Clean energy for EU islands Forum 2024

THE POWER OF ISLANDS: BUILDING RESILIENCE THROUGH RENEWABLES:

The opportunities for grid balancing and stabilization arising from sector coupling

BluEnergy Revolution

PRESENTATION AGENDA

Power grids of islands which are weakly or non-connected to the continental grids can have limited capacity to accept renewables.

Nevertheless, significant benefits may arise from the possibility to couple the power system with other services, such as transport, water production and waste management.

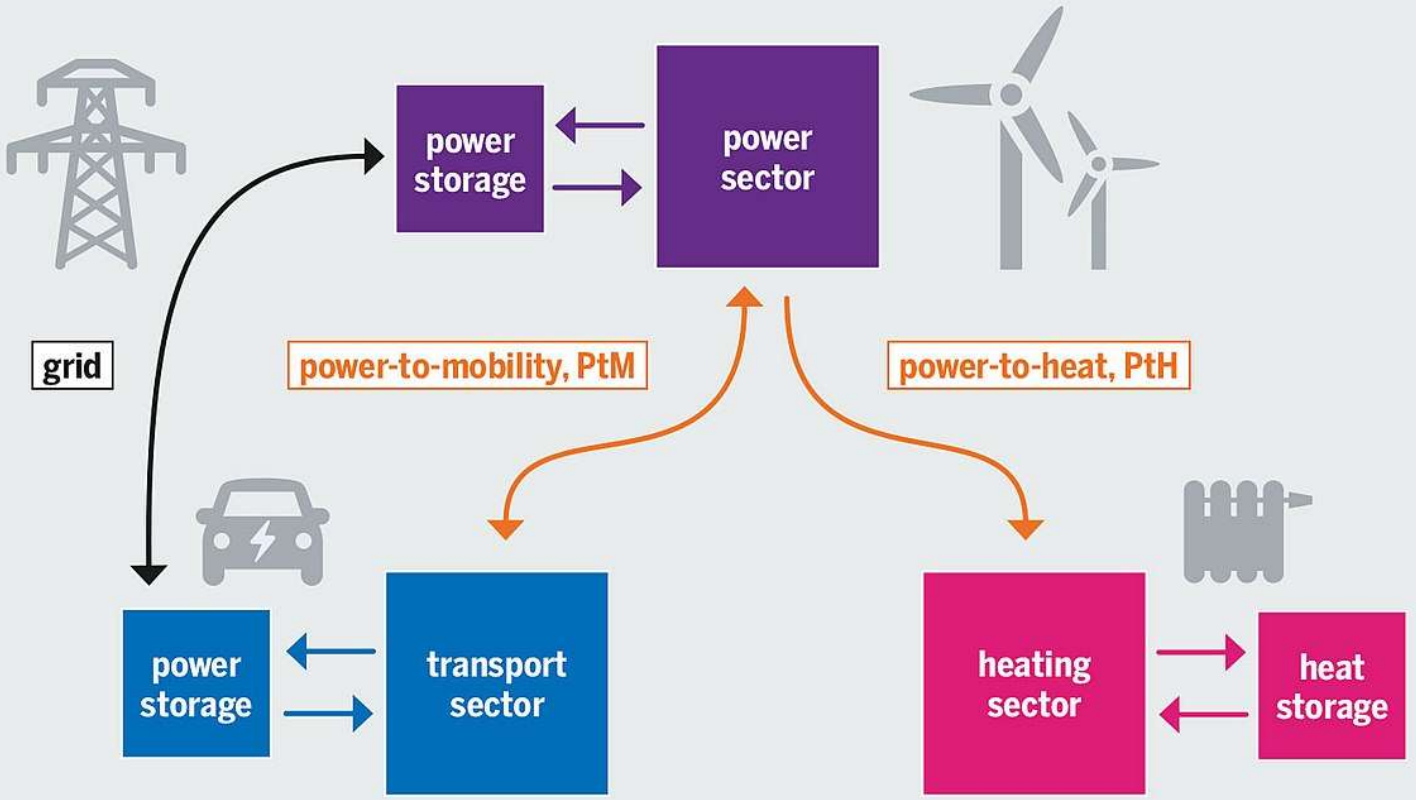
The working group, starting from the experience of the panelists, will discuss these and other opportunities, trying to identify the policy measures needed for enhancing sector coupling practices.

