



An alternative solution for
**POWER AND HEAT
GENERATION**



H₂PS-5

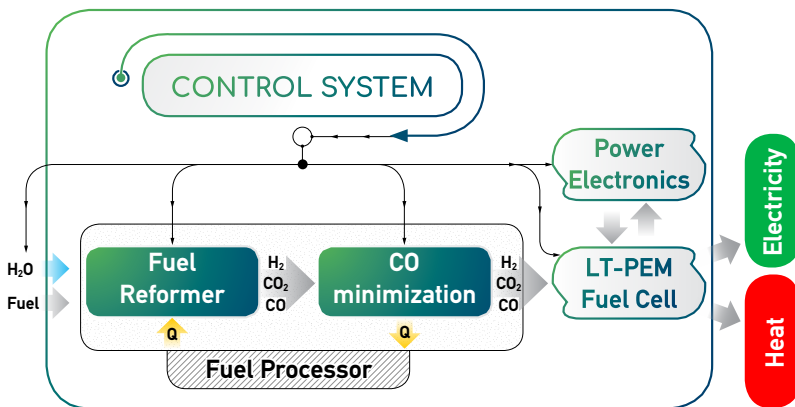
THE PRODUCT

H₂PS-5 is a Combined Heat & Power (CHP) system. It has a capacity of 5 kW electric power, while in the combined heat and power (CHP) mode, it can also produce up to 7 kW thermal energy in the form of hot water. The system is **multi-fuel fed**, i.e. it can operate with either Natural Gas, Propane/LPG or Biogas, converting it to electrical power through an intermediate production of hydrogen using a Proton Exchange Membrane Fuel Cell (PEM-FC).

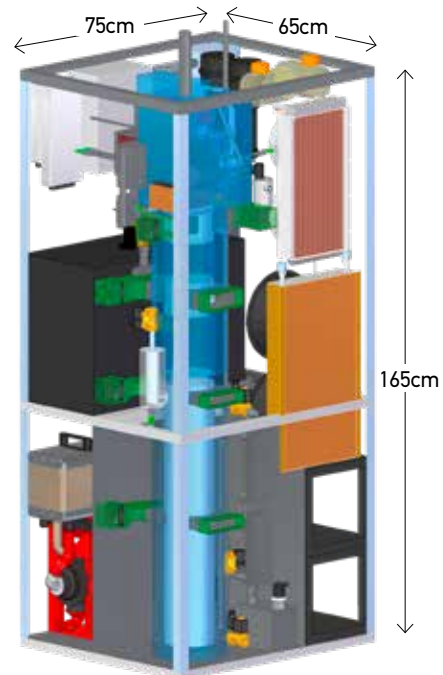
The unit is equipped with a power management system delivering electrical energy in the required form (DC or AC, grid connected or stand-alone), depending on the application. It has the ability to operate in the range of 40-100% of its nominal capacity. Its maximum electrical efficiency is greater than 35% (based on LHV), while total efficiency exceeds 85%.

The integrated system consists of the following sub-units:

- ❖ **Fuel processor/hydrogen production unit**, where hydrogen production takes place via the reformation of the feeding fuel
- ❖ **Low temperature PEM fuel cell stack**, where power production takes place using the produced hydrogen from the fuel processor
- ❖ **Batteries and electronic power management systems**, where the excess produced power is managed
- ❖ **Control system**, capable to control the unit and to achieve proper, smooth and safe operation of the **H₂PS-5**



Process Flow Diagram (Fuel steam reforming with LT PEM fuel cell)



COMPARE WITH OTHER SYSTEMS

Currently, gensets serve the market of decentralized power production, however they present significantly lower efficiency compared to **H₂PS-5** and possess a high environmental impact.

	Electrical Efficiency (%)	Fuel Cost* (€/kWh)	CO ₂ equivalent (kg CO ₂ produced/kWh)	NO _x (g/kWh)	HC (g/kWh)	CO _x (g/kWh)	PM (g/kWh)	SO _x (g/kWh)
H₂PS-5	35	0.26	0.76	0.004	0.04	0.3	N/A	0
Conventional Diesel Generator	16	0.58	2.57	7.5	8.0	0.4	0.17	

Comparison between **H₂PS-5** and a 5kW diesel generator

* based on Greek market prices (10/2018).
Propane as a feeding fuel for **H₂PS-5**

TECHNOLOGY

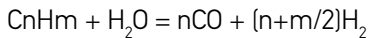
Helbio's technology is based on proprietary and patented reactor catalyst configurations for reformation processes. The reactor configurations utilize the concept of the Heat Integrated Wall Reactor which offers very rapid heat exchange characteristics.

