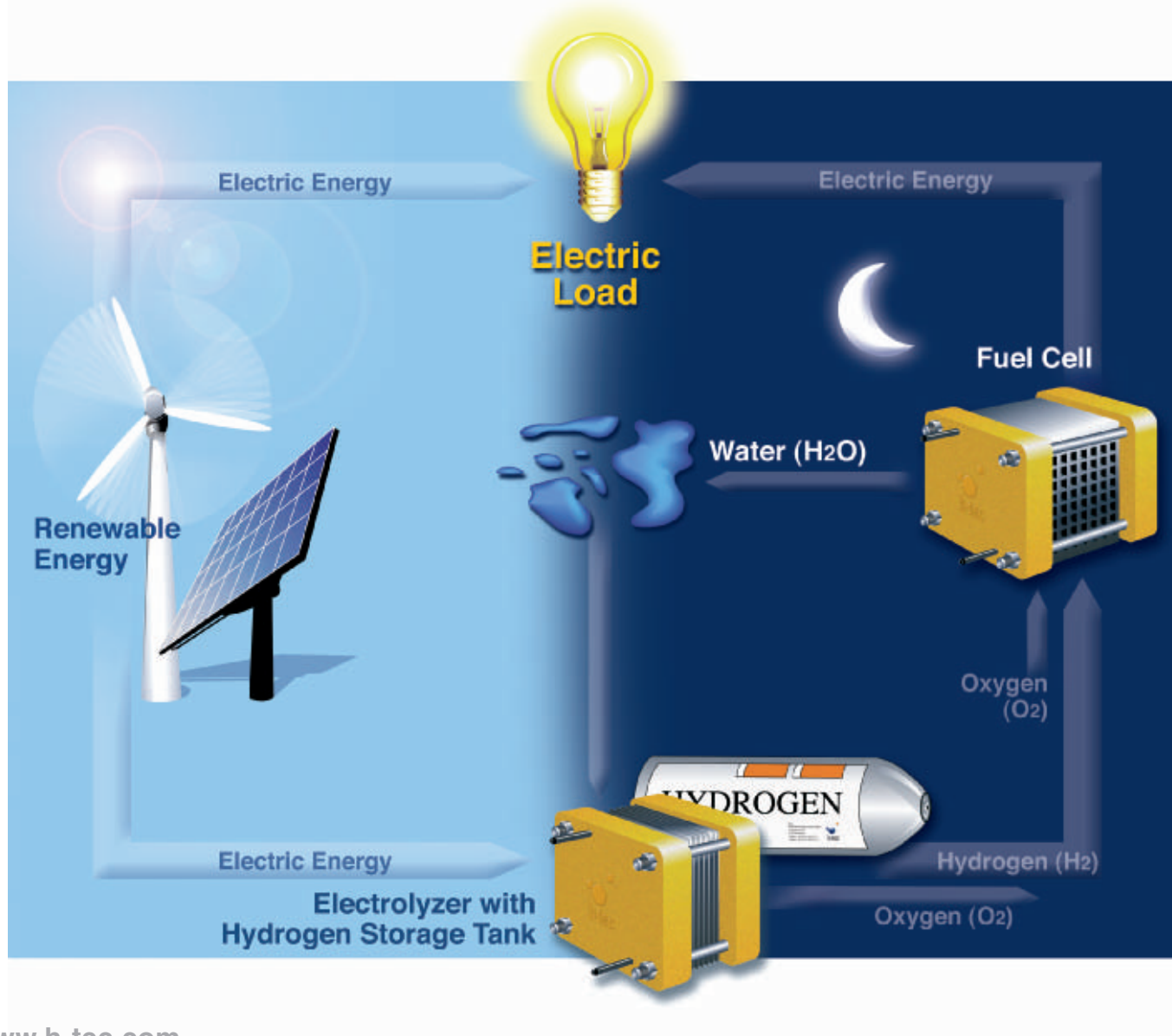
