

MESA DEL
HIDRÓGENO
VERDE DE LA REGIÓN
DE MURCIA



Siemens Energy: Tecnología y Aplicaciones para el Hidrógeno

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Dirección General de Energía y Actividad Industrial y Minera

COLABORA >



CONTENIDO

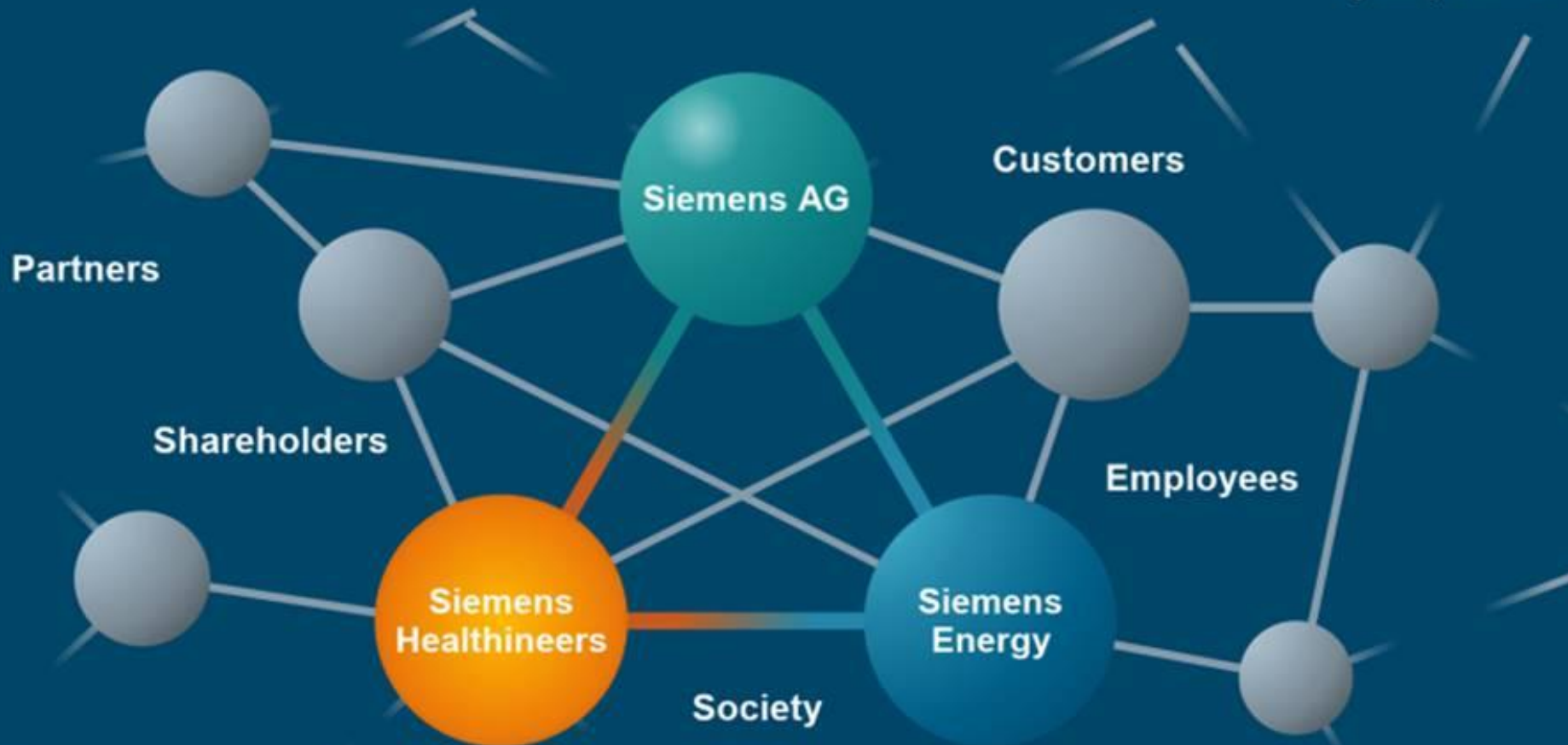
- **Visión Siemens Energy – We energize society**
- **Objetivo del Hidrógeno verde**
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The Siemens Ecosystem



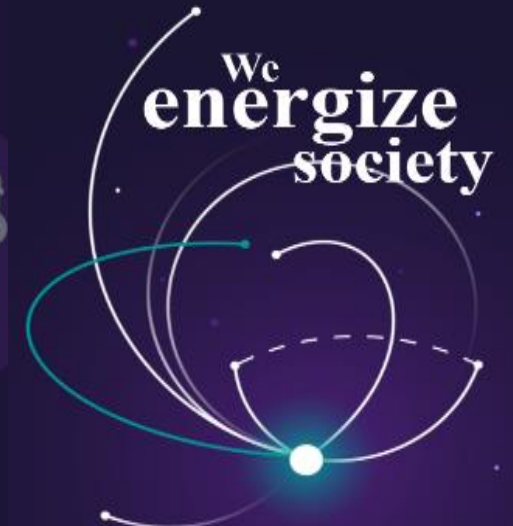


Introduction Siemens Energy Our portfolio

Siemens Energy will take a **leading role** in the energy industry.



