

GREEN HYDROGEN PROJECTS

From Power Point to Power Plant
“Viable Projects”



**International Conference on
Renewable Energies and Power
Quality (ICREPPQ'23)**

ABOUT UNIVERGY

UNIVERGY IN THE WORLD



- **Univergy** is a **Spanish-Japanese group** of companies, focused on the Renewable Energy sector and its multiple domestic, industrial and agricultural applications.
- **More than 10 years** in the sector with presence on all continents.
- Currently, the group has business activity in **more than 20 countries**.
- Global portfolio of projects with more than **12GW under different stages of development**.
- The Leadership Team counts on **more than 20 years of experience** in the Renewable Energy sector worldwide.
- Among its clients are, large investment funds, pv panel manufacturers, project builders as well as oil/gas and utilities companies.
- Professionalism, quality, avant-garde and a close relationship of trust with each client, are fundamental pillars of Univergy's corporate DNA.



- **What is the true magnitude of decarbonization problem?**
- **Why Hydrogen and why now?**
- **How may Hydrogen help to speed up the Energy Transition?**
- **What are our Hydrogen Targets?**
- **Is there somehow a Hydrogen bubble?**
- **How many of the existing projects will materialize into real projects?**
- **The chicken and egg problem. How to deal with it?**
- **What can we do to help? What Univergy is doing?**

TRUE MAGNITUDE OF DECARBONIZATION PROBLEM



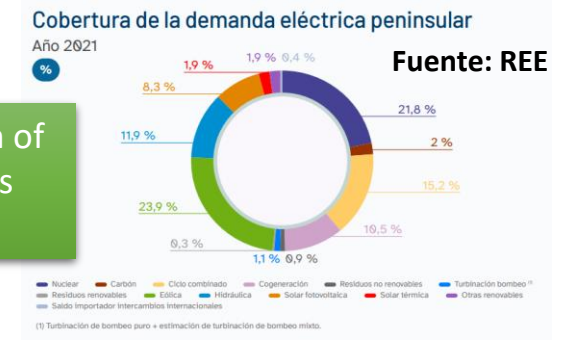
**25% is ELECTRICITY
(Home & Industry mainly)**

**75% is FOSSIL FUELS
(Transport, Industry & Home Thermal applications)**

OUR CHALLENGE

TRUE MAGNITUDE OF DECARBONIZATION PROBLEM

Just 1 of every 2 Mwh of electricity in Spain is Renewable Origin



TRUE MAGNITUDE OF DECARBONIZATION PROBLEM
3,5 of every 4 Mwh consumed today comes from fossil fuels

TRUE MAGNITUDE OF DECARBONIZATION OPPORTUNITY
2050 CO₂ Neutral Economy Target will require to **Increase Current Renewables by 6 to 8 times**

WHY HYDROGEN NOW?

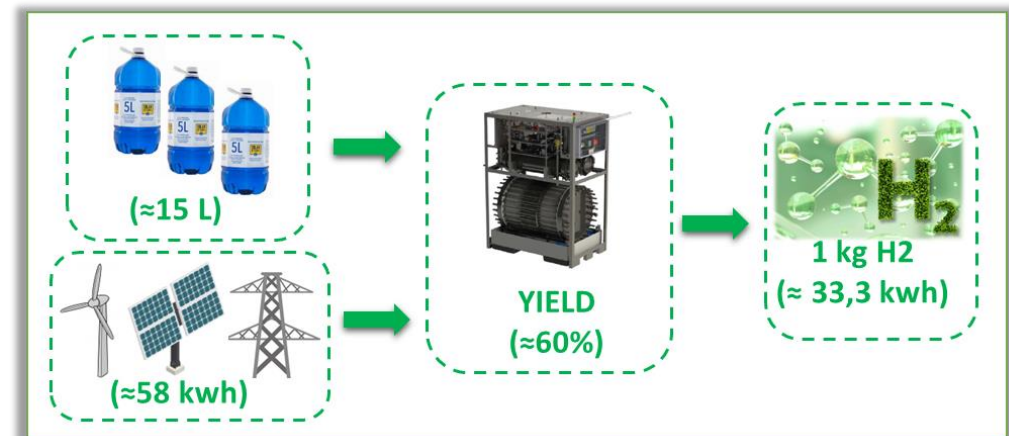
Renewable energies are cheaper than ever
Triple digit market growth



OUR VISION

WHY HYDROGEN AND WHY NOW?

- FOSSIL FUELS should be replaced** by ELECTRICITY OR ALTERNATIVE ZERO EMISSION FUELS **by 2050**.
- HYDROGEN** is a **VIABLE and REALISTIC ALTERNATIVE** to fossil fuels:
 - Zero Emissions Energy Vector.
 - Very Flexible (may be burnt or used to generate electricity).
 - It can be generated in situ (Energy self-sufficiency).
 - It is competitive in costs in the short, medium and long term.
- Electrolyzers perfectly combine** with our traditional RREE (Wind and Photovoltaic) development, **increasing the SUCCESS RATE of our projects as:**
 - We can now transform wind and sun into electricity or hydrogen.
 - We can now store wind and sun in form of Hydrogen.
 - We can promote and develop off grid projects.

