Green Hydrogen: New Challenges in the Energy Sector

An opportunity to decarbonise the renewable sector

UNIVERSIDAD DE ALMERÍA

EA4EPQ ICREPQ

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INTRODUCTION TO **GRANSOLAR GROUP** AND **INGENIA SOLAR ENERGY**

GRANSOLAR GROUP

Energy company with a strong technological base, a solid manufacturing capacity and the competences required to provide turnkey energy solutions on a constantly changing environment.

GRS

- Development
- EPC
- Testing and Comissioning
- Operation & Maintenance

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- Engineering Design
- Quality Control
- Self Energy Consumption
- Green Hydrogen

PVH

- Trackers & Support structure
- Controllers
- SCADA Systems

E22

- Energy Storage Solutions
- Vanadium redox flow batteries
- Lithium-ion Batteries
- EMS

IPS

- Power conversion systems
- Power and Energy Management Systems
- Controllers MPC Development

107	+2.4	108	+24	180	+11	8	23.3
PLANTS	GW INSTALLED	PROJECTS	GW TECH SUPPORT PROVIDED	PROJECTS	GW SUPPLIED	PROJECTS	MWh PERFORMANCE

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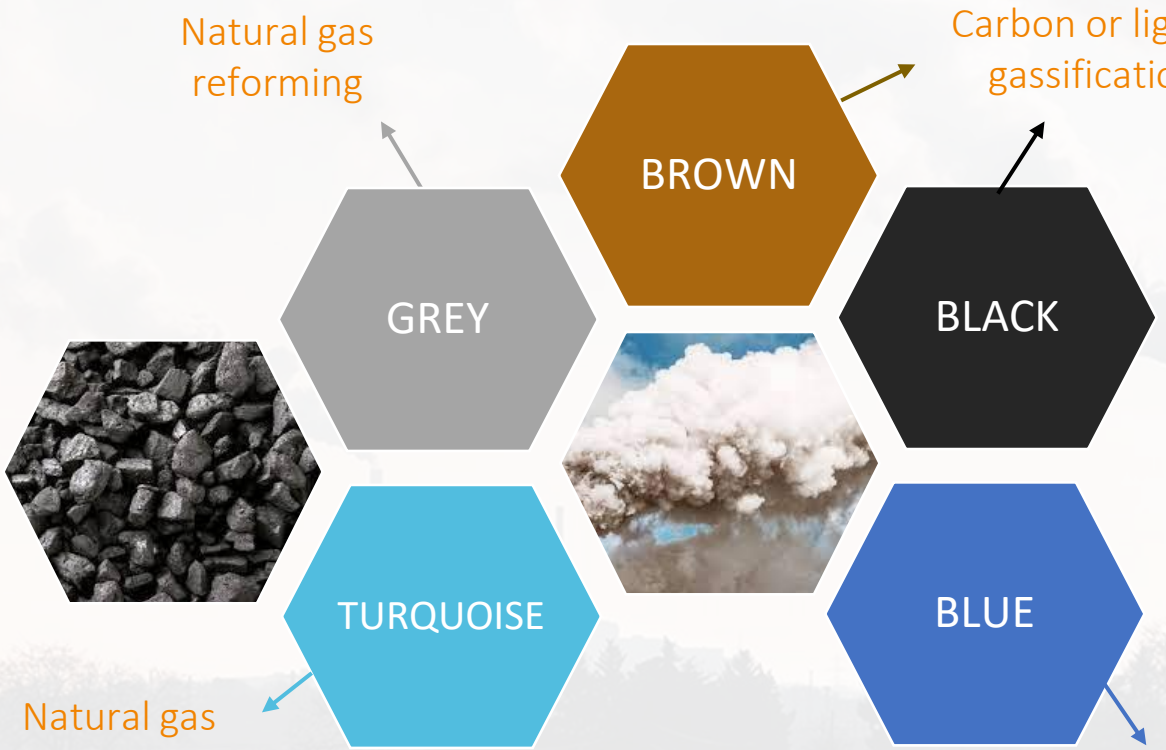
Hydrogen…?

TYPES OF HYDROGEN

Depending on the raw material and the transformation process used in the H2 extraction we can talk about.