SIEMENS energy



Objetivo: descarbonización → Sostenibilidad



Politics force worldwide decarbonization

G7 summit, 2015:

Decarbonization of the global economy by 2100:
Greenhouse gas emissions reductions of 40% to 70% by 2050 (baseline: 2010)

COP21, 2015:

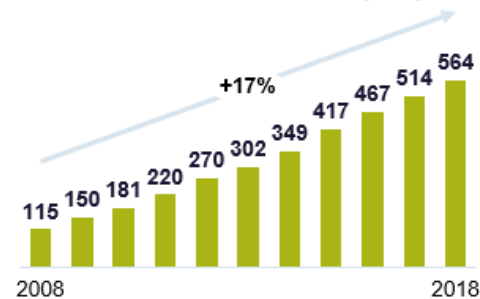
195 countries adopt the first universal climate agreement: Keep a global temperature rise this century well below 2°C

COP23, 2017:

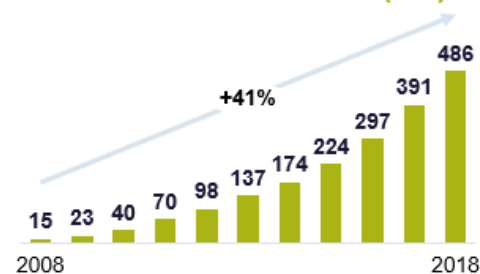
The 197 Parties discussed how and how far they can implement decarbonization measures

Renewables installation increase

Global Wind Installations (GW)¹

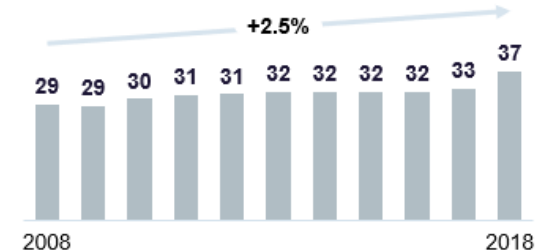


Global Solar PV Installations (GW)¹



But CO₂ grow constantly

Global CO₂ Emissions (Gt)²



! Renewables integration; Decarbonization of every industry; Changes in legislation

Sources: ¹ IRENA, Renewable Capacity Statistics 2019; ² IEA

Producción y Demanda Mundial de Hidrógeno

4% Electrolysis & others³

- Utilize electricity to split water into hydrogen and oxygen, mainly chlor-alkali electrolysis systems

48% Partial oxidation & Coal gasification³

- POx as by-product from chemical production
- Coal gasification as part of chemical processes in the steel industry

48% Steam Methane Reforming (SMR)³

- Synthesis from steam and natural gas, today most economic method



1% Mobility^{4,6}

- Expected growth by **green H₂**
- Penetration of **FCV** and **green fuels** are key drivers

9% Energy^{4,6}

- Expected growth due to need for **storage of curtailed renewables**

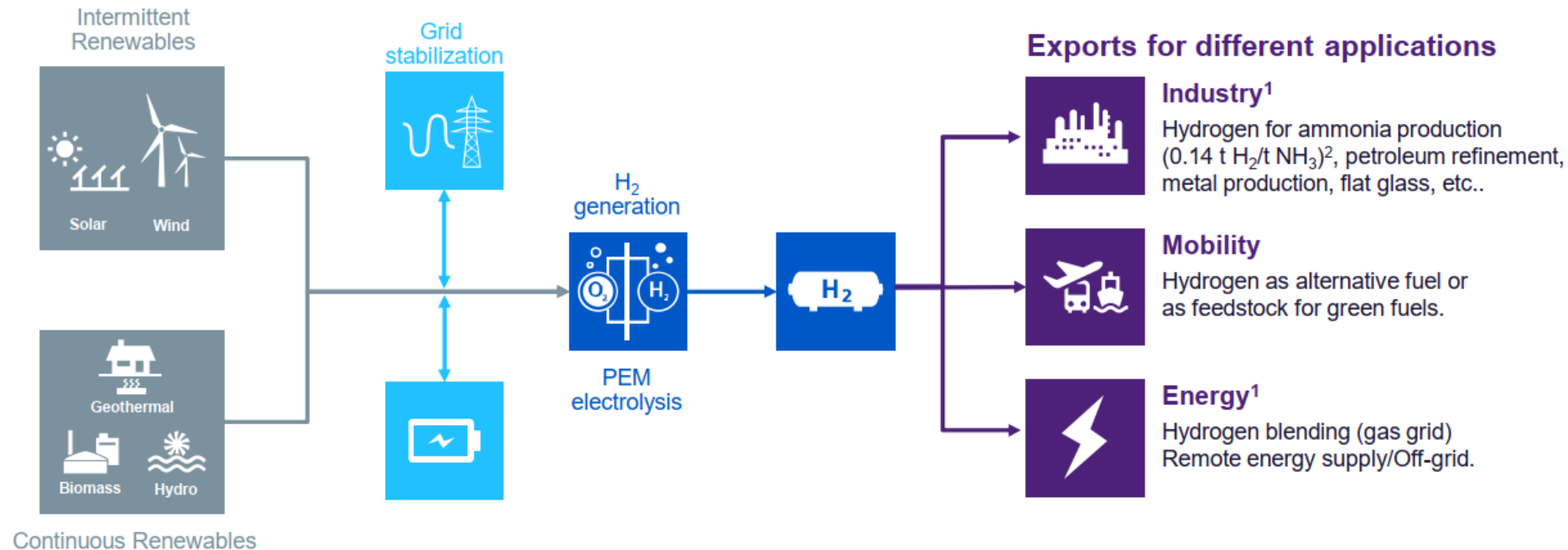
90% Industry⁶

- Includes chemical, refineries, metal processing and others
- Expected growth due to CO₂ emissions regulations

