REMOTE

Remote area Energy supply with Multiple Options for integrated hydrogen-based TEchnologies

European Hydrogen Week

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European Commission

Project Overview

Call year: 2017

Call topic:
FCH-02-12-2017: Demonstration of fuel cell-based energy storage solutions for isolated micro-grid or off-grid remote areas

Project dates:
2018 - 2023

Total project budget:
6’761’557.50 €

REMOTE

% stage of implementation
01/11/2021: 70 %

FCH JU max. contribution:
4’995’950.25 €

Other financial contribution: 0 €

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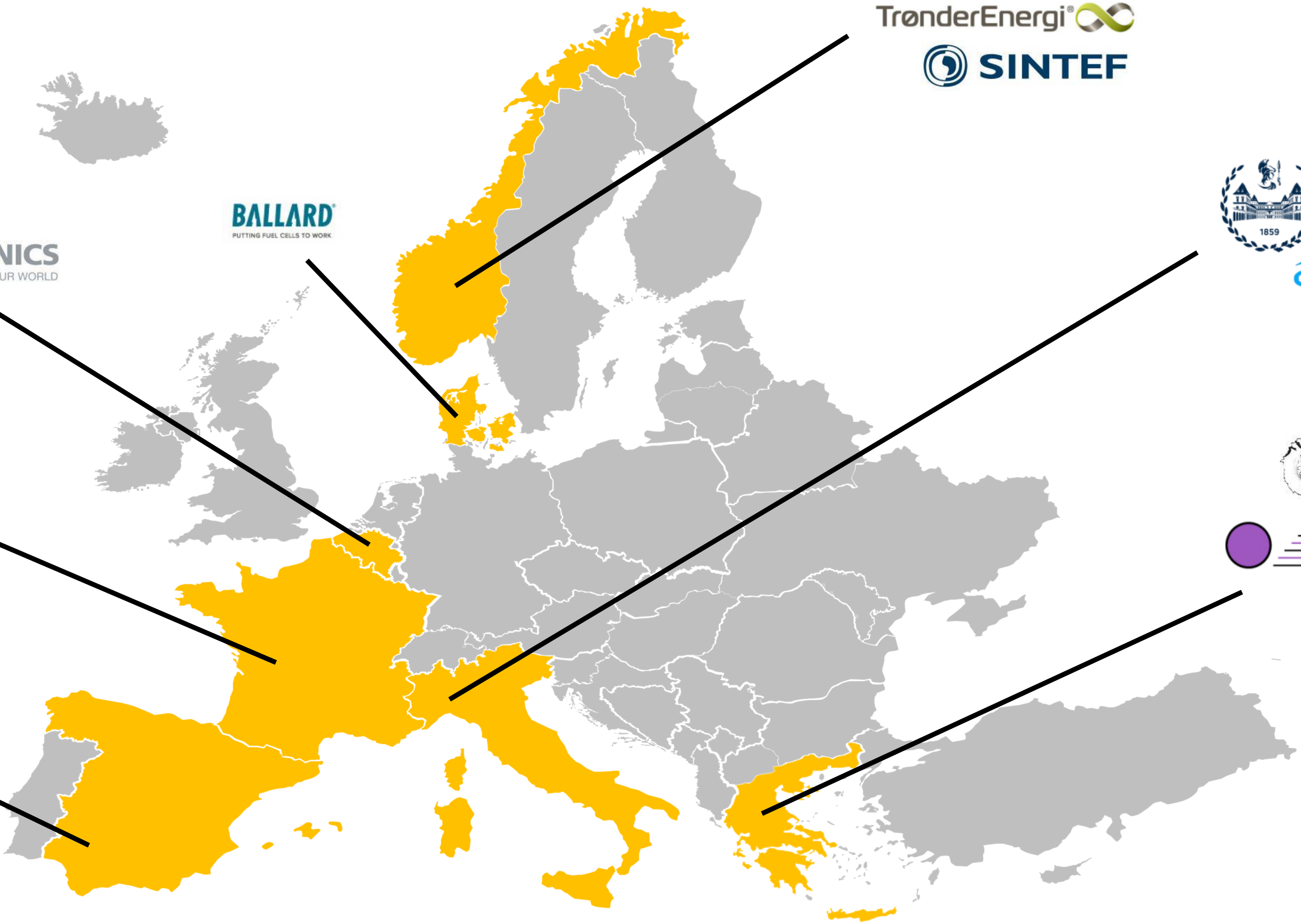
Partners



