
HYDROGEN ENABLER OF THE ENERGY TRANSITION

November 2018



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Our Mission

—



The Group's mission is to **unlock the energy transition**, by mastering the intermittency of renewable energy sources. Being pioneer of **Hybrid Storage Solutions**, transforming **intermittent renewable** sources into a **stable power source**. And **enabling renewables to power society**: reliably, affordably and sustainably.

HYESS: one vertically-integrated technology platform



ADDRESSABLE MARKETS

Grid Support

Utility-Scale and behind the meter

Storage
Systems

100%

45 GW

global 2016-2024

14 GW

EMEA

100

%



Independent Power Generation

and weak-grids stabilization

Microgrids

100%

600 GW

global to 2017

29 GW

Annually

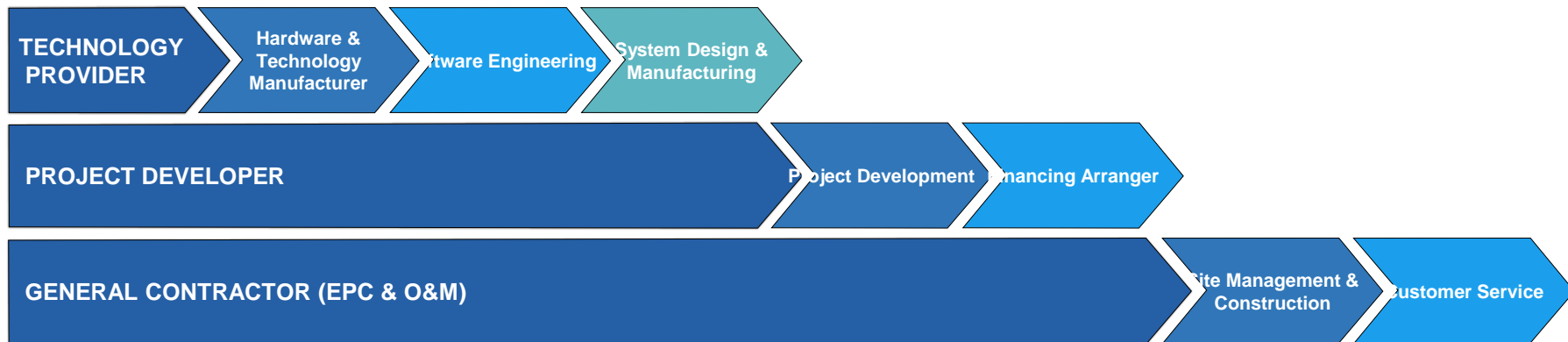
100

%



BUSINESS MODEL

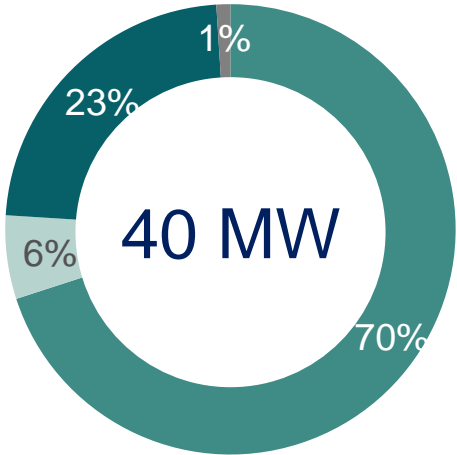
System Provider that develops its own pipeline of projects acting for the customer as a partner also for all the site activities: one single point of responsibility, minimizing project risk and complexity for the customer