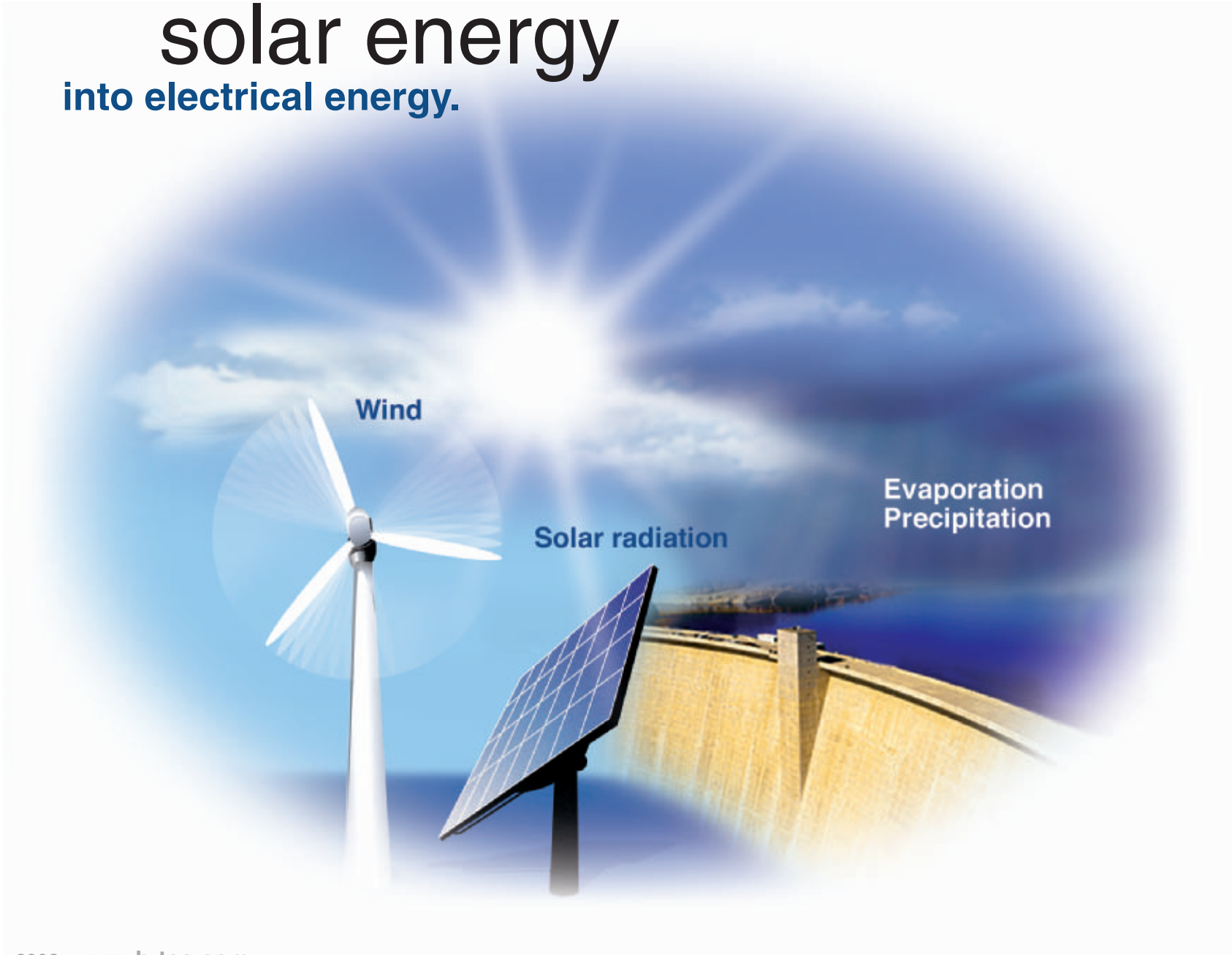