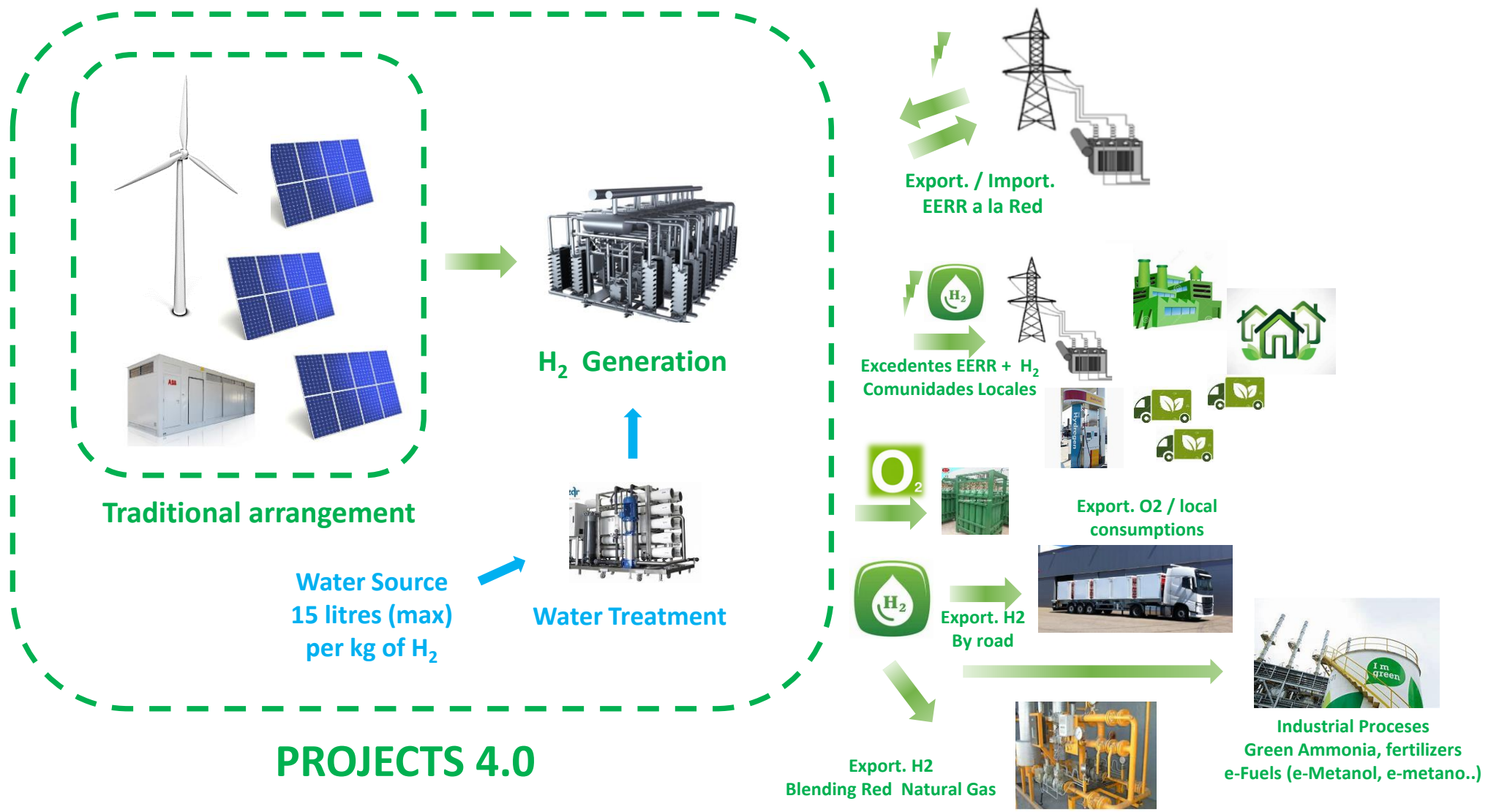


Basic process and energy balance to produce Hydrogen by Electrolysis

OUR VISION

HYBRIDIZATION + HYDROGEN

HOW MAY HYDROGEN HELP?



OUR VISION

HOW MAY HYDROGEN HELP?

SHORT TERM (2022-2025):

- **Pilot Scale (< 10 Mw)** industrial off takers or transport.
- Strong **subsidies required**.
- **“Seeding projects”**.
- Target is **to create strong networking links**.



MID TERM (2025-2030):

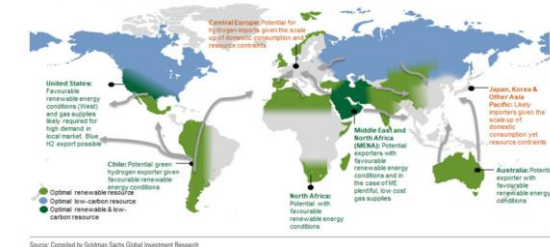
- **10 a 100 Mw** od electrolysis.
- Industrial areas or harbours.
- Natural Gas network or **seeding Hydro ducts**.
- Projects **to feed HRS networks**.



LONG TERM (2030 FORWARD):

- **100 a 1 Gw** for **country self-consumption hydrogen networks**.
- **> 1 Gw** in donor countries to export **green ammonia or e-Fuels**.

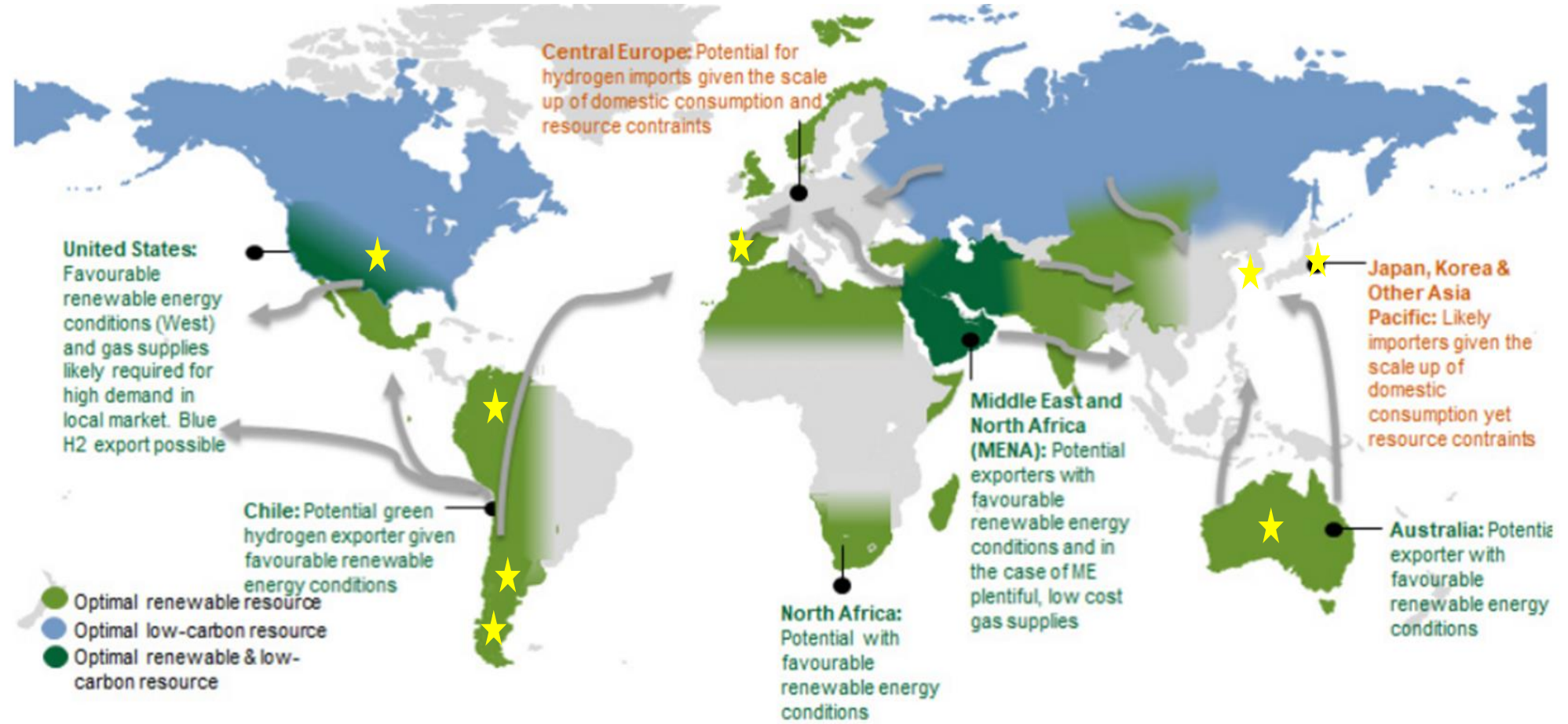
Exhibit 17: We see potential for c.30% of the global hydrogen market to be involved in international trade