GREEN

High decarbonisation scope

Zero emissions

Application versatility

Natural and unlimited resources

Purified water

Renewable energy

Water molecule split

H_2O_2 *H2 and O2*

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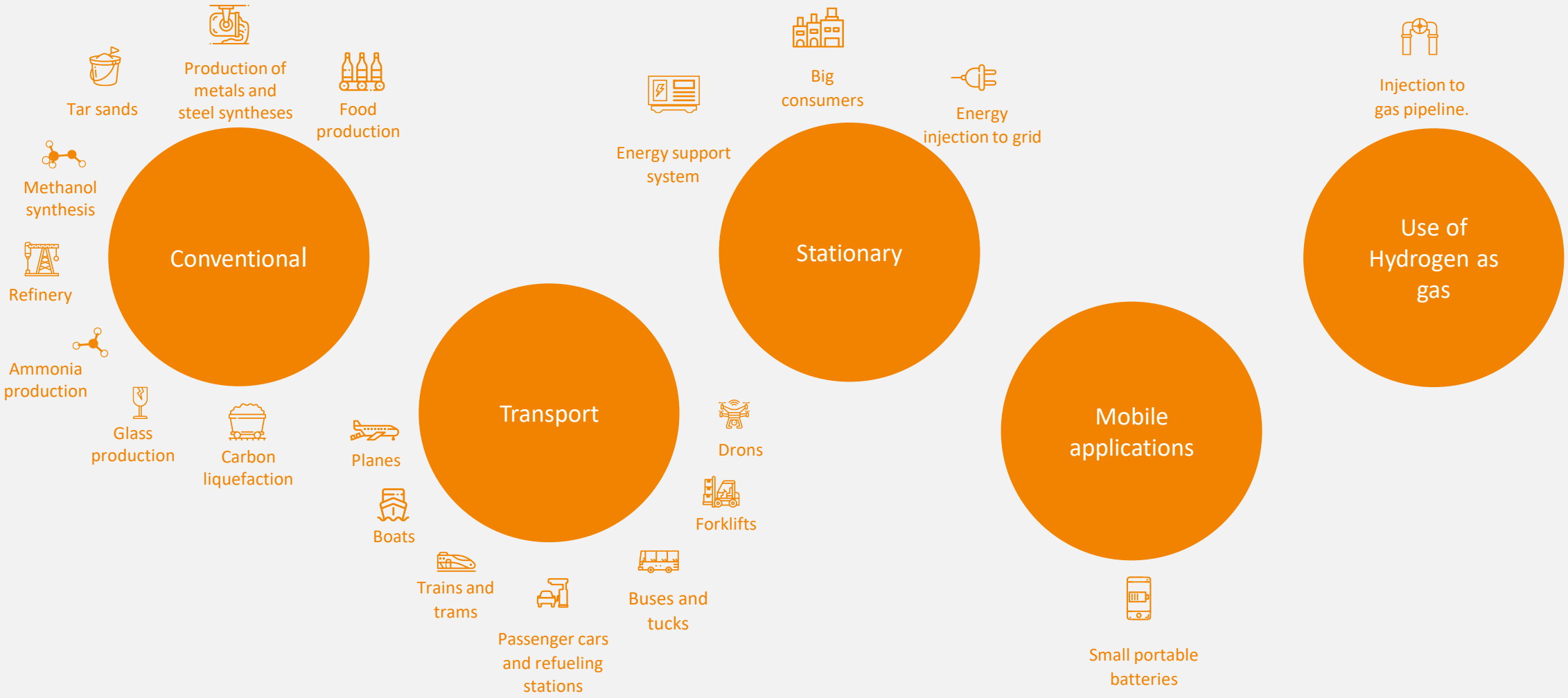
Conventional
Tar sands
Production of metals and steel syntheses
Food production
Methanol synthesis
Refinery
Ammonia production
Glass production
Carbon liquefaction
Transport
Planes
Boats
Trains and trams
Passenger cars and refueling stations
Buses and tucks
Drons
Forklifts
Stationary
Energy support system
Big consumers
Energy injection to grid
Mobile applications
Small portable batteries
Use of Hydrogen as gas
Injection to gas pipeline.

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HYDROGEN INSIGHTS

Accelerate manufacturing capacity and tackle high costs

Reduction of renewable electricity costs for green H2 production

Address sustainability

Facilitate the introduction of green hydrogen in the market and enable its demand

INTERNATIONAL PLANS

- KOREA: Hydrogen Economy Roadmap prioritizing the development of FC for vehicles and large-scale stationary FC for power generation
- EUROPE: 40 GW by 2030 electrolyser capacity target and investments amounting up to EUR 470 billion by 2050
- CHILE: Export GH2 and its derivatives, including 30 GW by 2030 electrolysis targets
- JAPAN: Basic H2 Strategy in 2017 and Roadmap for H2 and Fuel Cells in 2019
- AUSTRALIA: Leverage it`s expertise in renewable to produce and export GH2
- SAUDI ARABIA: 2 GW of electrolyser capacity by 2025 to produce GH2 to export.

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NATIONAL PLANS

Spanish Goals

- 4 GW electrolysis power
- 25% of Green Hydrogen in industry
- 150-200 FC Bus
  5.000-7.000 vehicles
- 100-150 H2 refueling stations
- 2 Train Lines
- Commercial hydrogen projects for energy storage
- 8.900 M€ of investment