! Electrolysis is a CO₂ neutral production method for hydrogen

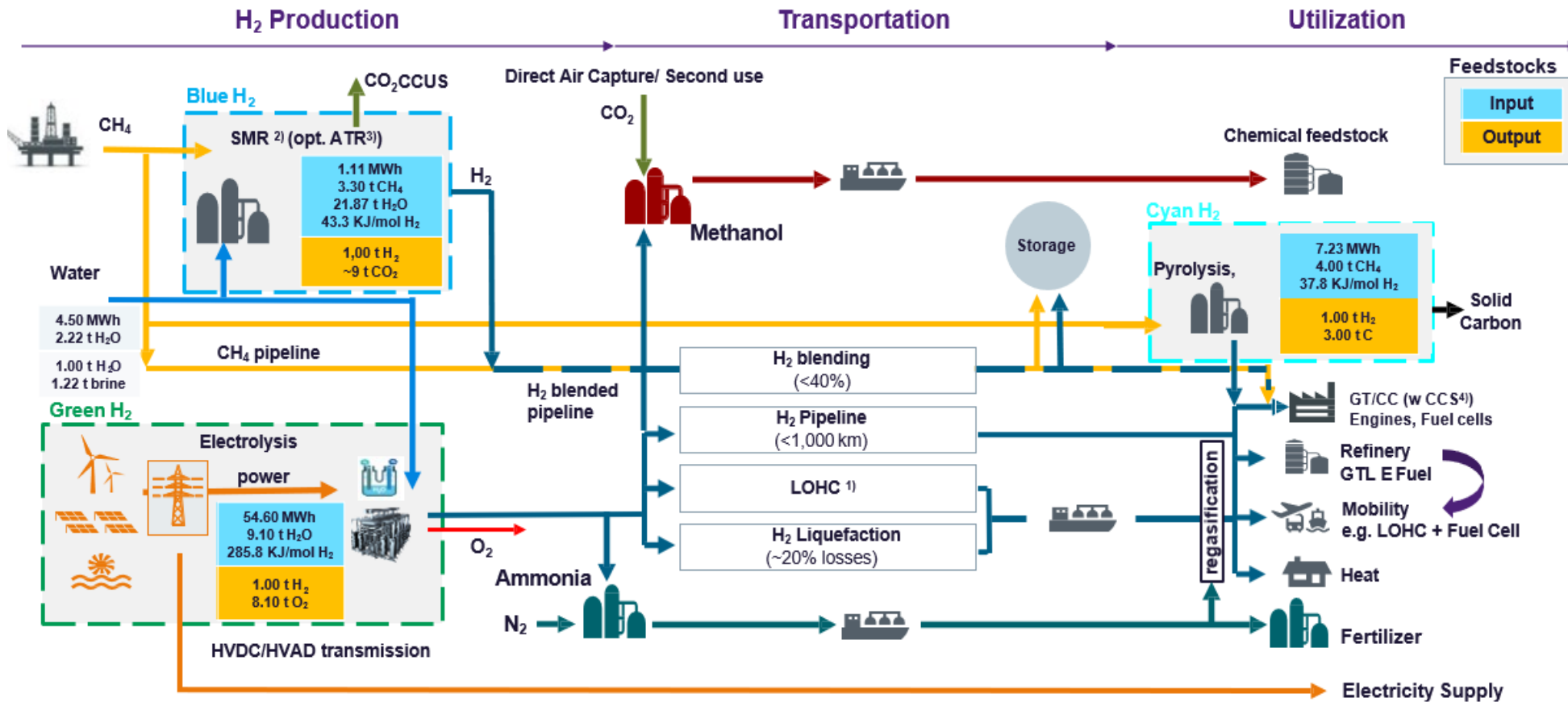
Source: ¹ Freedonia; ² https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_Hydrogen_2019.pdf p. ³ 2014 FCH GIA; ⁴ Navigant; ⁵ IEA 2019; ⁶ CertifHy

Aplicaciones del Hidrógeno (verde)



Source: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_Hydrogen_2019.pdf

Siemens Energy y su Tecnología para el H2



1) Liquid organic hydrogen carriers 2) Steam Methane Reforming 3) Autothermal reforming 4) Carbon capture and storage 5) Reverse Osmosis 6) 1kg natural gas ~50 MJ/kg

Electrolizador Silyzer 300

17.5 MW

Power demand
per full Module Array
(24 modules)