TrønderEnergi
SINTEF

Politecnico di Torino
1859

ENGIE eps

CERTH
CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

ΟΡΙΖΩΝ
Ανώνυμη Τεχνική Εταιρεία

BALLARD
PUTTING FUEL CELLS TO WORK

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

PowiDian
Power in all Meridians

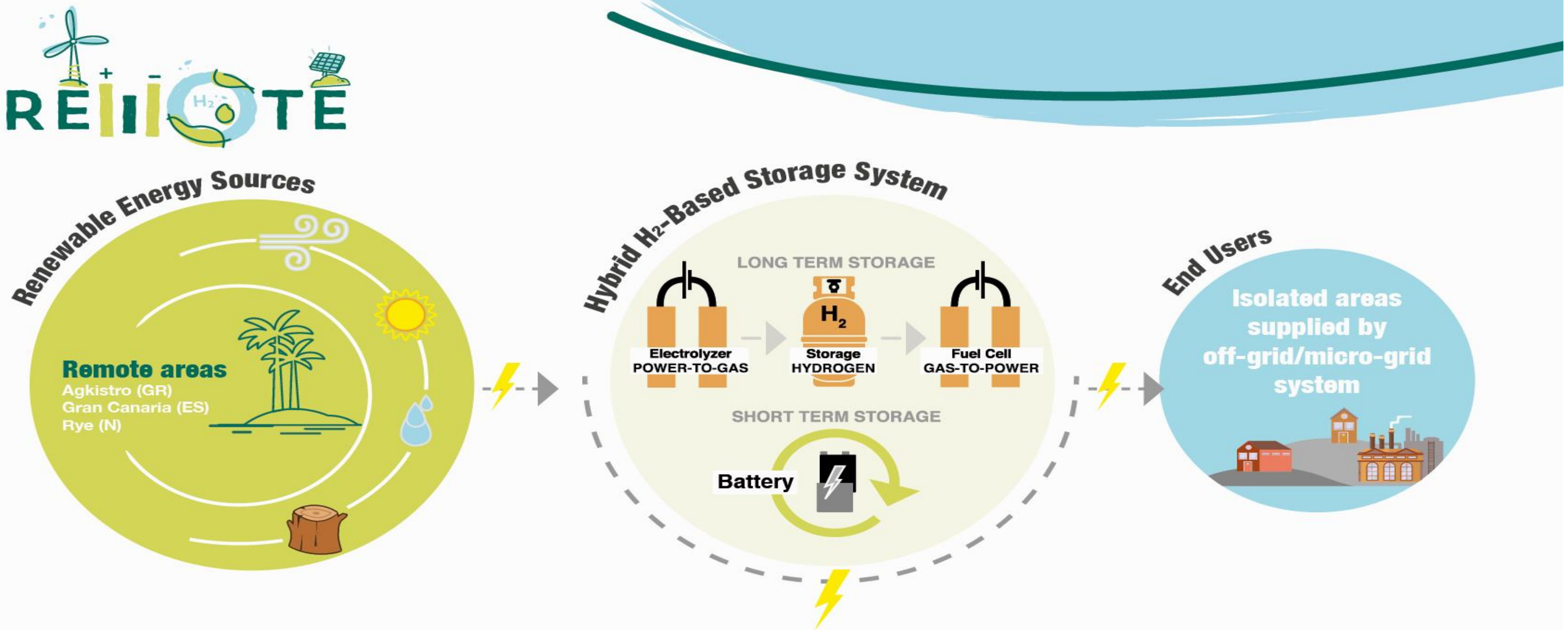
Inycom
innovation technologies

Grupo Capisa

itc

Project Summary

REMOTE: demonstration of the technical and economic feasibility of energy storage solutions for Renewable Energy Sources in remote locations, based on **hydrogen and fuel cell technologies**, in hybrid configuration with batteries.



TECHNOLOGY
An **innovative H2-Based power system** is used to store energy from RES avoiding the use of fossil fuels.

OBJECTIVE
Demostrate 3 **hydrogen-based P2P energy storage systems** located across **3 different countries** (Spain, Greece, Norway) and **different types of remote areas** (from the Atlantic Ocean to the north of Europe).

DEMONSTRATION SITES
3 DEMOs fed by renewable electricity will be installed in isolated micro-grids or off-grid remote areas.

ADVANTAGES
- Efficient, reliable, and clean solution able to generate power integrated with the existing RES system.
- Near-zero requirement for fossil fuel (diesel generators) and expensive power lines to the grid.

The project coordinated by Politecnico di Torino (IT) has the following partners. Ballard Power Systems Europe (DK), Hydrogenics Europe (BE), Powidian (FR), Orizwn (GR), Tronderenergi (N), SINTEF (N), Engie EPS (IT), CERTH - Ethniko Kentro Erevnas Kai Technologikis Anaptyxis (GR), Inycom (ES), Instituto Tecnologico de Canarias (ES), Grupo Capisa (ES).