HYDROGEN VALUE CHAIN

Hydrogen Production

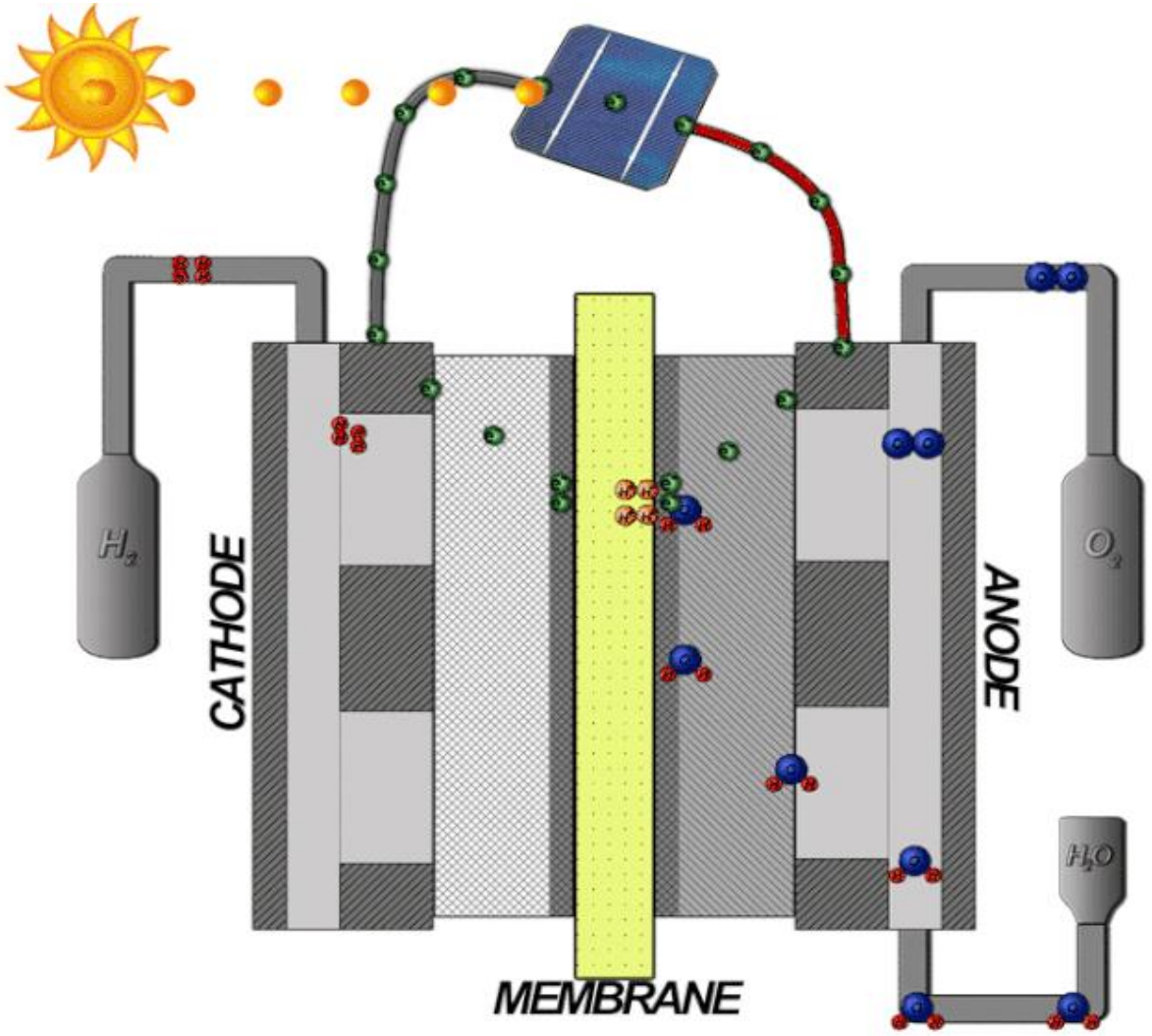
Hydrogen Transfer

Hydrogen Storage

Hydrogen Distribution

Hydrogen Dispensed

Hydrogen uses and applications



HYDROGEN PRODUCTION

Electrolysis cell:

It consists of an anode, positive pole, where water is oxidized and a cathode, or negative pole, where the water is reduced, and hydrogen is produced

Electrolysis stack:

In an electrolysis stack, cells are connected in series to reach a useful voltage and form a stack. These stacks are the building block of larger electrolysis systems.

Electrolyser:

The electrolysis stack is accompanied by other equipment to condition its inputs and outputs. This equipment makes up the electrolyser

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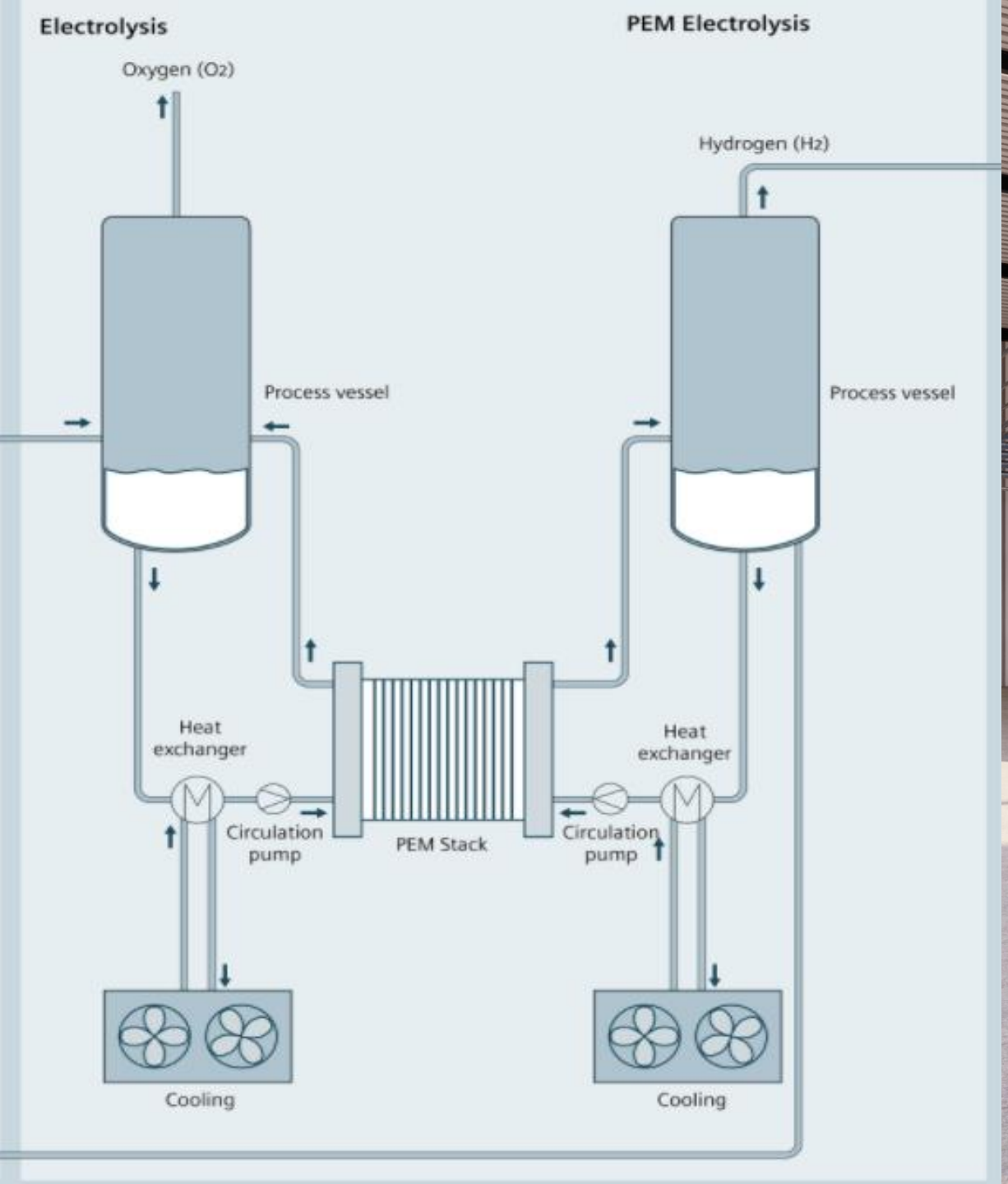
Electrolysis
PEM Electrolysis
Oxygen (O2)
Hydrogen (H2)
Process vessel
Process vessel
Heat exchanger
Heat exchanger
Circulation pump
PEM Stack
Circulation pump
Cooling
Cooling


