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Decarbonization of Syngas and Hydrogen Production

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Abstract

Hydrogen is currently used as an intermediate product in the chemical (mainly ammonia and methanol) and refining industries. It is produced mostly from Natural Gas in large scale plants using Steam Methane Reforming, a very mature technology. Hydrogen produced by Natural Gas has a high carbon footprint, considering that about 6-9 tons of CO_2 are co-produced (and emitted to the atmosphere) per ton of produced hydrogen, depending on Natural Gas composition. For this reason, Hydrogen produced from fossil fuels is nowadays named as “Grey” Hydrogen. The current production of Hydrogen is responsible for about 2.5% of CO_2 emissions worldwide.

For Hydrogen to remain in business and then become a factor in the energy transition period and later, decarbonizing its production is a must.

Partially decarbonized hydrogen produced from fossil fuels, through CO_2 Capture, is named “Blue” Hydrogen. A completely different path is followed for the production of fully decarbonized, or “Green”, Hydrogen. This path is already commercially available, though on a smaller scale than required for wide industrial application. It is the electrolysis of water, i.e. the use of electric power from renewable sources to break the water molecule into its constituent Hydrogen and Oxygen.

Pros & Cons of these two options will be critically examined with also some look to the other applications of Hydrogen in the so-called “Hard to Abate” sector, especially regarding green steel production and low carbon emission fuels (biofuels and e-fuels).

In the latter field, Saipem has elaborated its value proposition exploring opportunities to enhance SAF (Sustainable Aviation Fuels) production using its industrialized solutions "IVHY100™" and "Bluenzyme™". IVHY100™ is Saipem’s Green Hydrogen solution that is pre-engineered, modular, and scalable. It is designed for the creation of a 100 MW Power-to-Hydrogen industrial package using Nel alkaline technology. This approach aims to achieve reduced time-to-market and capital/operational expenditure. Bluenzyme™ is another solution developed by Saipem engineers for carbon capture. It uses an enzyme found in the human respiratory system to capture CO_2. The system is standardized and modular, allowing for easy installation and efficiency in capturing hundreds of tons per day of CO_2 in a sustainable manner.

Also, a few hints will be devoted to our involvement in the Puglia Green Hydrogen Valley project which will have two plants with 160 MW capacity, producing up to 260 million normal cubic meters of green hydrogen annually. The project promotes circularity by reusing wastewater and oxygen. The project will contribute to the decarbonization of nearby industrial sites and has secured EU funding approval (IPCEI). It will be operational around 2028.