Source: Compiled by Goldman Sachs Global Investment Research

OUR VISION

HOW MAY HYDROGEN HELP?



Source: Compiled by Goldman Sachs Global Investment Research

EU HYDROGEN ROADMAP



PHASE-1 (2020-2024):

- Up to 6 Gw of electrolysers & 1.000.000 tons of Hydrogen.
- Mainly targeting industries already consuming grey hydrogen.
- First deployment of HRS (Hydrogen Refuelling Stations).

PHASE-2 (2025-2030):

- Up to 40 Gw of electrolysers & 10.000.000 tons of Hydrogen.
- More generalization of applications in industry, heavy duty transport including marine applications.
- Applications for energy storage were convenient.

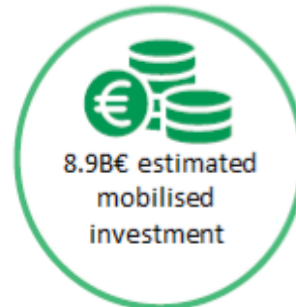
PHASE-3 (2030-2050):

- Big scale deployment and market generalization.

**But new geo-strategic scenario is redefining the Schedule....
Target has been announced to be doubled**

SPANISH ROADMAP

**4Gw installed
by 2030 !**



*500,000 t/year
hydrogen consumption,
mostly grey hydrogen,
mainly used as a raw
material in refineries
(around 70%) and
chemical product
manufacturers (25%)*

HYDROGEN ROADMAPS

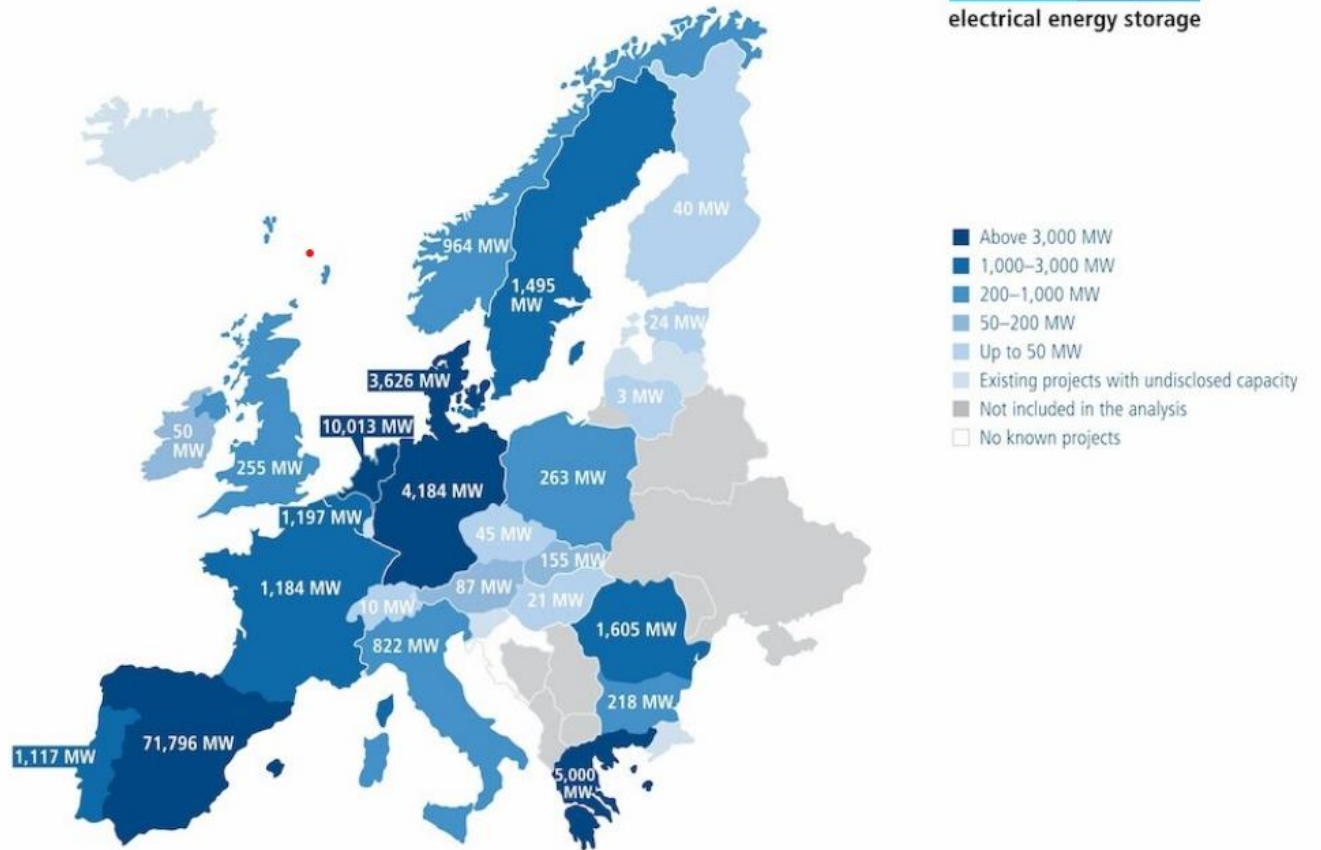
IS THERE SOMEHOW A HYDROGEN BUBBLE?

72 Gw vs 4 Gw of target in Spain
32 vs 36 Gw of target in the rest of Europe
104 Gw vs 40 of target....
Source: Hydrogen Europe

But new geo-strategic scenario is redefining the Schedule....

Target has been announced to be doubled so
Is it really a bubble or a quick response?

