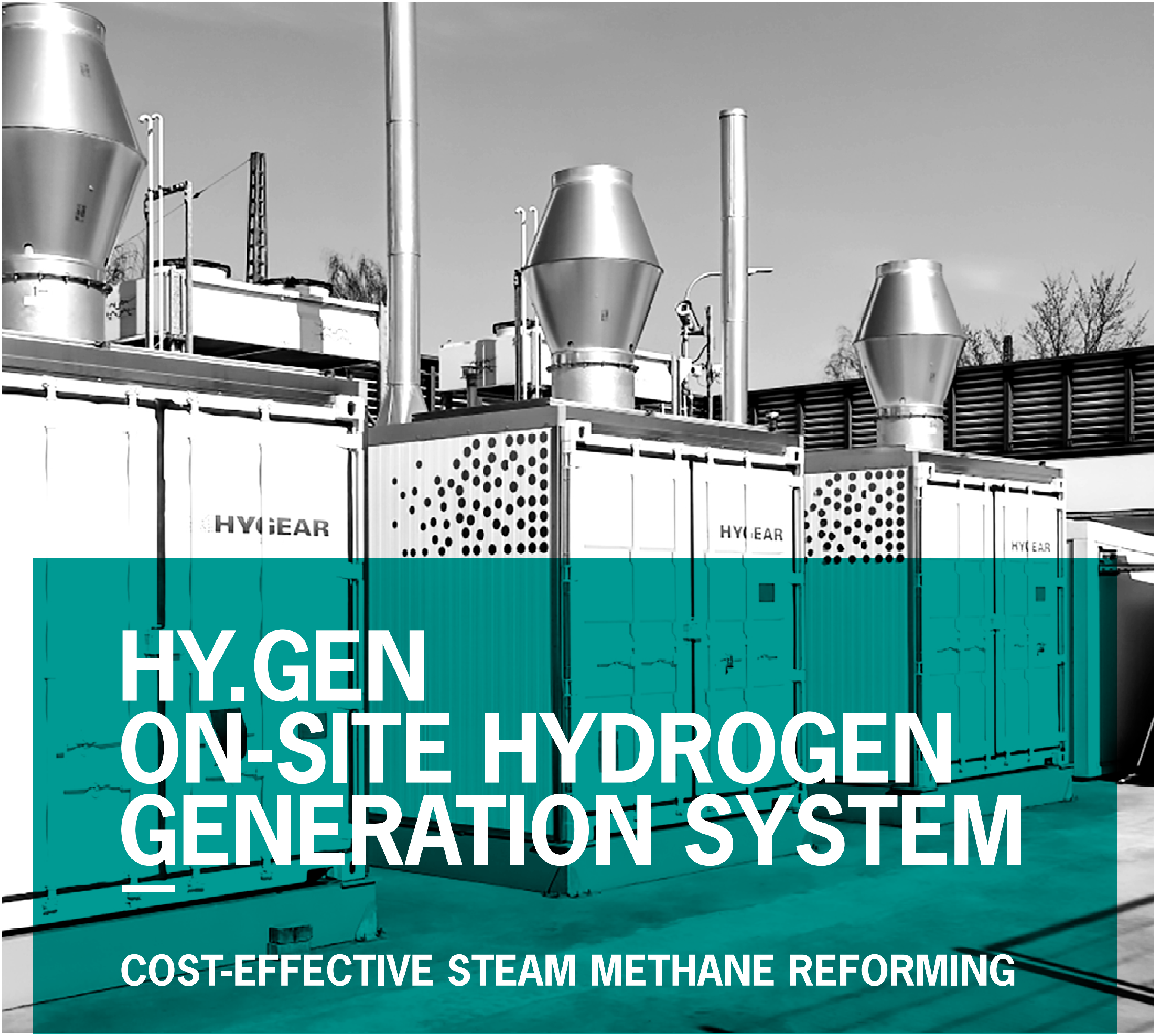


HY.GEN ON-SITE HYDROGEN GENERATION SYSTEM

COST-EFFECTIVE STEAM METHANE REFORMING

HYGEAR

COST EFFECTIVE HYDROGEN SUPPLY

HyGear offers hydrogen supply ranging from 10 Nm³/h up to 1000 Nm³/h by means of small-scale on-site generation systems. Four standardized models are available: Hy.GEN 50, Hy.GEN 100, Hy.GEN 150, and Hy.GEN 300 which are containerised and can be placed in parallel. This makes them highly suitable to be installed at industrial sites and hydrogen filling stations.

The Hy.GEN systems produce hydrogen by converting (renewable) natural gas with Steam Methane Reforming (SMR). Decentralised hydrogen production offers a safer, more reliable, and cost-effective alternative to conventional hydrogen supply by tube trailers or electrolysers and a significantly lower environmental impact.

The Hy.GEN systems of HyGear are also able to produce biohydrogen from renewable natural gas (RNG) or biomethane. Combined with carbon capture this results in carbon-negative hydrogen production.

Applications

- Flat glass industry
- Metal industry
