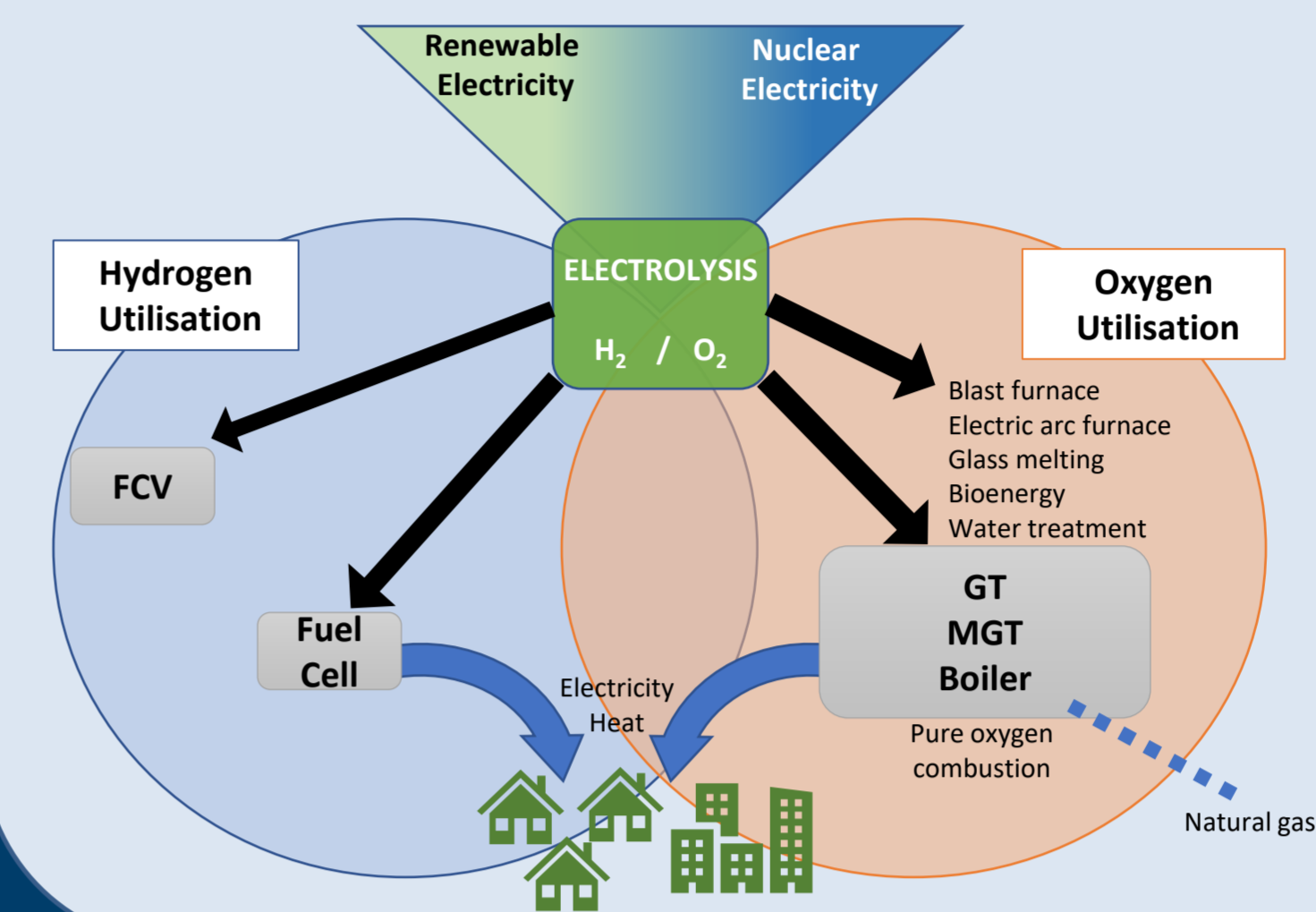
## Project AIM

To study the integration cost-effective carbon-free (*green*) Oxygen in the Industrial Sector as an alternative to other commercial options for large scale O<sub>2</sub> production