GRANSOLAR
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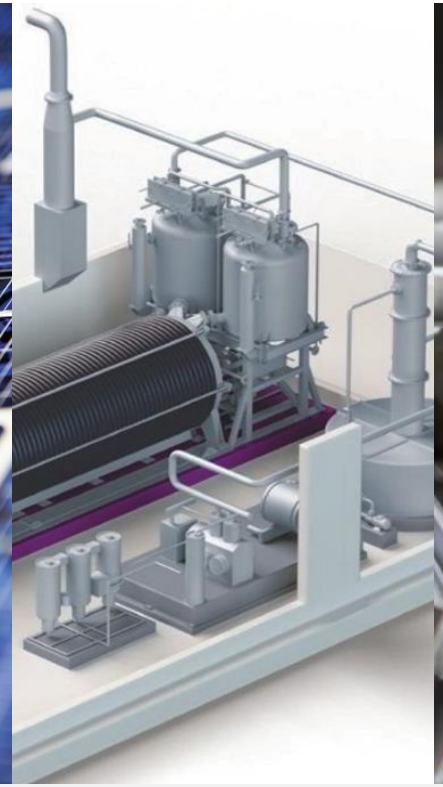
MAIN COMPONENTS OF AN ELECTROLYSIS PLANT (BoP)

