**FROM WASTE TREATMENT TO FUEL PRODUCTION:**

**ENSURING ENERGY CIRCULARITY**

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## Resume

Our global eco-system is, essentially, carbon based. Thanks to sunlight, photosynthesis incorporates atmospheric CO2 into plants which, among others, serve as food for animals and humans. Up to 1 billion tonnes of organic waste are globally produced each year and constitute an enormous potential for carbon recovery. Complexity and variability being key characteristics of this waste, render its processing challenging. Conversion to biogas holds promise as a manner to ‘simplify’ this carbon containing resource by significantly reducing compositional variations. This allows further, larger-scale centralized processing, e.g., according to the OBIWAN concept, of locally produced biogas.

OBIWAN comprises methane pyrolysis and CO2 hydrogenation step, after prior separation of both components from biogas, in its conversion to various value-added products. A minimum methane content of 60% is required in the biogas for the amount of hydrogen obtained via methane pyrolysis to be sufficient to hydrogenate all CO2 to methanol. An ElectroThermal Fluidized Bed (ETFB) reactor, fueled by renewable electricity, is an ideally suited candidate for driving this highly endothermic reaction, simultaneously generating high quality solid carbon (useful for battery or tire applications) as byproduct. CuZn based catalysts are the benchmark for CO2 hydrogenation to methanol and are the subject of high-throughput development. The obtained methanol serves as a starting material for Sustainable Aviation Fuel (SAF) synthesis over innovative ZSM-5 zeolites, including co‑feeding of heavier alcohols or olefins.

## Graphical Abstract

A diagram of a nuclear reactor

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