Project Summary

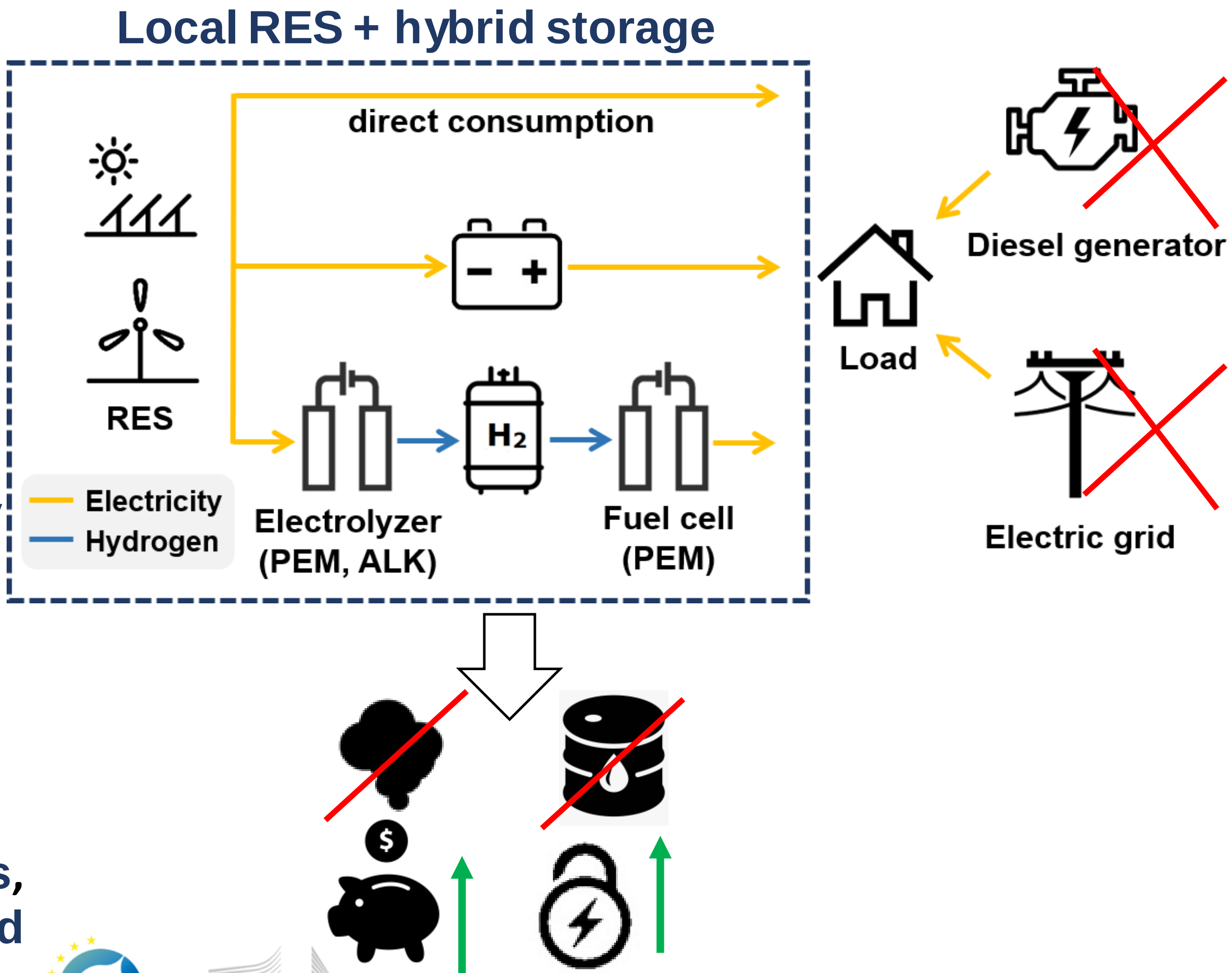
Why VRE-based P2P system for remote communities?

1. **Diesel engines**
   high fuel cost, fuel dependence, CO_2 emissions
2. **Grid connection** (when feasible)
   high installation costs, invasive works, frequent outages

Why considering **P2P**?

- To improve the reliability of the **electricity service**
- To enhance the **energy autonomy**
- To decrease **local pollution**
- To reduce the **cost of electricity**

Energy storage: **Power-to-Power (P2P) systems,** based on **hydrogen** in hybrid configuration with **closed batteries**



Project Progress

DEMO Norway (Rye, off-grid inland site), micro-grid operation

Achievement to-date

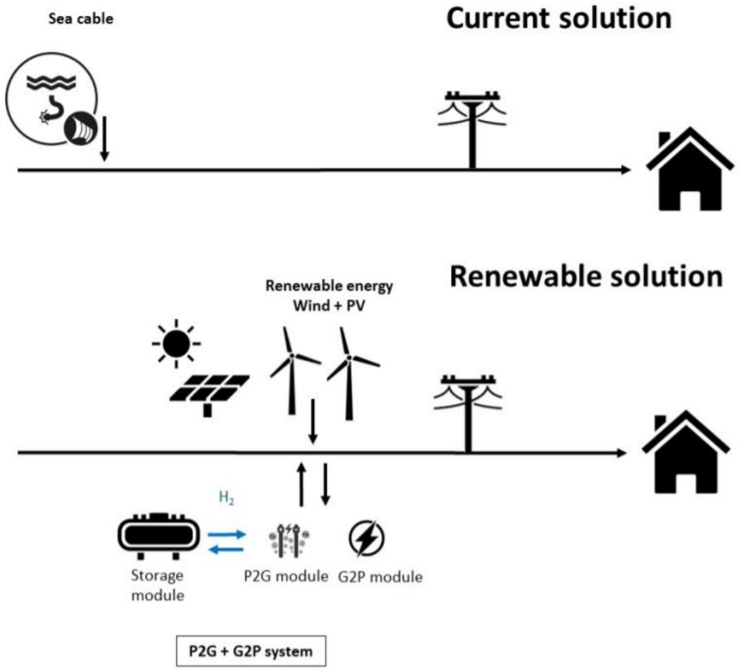
DEMO built
Operation from
December 2020

Installed 100 kW
G2P of total 250 kW
(project target)