H₂PS-5 uses a PEM Fuel Cell coupled with a fuel processor based on the fed fuel steam reforming. The system comprises a **fuel processing** and a **power generation step**.

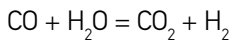
Firstly, the fuel processing step:

Reformate hydrogen is produced through the following reactions:

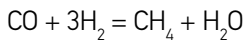
Steam Reforming:



Water Gas Shift (HT and LT WGS):

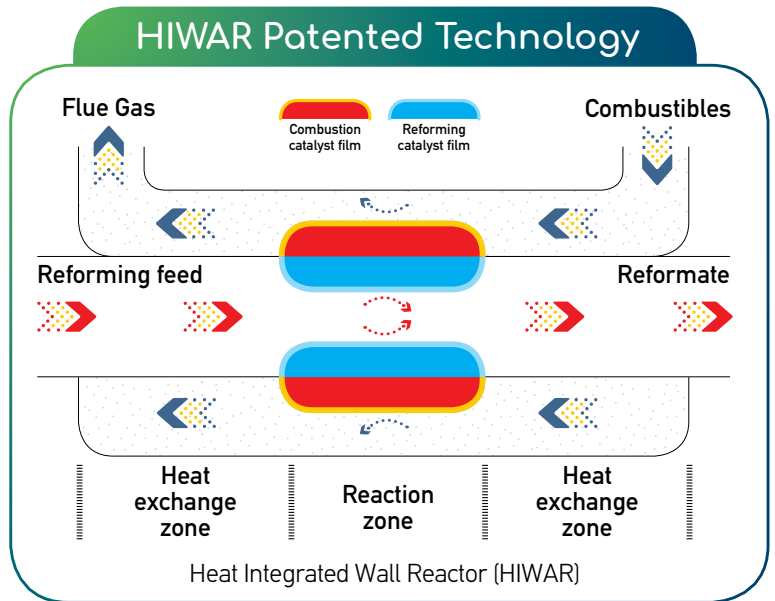


Methanation:



Secondly, the power generation step:

A low temperature Proton Exchange Membrane (PEM) fuel cell is used.

