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Technology and Costs

Biorenewable Insights: Bio-naphtha as a Chemical Feedstock

Bio-naphtha as a Chemical Feedstock is one in a series of reports published as part of NexantECA's 2020 Biorenewable Insights program.

Overview

The proliferation of processes for the production of bio-based hydrocarbons has opened up the possibility of using some of these bio-derived hydrocarbons as feedstocks for steam crackers. Naphtha steam crackers produce a significant portion of the world's ethylene and propylene, as well as C4 olefin's (e.g., butadiene, isobutylene) and aromatics—these are important chemicals; in fact the backbone of the chemical industry. Outside of the United States and Middle East, naphtha predominates as the feedstock of choice for steam cracking, and available bio-hydrocarbon production resembles naphtha fractions to the extent that drop-in usage for chemical production is possible. Studies of bio-naphtha cracking have revealed yields of ethylene and propylene comparable to those of petroleum-derived naphtha.

Steam cracking of bio-naphtha thus offers an intriguing avenue for sustainability that allows a drop-in product to enter the conventional value chain as ethylene, propylene, C4s, aromatics, or other commonly used derivatives. As a result, bio-naphtha as a chemical feedstock is increasingly recognized as a viable option for future sustainable chemicals production. However, capacity levels remain low and naphtha fractions from renewable fuels projects are generally regarded as byproducts. Many questions remain:

- At what petroleum naphtha prices do bio-naphtha cracking economics look attractive?
- How does the lack of dedicated capacity for bio-naphtha fractions affect the economics of production?
- How much capacity exists in the sector, and how much of announced capacity will see completion?

Technologies

This report focuses on the production of bio-naphtha itself, not on the steam cracking of bio-naphtha which is relatively well studied. Bio-naphtha feedstocks are covered from three major routes:

- Hydroprocessing of esters and fatty acids
- Fischer-Tropsch synthesis of bio-derived syngas
- Pyrolysis of biomass or other waste materials, including hydrothermal liquefaction technologies

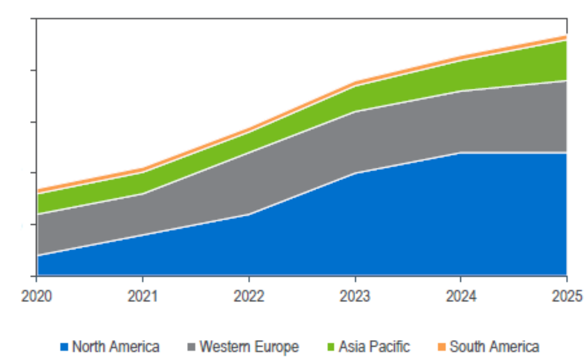
Process Economics

This report covers cost of production estimates for bio-naphtha using two commercial hydroprocessing technologies (Neste Oil's NExBTL process and Honeywell's UOP EcoFining process) as well as generic process economics using Fischer-Tropsch synthesis, pyrolysis, and hydrothermal liquefaction. These cost models are offered on a 3Q 2020 basis with location scenarios including the United States, China, Brazil, and Western Europe.

Commercial Impact

Bio-naphtha commercial impacts are examined on the basis of feedstock availability from hydrocarbon bio-diesel and bio-jet fuels, with bio-naphtha as a byproduct. Current capacity levels are assessed in the context of announced fuel projects and their locations.

Announced Bio-Naphtha Capacities, 2021-2025



Olefin Yields from Steam Cracking Using Naphtha vs. Bio-Naphtha, Weight Percent

	Ethylene	Propylene
Bio-Naphtha	31	18
Naphtha	34	16
Ethane	79	3
Propane	43	17
Butane	40	22
Gas Oil	31	19

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program (formerly known as PERP), the Biorenewable Insights program (BI), the Sector Technology Analysis, and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

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