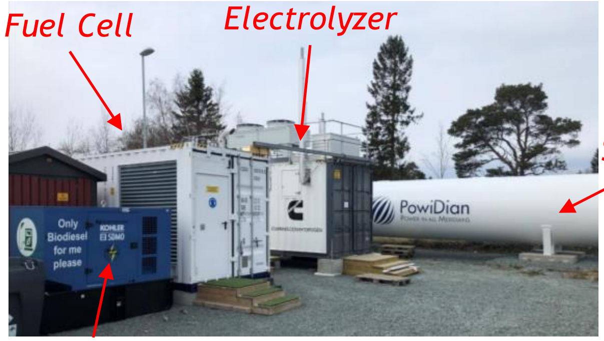
1 year (almost) of operation
achieved (Dec 2021)

25% 50% 75%

Complete
operation



Rye (N)
Off-grid
Non-Integrated P2P
RES: PV (85 kW) + wind (225 kW)
P2G: 50 kW (PEM)
G2P: 100 kW (PEM)
Hydrogen storage: 37 m³ (30 bar)
Battery: 550 kWh (Li-ion)
Biofuel generator: 45 kW



Project Progress

DEMO Greece (Agkistro, inland micro-grid), backup operation

Achievement to-date

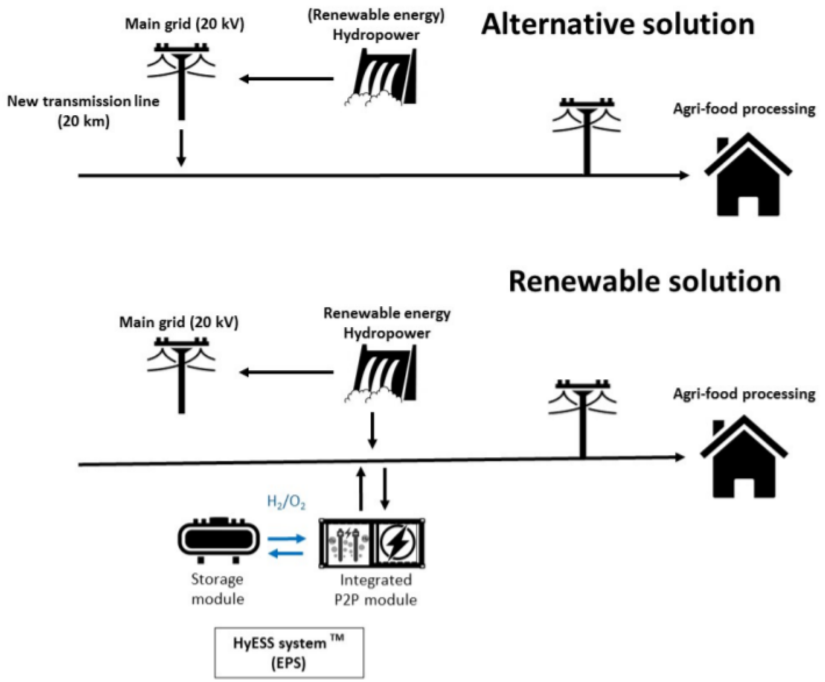
DEMO built
Operation from October 2020

Installed 50 kW G2P of total 250 kW (project target)

1 year of operation achieved (Oct 2021)

25% | 50% | 75%

Complete operation



Agkistro (GR)
Micro-grid
Integrated P2P
RES: Hydroelectric 0.9 MW
P2G: 25 kW (ALK)
G2P: 50 kW (PEM)
Hydrogen storage: 12 m³ (30 bar)
Battery: 92 kWh (Li-ion)

Project Progress

DEMO Spain (Canary Islands, micro-grid) plant construction in progress

Achievement to-date

Plant under construction — 25% — **45%** — 50% — 75% — Installation completed (100 kW G2P) … 1 year of operation to follow