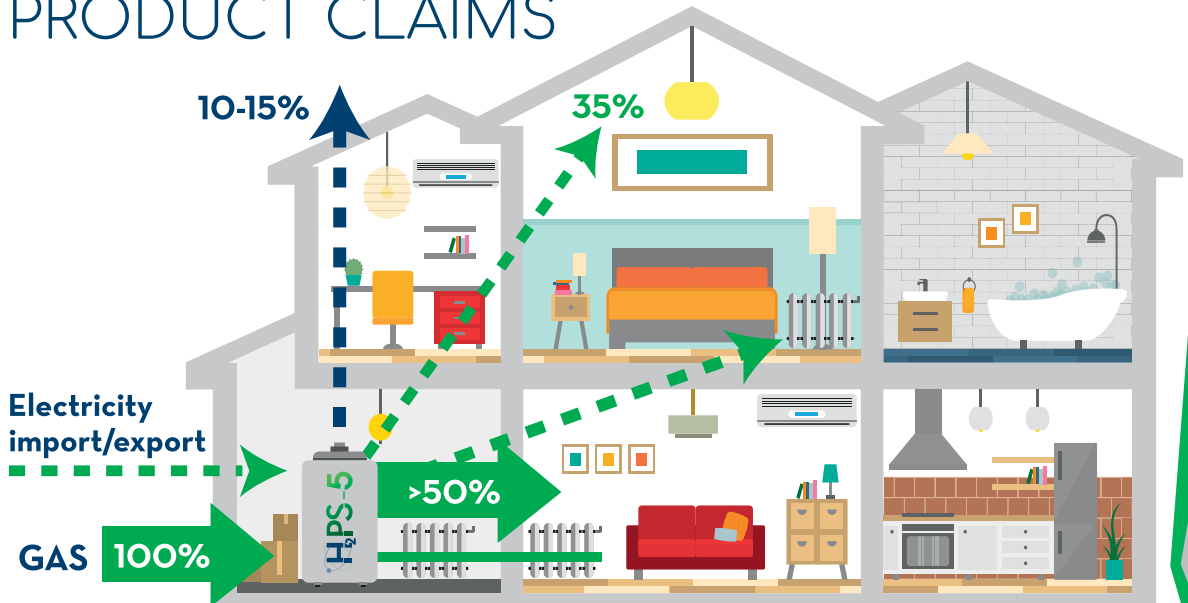


SYSTEM CHARACTERISTICS

TECHNOLOGY	
Reformer	Steam Reforming
Water Gas Shift	High and Low temperature
CO minimization	Selective CO methanation
Hydrogen quality	Reformate
SPECIFICATIONS	
Feeding Fuel	Natural Gas, LPG/Propane, Biogas
Energy Production	5 kWe + 7 kWth
Max Electrical Efficiency	> 35% (based on LHV)
Max Thermal Efficiency	> 50% (based on LHV)
Power Characteristics	48 VDC *
Operating Range Capacity	40-100%
Dimensions (LxWxH)	0.65 m x 0.75 m x 1.65 m
Weight	~ 200 Kg

*Other voltages available upon request

PRODUCT CLAIMS



Highly Innovative | Environmentally Friendly Energy Efficient | Cost Effective

- **Electrical efficiency of H₂PS-5 is greater than 35%**
(more than **twice the efficiency of common diesel generators**)
- **Operating cost (Fuel) of H₂PS-5 is more than 2 times lower**
than that of a conventional diesel generator
- **Maintenance cost** is expected to be **reduced to less than 50%**
compared to the maintenance cost of conventional power generators
due to **simplicity of construction**
- **Multifuel system**, operating with Natural Gas, Propane/LPG or Biogas
 - **Dramatically reduced emissions (H₂PS-5 emits**
170 times lower amounts of NOx and HC, 27 times lower amounts
of CO than conventional technologies and zero amounts of SOx)
 - **Very low noise and vibration** levels
 - Improved **safety** (no flames)
 - Excellent performance at partial loads
 - Capable to operate with raw biogas

H₂PS-5



Helbio

Hydrogen & Energy Systems

THE COMPANY

HELBIO is a **high-tech company** founded in 2001 and based in Patras, Greece specialized in development, manufacturing and marketing of **Hydrogen & Energy Production Systems**.



Unique selling point and expertise:

- Advanced **Hydrogen and Energy Production Technologies**
- Products based on **Innovative Technologies**, developed in-house
- **Reforming** technology of NG, LPG, Biogas and Bioethanol
- **Compact and efficient** reactor-catalyst configurations (patented HIWAR concept)
- Reaction engineering and Catalysis
- Process design
- System integration and control
- Efficient integration of hydrogen generation with **fuel cells**
- **6 International & European registered patents**, secure Helbio's "freedom to operate" (FTO), enabling a successful Commercialization of existing & new products

APPLICATIONS

Telecommunication stations

Telecommunications providers rely on backup power to maintain a constant power supply and to ensure the operability of cell towers. In telecommunication stations, **H₂PS-5** offers many advantages which include reliability, low maintenance costs, reduced frequency of refueling and reduced cost.



On- or off- grid households and other buildings

Main benefits of using **H₂PS-5** include: energy savings due to high electrical and overall efficiency, reduced (or zero, depending on fuel) CO₂ emissions, essential elimination of emissions of atmospheric pollutants such as NO_x, SO_x and particulates, and dramatically reduced noise and vibration level.



Sailing yachts and boats

Boats longer than 10m need a supplementary power generator for power and/or heat production when docked or in the occasion of failure of the main engine. **H₂PS-5** offers the same attractive characteristics as in any other mobile application: reliable, economic, quiet, vibration free, and emission free operation.



Trucks

The market for Auxiliary Power Units (APU) for trucks represents an interesting potential opportunity for fuel cell power systems. Replacement of diesel engines with a **H₂PS-5** power system will result in significant fuel savings, drastically reduced emission of pollutants and significantly quieter operation.



Small-size farms with biogas availability

Future and developing markets for **H₂PS-5** include small biogas producers in farms, food industries and food chains. In the biogas field, conventional technologies suffer from unreliable and interrupted operation due to the low heating value of the fuel, which is not an issue for **H₂PS-5**.



DISCLAIMER

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