Technology Solar-Hydrogen Energy System



Solar cells, wind power plants and water power plants transform
solar energy
into electrical energy.

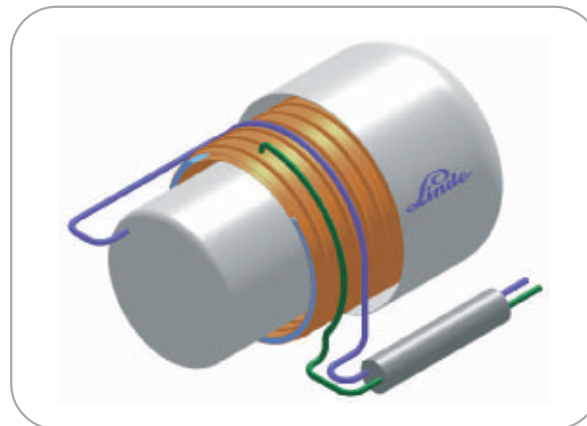


Different ways to store hydrogen



Pressure storage tank

Source: Dynetek



Cryogenic storage tank

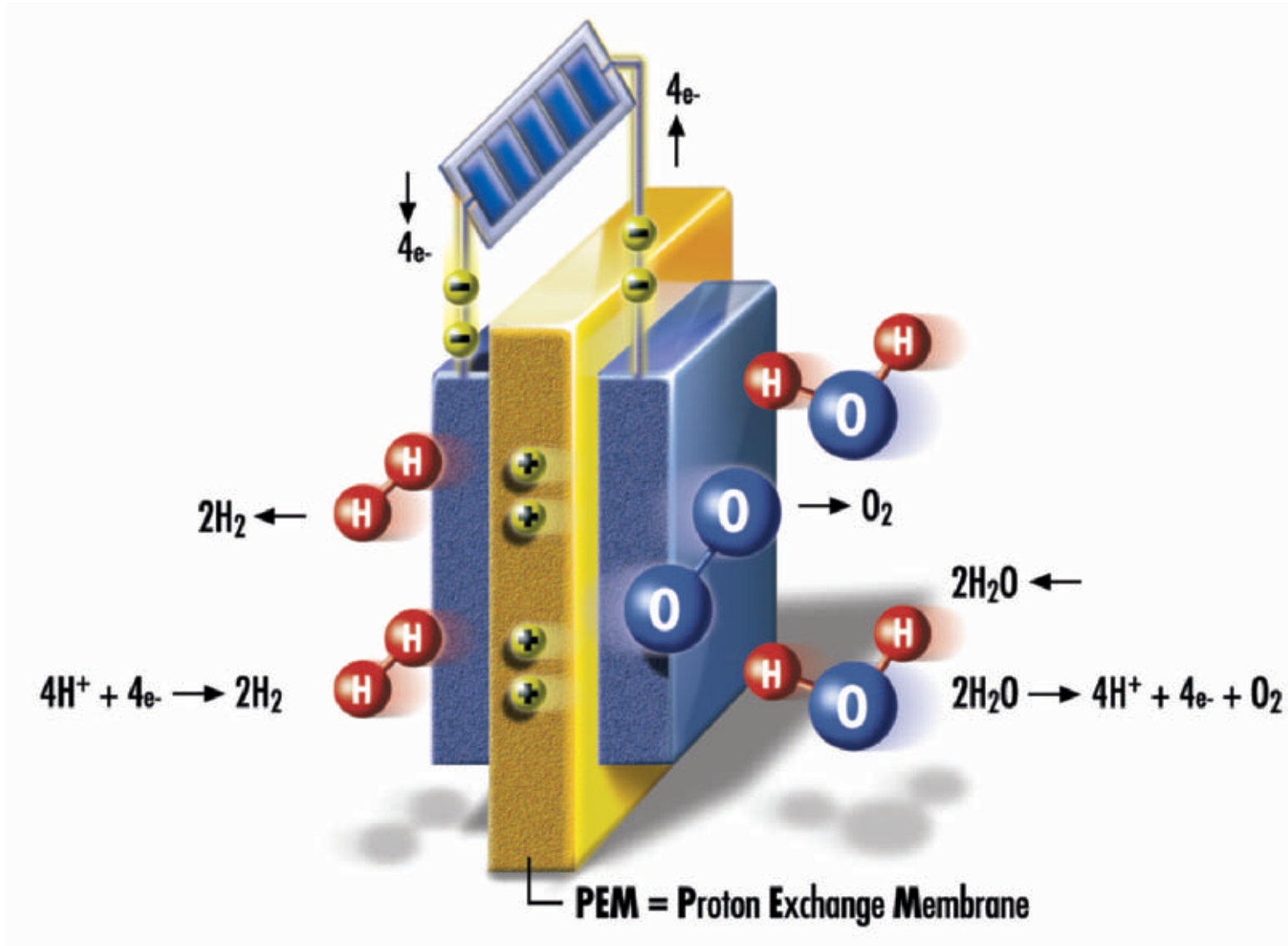
Source: Linde AG



Metal hydride storage tank

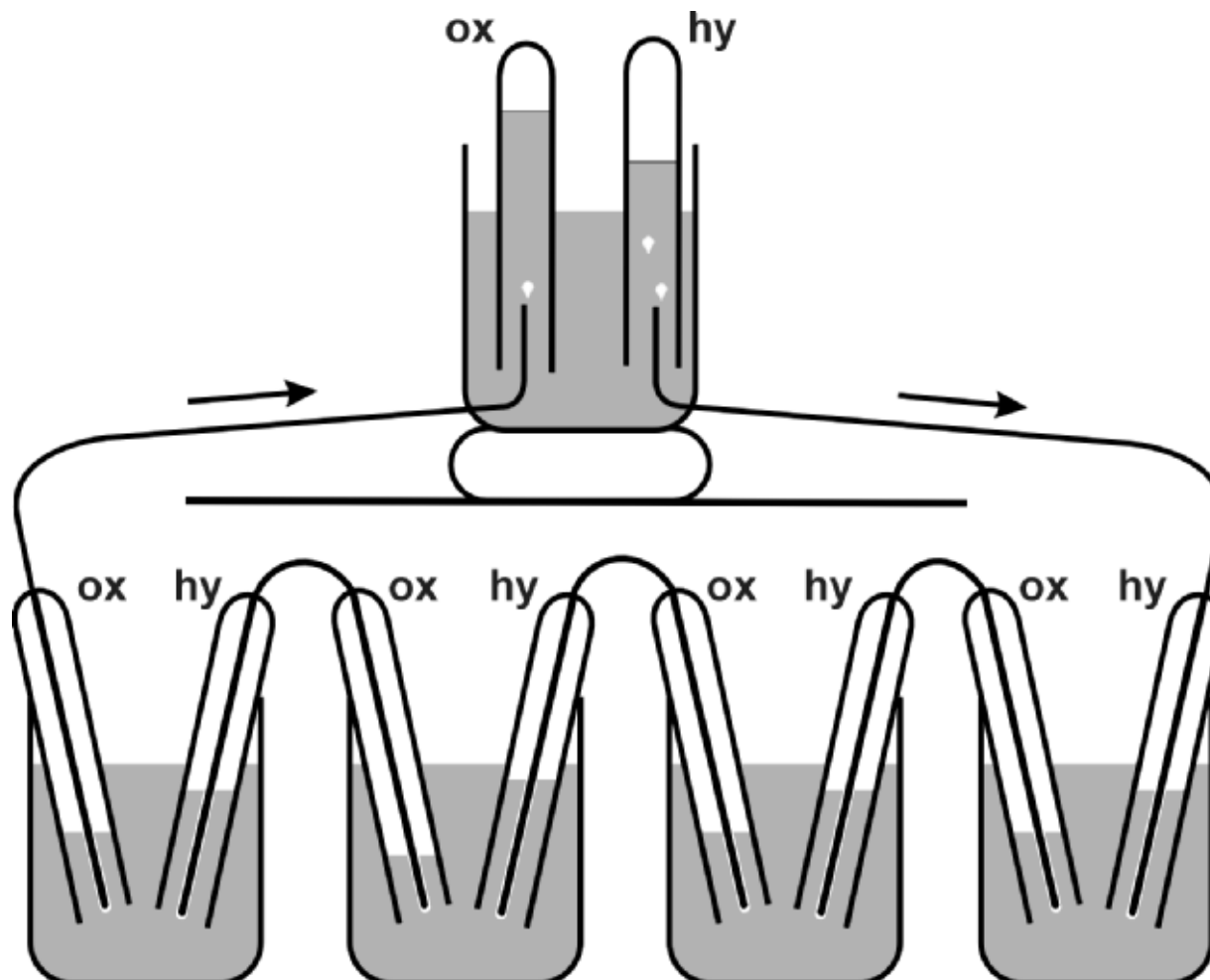