75 %

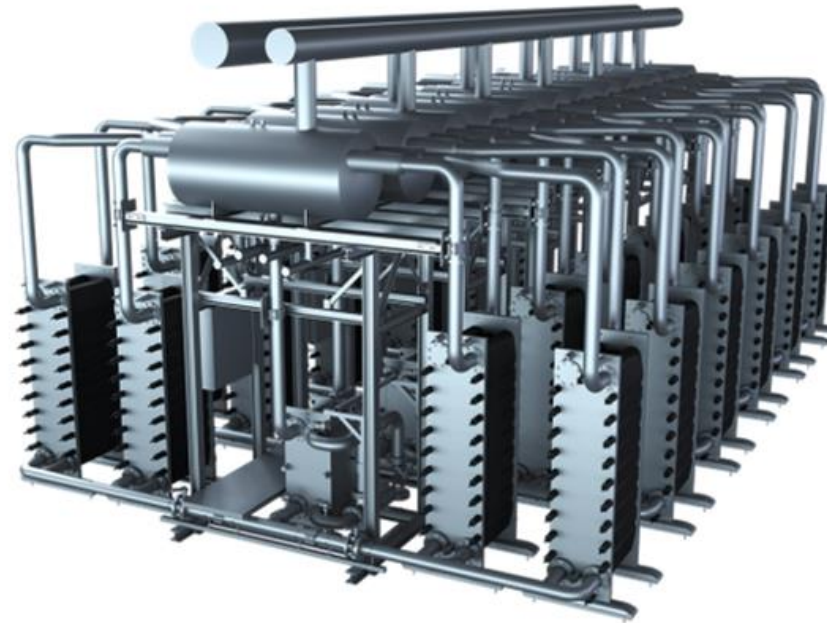
System efficiency
(higher heating value)

24 modules

to build a
full Module Array

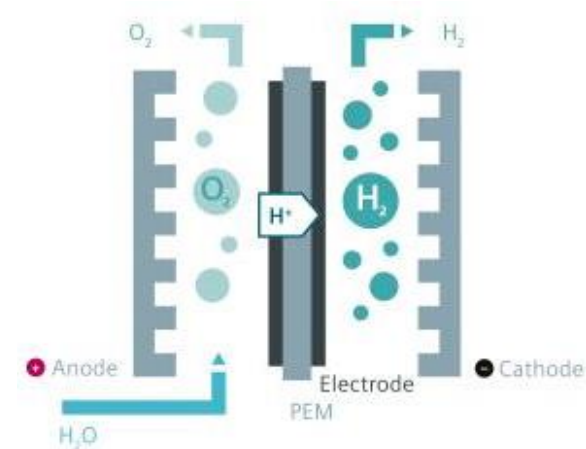
340 kg

hydrogen per hour
per full Module Array
(24 modules)