ISLANDS GRID CONNECTION CHALLENGES

1. Power cuts caused by multiple instabilities in the system or by weather conditions
2. High curtailment of intermittent renewable energy to ensure system reliability
3. Lack of grid capacity and electricity company resources
4. Lack of controllability of existing distributed PV generation
5. Permitting and/or connection policy for RE generation plants is complex and not transparent

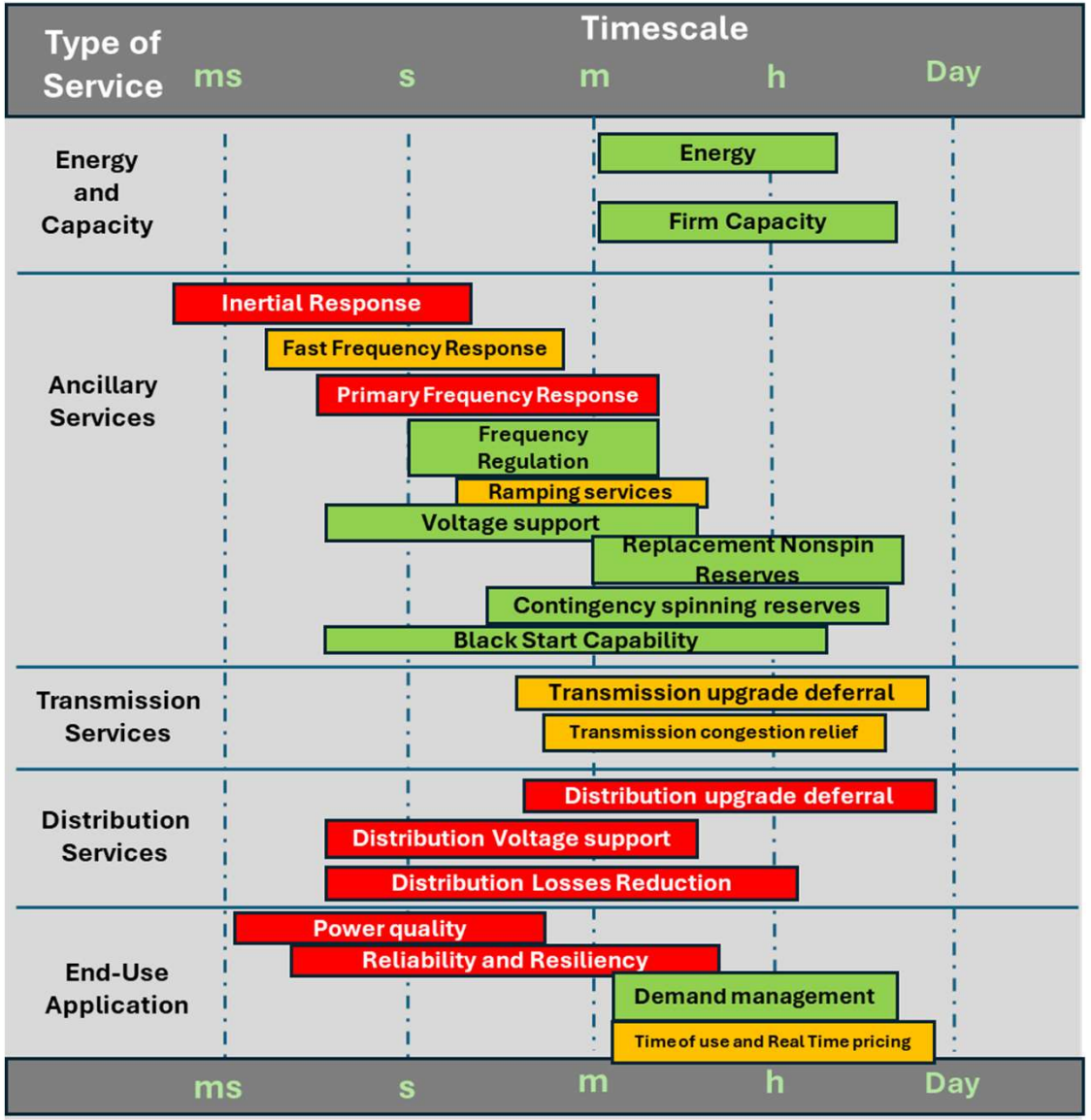
TRANSFORMATION IN JOINING UP SECTORS