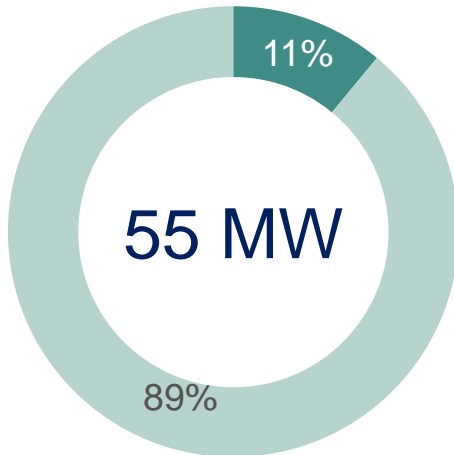
Source: EPS 2020 Technological Roadmap

Installed Base and systems under commissioning

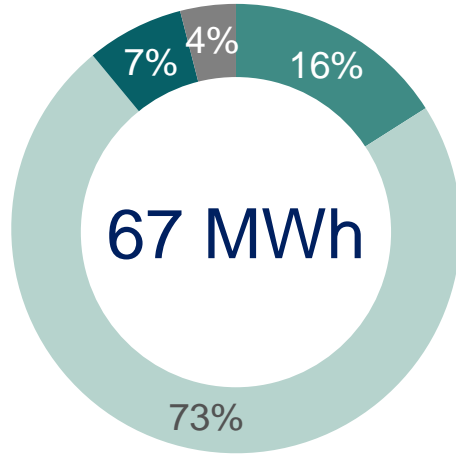
APAC Europe Africa Americas



Microgrids generation capacity



Grid-Support Solutions*



Energy Storage



* including utility scale and behind-the-meter solutions

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Technology Evolution



2005-2014

2015

2016

2017

2018



One of the
Largest
worldwi
de

20MW, the
Largest
in EU*

SYSTEM
SIZE

12 kW

50 kW

1 MW

5.9 MW

20+ MW

PRODUCT
FEATURES

- H₂
- Pb

- H₂
- Pb
- Li-ion titanate

- H₂
- Pb
- Li-ion ti
- Li-ion
- Na-Cl

- H₂
- all batteries

- H₂
- all batteries

ElectroSelf™

ElectroSelf™

HyESS®

HyESS®

HyESS®

MICROGRID
POWER SOURCE

- -

- Solar

- Solar
- Generators

- Solar
- Gener
- Wind

- Solar
- Wind
- Generators
- Power Plants

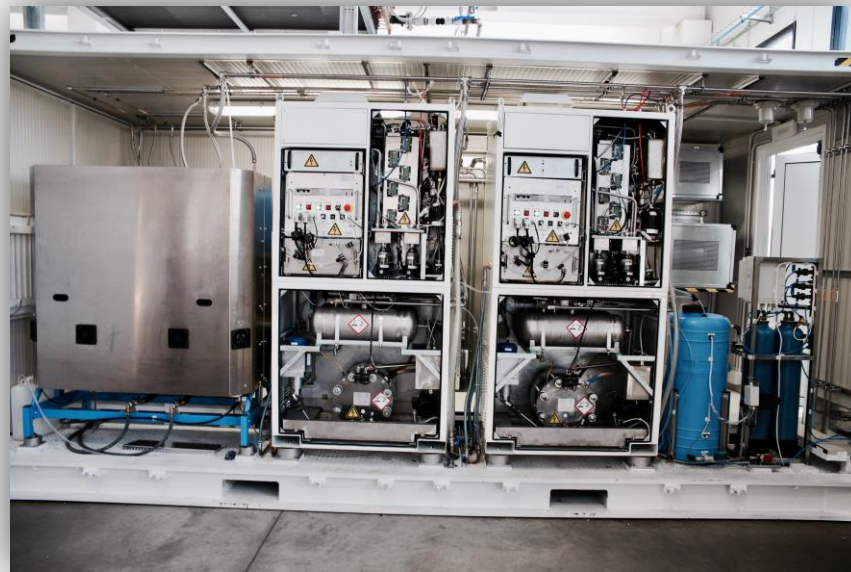
LITORAL - UTILITY-SCALE



SAT COMPLETED ON 24 SEPT 2018



H₂ Power to Power (P2P)



H2 P2P role in a solar/wind powered microgrid

Frequency and
voltage
stabilization
(power
application)

- 30-60mins of energy autonomy
- Fast response
- High-frequency, partial cycling

Li-Ion battery

Intra-day
cycling of solar
energy
(energy
application)

- Storage capacity (in MWh) of 1-3x PV capacity (in MWp), depending on load profile and cost of alternative sources
- One full daily cycle

Li-Ion vs other
chemistries vs H2

Energy supply
on
still/cloudy days
(capacity
application)

- At least 24/48h of full load coverage

H2 vs diesel



H2 P2P vs diesel generation in microgrids

1 **Storage-enabled solar PV is set to dominate** new power generation capacity **build-up moving** forward, from temperate regions down to the equator

2 As distributed battery systems becomes more and more competitive for time-shifting solar power from day to night, on sunny days solar energy **will increasingly displace everything else** – the only limit being the footprint

What about
cloudy days?