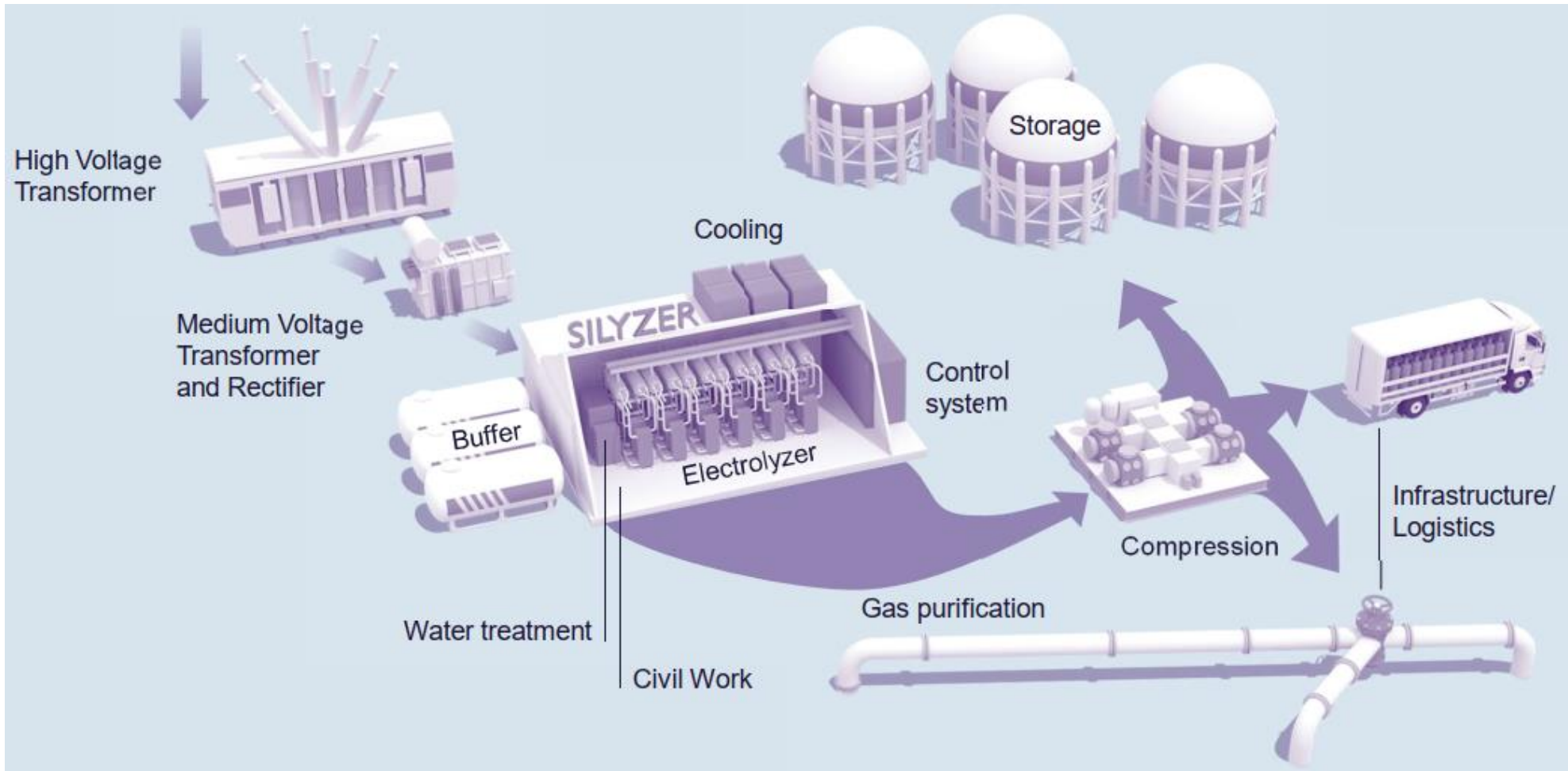


Silyzer 300 – Module Array (24 modules)

Electrólisis PEM (Proton Exchange Membrane)

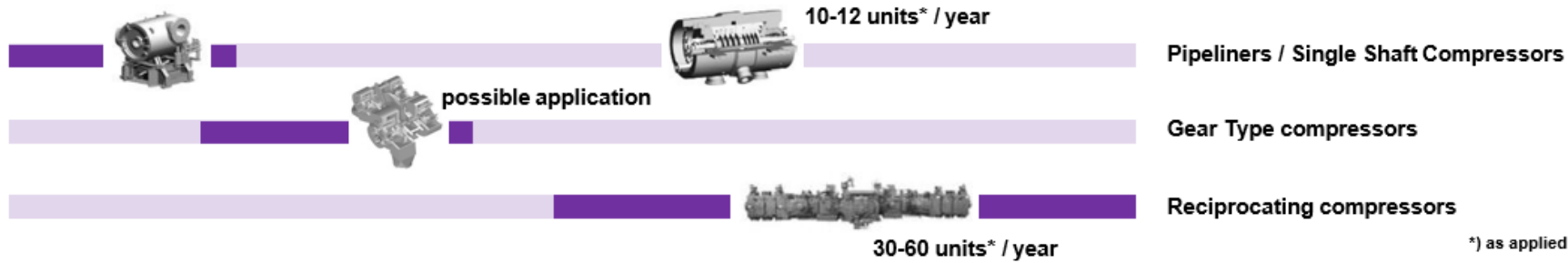


Producción de H2 verde: algo más que un electrolizador





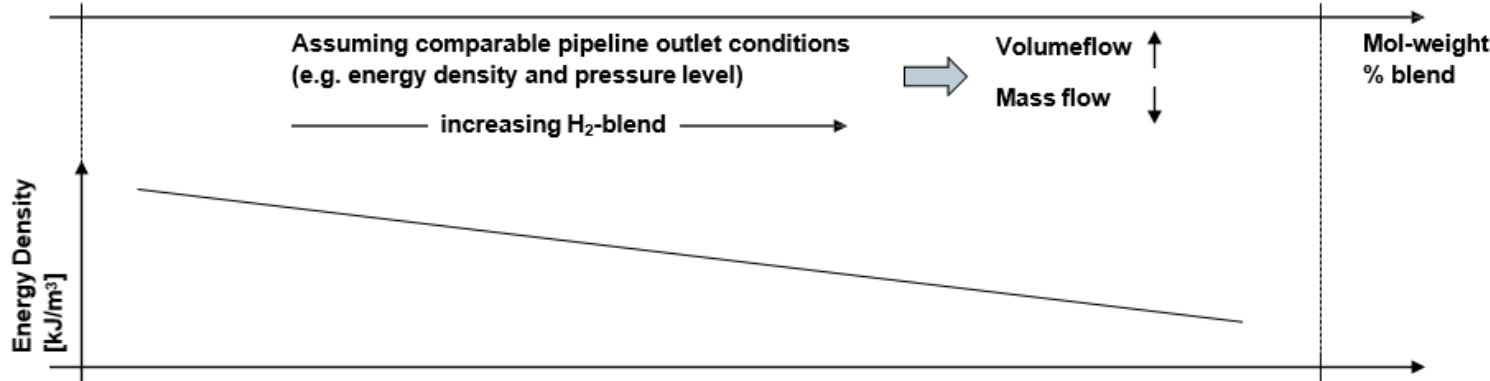
Equipos de Compresión en aplicaciones de Hidrógeno



*) as applied for low mol weights ($\geq 16\text{g/mol}$)

16,4 g/mol, 100% CH₄
($\rho = 0,72 \text{ kg/m}^3$)

2 g/mol, 100% Hydrogen
($\rho = 0,09 \text{ kg/m}^3$)



Increasing H₂ - content assuming constant stage head / same compressor size (turbo compressors) leads to...

- ... reduction of pressure ratio
- ... ~ constant volumeflow
- ... decrease of massflow
- ... decrease of power consumption

Compressor choice to be aligned acc. project-specific boundary conditions.

- gas-mixture, volume-/mass-flow, pressure-ratio, power consumption, energy density...
- CAPEX, OPEX, existing infrastructure,....