Source: HERA
Hydrogen Storage Systems

Technology PEM Electrolyzer



History

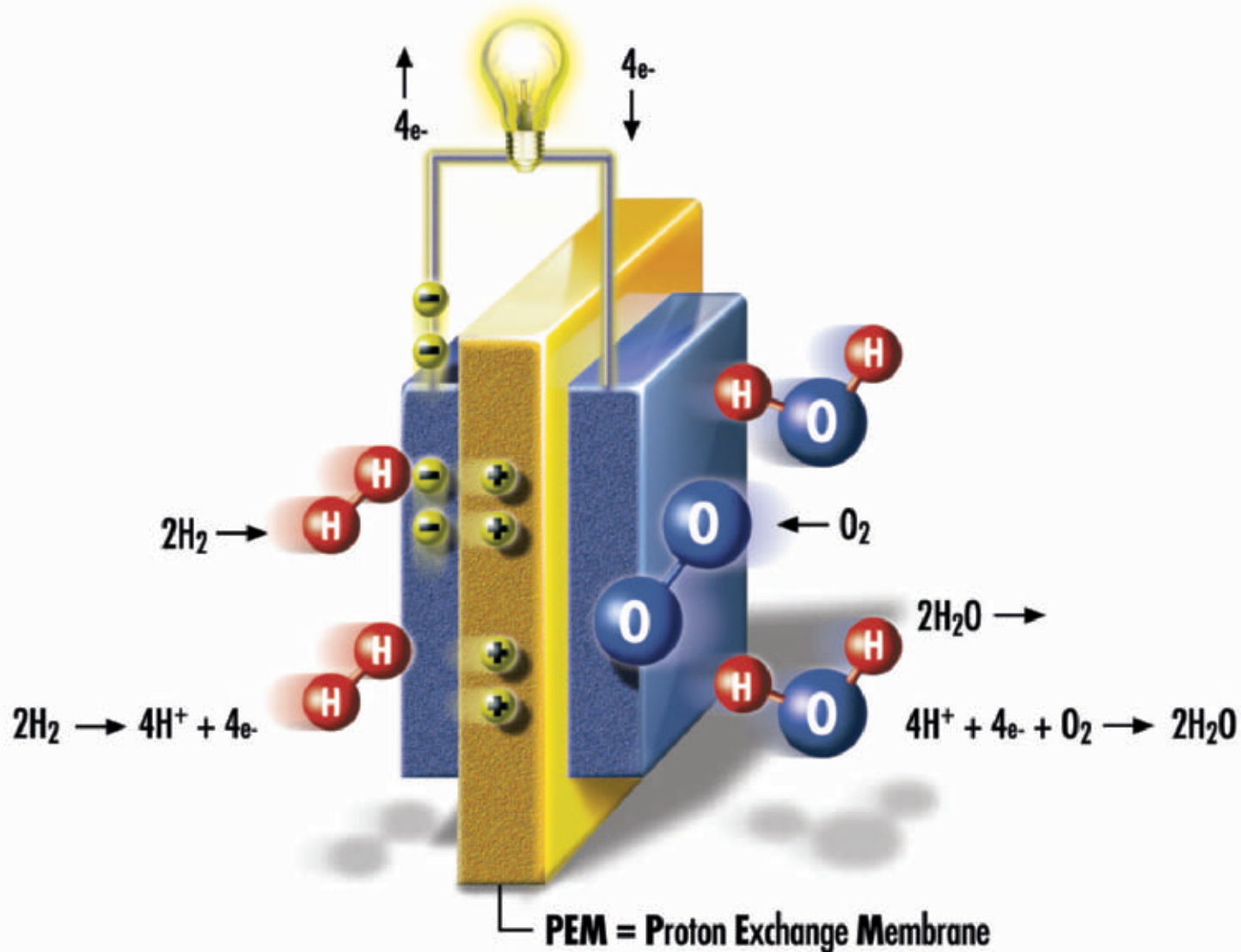
1839 - Sir William Robert Grove invented the first fuel cell