- 70-90kW
- Dynamic behaviour
- Reliability
- Low Maintenance

ELY

- 50kg
- 200bar

- 80-100kW
- Dynamic behaviour
- Reliability
- Plug&Play and Low Maintenance

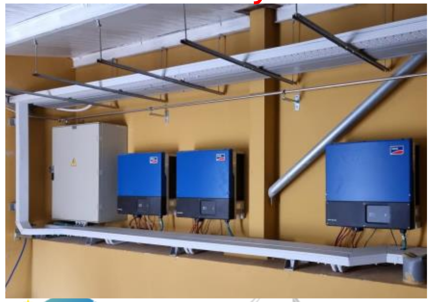
FCU

Electrolyzer

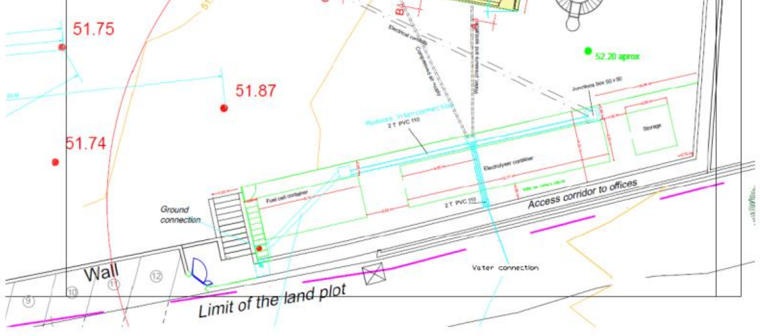
Storage

Gran Canaria (ES)
Micro-grid
Non-Integrated P2P
RES: PV (100 kW) + wind (20 kW)
P2G: 80 kW (ALK)
G2P: 100 kW (PEM)
Hydrogen storage: 50 kg (200 bar)
Battery: 200 kWh (Li-ion)

Battery



Site: cattle farm microgrid



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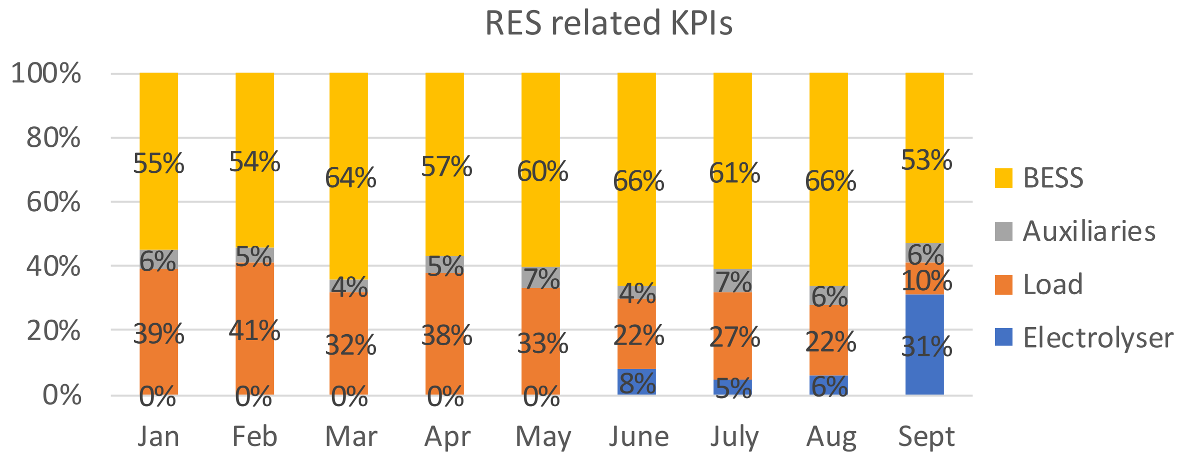
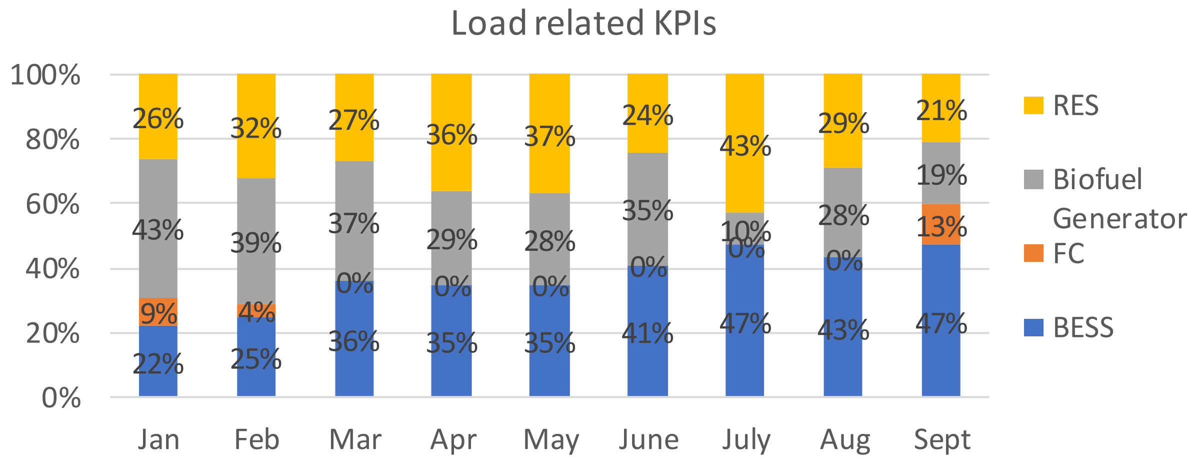
DEMO Norway - KPIs

9 months performance (Jan-Jun 2021)

KPI: round-trip efficiency

Month	$KPI_{RT,TOT}$ [%]
January	62.19
February	70.40
March	72.61
April	72.45
May	70.85
June	61.59
July	58.67
August	59.14
September	53.06



