COMPASS INTERNATIONAL INC.

Hydrogen Manufacturing Facilities

Forecasts suggest that $150 billion will be spent on new Hydrogen (H2) related EPC Capital Projects around the world in the next 5 years!

The use of Hydrogen in energy production has experienced significant growth in the last decade. Some of the world's leading Oil / Petro-Chemical producers are now investing and directing their annual CAPEX budgets into low-carbon Hydrogen facilities. Cleaner and environmentally acceptable energy solutions are essential for the well-being of future generations inhabiting our planet.

The global Hydrogen market is expanding at a rate close to 10% to 12% per year. Hydrogen will potentially be a major energy source in the coming years. Auto manufacturers are investing huge amounts of money into research and development, pursuing this very promising and much cleaner source of powering their vehicles.

What are advantages of utilizing Hydrogen as an energy resource?

1. Hydrogen is a clean and adaptable energy source.
2. Hydrogen facilitates low-carbon energy programs.
3. It is freely available now and is more efficient than carbon-based fuels like coal and oil.
4. It provides an immediate solution to reducing greenhouse gas emissions / carbon emissions.

What are disadvantages of using Hydrogen as an energy resource?

1. The CAPEX investment funds required to ramp up H2 production will be considerable.
2. Many existing refineries, chemical and power plants will need to significantly modify their existing supporting infrastructure / tank farms / storage areas and distribution facilities.
3. Storing hydrogen can be problematic; it is stored under high pressures and exceedingly low temperatures. Expensive piping / vessel materials are required that can withstand high operating pressures and extremely low temperatures must be utilized.
4. Hydrogen is an extremely combustible / volatile gas if not stored and handled correctly.

The need for new Hydrogen plants is increasing with the world focusing on clean energy sources. The following detailed cost benchmark report outlines the Engineering, Procurement & Construction (EPC) costs related to a mid-sized Hydrogen (H2) facility.

See data table on the following page.

Hydrogen Industrial Gas Facility Benchmark: Engineering, Procurement & Construction (EPC) Cost Benchmark – US Gulf Coast (Open Shop / Non-Union Labor)

2023 Cost Basis: *70 MMSCFD (Million Standard Cubic Feet per Day)*

Description	$ Millions	%
Major Equipment - Reformer / (Pressure Swing Adsorption Unit (PSA) / Columns, Vessels, Compressors, Heat Exchangers / Pumps & Tanks) & Utility Offsite Equipment	28.26	35.4%
Modules & Packaged Units (5)	2.41	3.0%
Freight	1.25	1.6%
Bulk Materials (Concrete, Structural Steel, Process & Utility Pipe, Electrical, Instrumentation & Insulation / Paint)	7.78	9.8%
Construction Labor	16.02	20.1%
Field In-Directs (Site Establishment, Field Supervision, Construction Equipment, Heavy Lift Cranes & Scaffolding)	2.56	3.2%
Home Office, Procurement & Project Management Support	0.89	1.1%
Engineering & Detailed Design + EPC Fees	8.50	10.7%
Construction Management & Fee	2.47	3.1%
Catalysis / Initial Chemicals	1.19	1.5%
Startup Costs	0.83	1.0%
Warranty / Royalty / Spare Parts	1.28	1.6%
Owner Oversight & BAR Insurance	0.67	0.8%
Contingency / Management Reserve	5.68	7.1%
Total Installed $ Cost (TIC)	79.78	100%
Cost per Cubic Foot 70,000,000 CF	$1.14 / CF	
TIC of Facility Accuracy of data -15%	$67.81	
TIC of Facility Accuracy of data +30%	$103.71	

60 MMSCFD Total Installed Cost (TIC) EPC Cost $70,200,000 (with accuracy of -15% and +30%)
80 MMSCFD Total Installed Cost (TIC) EPC Cost $88,800,000 (with accuracy of -15% and +30%)

Country	Location Factor
Argentina	0.94
Japan	1.02
Sweden	1.07
Vietnam	0.92

To build a similar H2 facility in the following selected countries, multiply the data above by the location factor to arrive at an approximate cost of the facility in that county.

Compass International has more than 135 Country Location Factors (we are showing 4 examples of our Country's Location Factors).

This data can be considered a hybrid of an AACE Class 3 & 4 Estimate with an accuracy range of -15% and +30%, the cost benchmark data is based on 3rd Q 2023.

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Details of our 2023 US & Global Construction Databases covering 125 countries can be found here:
compassinternational.net/books