## HOW?

- By mapping O<sub>2</sub> opportunities at Clusters with the need for pure oxygen (steel producers, chemical plants, general manufacturing...)
- Verifying the carbon footprint of Green Oxygen from electrolysis (LCA)
- Outlining technoeconomic routes for Green Oxygen utilization within Clusters (TEA) and
- Establishing industrial decarbonization potential for Green Hydrogen when scaled from MW to GW

## Oxygen from electrolysis



Global Oxygen market: **£44billion** ↑ 4-5% annually

Generates 9Mt of Oxygen per Mt of Hydrogen

Can offer carbon-free Oxygen to innovative CO<sub>2</sub> capture processes

Commercialising the by-product oxygen can make green Hydrogen more competitive with blue hydrogen

# Integration of Green O<sub>2</sub> to Industry

## STEEL INDUSTRY

EU 157 Mt of steel in 2019, 8% of the world total

7 Mt in UK

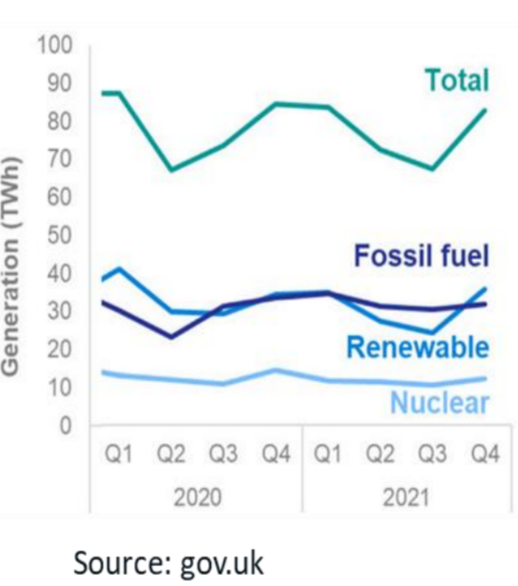
13.5% GHG emissions (2% total UK)

1 Mt of steel requires approx. 0.07 MtH<sub>2</sub>

7 Mt in UK 5.6 Mt of steel by BF/BOF

3-5 GW of electrolyser capacity (74% expected future efficiency)