Planned electrolyzer capacity by 2030 (MW)



Notes: Displayed electrolyzer capacities reflect projects that have an official starting date by 2030. There are numerous other projects with unknown starting dates that could be finished by 2030, but are not included in this analysis
 Graphic: ©Solar Promotion GmbH | As of August 2021 | Source: Hydrogen Europe

Hydrogen Production Projects

EL COMERCIO

“Hydrogen rush”
 February 20th 2022
3,6 GW




Kind of Projects:

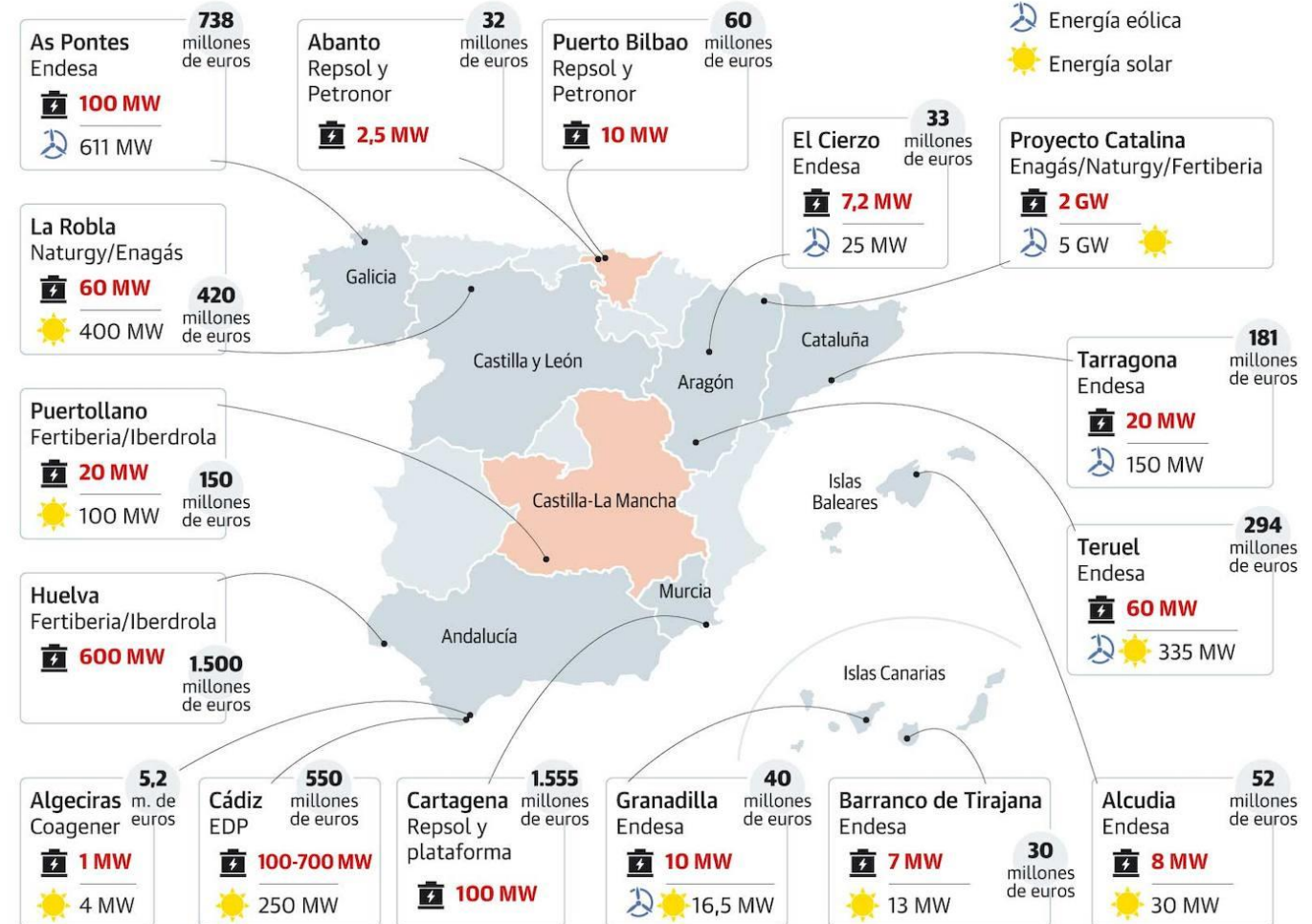
- Industrial
- Mobility
- E-Fuels

Principales proyectos de hidrógeno verde en España

Estas iniciativas competirán con las asturianas para captar fondos europeos

LEYENDA

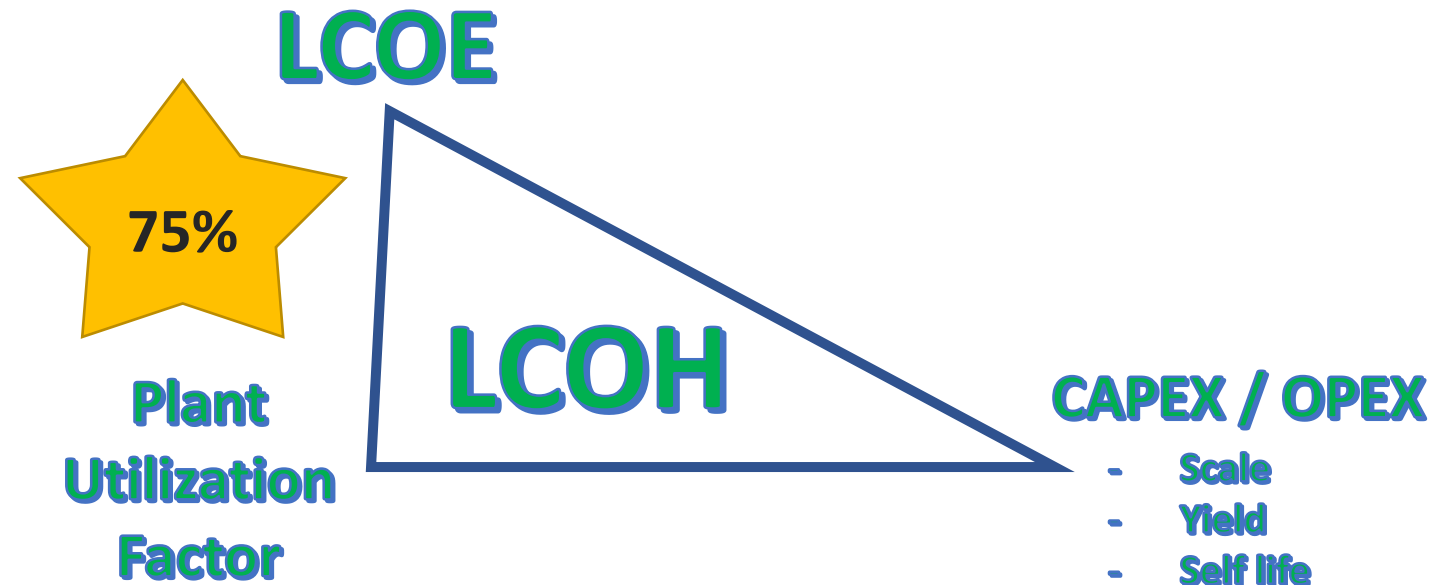
-  Potencia (Electrolizador)
-  Energía eólica
-  Energía solar



Lack of Off Takers??
NO, it is a matter of viability!!

