

# Lummus Technology Green Circle - 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.

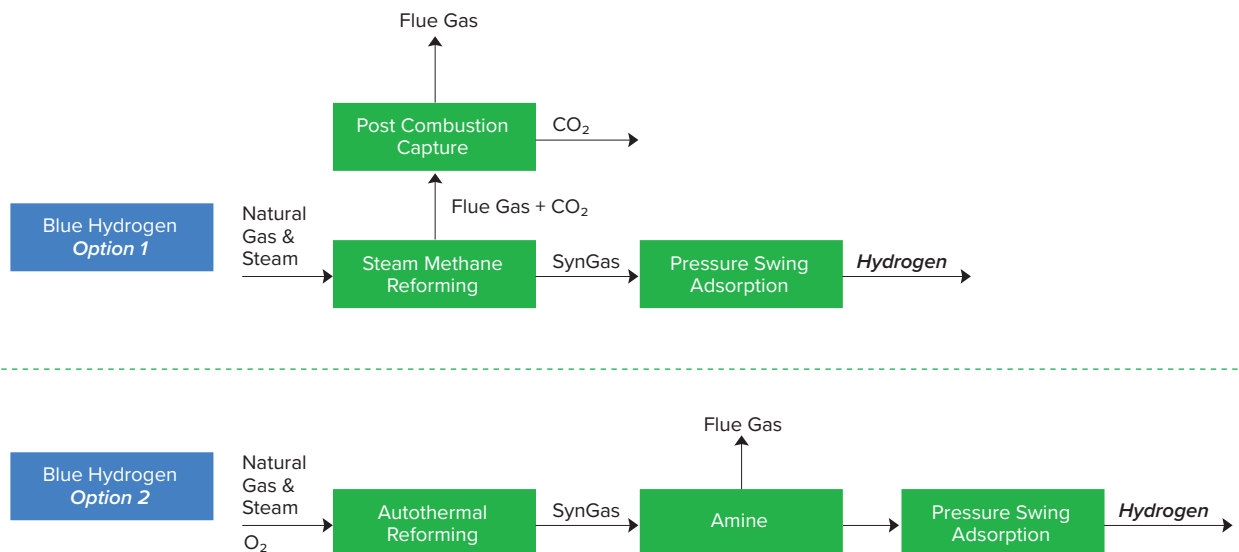
Hydrogen is in a unique position to support this increase in energy demand and decrease in carbon and greenhouse gas emissions through use as a

fuel and chemical. Lummus Technology's Green Circle is a market leader in both 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, waste heat recovery unit, ID Fan, and FD Fan. The SMR 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.

**Key Differentiators**

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**

Scope of supply can range from a process design package with proprietary equipment supply to full engineering, procurement, and fabrication of the entire plant.

**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.