- Food industry
- Semiconductor industry
- Electronics industry
- Chemical industry
- Hydrogen filling stations

KEY BENEFITS

- Cost-effective
- 100% reliability through backup supply
- Flexible contracting
- Significant reduction of harmful emissions
- Autonomous and safe operation
- Compact and modular system
- Independency from third party supply
- Energy efficient process

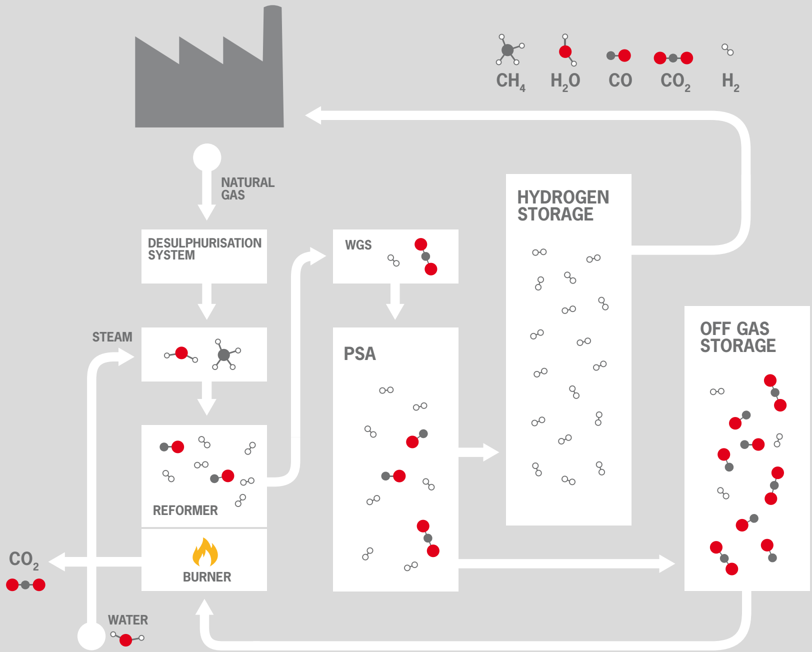
TECHNOLOGY

The steam (H_2O) produced from waste heat is added to the desulphurised gas and led into the reformer. The heat and catalytic properties of the reformer cause the following reaction: $CH_4 + H_2O \rightarrow 3H_2 + CO$.

The remaining carbon monoxide is then converted in the Water Gas Shift assembly (WGS) to produce more hydrogen: $CO + H_2O \rightarrow CO_2 + H_2$.

The gases enter the PSA where the hydrogen is separated from other gaseous species under elevated pressure using differences in adsorption properties.

Finally, the cleaned hydrogen is stored in the buffer vessel and can be used as an industrial gas or (renewable) energy source.



