Hydrogen

Market leader and proven reliability in delivering facilities worldwide
The Hydrogen industry’s
global leader

State-of-the-art engineering and technology
to meet today’s challenges

Tailored solutions for cost effective,
high efficiency decarbonized
flowsheets

TechnipFMC’s proven hydrogen technology offers tailored solutions for cost-effective, high-efficiency decarbonized flowsheets to meet the needs of the energy industry. With more than 55 years of experience and expertise in the production of grey and blue hydrogen, our full scope of services ranges from process design packages to EPC projects.

We provide a wide choice of proprietary technologies, including steam reforming technology used worldwide. Our references also include several of the world’s largest steam reformers for hydrogen-syngas applications.

Our plants are fully integrated with surrounding production facilities such as off-take of feedstock and utilities, and delivery of hydrogen product and export steam.

Global leader
in hydrogen market

35% Market share
55+ Years of experience and expertise
275+ Hydrogen plants using steam reforming technology
Sustainability and innovation supporting the energy transition

Hydrogen can be generated by renewable sources, and is therefore key to the future sustainable clean energy landscape. We support the energy transition by increasingly offering blue and green hydrogen solutions.

Significant innovations have been made to curtail the carbon footprint of the steam reforming process through smart equipment design, focusing on enhanced process integration and heat recovery.

**Extensive experience in blue hydrogen**

Further reduction through on-purpose recovery of CO₂ from the steam reformer syngas offers the possibility of “blue” hydrogen production: fossil-based but without or with substantially reduced CO₂ emissions. Blue hydrogen could be an intermediate alternative for fossil energy carriers seeking to reduce their carbon footprints.

TechnipFMC is a front runner in this rapidly expanding market, and a global leader in developing carbon capture and conditioning. We are continuously exploring new solutions to reduce energy consumption and investment cost.

**Supporting green hydrogen offshore and onshore project execution**

TechnipFMC is focused on positioning fully renewable (“green”) hydrogen in the current and future energy landscape, on the basis of its extensive expertise in hydrogen technology.

We are committed to further developing this sustainability principle which drives our innovation focus targeting environmental, economic and social benefits.
Full range of services from BDEP to EPC

TechnipFMC offers the most enhanced hydrogen plant design with commercially proven solutions.

We work with our clients from the earliest stage of their projects, providing a full scope of services from basic process design and engineering packages (BDEP) to EPC projects involving engineering, procurement, construction and start-up of facilities.

- Consulting and feasibility studies
- Conceptual design and basic design
- Front-end engineering design (FEED)
- Engineering
- Procurement
- Construction
- Commissioning
- Start-up
- Operational services
- Hydrogen and CO₂ management

From the highest standards in safety and design to installation, operation and maintenance, we provide world-class project management and execution. We offer flexible contract formats to help our clients optimize project costs and scheduling.

We are experts in the design of flexible feedstock plants, using refinery off-gases, natural gas, LPG or naphtha as stand-alone feed or in combination with each other. Our grassroots units range in capacity from 1,000 to 250,000+ Nm³/h. Thanks to our innovative technology solutions we can increase the capacity of existing plants by up to 30 percent in a cost-effective manner.

*Nm³/h: Normal metre cubed per hour, used to measure gas flow rates

“Delivering plants with the highest levels of reliability and efficiency in the industry”
Reliable and proven process design

TechnipFMC’s hydrogen plants have proven reliability and onstream availability of over 99 percent (excluding turnaround and forced outage). Our proprietary steam reformer design provides a compact solution with high thermal efficiency and low carbon emissions per unit of hydrogen/syngas. This cost-effective design, especially for larger capacities, can be modularized and customized for each application.

Key differentiators and continuous improvement

- Enhanced energy efficiency flow sheets with optimized reforming severity, optional pre-reforming, conforming level of shift conversion and advanced heat integration
- Value engineering solutions for lowest unit costs of hydrogen
- Recuperative reforming with our Parallel Reformer (TPR™), allowing up to 30 percent additional reformed gas
- Specific design and execution philosophy for smaller hydrogen plants
- Gas turbine combined cycle and exhaust integration for steam power synergy and reliable captive power
- Advanced modularization for faster, cost-effective execution
- High purity export steam based on high-pressure stripping of condensate, segregated or ‘dual-steam’ systems, or feed saturation concepts

Principal process steps in a hydrogen plant

- Hydrocarbon feed + fuel
- Hydrogen recycle
- Hydrogen product

- Feed purification
- Pre-reforming (optional)
- Reforming
- Shift conversion
- Product purification
- Process steam
- Make-up fuel
- Purge gas

Robust components

Steam reformers
Steam reforming is the predominant technology for cost-effective hydrogen production, widely adopted for its flexibility and simplicity. In addition, high energy efficiency is achieved through the use of case-specific optimization of heat recovery design.