GREEN HYDROGEN COST

- Hybridization?
- PPA/Grid costs?
- Delegated Act...
- Big Scale?
- Concentrated/Distributed production?

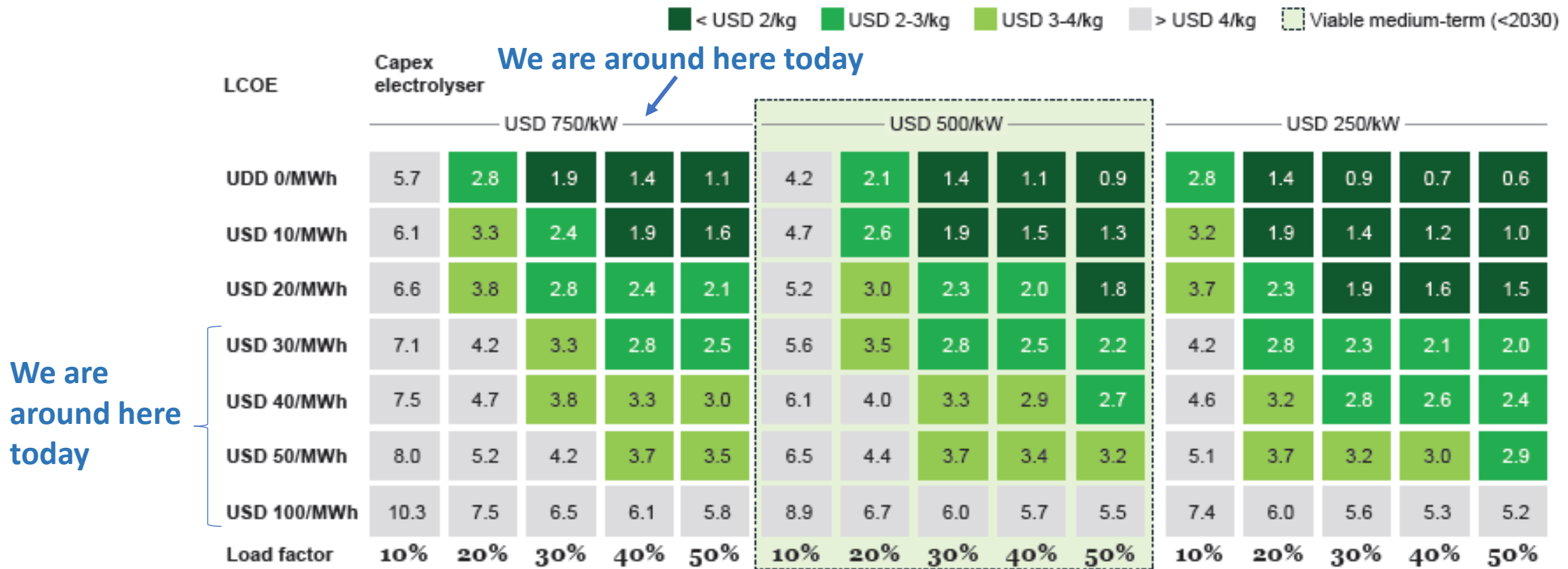


VIABLE HYDROGEN PROJECTS

HOW MANY OF THIS PROJECTS WILL MATERIALIZE?