Batteries with days of
autonomy,
cycling with low frequency, will
never
be commercially viable

Need for a non-battery-based
capacity-oriented solution

3 In developed economies such role shall continue to be played by **natural gas in the next future**

4 In *non-methanized* regions, the game is on

Diesel fuelled gensets
Vs.
Renewable + H2 P2P



Hybrid power plant in Chile

Group credentials

Stage: commissioned and in operation



For the first time, this Hybrid Power Plant combines renewables with the complete set of innovative technologies developed by the EPS Group to implement a micro-grid in Chile that brings electricity to more than 300 technicians constructing a power plant in the Atacama Desert, 4000 meters above sea level.

The entire system has been engineered in a containerised, plug & play solution that provides stable power on demand with the same level reliability of to the national electrical grid, using intermittent, renewable power sources coupled with storage.

Hybrid Power Plant:



PV: 125kWp



Hydrogen: 1MWh



Storage: 120kWh
(Li-ion titanate chemistry)



Master Controller
Pool Algorithms & Black Start Function



250kW Power Conversion System
Full Inertia DROOP Control Technology
Full DC BUS system.

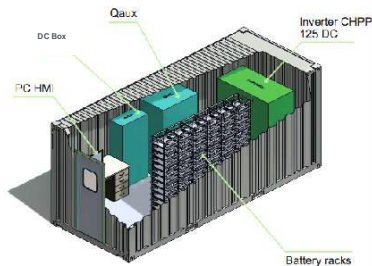


Peak Load PCS: 125kW
People: 300
Diesel reduction: 100%, backup only



Hybrid power plant in Chile

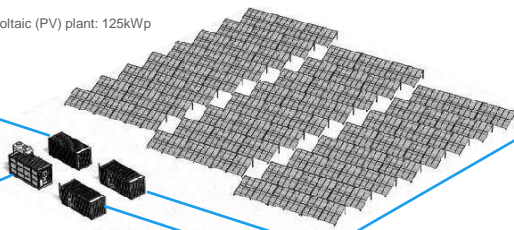
Balance of Plant (BoP Container)



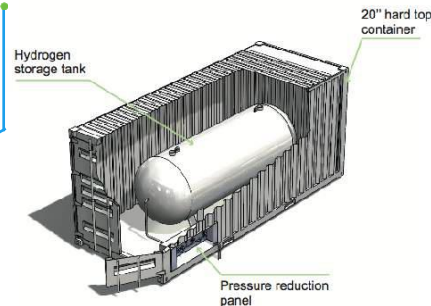
- 125 kVA Power Conversion System DROOP Virtual Inertia
- 132 kWh Li-ion Battery
- Microgrid Management System with POOL algorithms

First Hybrid Mini-Grid with hydrogen and li-ion storage technology. Cheap electricity to remote communities, operating in islanded mode 24/7. Complete replacement of the existing fossil fuel-based generator.

Photovoltaic (PV) plant: 125kWp

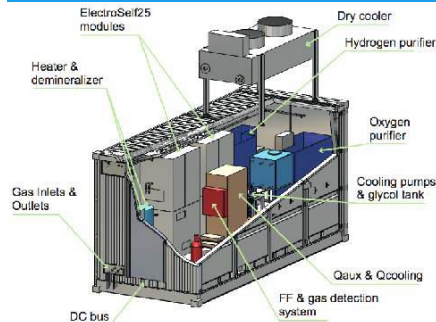


Oxygen Storage (O₂ Container)



- 6,000L pressurized Tank (Phom 30 Bar)

Power-to-Power (P2P Container)



- 2x25kW Electrolyzer, as Power-to-Gas (P2G) modules
- 2x25kW FuelCell, as Gas-to-Power (G2P) modules P2P
- Energy Management System

INNOVATION AT FULL SCALE

DIESEL FREE, PLUG & PLAY

Hydrogen as "green fuel", generating pure water as waste product. Plug and Play containerized solution, ready to scale-up power in case of demand increase.

OVERCOME DIESEL EFFICIENCY

Hybrid Storage configuration with an high-efficiency Li-ion battery to maximize the daily energy turnaround and P2P hydrogen system to provide long-duration capacity

CAPEX REDUCTION

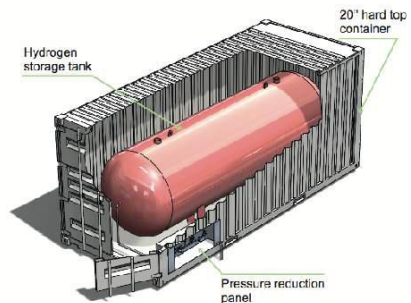
Higher Efficiency and CAPEX reduction: battery and H₂ Storage are charged directly by

DC Link with PV. Only one bidirectional Inverter for the entire system.