Mol-weight % blend

Turbinas de Gas para un futuro sostenible



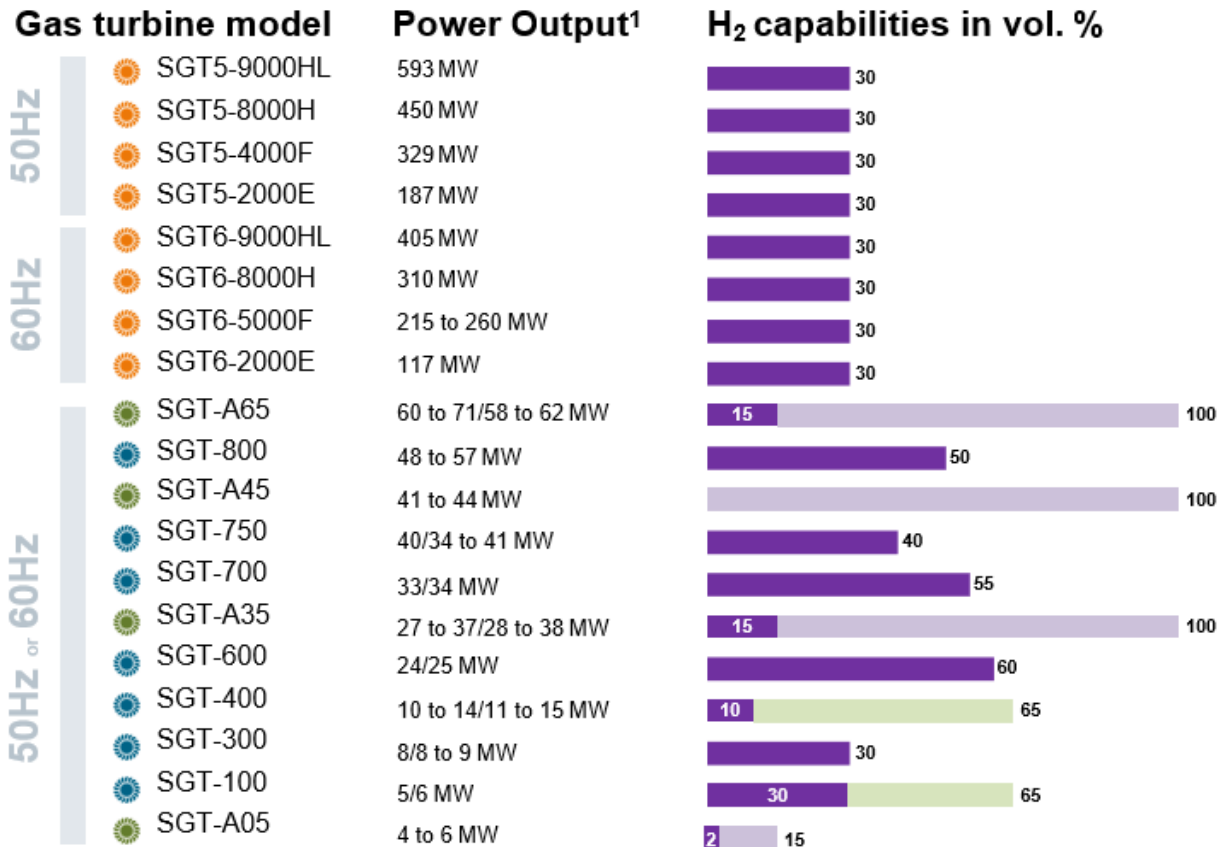
Heavy-duty gas turbines



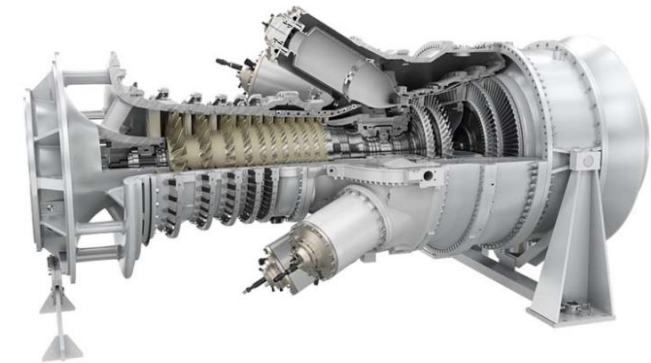
Industrial gas turbines



Aeroderivative gas turbines