30 TWh of clean energy per year

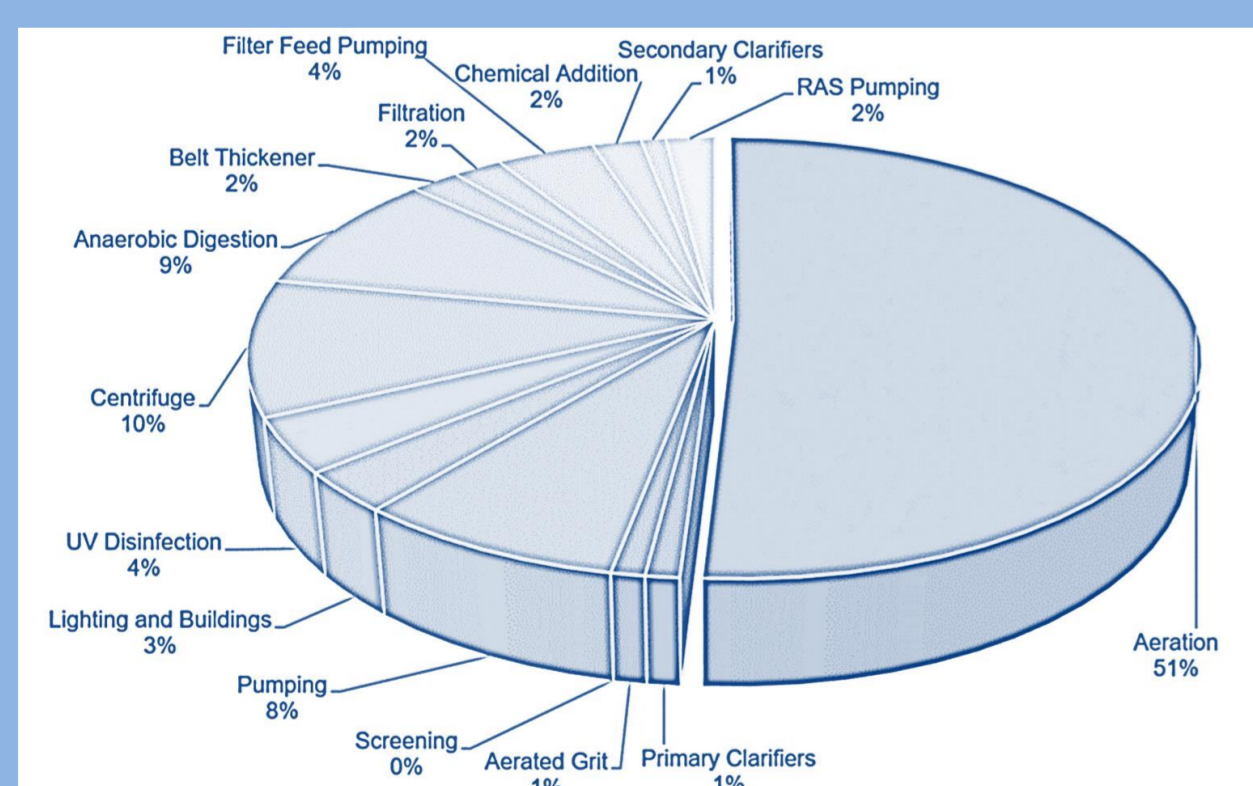


0.4 MtH<sub>2</sub>

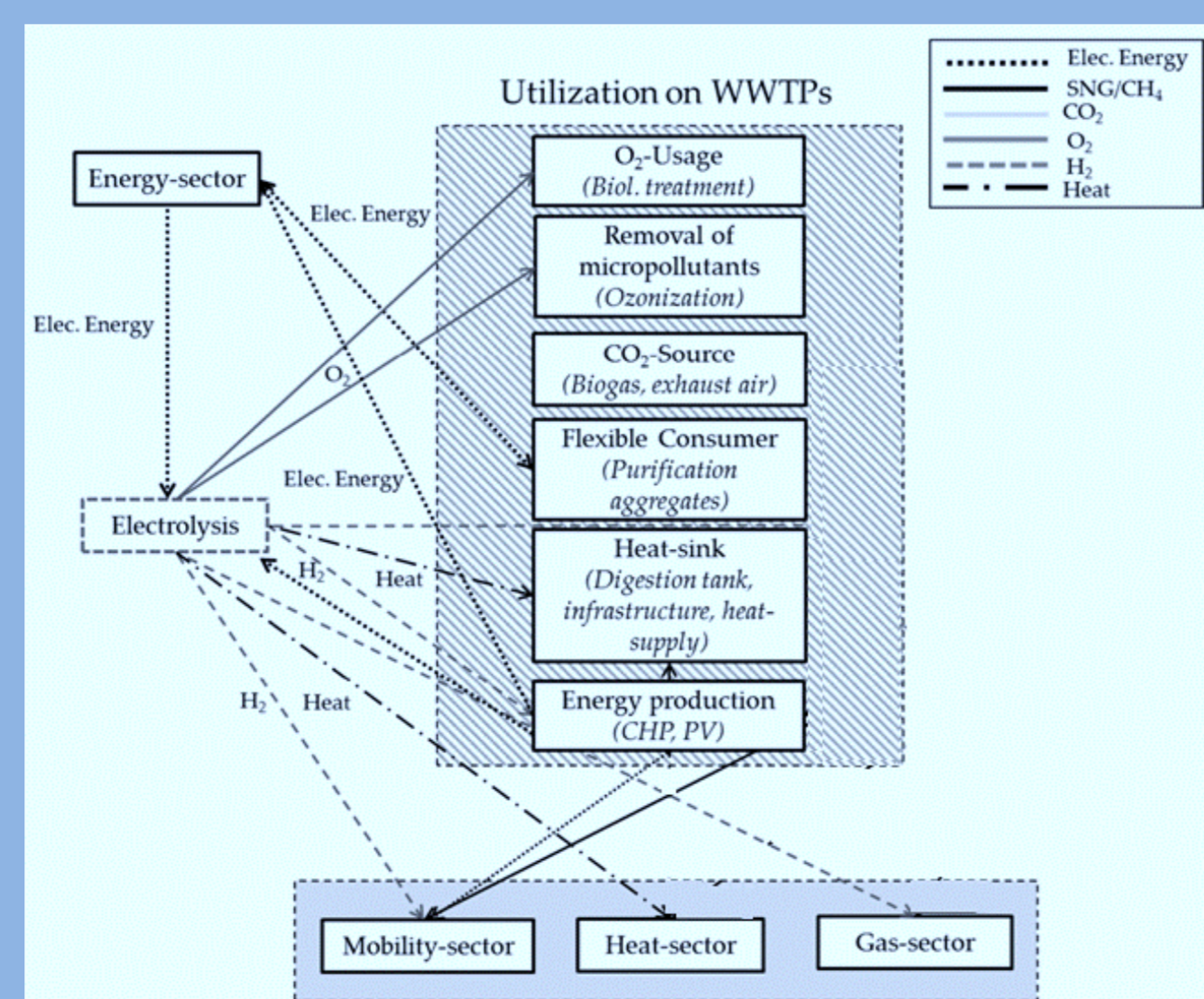
+ 3.6 MtO<sub>2</sub>

- Blast Furnaces** → 40% of the total amount of O<sub>2</sub> used in a typical integrated steel mill.
- Basic Oxygen Furnaces** → O<sub>2</sub> is used for decarburization and the conversion of hot metal formed in a blast furnace to liquid steel.
- Electric Arc Furnaces** → O<sub>2</sub> used to run oxy-fuel burners/high velocity lancing/sub-sonic injection processes (for post combustion of CO<sub>2</sub>).
- Rotary Furnaces** → O<sub>2</sub> allows for the avoidance of heat loss → reducing operation time.
- Steel Reheating, Cutting and Burning** → O<sub>2</sub> used on oxy-fuel burners. High purity O<sub>2</sub> is used in cutting and burning processes.

## WATER TREATMENT INDUSTRY



The aeration is usually realized by inserting compressed air (blowers/compressors) into the system. This part of wastewater treatment is the biggest energy consumer, with 50%–70% of the overall energy consumption, while the cost of consumed power may constitute as much as 15–49% of total costs within a plant.

