Hydrogen

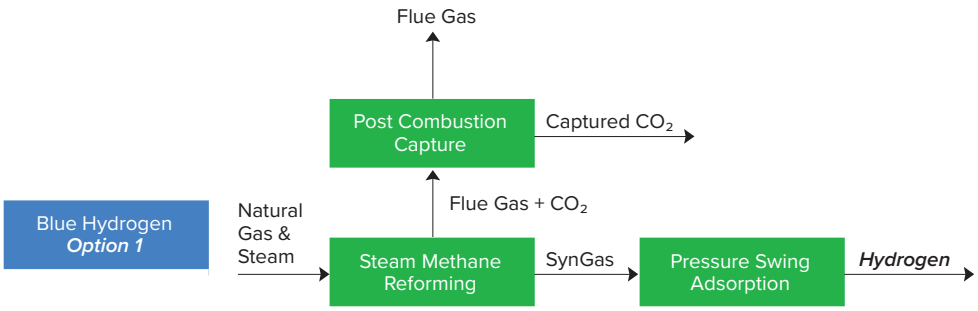
Overview

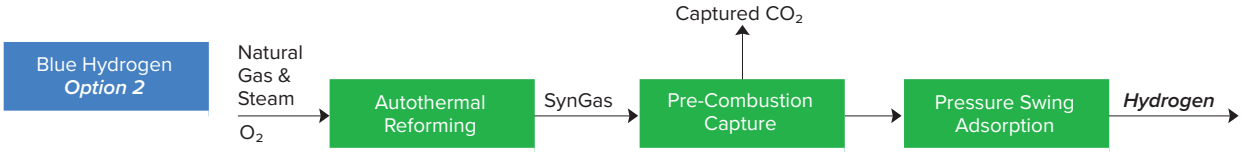
Global energy demand is expected to grow 50% by 2050 (IEA) as populations grow and over 1 billion people move into the middle class. Simultaneously, governments and corporations have set ambitious goals to reduce their environmental impacts through carbon reduction and greenhouse gas emission cuts to become carbon neutral and address climate change.

Hydrogen is in a unique position to support this increase in energy demand and decrease in carbon and greenhouse gas emissions through use as a fuel and chemical. Lummus Technology is a market leader in both conventional hydrogen and blue hydrogen production plants. Blue hydrogen produces hydrogen similarly to conventional hydrogen while capturing carbon emissions, reducing your carbon footprint in the production of the hydrogen as well as its use as a fuel or chemical. These units support clients in refining, petrochemicals and industrial gas companies where reliability and sustainability are of utmost importance.

Overall Process Description

Lummus Technology's hydrogen production process is comprised of 1) feed pretreatment to remove catalyst poisons such as sulfur and chlorides, 2) steam methane reforming to convert hydrocarbons to hydrogen, 3) shift converting of residual carbon monoxide to hydrogen, and 4) hydrogen purification using a pressure swing adsorption unit (PSA) to produce hydrogen with a purity of 99.9%+. With the addition of carbon capture technology, conventional hydrogen production becomes blue hydrogen.





Key Proprietary Equipment

Proprietary equipment for the hydrogen technology includes the steam methane reformer and waste heat recovery unit. The steam methane reformer is the essential piece of equipment related to hydrogen production. Therefore, Lummus has developed the reformer design over the course of several decades to ensure reliable performance and long-term plant life.

Carbon Intensity

Carbon intensity will play an important role in technology selection for future hydrogen plants. Lower carbon intensities will result in a lower carbon footprint and help achieve carbon neutrality by 2050.

Technology	Carbon Intensity (kg CO_2 / kg H_2)
SMR (Grey)	9 - 13
SMR (Blue)	1 - 5
ATR (Blue)	0.1 - 1.0

CO_2 Capture

Lummus Technology and Toshiba Energy Systems & Solutions Corporation have entered into a master collaboration agreement to jointly develop carbon capture projects. Lummus' post-combustion carbon capture technology is coupled with Toshiba's advanced amine-based solvents specifically tailored for post-combustion carbon capture.

These advanced amine-based solvents can handle various process conditions, from gas turbine exhaust to higher CO_2 concentration applications, with high reliability and stability. These proprietary solvents are characterized by low energy recovery, minimal degradation, and reduced amine emissions.

Key Differentiators & Advantages

Lummus Technology's hydrogen technology is based on a top fired, down flow steam methane reformer design. The combustion gas and process gas flow co-currently, providing superior heat transfer along the tubes and uniform temperatures throughout the reformer. This results in a higher efficiency furnace design than side-fired and terrace-wall furnaces. The reformer design includes 1) symmetrical design to promote even distribution, 2) wider lane spacing to prevent flame impingement on the tubes, 3) flue gas collection tunnels to prevent bypassing, 4) single burner level for ease of operation and maintenance, and 5) single unit designs with capacities up to 240 MM SCFD (million standard cubic feet per day).

Scope of Supply

Lummus Technology provides process design packages with proprietary equipment, catalyst supply and solvent for CO_2 capture applications.

Contracting Strategies

Most Lummus Technology projects are contracted on a fixed price lump sum basis; however, Lummus is flexible in contracting approaches including reimbursable cost and hybrid fixed price/ reimbursable cost scope splits.

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