Water treatment

Power Electronics



AEL/PEM Electrolyser

Hydrogen Compressor

Storage Tanks

Hydrogen Distribution

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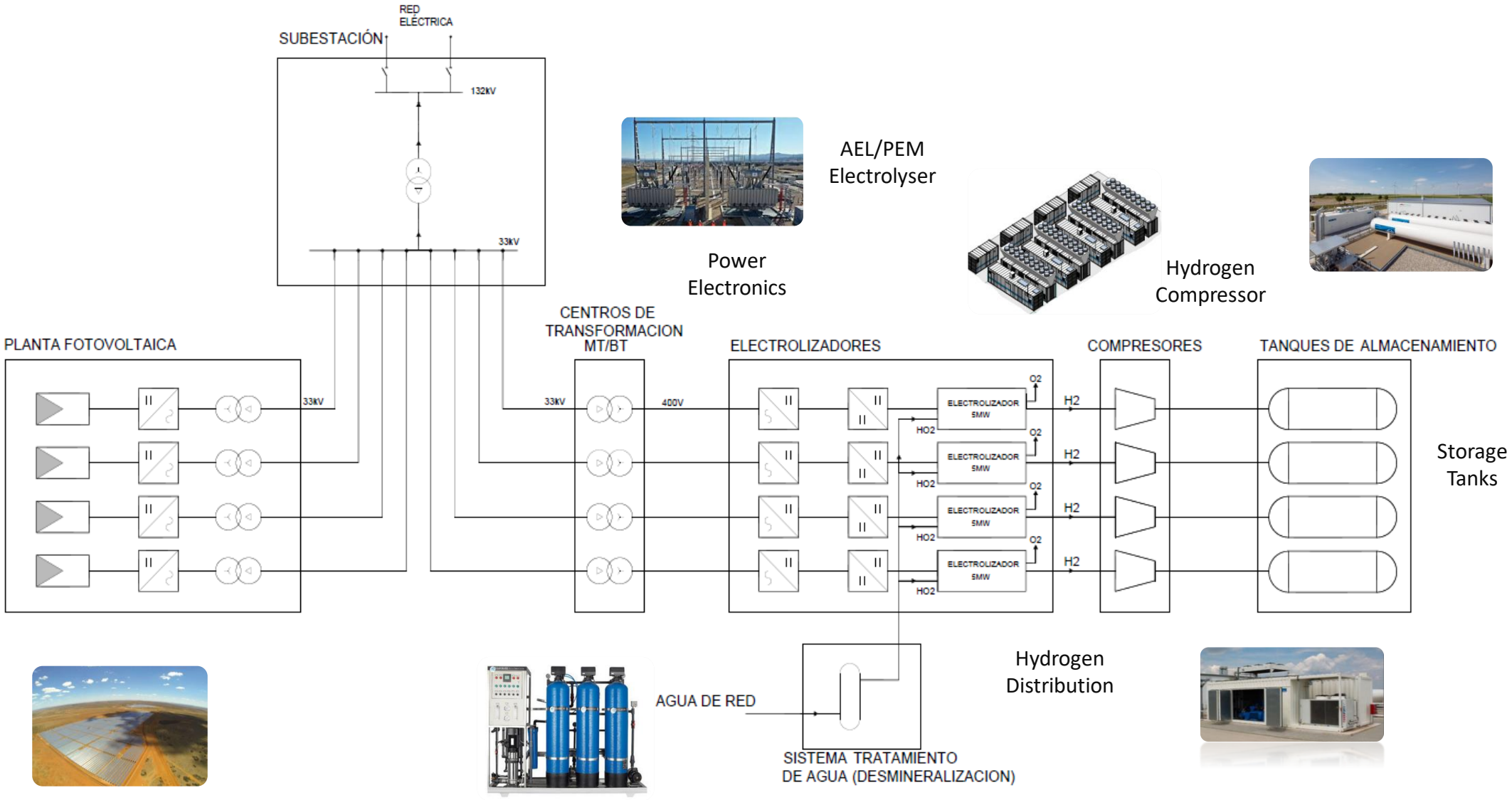
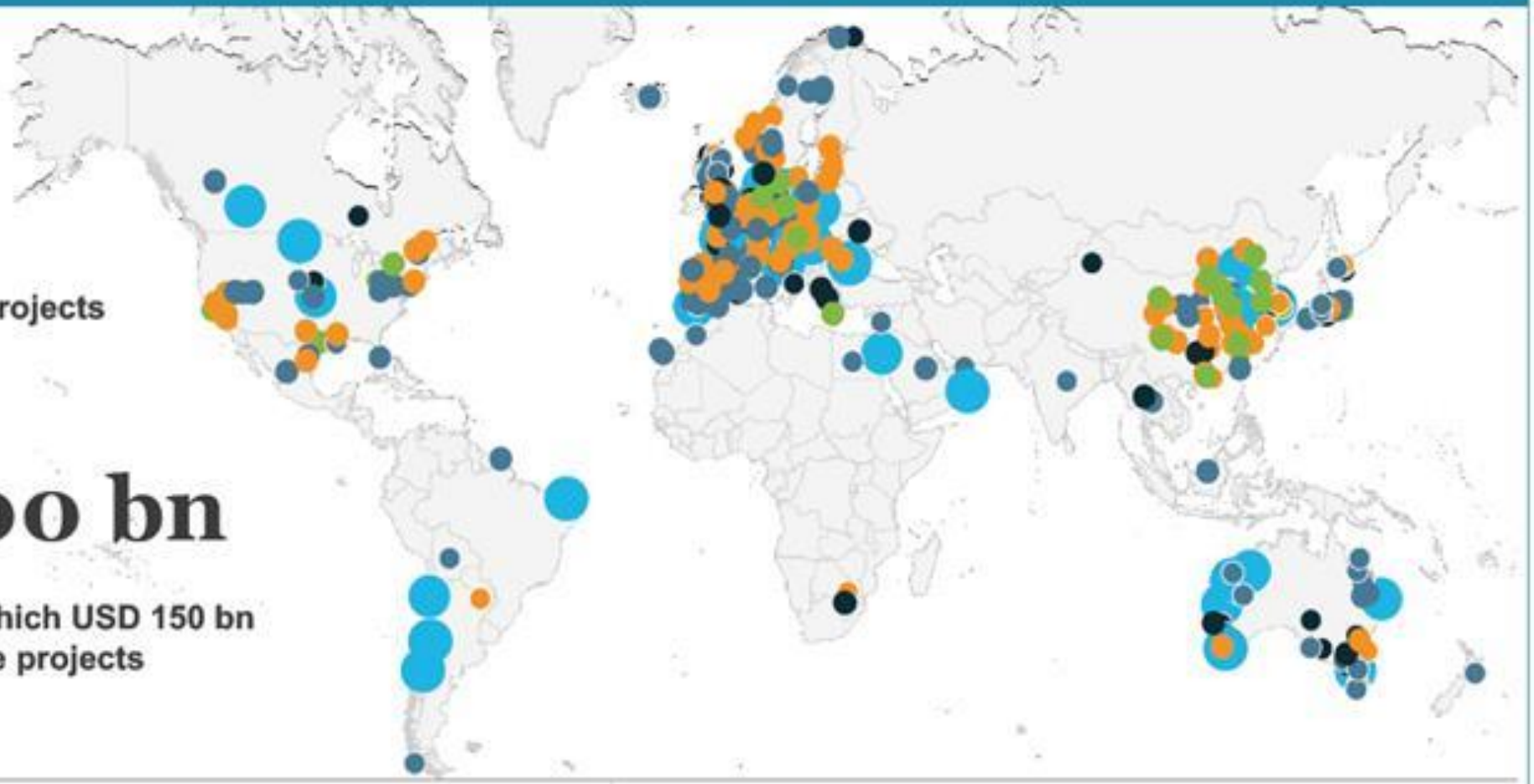
MAIN COMPONENTS OF AN ELECTROLYSIS PLANT (BoP)