Steam generation and process condensate recovery
We offer various well-referenced concepts for hydrogen plant steam systems, ensuring reliable supply to the reformer. We are able to tailor the amount and quality of export steam to requirements for integration into the existing complex.

CO₂ recovery
We have applied CO₂ removal in many of our plants, either to generate CO₂ as a byproduct for the food industry, or to adapt hydrogen/CO ratios for syngas applications. CO₂ removal from syngas is a means for generating blue hydrogen.

SCR
Selective Catalytic Reduction of NOx in reformer flue gas is an option when stringent regulations require emission levels that cannot be reached using Low-NOx burner technology alone. These are core components of our proprietary technology:
- Mega steam reformer with steam power synergy and CO₂ capture
- Proprietary equipment (steam methane reformer, TPR™, LSV™ burners, advanced process gas boiler, EARTH™ reformer tubes)
- Multiple industry “firsts”: largest plants, multiple-feed flexibility, power cogeneration and carbon management

Benefits

- Proven experience in improving the hydrogen plants’ energy efficiency through emissions and operating costs reduction.
- Optimization of the hydrogen network in refineries resulting in more effective use of hydrocarbon resources.
- Improvement of refineries’ energy efficiency and carbon footprint through use of gas turbine exhaust as combustion air for SMR burners.
- Offering carbon capture readiness in hydrogen plants, targeting more than a two-thirds reduction in CO₂ release.
- Providing clean fuel and sustainable energy pathway, ensuring a cleaner environment.

‘Improving the energy efficiency of our clients’ facilities for 30 years’
Innovative and clean proprietary technologies

TechnipFMC offers a wide range of proprietary technologies for complete hydrogen plants. We have specific expertise in upgrading existing plants in order to process heavier and sour crudes. We are also able to maximize the middle-distillate pool while meeting stricter clean fuels requirements.

**Hydrogen Network Design Tool (HyNDT™)**
HyNDT™ optimizes refinery hydrogen networks for performance, cost efficiency, operational flexibility and HSE targets by balancing the production and consumption of hydrogen.

**LSV® Ultra low-NOx burner**
The advanced Large Scale Vortex (LSV®) burner, with its innovative flame stabilizer and unique fuel premix injection system, offers ultralow NOx emissions.

**TPR® heat exchange reformer**
TPR® is our proven, proprietary convective recuperative heat exchange reformer, ideal for retrofits or new plants. It is designed to optimize the high-grade heat cycle and increase reforming capacity without additional firing, thus resulting in lower CO2 emissions.

**EARTH® recuperative reformer tubes**
EARTH® is our newest (heat) recuperative reforming technology. It is a drop-in insert for reformer tubes consisting of a structured reforming catalyst and concentric internal tubes for retrofits or new plants. It allows the reformer to operate with up to 10 percent lower CO2 footprint for hydrogen, or allows for fuel savings up to 10 percent and corresponding reduction of CO2 emission at same throughput compared to conventional technology.

**Dual Chamber Process Gas Boiler**
Our proprietary Dual Chamber Process Gas Boiler enhances cost effectiveness and improves energy efficiency through extended heat recovery. Its design includes two chambers separated by an intermediate compartment, and an external bypass assembly to control exit temperatures.

**Bulgaria – 83,400 Nm³/h Hydrogen**
Over-the-fence hydrogen supply

Advantages of over-the-fence hydrogen supply

- Air Products (TechnipFMC’s alliance partner) as owner provides the capital investment for the hydrogen plant, guaranteeing uninterrupted hydrogen supply under a long-term contract. Cost of delivered hydrogen is optimized (opex & capex).
- Any risks associated with project execution, plant efficiency or on-stream performance lie with the gas supplier (Air Products), not with the end-user.
- Extensive operational feedback drives design enhancements.
- Leading-edge reliability of hydrogen generation and/or supply is further facilitated by multi-plant, multi-customer pipeline networks and/or back-up franchise provisions.