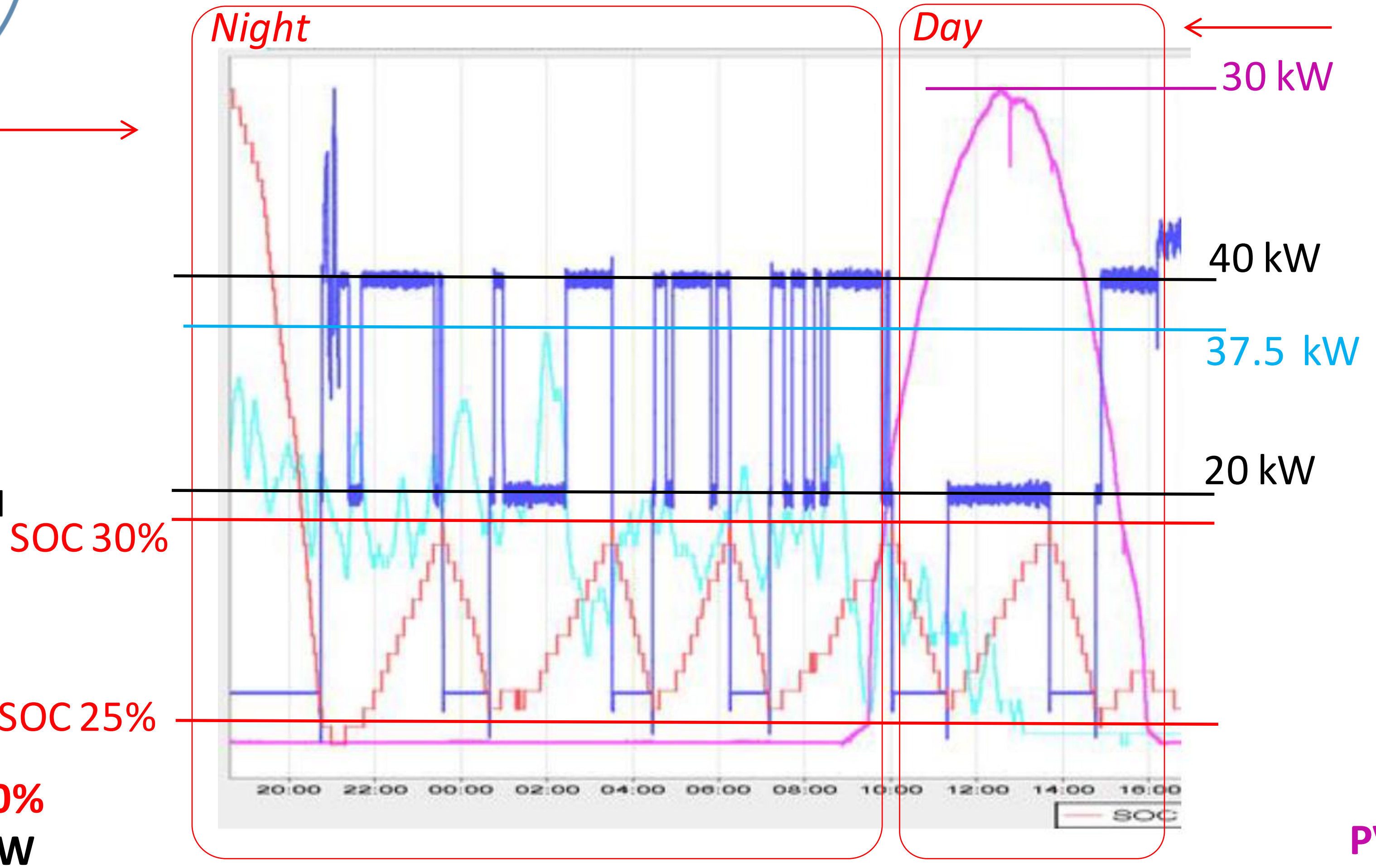


DEMO Norway - Daily operation

Example of operation: day in Feb 2021 – low battery SOC conditions

During night:

- WT is producing @ low power (< 30 kW)
- FC is producing when SOC is < 30%.
- FC setpoint can be fixed (cycle charging) or adapted to the load (load following)



During day:

- PV produces during the day (short period, it's February in Norway) and WT production decreases
- Battery is discharged and then excess PV is used to recharge it. The FC is set at lower setpoint (20 kW) thanks to PV.