Global hydrogen projects and investment across the value chain

Source: Mckinsey & Company



359

Announced large-scale projects

~USD 500 bn

investment by 2030, of which USD 150 bn is associated with mature projects

28

Giga-scale production

Renewable hydrogen projects >1 GW and low-carbon hydrogen projects >200 ktpa

141

Large-scale industrial usage

Refinery, ammonia, methanol, steel, and industry feedstock

96

Transport

Trains, ships, trucks, cars, and other hydrogen mobility applications

56

Integrated hydrogen economy

Cross-industry and projects with different types of end uses

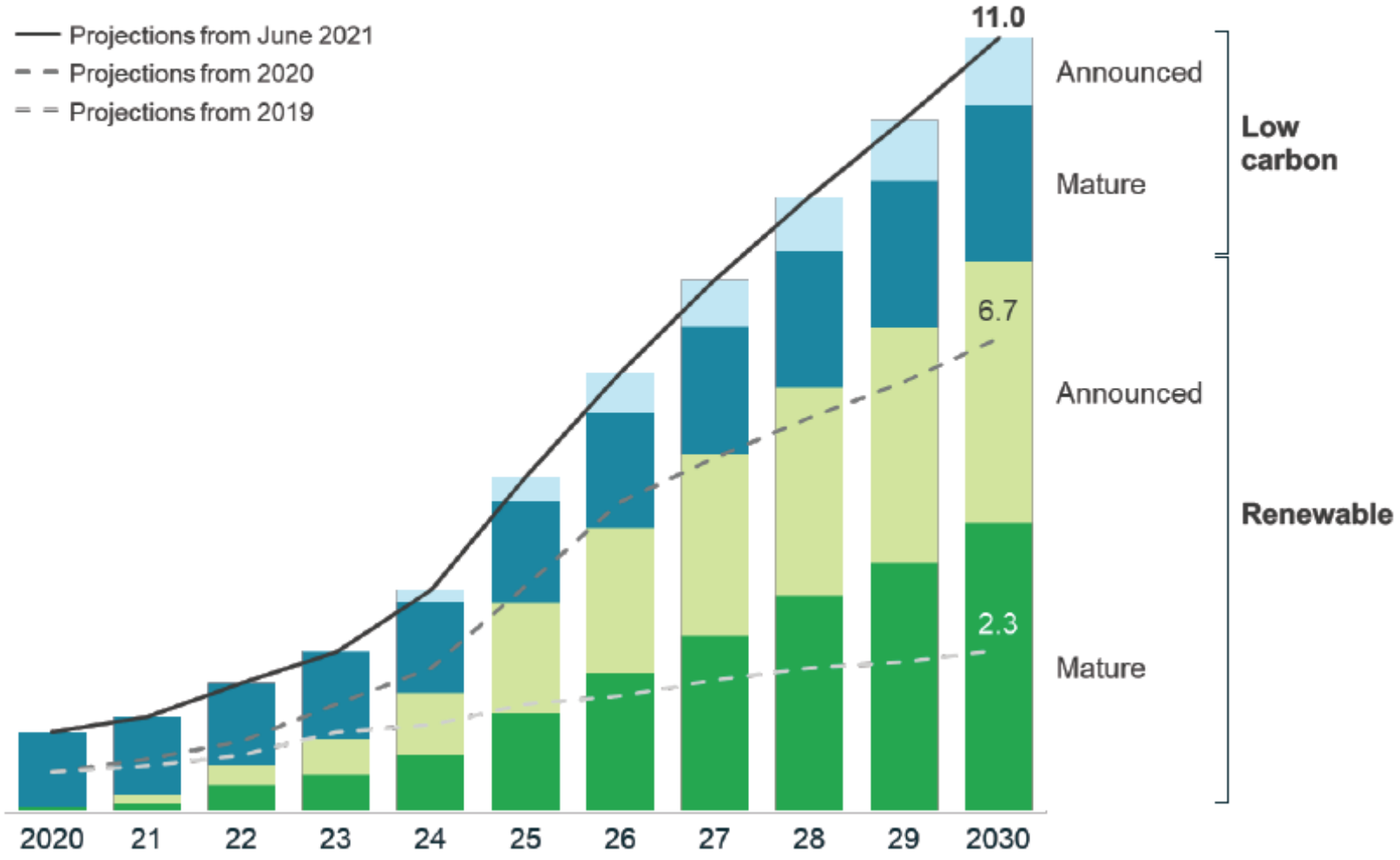
38

Infrastructure projects

Hydrogen distribution, transportation, conversion, and storage

Announce clean hydrogen capacity through 2030

Cumulative production capacity, Million tons p.a.



>60%
increase in capacity
announced in the past 5 months

69 GW
clean hydrogen capacity
by 2030 announced

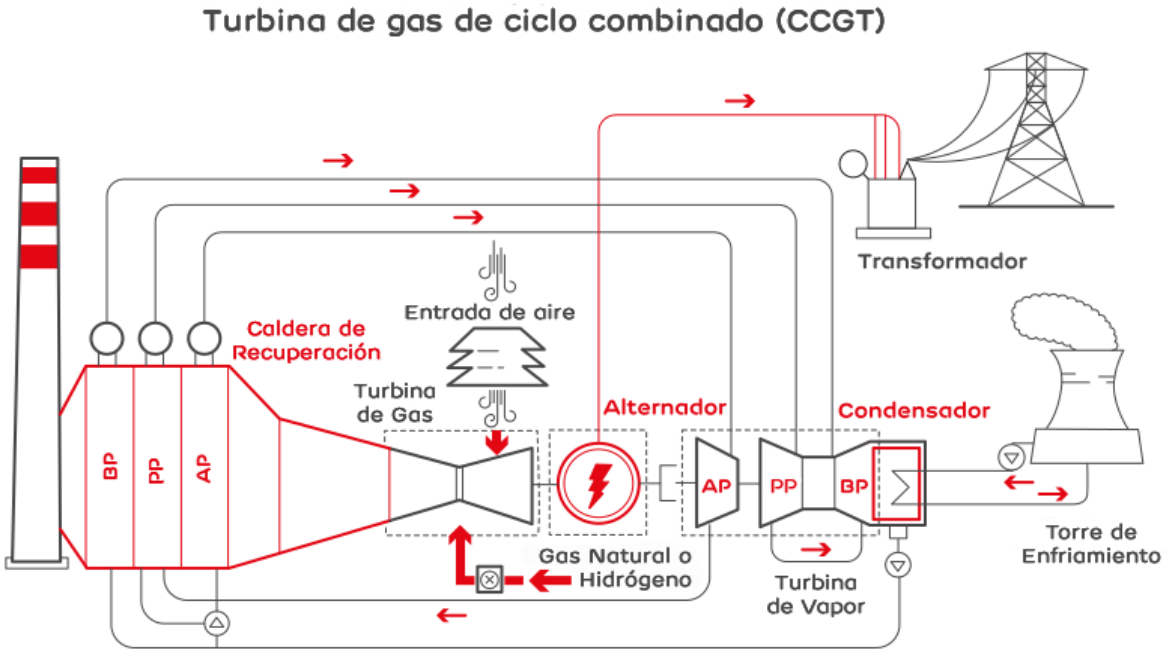
+7.7 Mt
additional capacity
(low carbon and renewable)
announced for post-2030