SEAMLESS ISLANDED MODE

Seamless transition from grid connection to islanded mode. Meet the challenge for robust power supply, gaining control of the power needs on a "local" level.

Hydrogen Storage (H₂ Container)



- 12,000L pressurized Tank (Phom 30 Bar) 1
- MWh storage gross capacity

Hybrid power plant in Chile

Balance of Plant (BoP Container)



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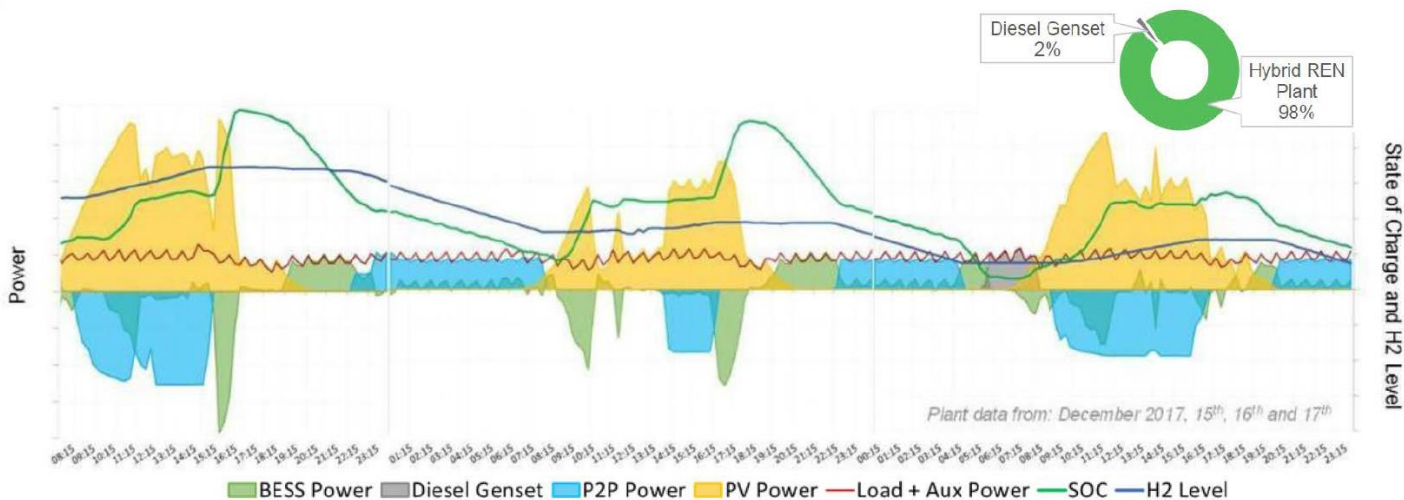
Hydrogen Storage (H₂ Container)



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- MWh storage gross capacity

Hybrid power plant in Chile: operational data

Results



With gas tank full the hybrid plant is able to cover up to 100% of the total daily camp load for 3 days

Courtesy of Enel Green Power

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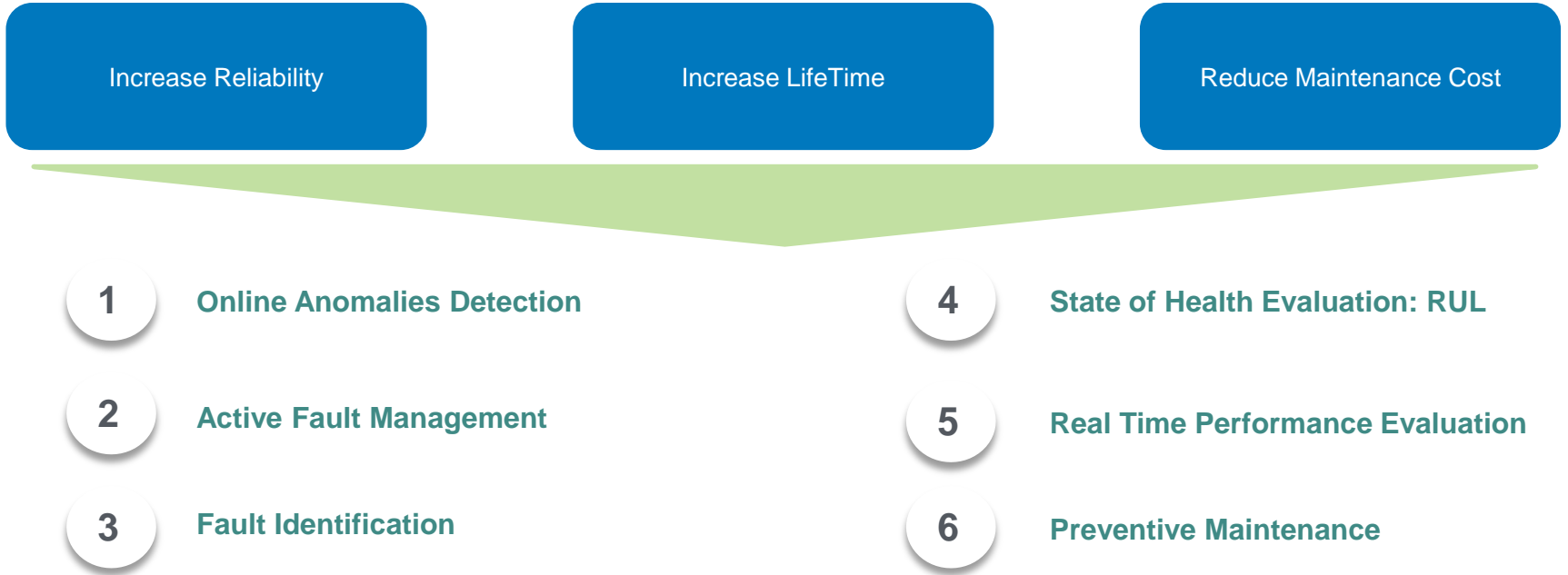
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EPS in Health Code