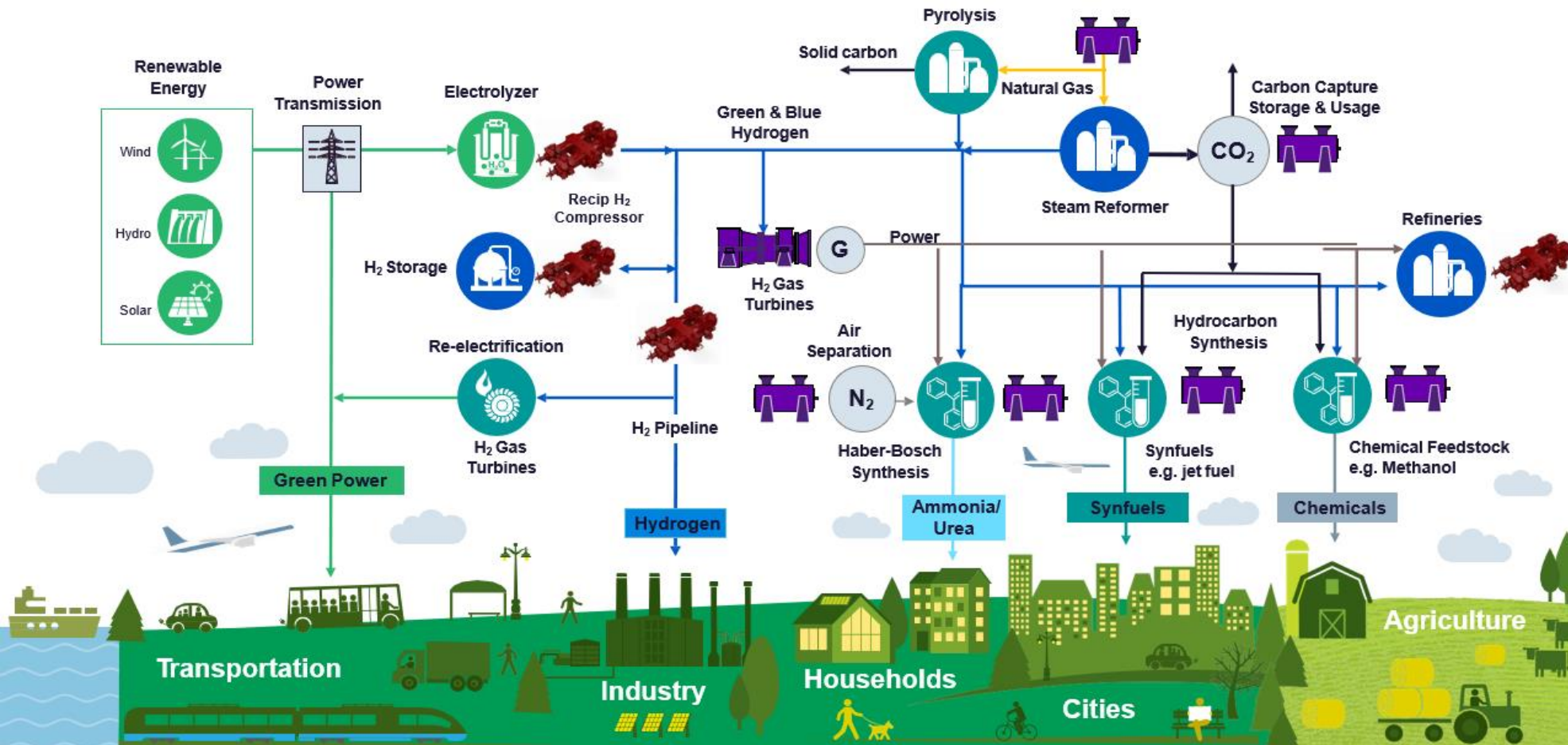
Objetivo 100% H₂ en 2030



¹ ISO, Base Load, Natural Gas Version 2.0, March 2019

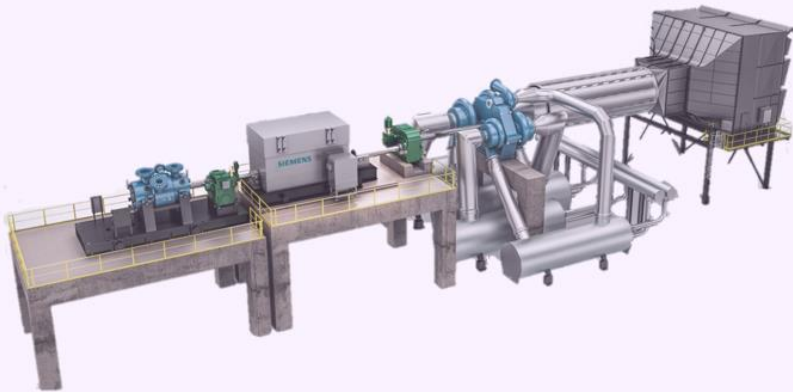
■ DLE burner ■ WLE burner ■ Diffusion burner with unabated NO_x emissions

