NexantECA

Technology and Costs

Biorenewable Insights: Propylene

Propylene is one in a series of reports published as part of NexantECA's 2023 Biorenewable Insights program.

Overview

With a growing global focus on greenhouse gas emissions reduction and the consumption of plastics continuing to grow, the establishment of commercially viable "green" alternatives to conventional petro-based polymers, such as polyethylene, polypropylene, and PET, is becoming increasingly important. Some technology players are pursuing the development and commercialization of novel renewable polymers, such as polylactic acid (PLA), polyhydroxyalkanoates (PHAs), and furandicarboxylic acid (FDCA), to replace conventional petro-based polymers. However, the commercial viability of these polymers is often reduced by high production costs relative to conventional routes, comparatively poor processability, and inferior physical properties for certain applications. Thus, it is desirable to develop and scale-up technologies to produce renewably derived "green" analogs to key olefin intermediates, such as propylene, with identical physical properties to conventional propylene that can be used as a drop-in chemical for the propylene value-chain.

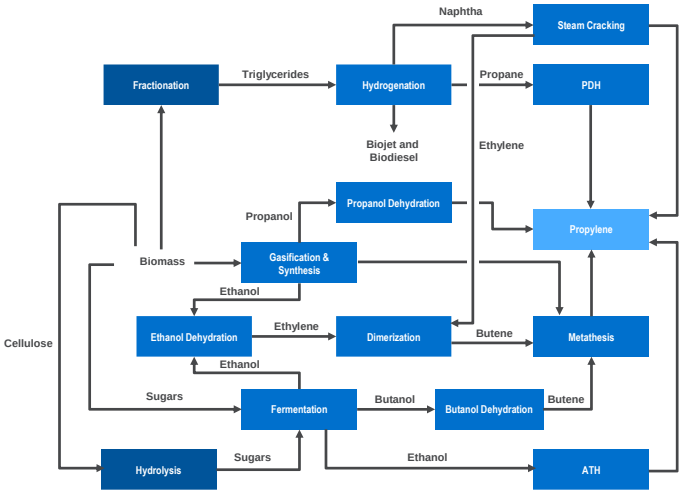
More broadly, the growth in demand for propylene is driven by its versatility as a building block and as a feedstock for a wide range of important monomers, polymers, intermediates, and chemicals. This versatility stems from the unique chemical structure of propylene—thus propylene cannot simply be substituted away, a sustainable and renewable source is required.

Technologies

Many routes exist theoretically for the conversion of biomaterials to propylene, many utilizing already commercial technologies and some with significant potential for reduced carbon intensity.

Propylene has been a secondary priority, behind ethylene, for a considerable amount of time and is only now becoming a primary product of focus for many. Significant upstream developments in bionaphtha, biomethanol, and bio-propane produce significant material to allow some feedstock switching of conventional propylene feedstocks for biomaterials. Significant decarbonization of propylene is very feasible,

NexantECA has identified many potential routes to produce bio-based propylene that are technically feasible. However, only a few of these routes are currently being explored for commercial viability. Potential process routes to bio-propylene are presented below.



Process Economics

Economics are investigated in USGC, Brazil, China, and Western Europe. The following technologies are compared:

- HVO Naphtha Steam Cracking
- FT Naphtha Steam Cracking
- ATJ Naphtha Steam Cracking
- rPDH
- rMTP
- Ethanol-based Metathesis
- Enhanced FCC of Triglycerides
- ATH
- Glycerine Dehydration
- Direct Fermentation

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The BI program (sister program to the world renowned TECH program, formerly known as PERP) is globally recognized as the industry standard source of process evaluations of existing, new and emerging technologies of interest to the renewable energy and chemical industries.

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), 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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