Source: Mckinsey & Company

Examples of main green hydrogen projects

SPAIN (Puertollano)

H2 PRODUCTION:	2,300 Ton H2/year
ELECTROLYSER :	20 MW Cumming(NEL)
RENEWABLE ENERGY:	100 MW solar
	20 MWh storage
DEVELOPERS:	IBERDROLA, FERTIBERIA
BUDGET:	150 M€
H2 DESTINATION:	**Ammonia for production of fertilizer**



Examples of main green hydrogen projects

SPAIN (Amorebieta)

H2 PRODUCTION:	2,000 Ton H2 /year
ELECTROLYSER :	20 MW
RENEWABLE ENERGY:	PPA (green energy) from Grid
DEVELOPERS:	NORTEGAS/SENER/CCI/ WSC
BUDGET:	160 M USD
H2 DESTINATION:	**Decarbonization of a combined cycle plant**

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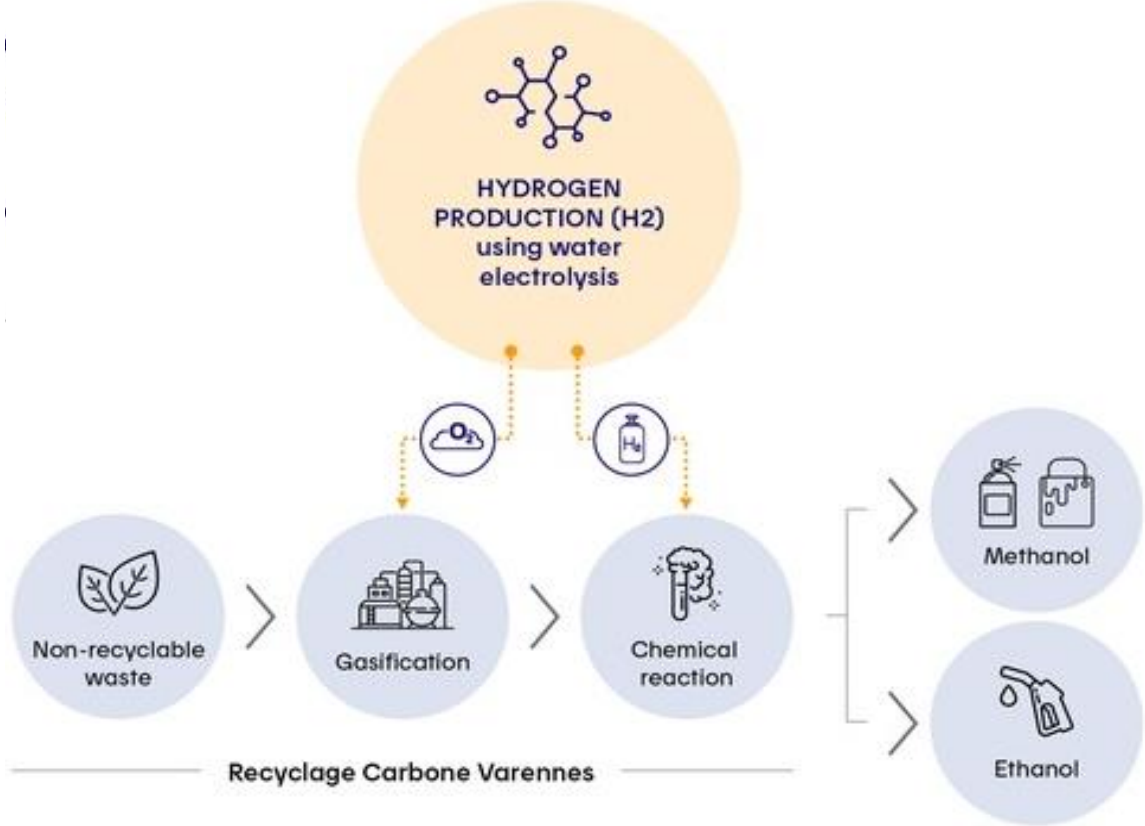
Examples of main green hydrogen projects

CANADA (Varennes)

H2 PRODUCTION:	11,100 Ton H2/year
ELECTROLYSER :	88 MW Thyssenkrupp
RENEWABLE ENERGY:	**100% Hydraulic energy**
DEVELOPERS:	HYDRO-QUEBEC
BUDGET:	160 millions of USD
H2 DESTINATION:	Bio-fuel Plant from non-recycable waste



Examples of main green hydrogen projects

SAUDI ARABIA (Neom)

H2 PRODUCTION:	650 Ton H2/day (220,000 Ton H2/Year)
ELECTROLYSER :	about 1,5 GW
RENEWABLE ENERGY:	4 GW not defined (wind, solar and storage)
DEVELOPERS:	ACWA POWER AIR PRODUCTS NEOM
BUDGET:	5,000 millions of USD
H2 DESTINATION:	Megacity NEOM