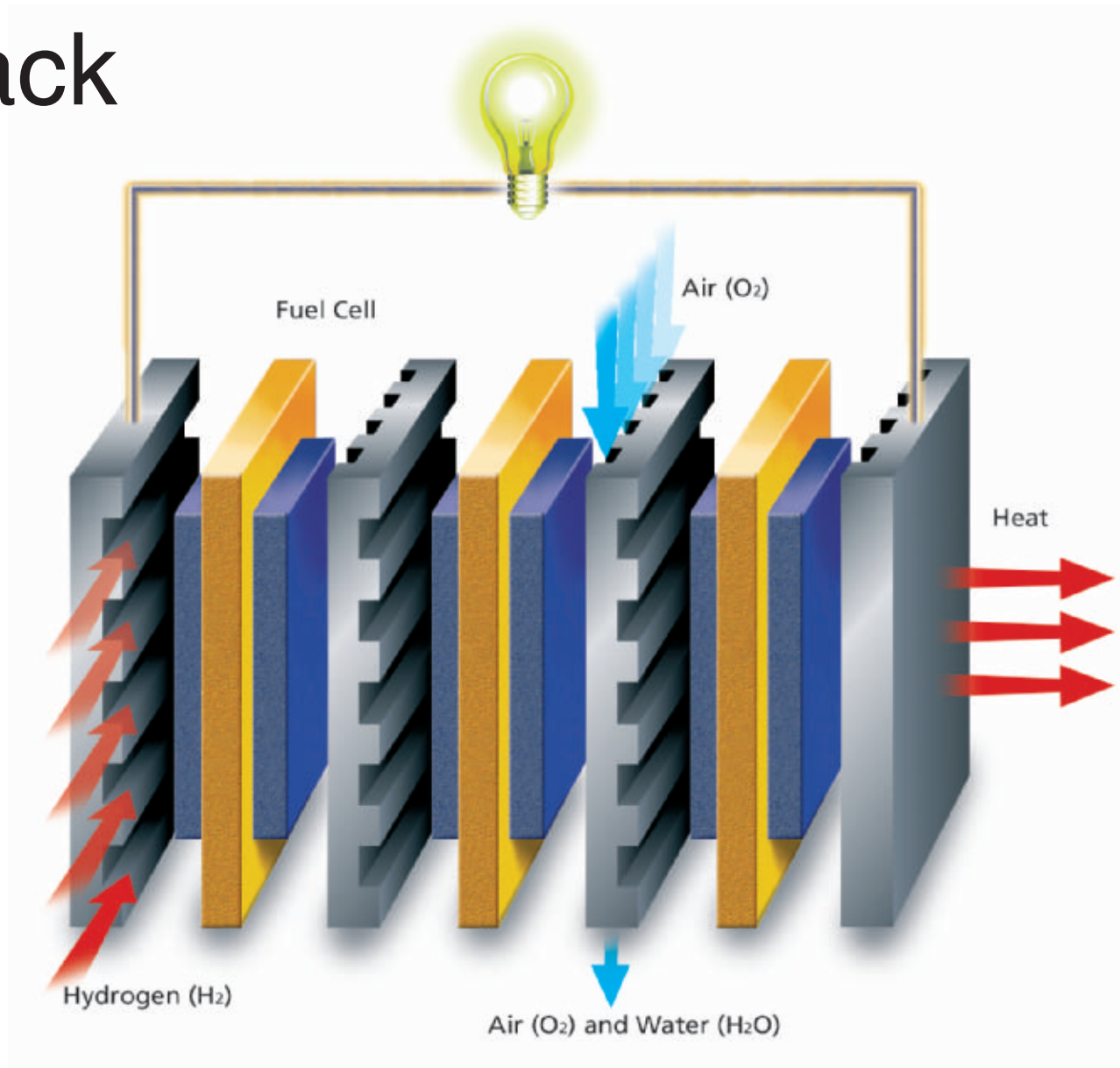
Types Fuel Cell = FC

Fuel Cell	Electrolyte	Operating temperature	Electrical efficiency	Fuel <i>Oxydant</i>
Alkaline Fuel Cell AFC	Potassium hydroxid (KOH) solution	Room temperature to 90° C	60 - 70 %	H ₂ O ₂
Proton Exchange Membrane Fuel Cell PEMFC	Proton exchange membrane	Room temperature to 80° C	40 - 60 %	H ₂ O ₂ , Air
Direct Methanol Fuel Cell DMFC	Proton exchange membrane	Room temperature to 130° C	20 - 30 %	CH ₃ OH O ₂ , Air
Phosphoric Acid Fuel Cell PAFC	Phosphoric acid	160 - 220° C	55 %	Natural gas, bio gas, H ₂ O ₂ , Air
Molten Carbonate Fuel Cell MCFC	Molten mixture of alkali metal carbonates	620 - 660° C	65 %	Natural gas, bio gas, coal gas, H ₂ O ₂ , Air
Solid Oxide Fuel Cell SOFC	Oxid ion conducting ceramic	800 - 1000° C	60 - 65 %	Natural gas, bio gas, coal gas, H ₂ O ₂ , Air

