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Technology and Costs

Biorenewable Insights: Low Carbon Intensity Marine Transport

Low Carbon Intensity Marine Transport is one in a series of reports published as part of NexantECA's 2023 Biorenewable Insights program.

Overview

In 2018, the International Maritime Organization (IMO) set an initial target of reducing the shipping industry's GHG emissions by at least half by 2050 and reducing the carbon intensity of emissions by 40 percent by 2030 and 70 percent by 2050, compared to 2008 levels. As part of the industry's ongoing decarbonization efforts, alternative fuels which emit lower GHG emissions compared to conventional marine fuels (e.g., crude oil-derived fuel oil and gas oil) are currently being developed.

Renewable drop-in fuels such as biodiesel (or fatty acid methyl ester; FAME), Renewable Diesel, and bio-liquefied natural gas (bio-LNG) are already seeing limited blended use as marine fuels. Fuels with relatively low or near-zero GHG emissions, such as methanol, ammonia and hydrogen, are considered emerging marine fuels.

This report discusses various low carbon-intensity marine fuel options and alternative power options such as electricity, wind, and nuclear propulsion for the shipping industry. The report also provides a technoeconomic analysis of available production technologies for low carbon/carbon neutral marine fuels at various scales and regions, as well as the associated greenhouse gas emissions of these processes.

Technologies

This report covers the following low-carbon marine fuel technologies by selected licensors/producers:

- Conventional base-catalyzed biodiesel
- Renewable Diesel

  (via Hydrotreated Vegetable Oil [HVO], biomass gasification and pyrolysis pathways)
- Renewable Natural Gas

  (via anaerobic digestion, landfill gas and biomass gasification pathways)
- Green Methanol (Biomethanol and E-Methanol)
- Green Hydrogen

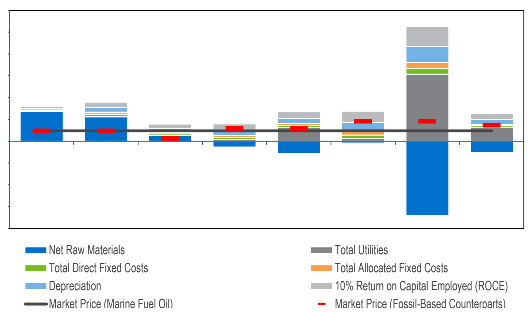
  (via bio-feedstocks reformation, biomass gasification and PEM electrolysis)
- Green Ammonia

  (via PEM electrolysis and Haber Conversion)

Process Economics

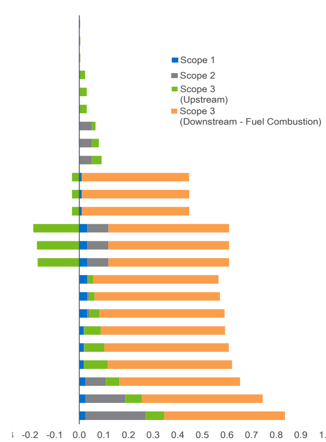
Cost of production estimates expressed in terms of US$ per ton of marine fuel and per nautical mile of distance travelled for three locations (United States, Western Europe and China) are presented for production of low-carbon marine fuels from various routes:

- Base-catalyzed vegetable oil-based biodiesel
- Waste oil-based Renewable Diesel via the HVO pathway
- Pipeline-quality Renewable Natural Gas via Anaerobic Digestion
- Biomethanol via Gasification of Municipal Solid Waste
- E-Methanol via Waste CO_2
- Green Hydrogen via Biomass Gasification
- Green Hydrogen via PEM Electrolysis
- Green Ammonia via PEM Electrolysis and Haber Conversion



Carbon Intensity

This report includes models of scope 1, 2 and 3 emissions for the abovementioned fuel pathways, as well as regional carbon intensity baselines, in terms of ton CO_2 eq per ton of marine fuel and per nautical mile of distance travelled.



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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.

BI's comprehensive studies include detailed technology analyses, process economics, as well as capacity analysis and impacts on conventional industry. Reports typically cover:

- Trends in technology
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- Chemistry
- Process flow diagrams and descriptions of established/conventional, new and emerging processes
- Process economics – comparative costs of production estimates for different technologies across various geographic regions
- Capacity tables of plants and analysis of announced capacities
- Regulatory and environmental issues where relevant

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- Cost of production tables in spreadsheet format (as requested)
- Consultation time with the project team

An annual subscription to BI includes 10 reports published in a given program year. Reports can also be purchased on an individual basis, including reports from previous program years.

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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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