EPS in Health Code



ElectroSelf



DcDc Converter



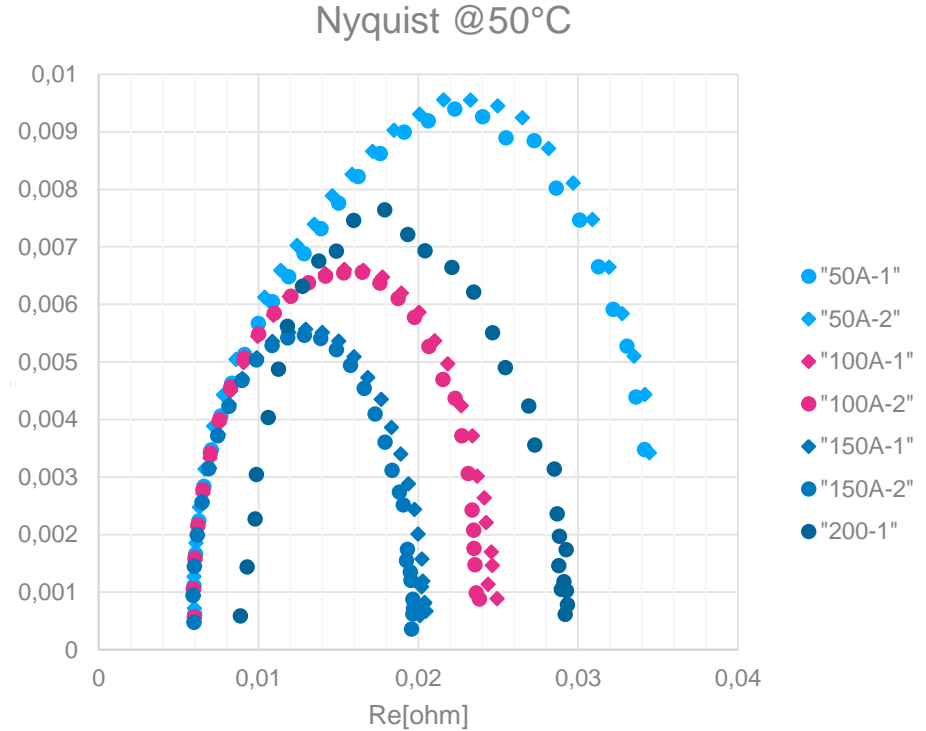
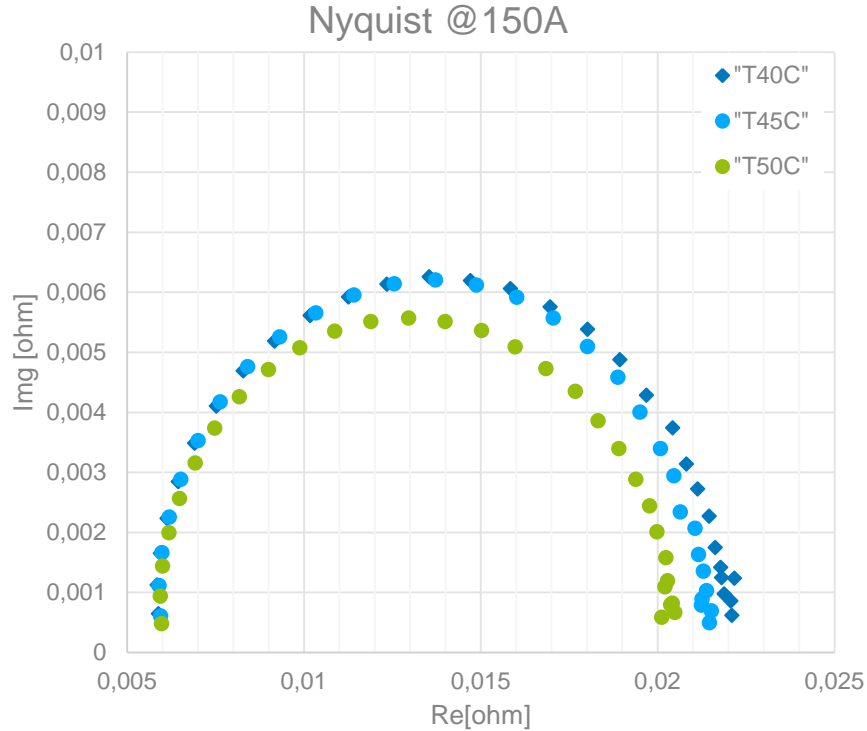
EIS Board