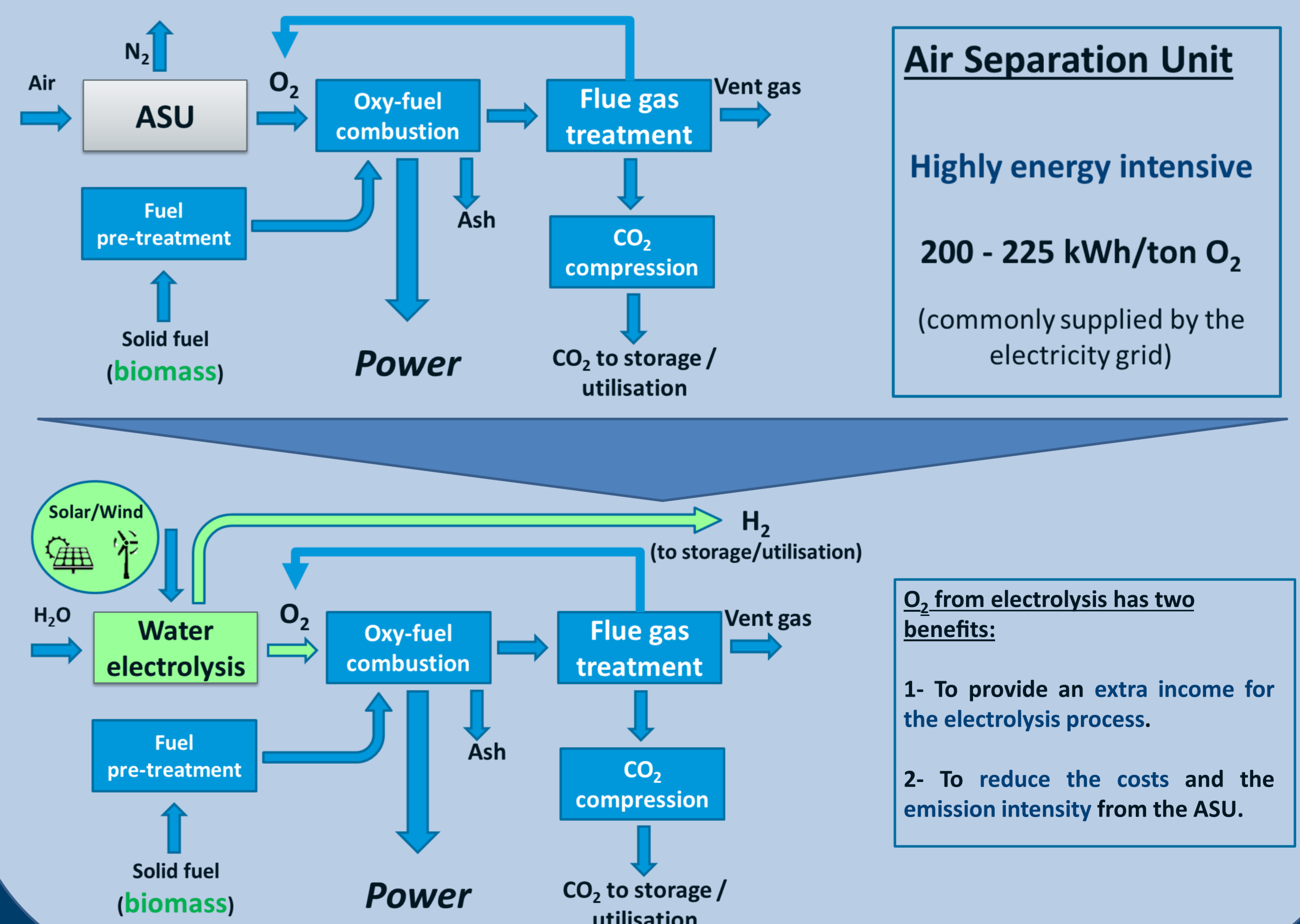


Source: Energies 2020, 13, 2088

- Reduction of the needed gas volume due to a five-times higher O<sub>2</sub> content of pure O<sub>2</sub> than compressed air.
- Better O<sub>2</sub> transfer rate and higher dissolved O<sub>2</sub> concentrations due to higher possible biomass concentrations.
- Smaller and more compact basin constructions are possible for locations with limited spatial conditions.
- Pure O<sub>2</sub> is usable to support aeration processes as an additional system and compensate peaks in O<sub>2</sub> demand.
- Good short/medium-term reconstruction measures for capacity increases in purification quality.

## ELECTROLYSIS AND BIOENERGY

### Oxy-fuel Combustion



### Air Separation Unit

Highly energy intensive

200 - 225 kWh/ton O<sub>2</sub>

(commonly supplied by the electricity grid)

### O<sub>2</sub> from electrolysis has two benefits:

- To provide an extra income for the electrolysis process.
- To reduce the costs and the emission intensity from the ASU.