Cost of renewable hydrogen with varying LCOE and load factors
USD/kg H₂

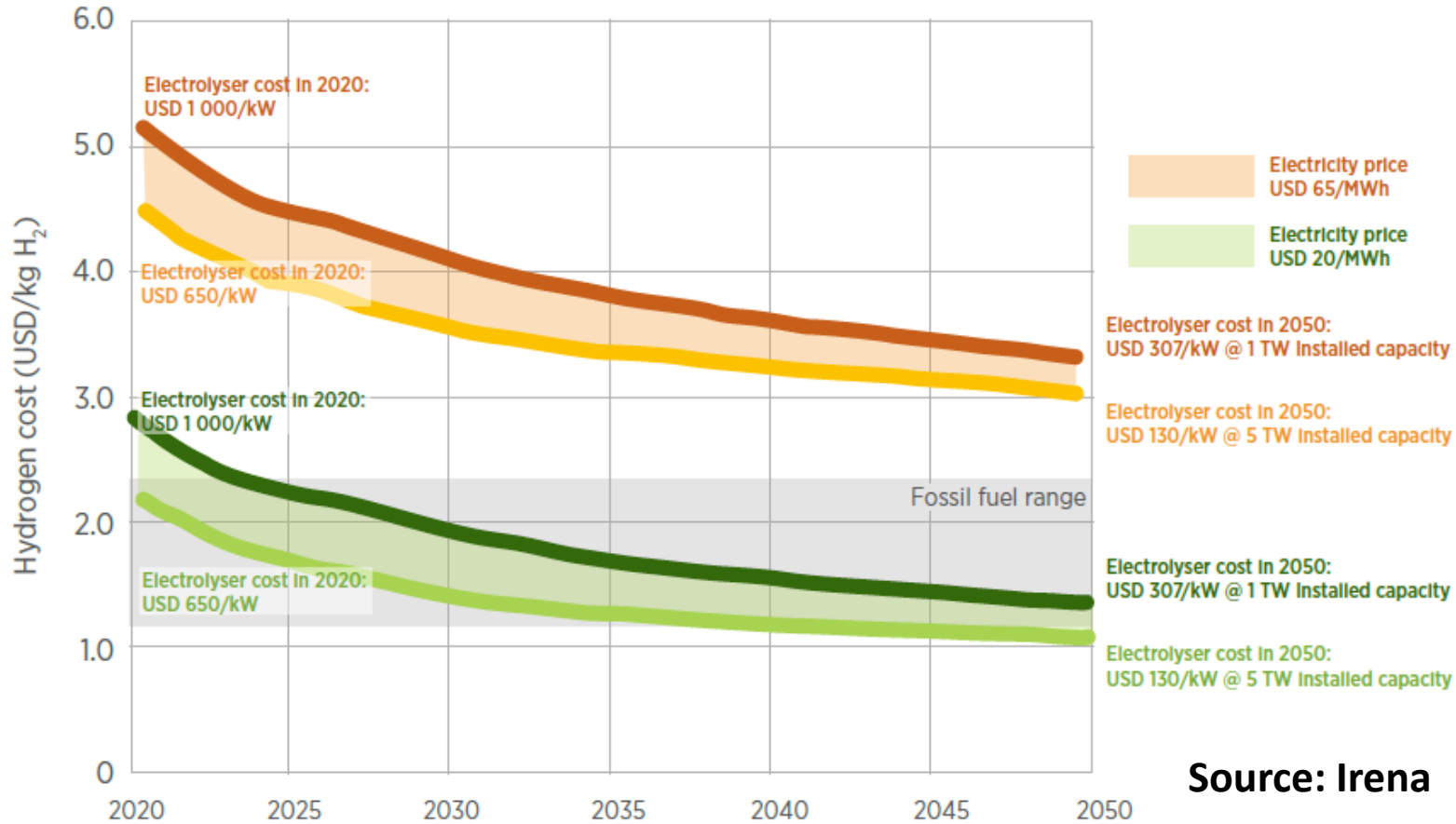
Remark: Just generation costs



Source: McKinsey

VIABLE HYDROGEN PROJECTS

HOW MANY OF THIS PROJECTS WILL MATERIALIZE?



Source: Irena

	2030	2040	2050
Pesimistic	4,0 \$/kg	3,5 \$/kg	3,0 \$/kg
Optimistic	2,0 \$/kg	1,5 \$/kg	1,0 \$/kg
Pesimistic	120 \$/Mwh	105 \$/Mwh	90 \$/Mwh
Optimistic	60 \$/Mwh	45 \$/Mwh	30 \$/Mwh

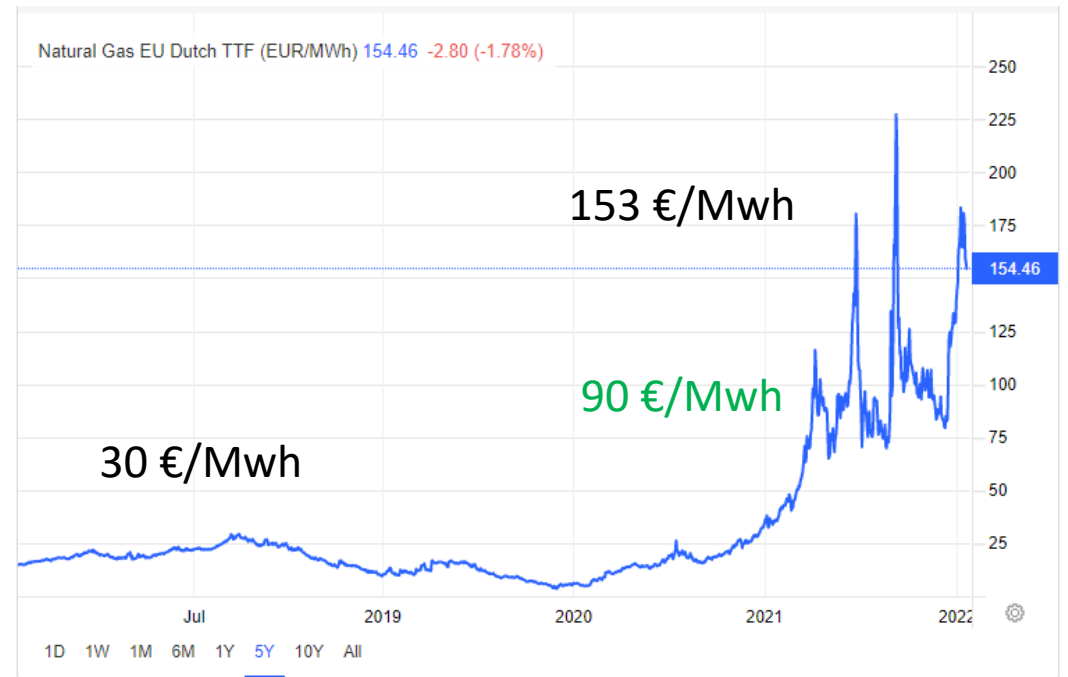
VIABLE HYDROGEN PROJECTS

THE CHICKEN AND EGG PROBLEM IN FIGURES

Precio de Diesel (€/l)	1,00	1,25	1,50	1,75	2,00	2,50
Equivalent Price of Green Hydrogen for Fuel Cells (€/kg)	5,01	6,26	7,51	8,77	10,02	12,52



June-28-2022
12,85 €/kg of H2



H2 Costs	2030	2040	2050
Pesimistic	120 \$/Mwh	105 \$/Mwh	90 \$/Mwh
Optimistic	60 \$/Mwh	45 \$/Mwh	30 \$/Mwh

For 2023 to 2030 viability will be linked to subsidies

- IRA (US) currently 3 USD/kg tax reduction.
- EU. October pilot tender (max 4 €/kg)

Air, Marine & Automotive (Transport) Sector



H2 Industrial Sector



Home / Cities



Transport Sector:

- It is not mainly a Green Hydrogen Cost.
- Fuell Cells are too expensive by now. x5 vs diesel engines.
- Storage of H2 in vehicles not that critical.
- Storage of H2 in big ships is critical.

How is technology reacting?

- H2 combustion engines.
- Ammonia and eFuels for Ships



Industrial Sectors:

- Refineries, Fertilizer Manufacturers, currently using grey hydrogen (2,5 to 3 €/kg)
- Other industries use Natural Gas (1€/kg...)

How is technology reacting?

- EU Hydrogen Network (pipe).
- Big Scale Projects in Africa, Australia, Latin America...

ACTUAL PROJECTS

WHAT CAN WE DO? WHAT UNIVERGY IS DOING?