Technology PEM Fuel Cell

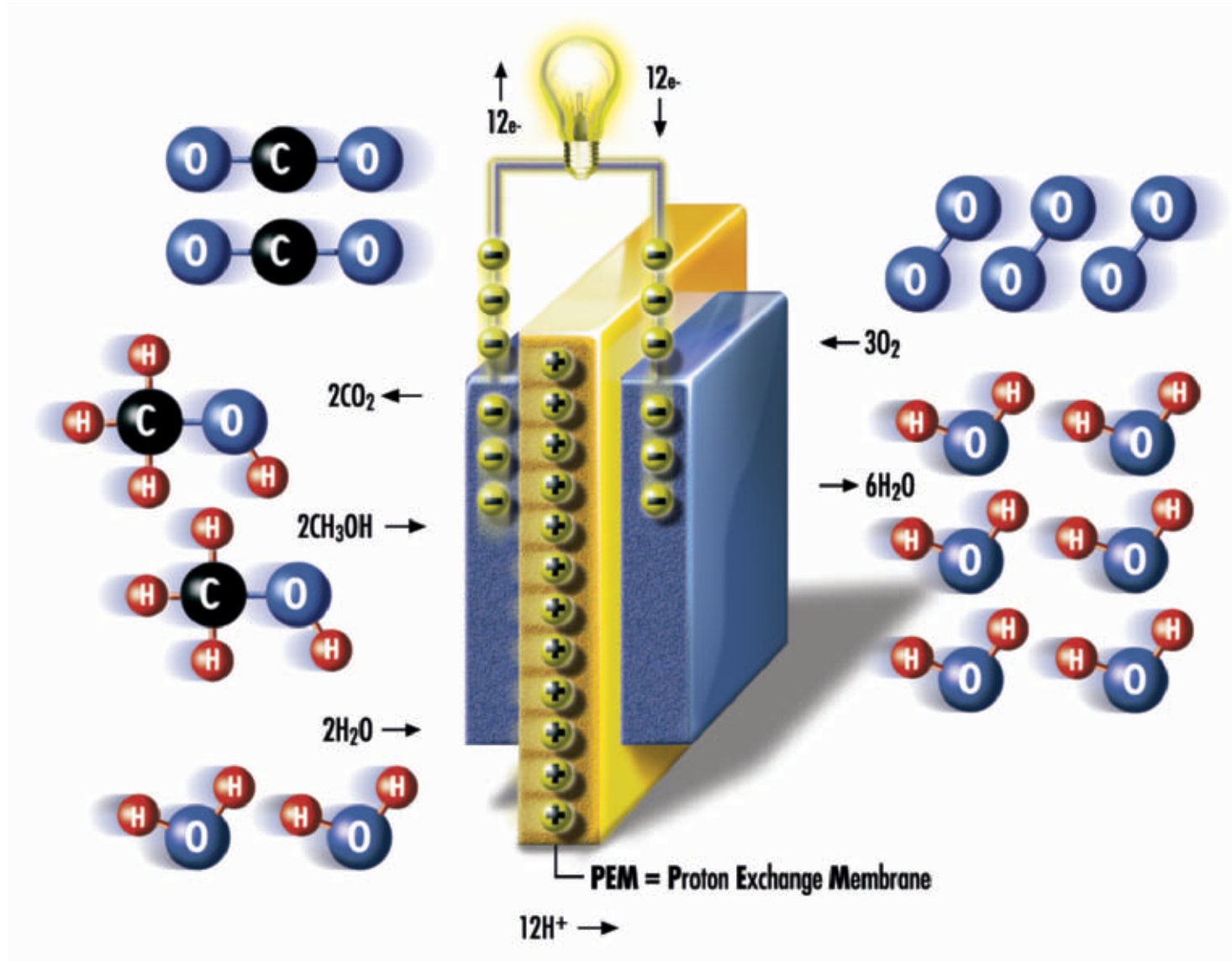


Fuel Cell Stack

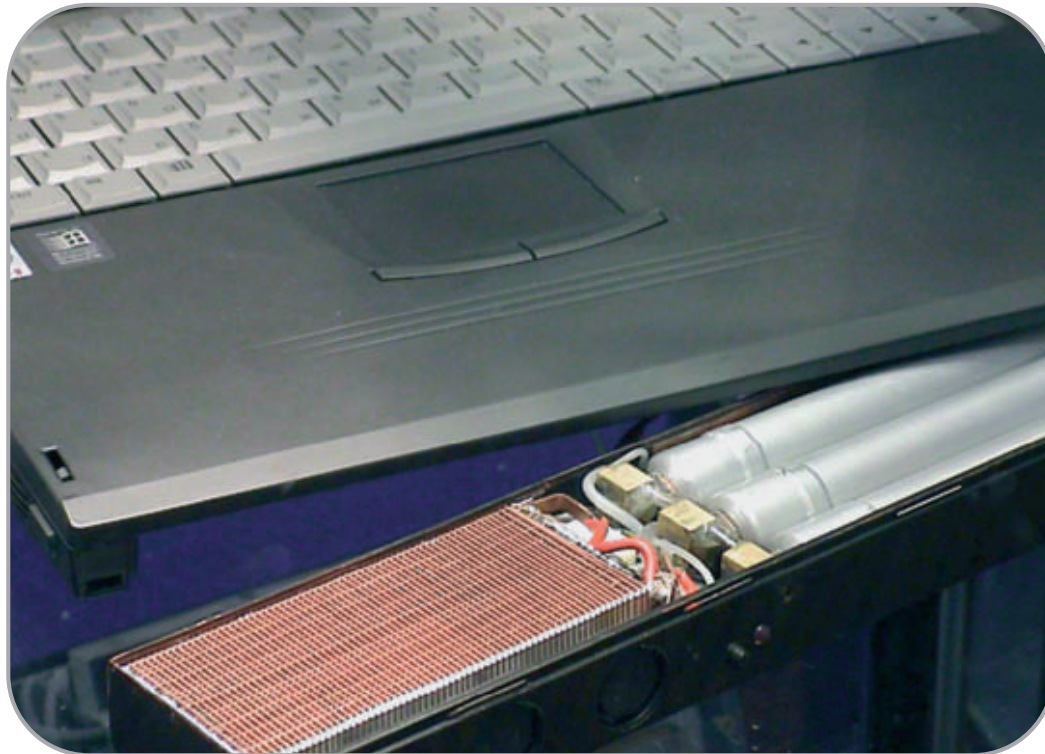


Technology

Direct Methanol Fuel Cell



An example of portable application



Fully integrated **fuel cell system** powering a laptop.
The dimensions of the system are equivalent to the rechargeable batteries used typically.