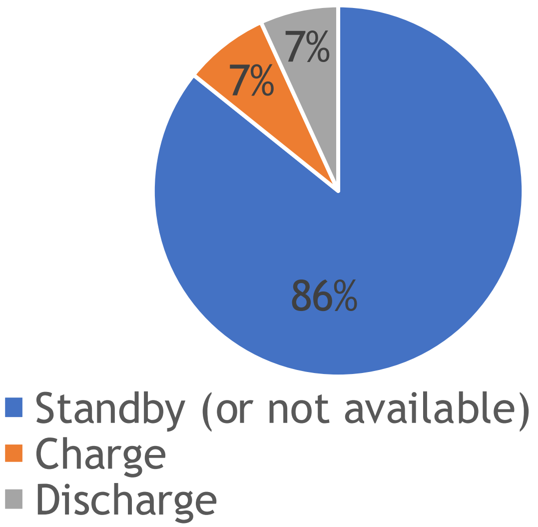
Battery SOC: 25%-30%
FC Power: 0-20-40 kW
Wind Turbine Power: 0-37.5 kW

PV Power: 0-30 kW
Genset Power: 0 kW

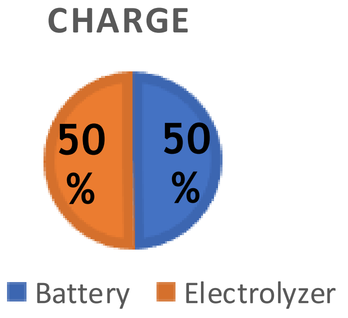
DEMO Greece - KPIs

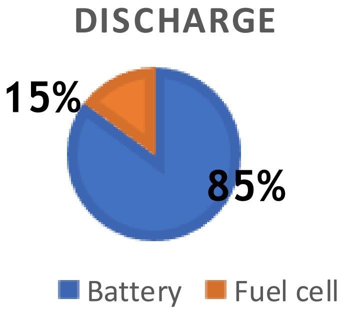
12 months performance (Oct 2020 - Sept 2021)

Hours of operation



Energy Shares





Average efficiency: electrolyzer, fuel cell, round-trip

Month	η_{EL}*	η_{FC}*	$\eta_{RT,total}$**
Oct (2020)	55%	43%	63%
Nov (2020)	-	-	-
Dec (2020)	55%	-	84%
Jan	-	-	-
Feb	57%	51%	86%
Mar	57%	42%	87%
Apr	53%	43%	47%
May	53%	46%	59%
June	53%	-	45%
July	54%	47%	38%
Aug	56%	-	-
Sept	55%	44%	45%

Higher battery share

**average of instantaneous values*

*** calculated on energy flows*

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Risks and Challenges

DEMOs in South EU

- **Risk:** two DEMO sites planned in South EU (Italy) not installed due to the reduction of the involvement of one of the technology providers; in one case, also unsuitable site (geologic instability). Risk of not achieving 100 kW of Fuel Cell installation (total 250 kW required).
- **Mitigation:** new system integrator and end-user identified, one new site available (Spain) to install 100 kW Fuel Cell and ensure 1 year of operation within the project.

DEMO in Norway

- **Risk:** authorization refused for RES (wind turbine) installation in off-grid island (protected area). Risk of not achieving 100 kW of Fuel Cell installation in North EU.
- **Mitigation:** installation in inland – shore – micro-grid (Rye site).

- **Challenge:** difficult support to installation/startup/maintenance due to site remoteness → use of technological support (augmented reality smartglasses) to remotely support activities.
- **Challenge:** off-grid start-up of wind turbine → technology improvement on wind turbine.

Exploitation Plan/Expected Impact

Exploitation

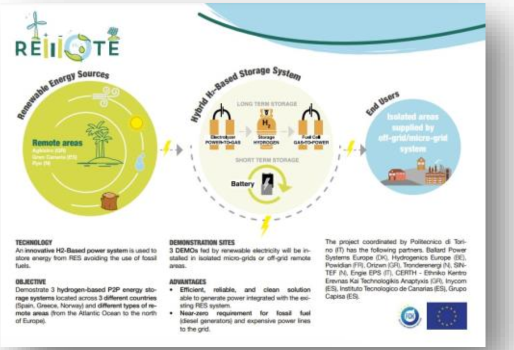
- *Industrial suppliers*:
    1. incorporation of technical learning in product improvements;
    2. information on performance and durability of components to be fed back to the relevant suppliers;
    3. marketing and communication of the results and experience to create new business.
- *End-users*:
  replication in other off-grid and isolated micro-grids where competitive technologies (diesel generators) are not economically or environmentally viable.
- *Industry, academy and research institutions*:
  experience from REMOTE applied in industrial projects (e.g. project running in Sardinia, IT) and EU HORIZON proposal participation for demonstration of innovative renewables storage in off-grid applications.

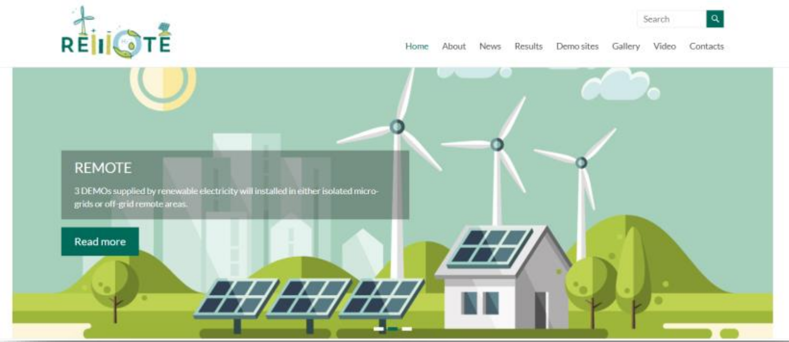
Impact

1. Reduction of 57 tonnes of CO_2 production per year per site.
2. Reduction of the cost of energy to the final users.
3. Establish confidence in technology, business models and market readiness with end-users and authorities of isolated territories.
4. Demonstrate a viable solution and a replicable business case. Potential capacity estimated in 2 GW/year and investments of 340 M€/year.
5. Only considering island, around 750 million inhabitants around the World are involved, and they can save the emissions of **1.5 GtonCO_2/year (4% of global World emissions)**
6. Supplier and end user experience of installation, commissioning, operation, maintenance and use of electrolyser and fuel cell power generation in critical environment.