Global alliance with Air Products

Since 1992, TechnipFMC and Air Products have been working together in an alliance to supply outsourced “over-the-fence” hydrogen to the global refining industry. TechnipFMC provides the design and construction expertise for steam reformers and Air Products provides the gas separation technology. Both companies bring effective operational and engineering knowledge into the design for high reliability and efficiency. TechnipFMC offers a large reference base and Air Products an extensive operating network.

The alliance is responsible for 40 hydrogen plants with a global design capacity of over 2689 MMSCFD (2,984,000 Nm³/h) of hydrogen. Air Products and TechnipFMC are fully committed to hydrogen as their worldwide core business applying the highest HSE standards.

*MMSCFD: million standard cubic feet per day
The highest HSE and quality design standards

Safety is our foremost focus during all project phases. Extensive HAZOP* reviews, safety studies, CFD** simulations and critical design analyses are conducted to ensure the safety of personnel and equipment, in line with our commitment to embed safety into all of our designs.

Best technology for environmental and compliance

Our solutions are designed to minimize NOx emissions from the steam reformer furnace and reuse spent process condensate. We have the expertise to design plants for the lowest energy consumption. We can also provide CO2 capture facilities as required.

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Key project references

**Hydrogen plant**
- **Start-up:** under construction
- **Client:** HPCL
- **Location:** Visakhapatnam, India
- **Scope:** 2 hydrogen trains of 113 KTPA each, including a power generation unit of 12.9MW

**Hydrogen plant**
- **Start-up:** 2009, revamped in 2020 for +20 percent capacity
- **Client:** Indian Oil Corp.
- **Location:** Haldia, India
- **Scope:** One of the largest plants with pre-reforming, LT shift and dual-steam system/104,000 Nm³/h hydrogen and 28,000 Nm³/h syngas

**Hydrogen and syngas plant**
- **Start-up:** 2011
- **Client:** Air Products
- **Location:** Chengdu, China
- **Scope:** One of the largest HyCO facilities based on steam reforming/100,000 Nm³/h hydrogen and 28,000 Nm³/h syngas

**Hydrogen plant** (UE-1 hydrogen plant 9-4)
- **Start-up:** 2005
- **Client:** Syncrude
- **Location:** Ft. McMurray, Canada
- **Scope:** Largest operating single-train plant with 75 MW cogeneration/200 MMSCFD

**Hydrogen plant**
- **Start-up:** 1998/2011
- **Client:** Total
- **Location:** Le Havre, France
- **Scope:** Original plant of 96,000 Nm³/h revamped with TPR to 117,000 Nm³/h

**Hydrogen plant**
- **Start-up:** 1997
- **Client:** PKN Orlen
- **Location:** Poland
- **Scope:** Plant with multiple feed flexibility (NG, LPG, naphtha and mixture)/111,000 Nm³/h

**Hydrogen plant**
- **Start-up:** 1994
- **Client:** Air Products
- **Location:** California, USA
- **Scope:** First plant built by the TechnipFMC/Air Products alliance/35 MMSCFD

**Hydrogen and syngas plant**
- **Start-up:** 1998
- **Client:** PKN Orlen
- **Location:** Poland
- **Scope:** Plant with multiple feed flexibility (NG, LPG, naphtha and mixture)/111,000 Nm³/h

**Hydrogen plant**
- **Start-up:** 2014
- **Client:** Air Products
- **Location:** Tuapse, Russia
- **Scope:** Largest single-train plant in the world/238,000 Nm³/h

**Hydrogen plant**
- **Start-up:** 2014
- **Client:** Air Products
- **Location:** Texas, USA
- **Scope:** Largest gas turbine (exhaust) integration with 100 MW cogeneration/115 MMSCFD

**Hydrogen recovery plant**
- **Start-up:** 1998
- **Client:** PKN Orlen
- **Location:** Poland
- **Scope:** RUSG recovery plant with PSA and cold box hybrid/106,000 Nm³/h H2 and co-producing C2 of 21 t/h using over 20 H2 rich streams from the Complex

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*HAZOP: hazard and operability study
**CFD: computational fluid dynamics

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Bulgaria – 83,400 Nm³/h Hydrogen

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