FC Stack



EPS in Health Code



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REIDS Project – Semakau Island

Group credentials

Stage: Under Construction

State of the art improvements:

Lifetime and reliability through electrolyte recovered and reused; and 99.9995% Hydrogen gas generated able to be used in a nearby **Fuel Cell Electric Vehicle Refilling station**.

P2G

50kW
Power-To-Gas

G2P

50kW
Gas-To-Power



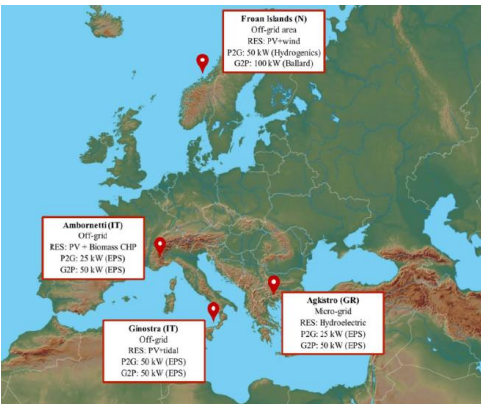
2MWh Hydrogen
and Oxygen storage



70 kVA
bi-directional PCS



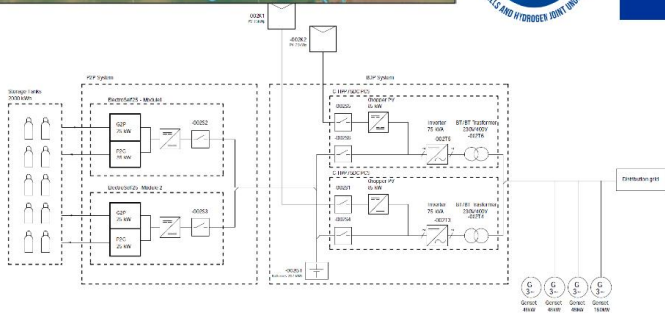
REMOTE Project



In the REMOTE project

EPS will develop 3 microgrids, all based on the integration of RES, batteries and hydrogen-based energy storage solutions

- Ginostra Smart Island, 2MWh (Italy)
- Off-Grid Microgrid in Serres, 1MWh (Greece)
- Off-Grid Microgrid in Ambornetti, 0.5MWh (Italy)



From kW to MWs

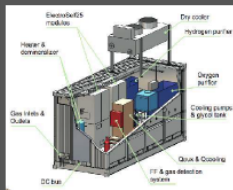


Closed Innovation on KW scale

ONGOING PROJECTS

- SEMAKAU
- REMOTE

OBJECTIVE: P2P TRL 9



TARGET MARKETS

- Microgrid capacity applications
- Backup

Open Innovation on MW Scale

ONGOING ACTIVITIES

- DeNora JDA discussion
- Positioning within ENGIE

OBJECTIVE: OPEN COE



TARGET MARKETS

- Mobility: refueling stations
- P2G (network operators, industrials)

Thank you for your attention!

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