Cadena de valor del H2 y el portfolio de Siemens Energy



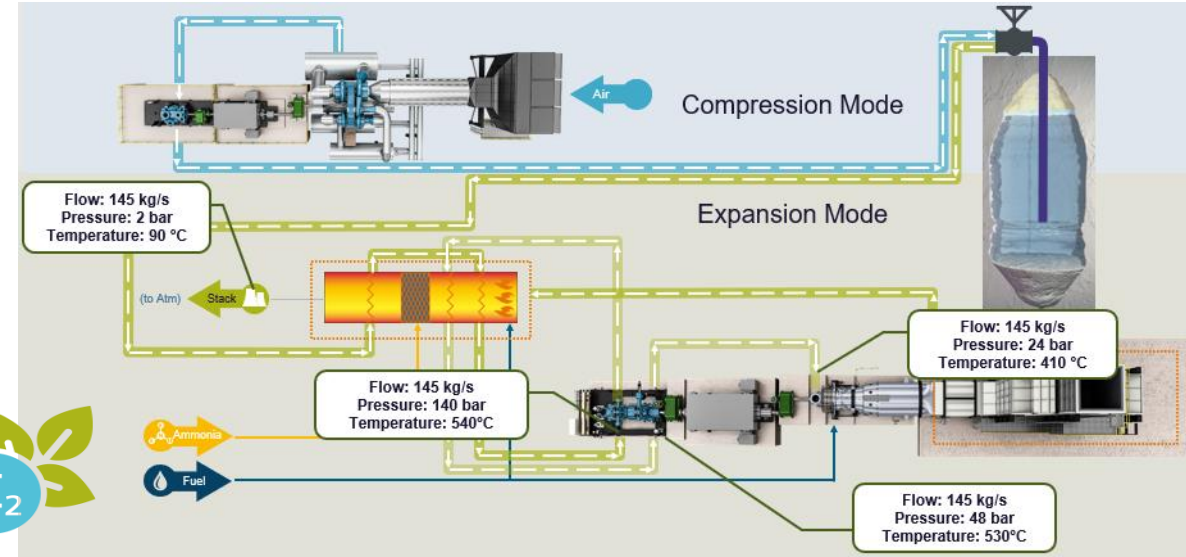
Otras Tecnologías: Smart CAES

Compression Train



- Proven compressors references
- Up to 125 MW

Compressed Air Energy Storage



Expansion Train



- Industry proven turbines (SST-800 & SGT-800)
- **16MW to 140/160MW** generation output
- Up to **50% H2** co-firing; **path to 100%**

Proyectos – H2FUTURE



6 MW

Power demand based on
Silyzer 300

1.200 Nm³

of green hydrogen per hour

- **Partners:** VERBUND (coordination), Voestalpine, Austrian Power Grid (APG), TNO, K1-MET
- **Country:** Austria
- **Installed:** 2019
- **Product:** Silyzer 300

<https://www.h2future-project.eu/>



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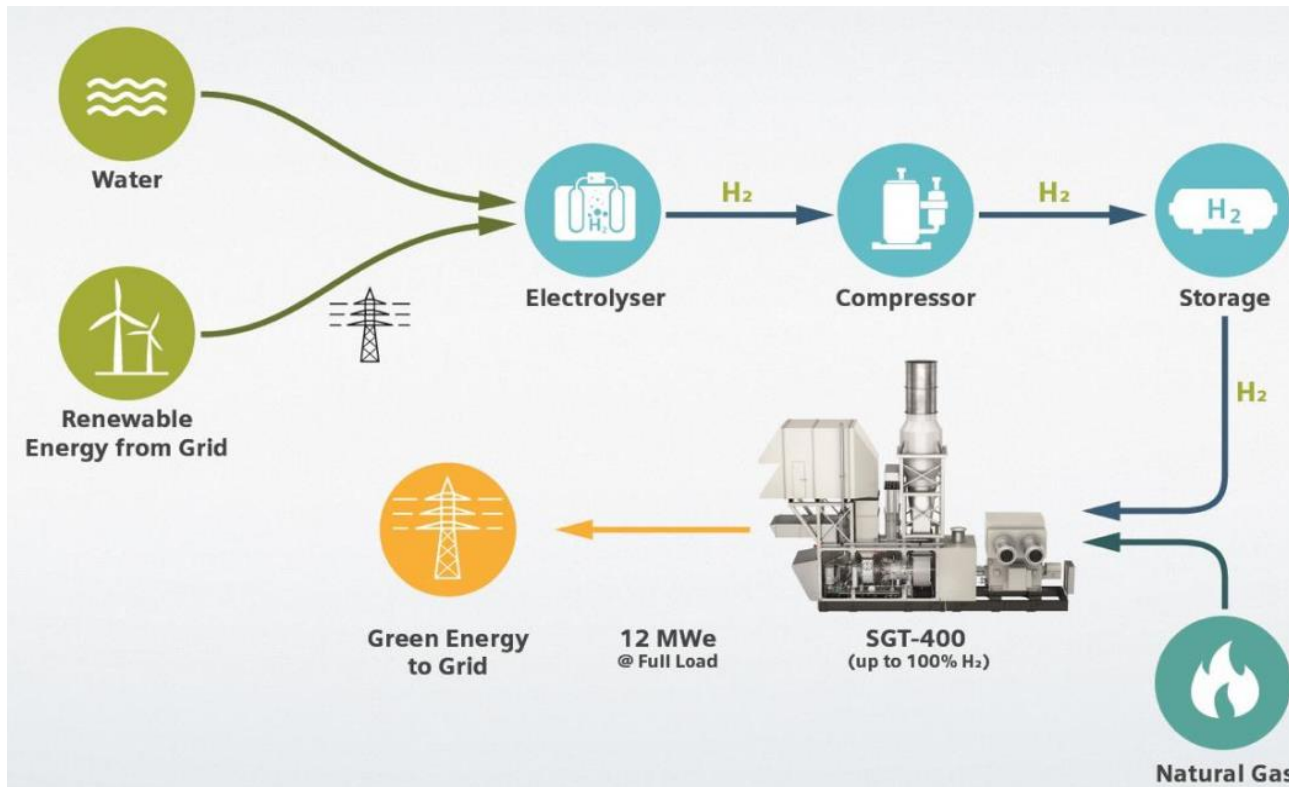


**Hydrogen for the steel
making process**



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735503. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and NERGHY.

Proyectos – HYFLEXPOWER



**SIEMENS
ENERGY**
(coordination)

The world's first integrated power-to-X-to-power hydrogen gas turbine demonstrator



- **Partners:** Engie, Centrax, German Aerospace Center (DLR), Arttic and four European universities (Lund, UCL, Duisburg-Essen, NTUA)
- **Country:** France
- **Kicked Off:** May 2020
- **Product:** Silyzer 300 and High H₂ DLE SGT-400

<http://www.hyflexpower.eu/>



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¡GRACIAS!

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