Scheme of coupled sectors and major linking "power-to-X" technologies



RES + Hydrogen

Service to grid



Sector Coupling

Sector coupling can contribute to the cost-efficient decarbonisation of the energy system, by valuing synergy potentials and interlinkages between different parts of the energy system.

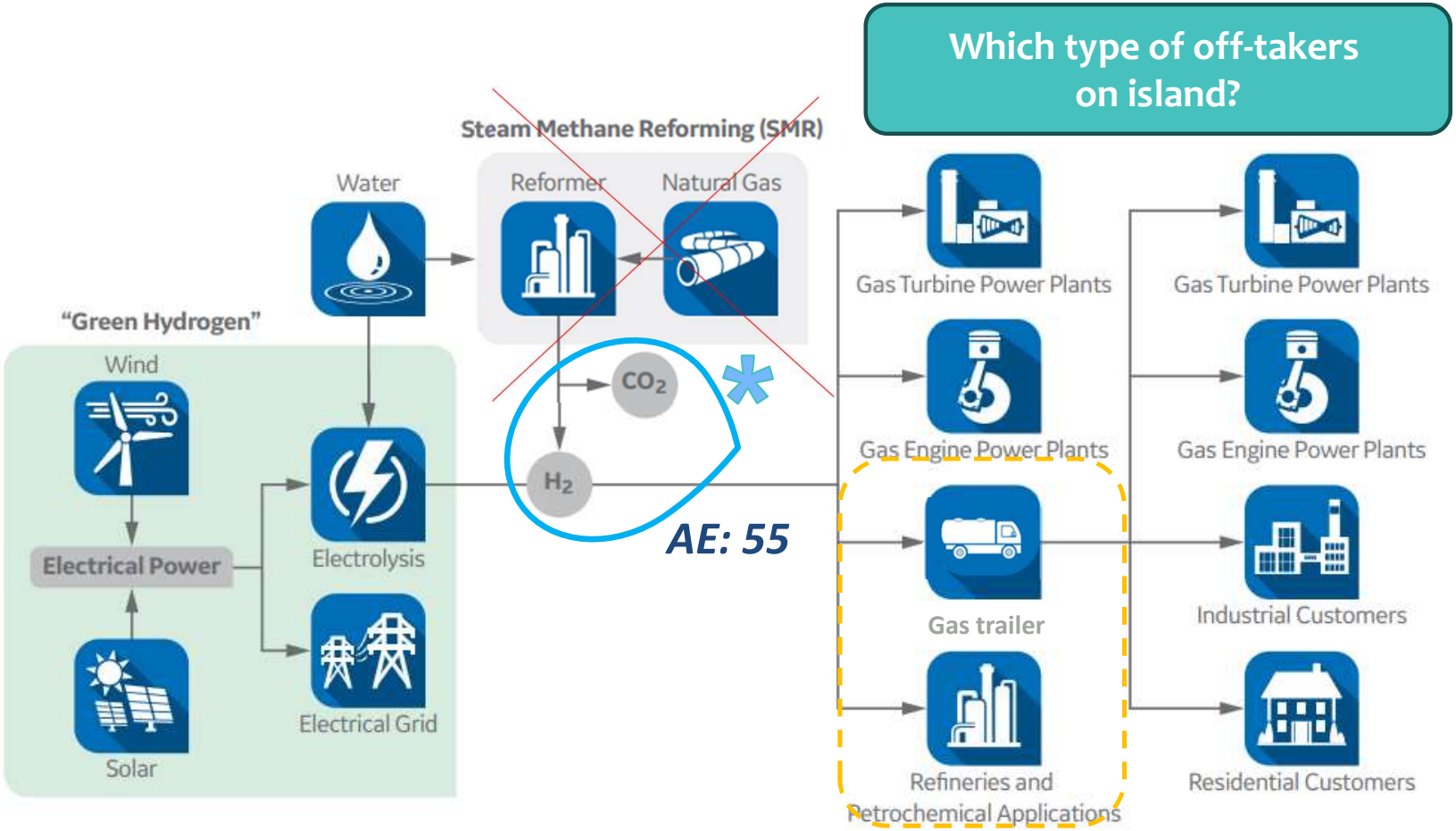
The European Commission understands sector coupling as a strategy to provide greater flexibility to the energy system so that decarbonisation can be achieved in a more cost-effective way