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<p>JULIO VERNE 1,4 Mw (Junio 2024)</p>	
<p>PUERTO DE FERROL 0,5 Mw (2024-2025)</p>	
<p>PALENCIA 10 Mw (2025 - 2026)</p>	
<p>EXPLOTACIÓN MINERA 10 Mw (2025 - 2026)</p>	

<p>VALLE DE HIDROGENO CYL 300 Mw (2028-2029)</p>	
<p>VALLE DE HIDROGENO GAL 250 Mw (2028-2029)</p>	
<p>VALLE DE HIDROGENO ALB 300 Mw (2028-2029)</p>	

<p>AMMONIA / METHANOL 3 Gw (2030-2035)</p>	
<p>AMMONIA / METHANOL 10 Gw (2030-2035)</p>	



JULIO VERNE PROJECT

PORT OF VIGO



UNIVERGY



Puerto de Vigo



Autoridad Portuaria de Vigo

PROJECT SCOPE:

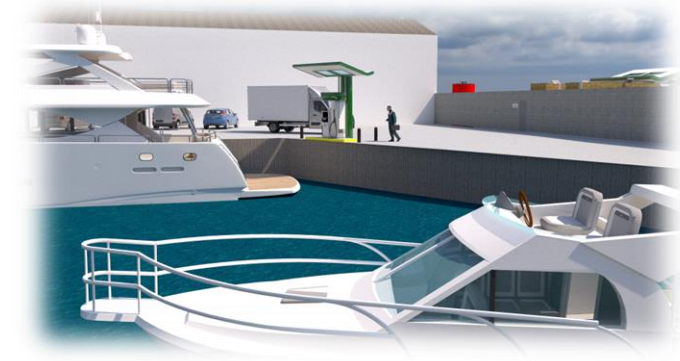
Local Generation and dispensing of Green Hydrogen for **port logistic operations, industrial** consumptions, **heavy transport / marine mobility** applications and "zero emissions" **Cold Ironing** application in the port area of Vigo.

Main Figures:

- Location: Port of Vigo (Bouzas).
- Electrolyzer: Alkaline 1,4 Mw.
- H2 Generation (350 bar): 570 kg/day. 213 tm/year.
- Max refuelling capacity: > 40 refuelling/day (Heavy trucks).
- CAPEX: 6 Mio€
- Start up: January 2024.

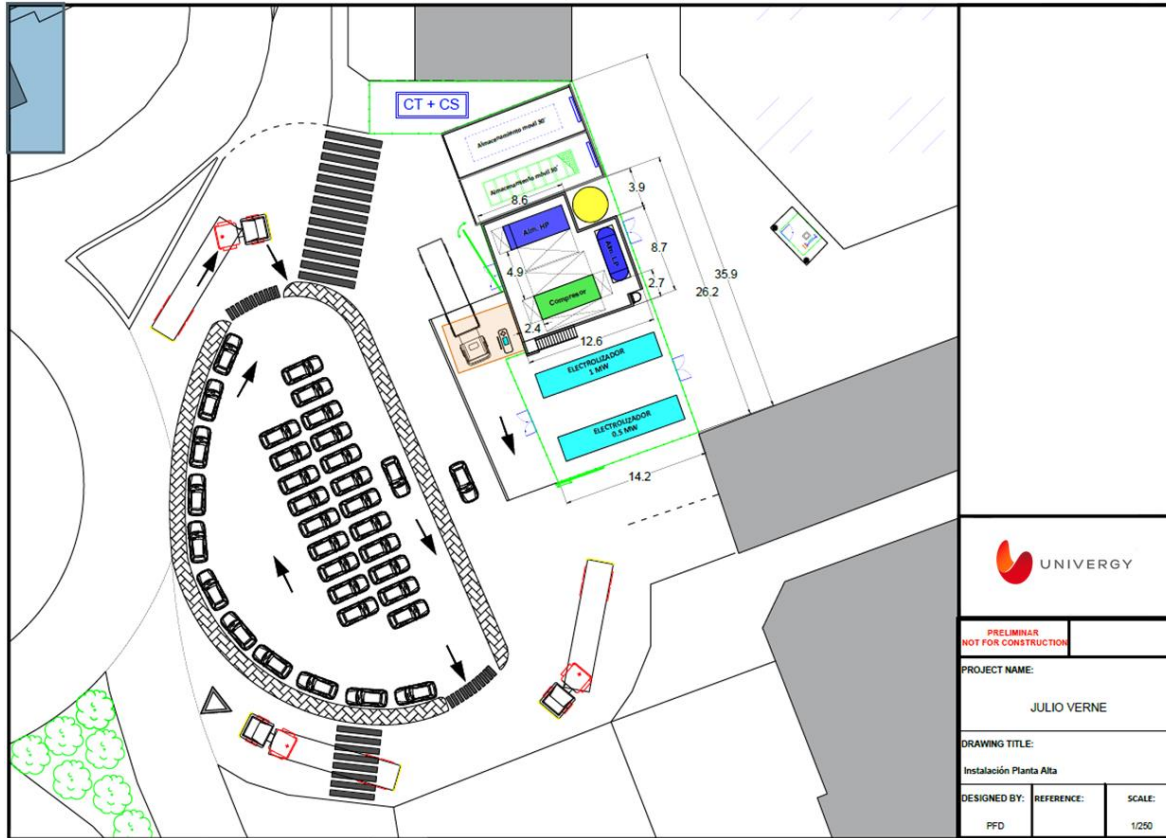
Project Main Singularities:

- Public Access to our refuelling station.
- Land/Marine Transport applications.
- Industrial Consumptions (Grey Hydrogen replacement).
- Cold Ironing "Zero Emissions".



