NexantECA

Technology and Costs

TECH 2023S7: Ammonia as a Hydrogen Carrier

Ammonia as a Hydrogen Carrier is one in a series of reports published as part of NexantECA's 2023 Technoeconomics – Energy & Chemicals (TECH) program.

Overview

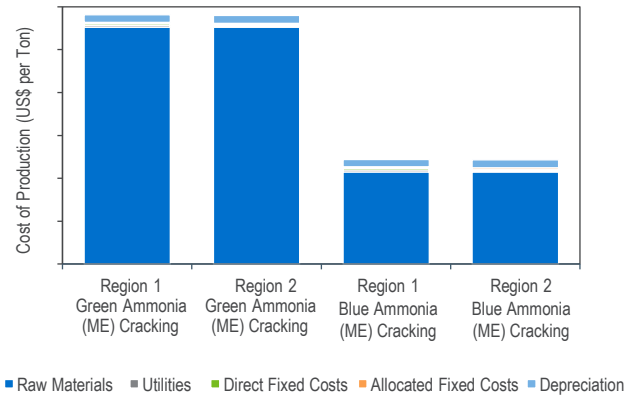
Due to the transport and storage challenges associated with hydrogen, ammonia is considered a potential " "hydrogen carrier". Ammonia has a high hydrogen content (17.8 percent by weight and a volumetric density of 121 kg H_2 per m^3 at 10 bar) and can liquefy at low pressures or temperatures, 10 bar at 25 °C or 1 bar at −33 °C, so its transport and storage are relatively easy and require a low amount of energy.

Ammonia can be decomposed, "cracked", over a catalyst to produce the desired fuel - hydrogen - along with nitrogen, an inert, non-greenhouse gas. Ammonia has an advantage over other proposed "hydrogen carriers", such as methanol, as no carbon dioxide is produced from its decomposition.

In addition to coverage of the technology landscape, the report contains a comprehensive analysis of blue / green ammonia cracking and hydrogen value chains; covering both cost and carbon intensity. The following questions are addressed in the report:

- What processes are used to crack ammonia?
- Who are the licensors and what are the key differentiators? What technologies are under development?
- How much does it cost to produce hydrogen from ammonia (blue and green)?
- What are the market drivers and forecast capacity for green ammonia as a hydrogen carrier?

Regional Comparison: Green and Blue Ammonia Cracking



Commercial Technologies

As well as comprehensive process descriptions, additional commentary around deployment models (centralized and decentralized ammonia cracking) and the potential challenges and opportunities associated with using ammonia as a fuel versus cracking is covered.

Process Economics

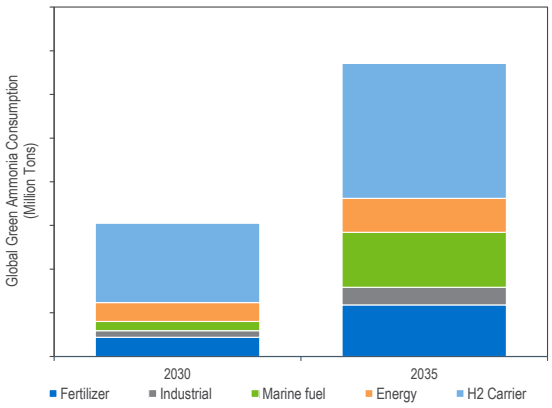
The economic analysis provides production costs for hydrogen from Middle East ammonia in Western Europe and Japan (importers of low carbon ammonia in the hydrogen economy).

A value chain analysis comparing the cost per delivered ton of hydrogen through direct transport of liquefied hydrogen versus hydrogen via ammonia cracking is also presented for blue and green hydrogen / ammonia.

Commercial Overview

Due to the current lack of ammonia cracking capacity, NexantECA presents green ammonia capacity and demand - regional and end use - indicating the growth for cracking capacity globally.

Global Green Ammonia Consumption by End Use
Million tons per year



Carbon Intensity

Carbon intensity analysis covering scope 1, 2 and 3 emissions for blue / green ammonia cracking and hydrogen value chains is presented. With commentary around the potential cost implications under the carbon border adjustment mechanism (CBAM).

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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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