- Power to water
- Power to Heat
- Power to vehicle
- Power to H2 (P2G)

OPPORTUNITIES ON ISLAND AND FOR MAINLAND!

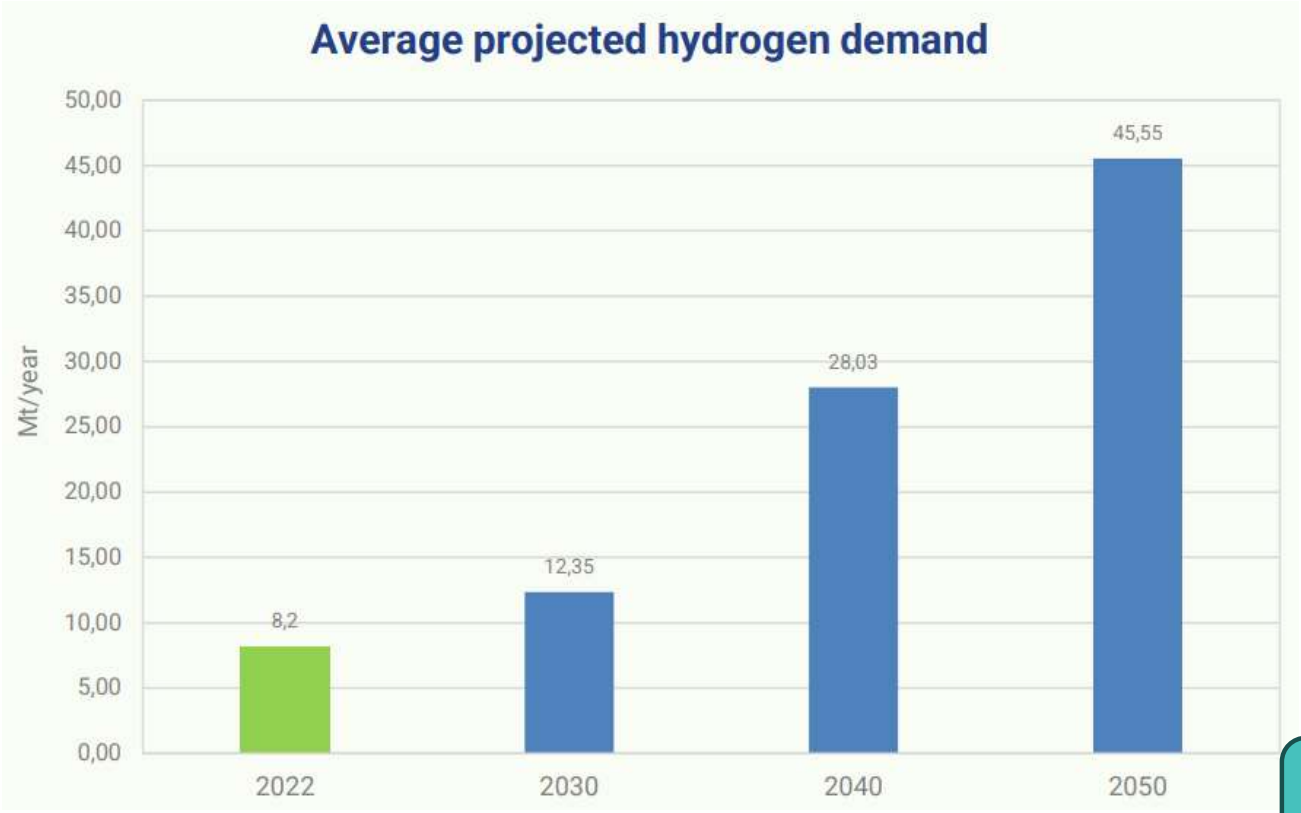
https://www.europarl.europa.eu/RegData/etudes/STUD/2018/626091/IPOL_STU(2018)626091_EN.pdf