ACTUAL PROJECTS

JULIO VERNE PORT OF VIGO





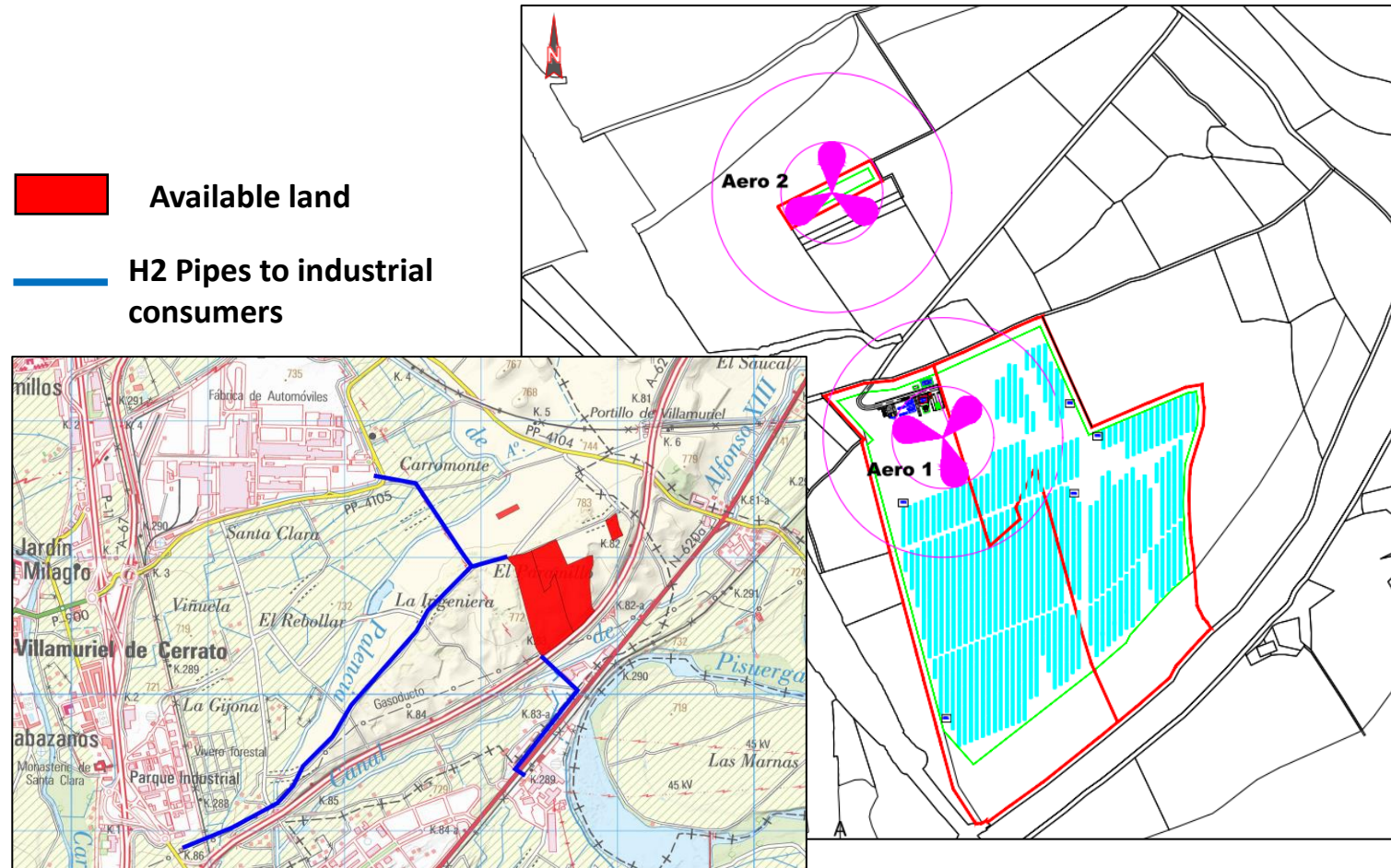
GREEN HYDROGEN PROJECT

VILLAMURIEL PHASE-I



Main Figures:

- Surface: 34 Ha
- **Electrolyzers: 10 Mw**
- PV Power: 14,7 Mw
- Wind Power: 13,2 Mw
- Grid Connection (PPAs): 5 Mw
- Water consumption: 50 m³/day
- Hydrogen Product.: 3,4 Tons/day
- Oxygen Product.: 27 Tons/day
- CAPEX: 41,1 million€
- Forecasted start up: 2026





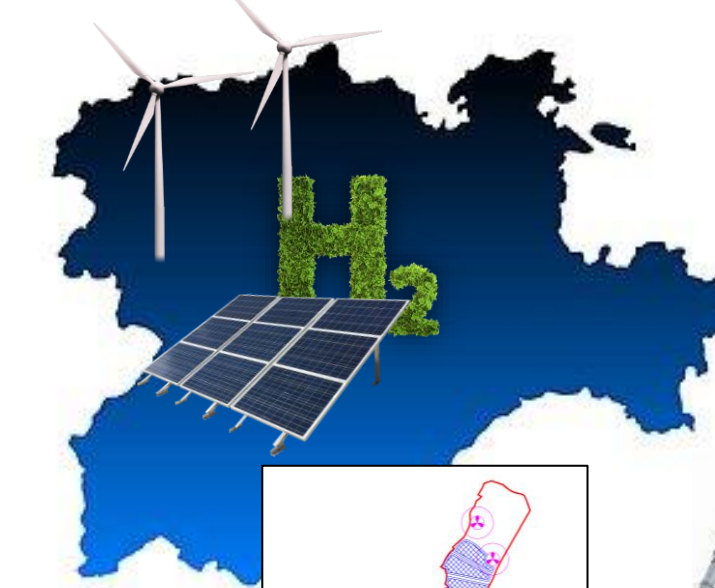
GREEN HYDROGEN PROJECT

VILLAMURIEL PHASE-II

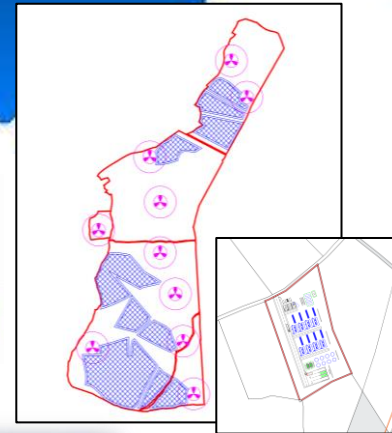


Main Figures:

- Surface: 1.400 Ha
- Electrolyzers: > 230 Mw
- PV Power: > 280 Mw
- Wind Power: >184 Mw
- Hydrogen Production: > 15.695 Tons/year
- eMethanol: > 58.542 Tons/year
- CAPEX: 640 million€
- Forecasted start up: 2026



Hydrogen Corridor



Green Ammonia /
eMethanol





RAINBOW SERPENT PROJECT (10GW H₂)

PROJEC TARGETS AND SCOPE



PROJECT TARGETS & SCOPE

Project targets:

- To become Far North Queensland (FNQ) as the first self-sufficient 100% green energy area in the world.
- To make FNQ one of the main export areas of hydrogen and its derived products to the rest of the world.
- Provide green and cheap energy enough to support the industrial and touristic development of FNQ.
- Create stable and high-quality employment for people in the area.

Scope of the project:

- Renewable Energy:
 - Minimum: 14 Gw of Photovoltaic modules.
 - Minimum: 12 Gw of Wind turbines.
- Electrolysis:
 - Minimum: 10 Gw of electrolysis plant.
- e-Fuels Facility:
 - Multipurpose Chemical plant to produce Green Ammonia and e-Fuels (e-Methane, e-Methanol...).

Investment:

- More than 25 billion USD of investment in the area.





JULES VERNE

“Water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable”
(The Mysterious Island. Jules Verne 1875)

“WATER IS THE COAL OF THE PRESENT.....” 2022

THANK YOU!