From CO2 capture to e-fuel production, integration is the key

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CO2 based fuels are part of the solution to reach net zero emission by 2050. The main sectors where CO2-base fuels are expected to arise in the near future are the hard to abate sectors, such as heavy-duty transport (shipping, trucking and aviation), in which energy density is key. In such fuels, CO2 is the source of carbon, water the source of hydrogen and energy is provided by renewable electricity. This is why CO2-based fuels are also named e-fuels or electro-fuels. Together with biofuels, CO2 based fuels requires regulation to drive the shift from fossil to sustainable fuels. As an example, ReFuel EU aviation initiative proposes ambitious and increasing shares of sustainable aviation fuel (SAF), including CO2-based kerosene.

Synthetic kerosene can be produced from syngas by Fischer-Tropsch synthesis followed by an upgrading step to transform the obtained wax into fuels with given specifications.
IFPEN has developed the Fischer-Tropsch process in collaboration with Axens and ENI, in the late 90s. The process is now commercialized by Axens as Gasel® process.
Syngas is a mixture of carbon monoxide and hydrogen. Historically syngas was fossil based, produced from natural gas or coal, aiming at producing liquid fuel from gas or coal, i.e. Gas To Liquid or Coal To Liquid conversion. Nowadays, sustainable liquid fuels can be obtained by the conversion of biomass or captured CO2 into syngas and further Fischer Tropsch synthesis. IFPEN has developed biomass gasification and CO2 capture processes up to demonstration unit scale.
For CO2 conversion into syngas, IFPEN has decided to develop a process based on the most mature path, i.e. reversed water gas shift (RWGS) reaction. With this RWGS process, IFPEN together with Axens are able to provide a unique offer from CO2 capture to synthetic paraffinic fuels production.

Fischer-Tropsch synthesis is exothermic and exports steam, while RWGS reaction is endothermic and requires energy. CO2 capture also requires heat for the regeneration. Therefore, the integration between processes is key to improve the overall efficiency.
Life Cycle Analysis is also an important tool to compare and select optimal e-fuel scheme based on GHG emissions.