Hydrogen from water electrolisys



**CCUS opportunities for H2 based e-fuels*

Europe H2 Demand forecast



EU H2 Demand	years
8.200 t/y	today
12.350 t/y	2030
28.000 t/y	2040
40.550 t/y	2050

CAN EU ISLANDS BECOME EU HYDROGEN HUBS?

The European hydrogen market landscape, European Hydrogen Observatory, 2023

European Commission

H2 as a fuel

NORLED HYDRA – LH2 hybrid ferry

Hydra ferry operates between Hjelmeland and Nesvik off the coast of Stavanger on the Norwegian west coast for Norled, one of Norway's largest ferry and fast boat operators.

Linde Engineering provides the ship's hydrogen system, and Ballard Power Systems provides the two fuel cell modules, each with 200 kW, that power the ferry. The liquid hydrogen storage contain enough fuel for 12 days of operation at an average speed of nine knots, allowing the ship to cover nearly 1,000 nautical miles.

THIS VESSEL LOOKS AS ONE OF THE MOST SIMILAR EXAMPLE IF COMPARED TO GIGLIO-GIANNUTRI CASE STUDY

Capacities

Cars:	80
Trucks:	10
Pax	299 (including crew)
Biofuel:	21,6 m^3
Fresh water:	20,7 m^3
Accommodation:	8 off

Principal particulars

Length o.a.:	82,4 m
Length p.p:	80,2 m
Breadth Extreme :	17,5 m
Draught Max:	2,9 m
Class:	1A Car Ferry B Battery (Power) E0 LC R4(Nor)

H2 as a fuel

The fuel cell electric bus is an all electric zero emission solution that offers an operation close to that of a diesel bus and hence is marketed as the closest like for like zero emission option to replace diesel https://fuelcellbuses.eu/

Toyota MIRAI – H2 car

HYUNDAI: 2x95 kW FC System + 7x32 kg bottles
400 km autonomy– refuelling time 15 minutes

Hydrogen Refuelling Stations

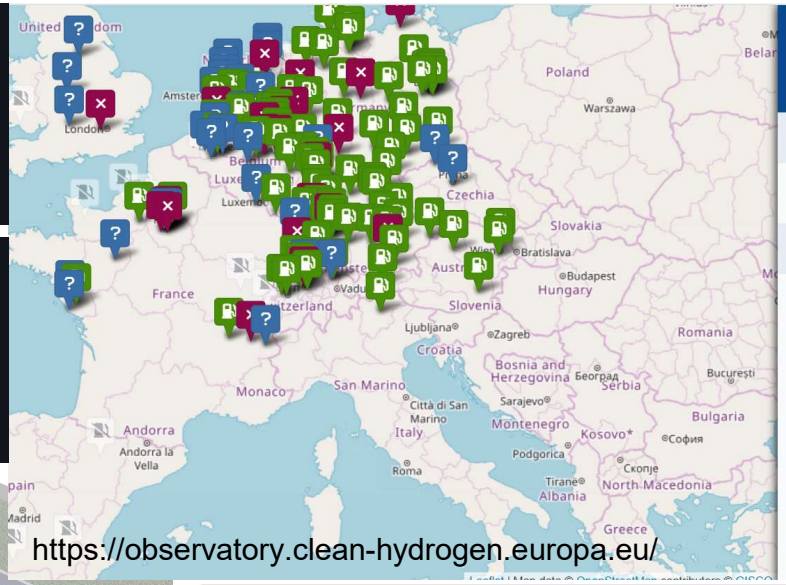
Related

Total and Air Liquide join forces to build more than 100 hydrogen filling stations for heavy-duty vehicles in Europe

Related

Italian government lines up more than €100m of funding for 36 new hydrogen fuelling stations across country

www.haskel.com



https://observatory.clean-hydrogen.europa.eu/

Since 2015, the total number of HRS in Europe has grown at an accelerated pace to 178 operational and publicly accessible HRS by the summer of 2023. Most HRS are located in Germany (96), followed by France (21) and the Netherlands (14). The vast majority of the HRS have dispensers for refuelling of cars at 700 bar. About one in three HRS have dispensers that allow buses or cars, or both, to refuel at 350 bar.