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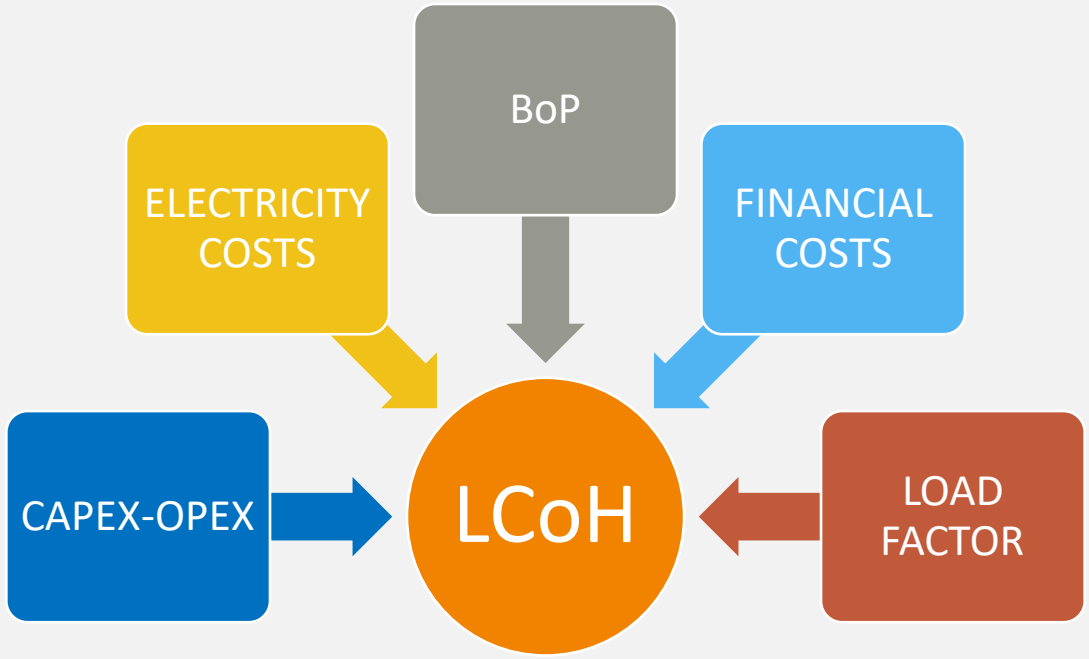
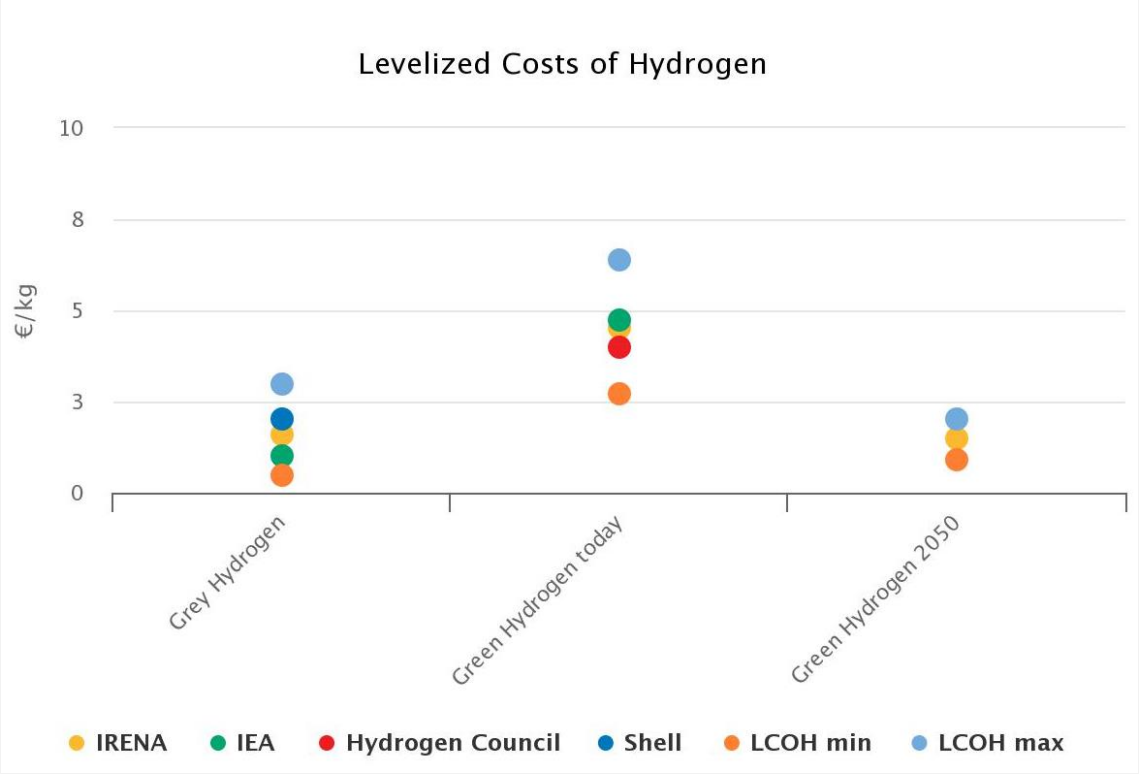
LEVELIZED COST OF HYDROGEN





CONCLUSIONS

- Global effort to meet **economy's decarbonisation targets for 2050.**
- Agreement **to bet for green hydrogen.**
- Expected fall of the LCOH from **€5/kg to €2/kg by 2050**.
- Electrolysis process and equipment are being **improved** to increase their performance and lower prices.
- The number of **large-scale projects announced is growing** every day.

ISE – INGENIA SOLAR ENERGY

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