Advanced reforming

HyGear uses its proprietary reforming technology to generate a hydrogen rich stream from natural gas. To ensure long lifetime, high system efficiency and avoid catalyst deactivation, the natural gas is stripped from sulphur before it is led into the reformer.

Effective (V)PSA technology

HyGear uses Vacuum Pressure Swing Adsorption technology. This is more energy and cost efficient than traditional gas separation systems. The (V)PSA consists of four parallel active vessels, enabling a continuous cleaning process. In the (V)PSA, the hydrogen is separated from other gaseous species under elevated pressure by using differences in adsorption properties.

Optimised energy efficiency

By re-using the waste gases and waste heat of the process, the energy efficiency of the Hy.GEN is optimised to the highest level. No external fuel gases are needed for the reform reaction and steam generation. The off-gas from the (V)PSA is used as input for the burner that provides heat for the reforming reaction. The residual heat is used for generating steam, which is mixed with natural gas for the steam reforming process.

Connectivity

The system includes gas desulphurisation and water purification and can therefore be connected directly to the natural gas and feed water lines. Other required connections are electricity for controls and auxiliaries, hydrogen and nitrogen for system start-up and compressed air for valve operation.

WHAT'S INSIDE

1. Ventilation fan
2. Desulphurisation vessel
3. PSA-vessels
4. Off-gas storage
5. Hydrogen storage
6. Water separator for vacuum pump
7. Vacuum pump
8. Coolant heater
9. Reformate cooler
10. Electronics cabinet
11. Steam generator
12. Reformer unit
13. Low temperature shift
14. Coolant expansion vessel
15. Burner air blower
16. Water purification system

SPECIFICATIONS

MODEL	HY.GEN 50	HY.GEN 100	HY.GEN 150	HY.GEN 300
OUTPUT				
Nominal hydrogen flow *Dependent on hydrogen purity	Max. 47 Nm^3/h	Max. 94 Nm^3/h	Max. 141 Nm^3/h	Max. 300 Nm^3/h
Hydrogen purity range	99.5% - 99.9999%	99.5% - 99.9999%	99.5% - 99.9999%	99.5% - 99.9999%
Pressure range	1.5 - 7.0 bar(g)	1.5 - 7.0 bar(g)	1.5 - 7.0 bar(g)	10 - 30 bar(g)
TYPICAL CONSUMPTION DATA				
Natural gas / Biomethane	Max. 23 Nm^3/h	Max. 46 Nm^3/h	Max. 69 Nm^3/h	Max. 140 Nm^3/h
Electricity	14.5 kWe	26.0 kWe	29.5 kWe	59 kWe
Water	100 L/h	200 L/h	300 L/h	600 L/h
Compressed air	Max. 1.5 Nm^3/h	Max. 3.0 Nm^3/h	Max. 4.5 Nm^3/h	Max. 9 Nm^3/h
DIMENSIONS				
Size	20 ft	40 ft	40 ft	40 ft + skid
Weight	7,300 kg	12,000 kg	15,000 kg	20,000 kg
OPERATING CONDITIONS				
Start up time (warm)	Max. 30 min	Max. 30 min	Max. 30 min	Max. 30 min
Start up time (cold)	Max. 3 h	Max. 3 h	Max. 3 h	Max. 3 h
Modulation (H_2 product flow)	10 - 100 %	10 - 100 %	10 - 100 %	10 - 100 %
Ambient temperature range	-20 °C to +40 °C	-20 °C to +40 °C	-20 °C to +40 °C	-20 °C to +40 °C

All data and values are indicative and based on nominal and non-frost conditions.
Values might differ due to local circumstances and feedstock characteristics.
Normal condition (Nm^3) is defined at a temperature of 0^oC and pressure of 1.013 bar(a).

IF YOU REQUIRE OTHER SPECIFICATIONS, CONTACT US TO ASSIST YOU WITH THE MOST OPTIMAL SOLUTION.

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