ISLANDS CONTEXT: challenges and opportunities

Living Labs

High cost of fuels

High cost of energy

Lack of energy infrastructure (NG grids and MV/HV grids)

Space availability for RES

Seasonality of Demand

ISLANDS CONTEXT: Power to Gas SWOT

Strenghts

- Living lab opportunity
- «Island Mode» of grid systems
- RES potential

Weaknesses

- Less potential off-takers
- Lack of energy infrastructure
- Risk of high population density area
- Fresh Water needs

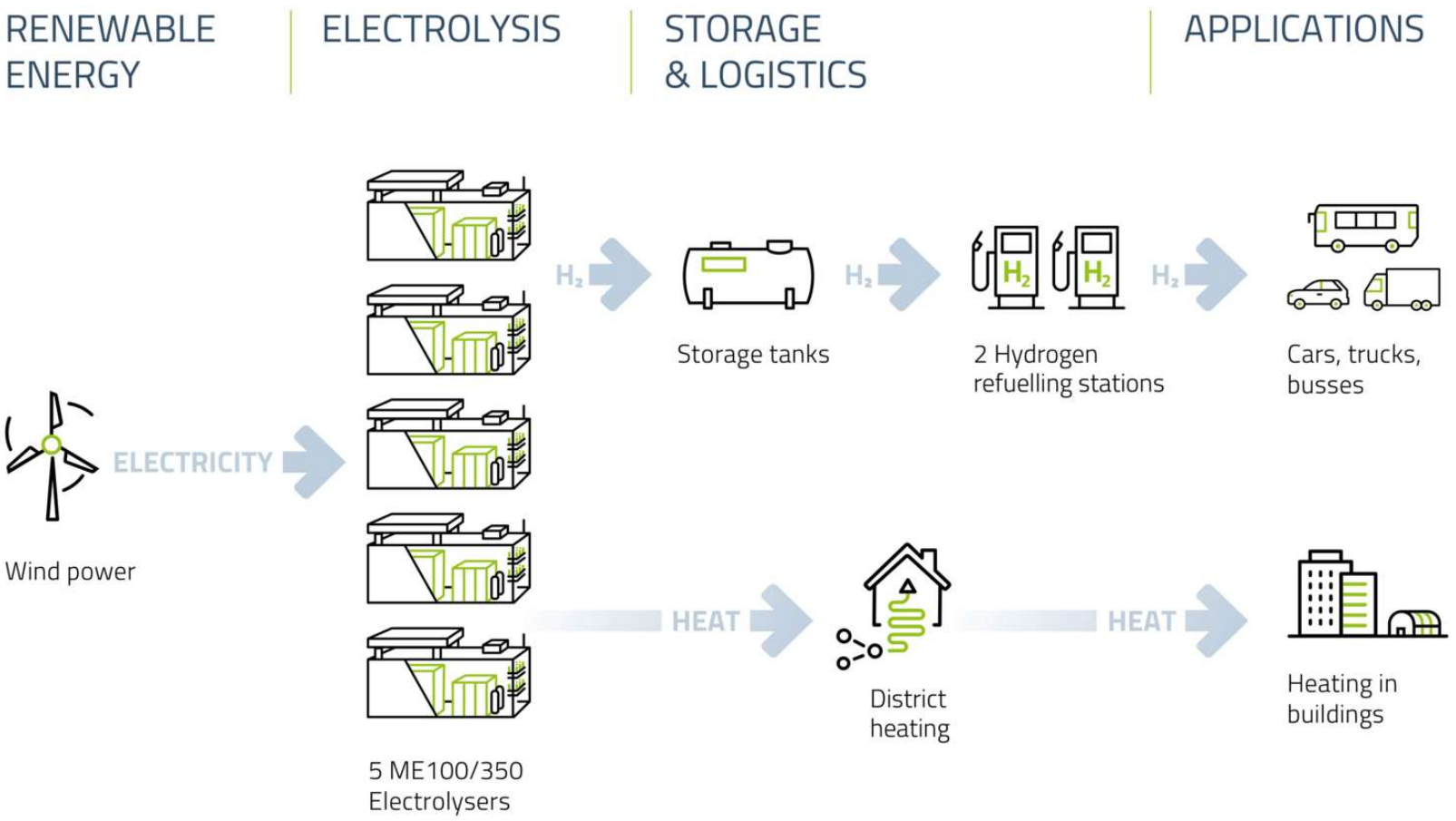
Opportunities

- Demand seasonality (need of seasonal storage)
- Motorways of the sea (short duration)
- Eco-friendly vocation
- Creation of ecosystems easier (less stakeholders to be engaged)
- Potential incentives

Threats

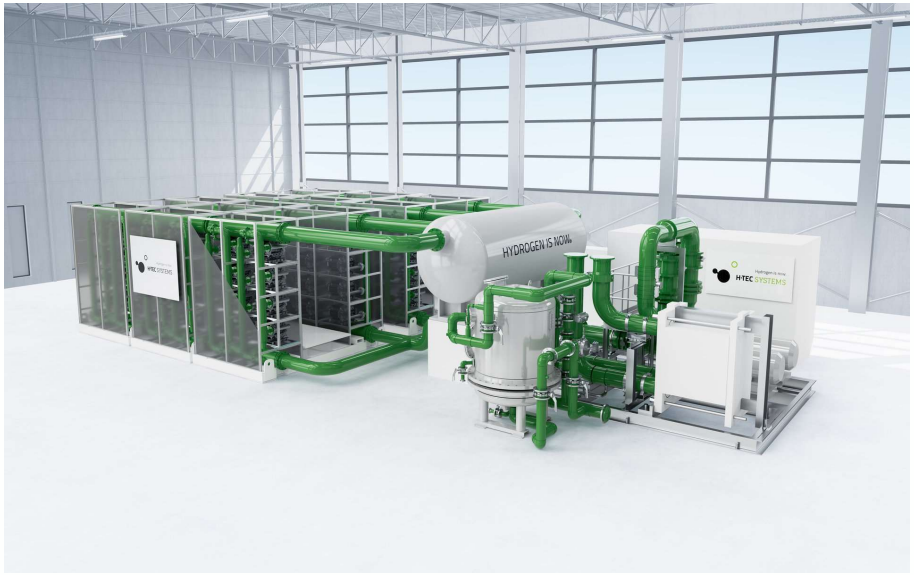
- High costs of green H2 (still higher than fossil)
- Higher investments (and Risks due to limited off-takers alternatives)
- Lack of incentivations
- Social acceptance

Power to Gas package



https://www.h-tec.com/en/applications/references-detail/efarm-north-frisia/

Power to Gas package



system available in 10 MW blocks

H_2 production nominal	4,600 kg/d | 2,130 Nm^3/h
Energy consumption[1]	4.6 kWh/Nm^3 H_2 | 51 kWh/kg
System efficiency[1]	77 %
Performance class	10 MW
H_2 production modulation range	213 – 2,130 Nm^3/h | 10 – 100 %
H_2 purity including optional hydrogen purification	3.0 or 5.0 (fulfils ISO 14687:2019 Table 2)
H_2 purity without optional hydrogen purification	Water saturated at 65 °C and 30 bar(g)
H_2 output pressure	30 bar (g)
Load change	30 s (minimal load to nominal load)
H_2O required quality including optional fresh water treatment	TrinkwV 2020 | EU Directive 2020/2184-EU
H_2O required quality without optional fresh water treatment	DI water (fully desalinated)