Source: Fraunhofer ISE

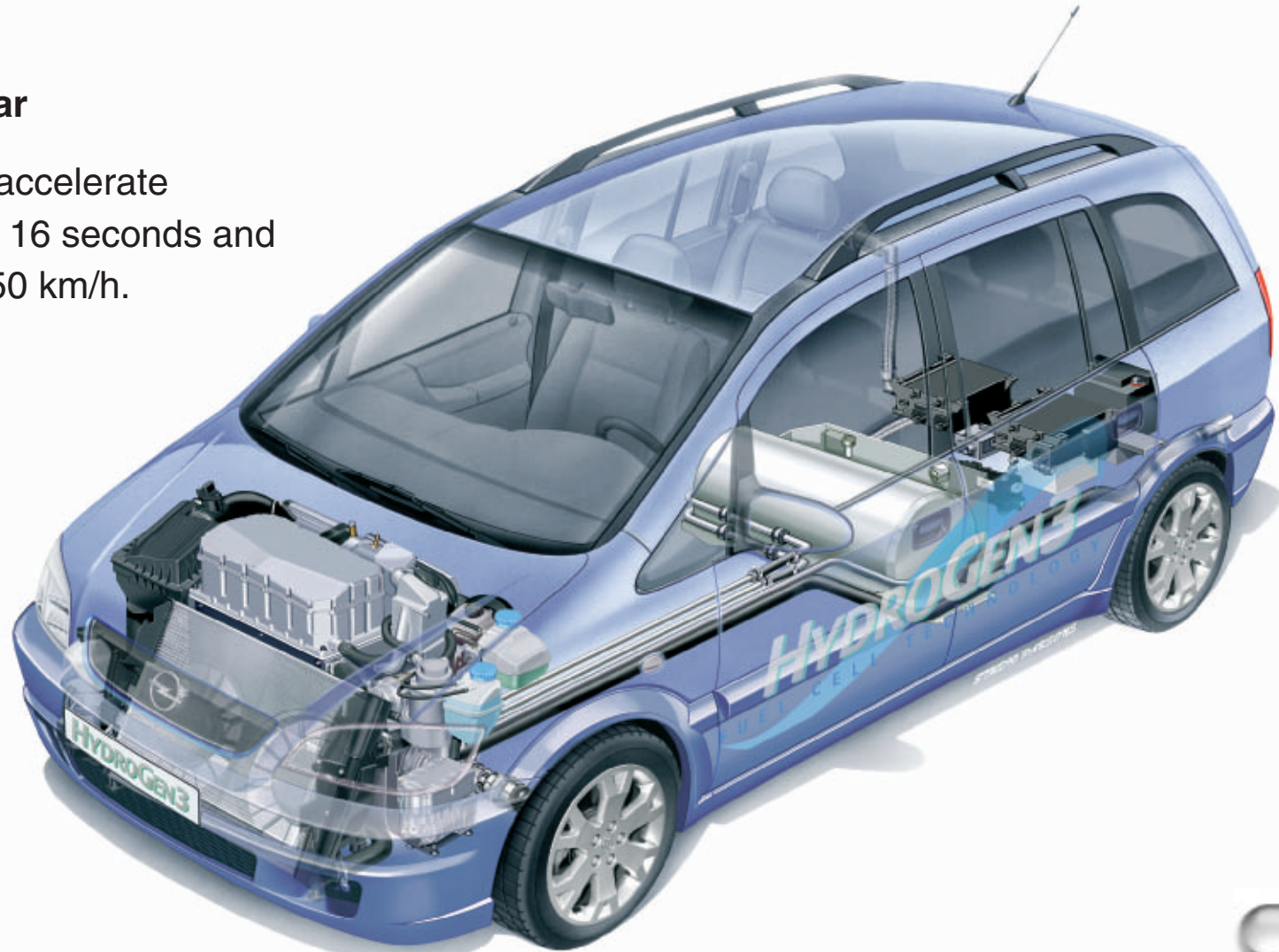
An example of mobile application



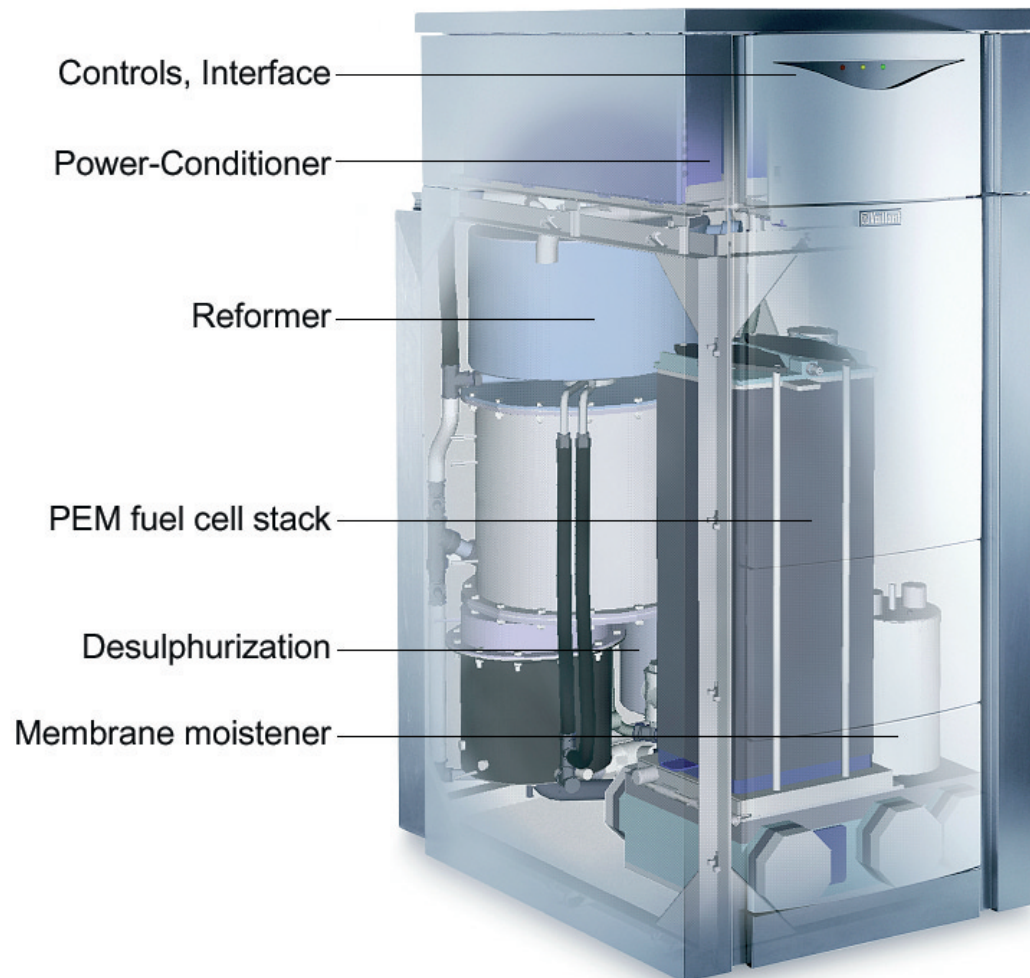
Fuel cell powered car

The HydroGen3 can accelerate from 0 to 100 km/h in 16 seconds and has a top speed of 150 km/h.

Source: Adam Opel AG



An example of stationary application



Fuel cell heating system

At present powered by natural gas, but could be powered by regenerative hydrogen in the future.

This device supplies two kinds of usable energy:

Electrical energy

Thermal energy

Source:
Vaillant GmbH