10.0 MW
ELECTRIC POWER

4,600.00 kg/d
NOMINAL HYDROGEN PRODUCTION

4.6 kWh/Nm^3
ENERGY CONSUMPTION

European Commission

Power to Gas

Puertollano Iberdrola: A 100 MW solar plant

The installation has bifacial panels, which enable greater production since they have two light-sensitive surfaces and provide a longer useful life.
The plant has been designed with cluster inverters or string inverters, which improve the yield and allow better use of the surface area.
The plant is equipped with a storage system, which will facilitate plant management.
The battery system (with 5 MW of power) has a storage capacity of 20 MWh.
The plant would achieve **830 MW** of electrolysis, by 2030, and would ensure that around 25 % of the hydrogen currently consumed in Spain would not generate CO2 emissions.
Spain electrolysis national target: 4 GW installed

https://www.h-tec.com/en/news/detail/green-hydrogen-from-wind-energy-h-tec-systems-electrolysers-for-efarm/

FERRY SERVICE: H2 ON SITE PRODUCTION

Renewable (MWp)

1. Installed power availability
2. Grid injection constraints
3. Land/roof availability

10 MWp

12 ÷ 15 M€

System design output

Water

ELY

3 MWp

6 ÷ 8 M€

H2 Production (kW)

H2 1.000 kg/day

Hydrogen

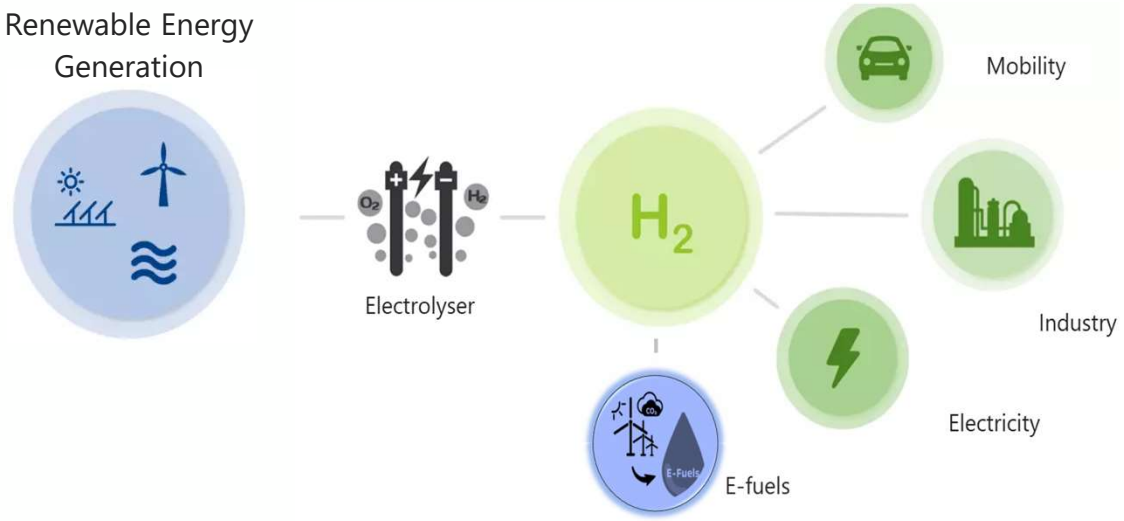
H2 Storage weekly (kg)

3000 kg

600 – 900 k€

#CleanEnergyIslands

P2G Hydrogen Production potential



10 MWp Electrolyser H2 Potential

- **H2 1.000 t/year**
- **H2 3 t/day**

- **43 /day**
- **15000 /year**

- **500 /day**
- **182500 /year**

- **55 MWh /day**
- **20000 MWh/year**

European Commission

ISLANDS GRID CONNECTION CHALLENGES

P2G OPPORTUNITIES

1. Power cuts: P2G2P as a backupsystem
2. High curtailment of renewable energy: P2G adsorb RES excess
3. Lack of grid capacity: P2G enabling microgrid and distributed generation
4. Controllability of existing distributed PV generation: microgrid and distributed gen
5. Permitting and/or connection policy for RE generation plants is complex and not transparent: N/A

Off Shore Wind +
Hydrogen +
Islands =

HYDROGEN ISLANDS? 34 B$!

European Commission

Thank you!

ldifresco@bluenrev.com
sbarberis@bluenrev.com

info@euislands.eu

Belgium, Kalkkaai 6 1000 Brussels