Communications Activities 1

- Visual identity of the REMOTE project (logo, website, brochure, infographic)
- Social media activities (Facebook, Instagram, Twitter and Linkedin)
- 3D motion video to show the concept beyond the project





Communications Activities 2

- Story telling videos to present the partners and their role, and after one year to show the progresses
- EUSEW Award (INNOVATION category) to the REMOTE project, 2020: videos

REMOTE communication in numbers:

- 4 press releases
- REMOTE has been mentioned in 100+ articles all over Europe
- 4 awards received by the project and the partners
- DEMO visits and the Norway Demo Plant
- 21 videos in the dedicated playlist on Youtube
- Openings of the DEMOs in Norway and Greece

There are many visits and events that, in the course of 2020, have taken place in Rye, at the Demo 4. On 16 October, European Youth, an active organization for cooperation between Norway and the European Union (https://www.eyp.no/), visited the Demo in order to analyze the project as a case of ongoing collaboration between Norway and the European Union. During two major scientific conferences (PTK and Enova, both held in Trondheim), a delegation visited the installation.

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Dissemination Activities

- Events participation (17+ international conferences, workshop, invited talks, at national and international level)
- 4 scientific publications
- Public deliverables are available on the REMOTE website
- Dedicated press releases on the results from the DEMOs in Norway and Greece will be produced and published by the end of the year.

EHEC 2021

EUROPEAN HYDROGEN ENERGY CONFERENCE

EFCF

Partner	Type of event (*)	Name of event	Date	Place	Speaker	Presentation title	URL of the event web (agenda/ proceedin
SINTEF	Conference	European Hydrogen Energy Conference (EHEC) 2018	March 2018	Malaga, Spain	Kyrre Sundseth	Water electrolysis in conjunction with fish hatcheries – a viable business concept	http://www.ehec.in
POLITO	Specific local event on remote areas	Installazioni off grid in aree remote	18 May 2018	Turin, IT	Massimo Santarelli,	Altre esperienze locali: progetto EU	https://www.caitorino.it/news/2018/0
SINTEF	Partner Meeting		June 2018				
EPS POWIDIAN	Conference	Second Conference: Consultation Forum for Sustainable Energy in the Defence and Security Sector Phase II (CF SEDSS II)	16-17 October 2018				
POLITO	Workshop	Joint Workshop for Energy and Environment EMPIR calls in 2019	22 – 24 October 2018				
POLITO	Event	Idrogeno:....il domani è già cominciato?	25/10/2018	Camera di Commercio di Milano Monza Brianza Lodi (IT)	Domenico Ferrero		http://energia-plus.it/evento/idrogeno-il-domani-e-gia-cominciato/
POWIDIAN	Partner Meeting		31/1-1/2/2019	Versailles (Fr)	Marta Gandiglio, Massimo Santarelli, Claudia Sibilla		https://www.remote-euproject.eu/2019/02/01/partner-meeting-in-versailles/
POLITO	Conference	3rd Clean Energy for EU Islands Forum	14-15/5/2019	Stockholm (Swe)	Massimo Santarelli		https://www.remote-euproject.eu/2019/05/13/3rd-clean-energy-for-eu-islands-forum/
POLITO	Conference	ICE 2019	9-13 June 2019	Loen, Norway	Paolo Marocco	Optimal sizing of H2-based hybrid EES in remote areas: the case study of the island of Ginostra (IT)	https://www.sintef.no/projectweb/ice2019/
SINTEF	CONFERENCE	Dublin Euro Conference 2019	23-26 June 2019	Dublin, ireland	Miguel Muñoz Ortiz, Vibeke Nørstebø, Adrian Werner, Kyrre Sundseth	Business Cases for Remote Micro Grids and Off Grids with Hydrogen-Based Technologies	https://www.remote-euproject.eu/2019/06/24/dublin-euro-conference-2019/
POLITO	Conference	EFCF 2019	2-5 July 2019	Lucerne, Switzerland		REMOTE project: techno-economic analysis of H2-based energy storage systems in remote areas	https://www.efcf.com/
POLITO	Conference	EFS 2019	24-26 July 2019	Turin, Italy		H2-based energy storage systems in remote areas: the remote project	http://www.efs2019.uc.pt/projectos/efs2019/index.php?module=sec&id=739&f=1
Orizon	Award	iGreen Awards 2021,	2021	Greece		Green Technology Concept of the pillar Sustainable Development / Operations / Technology.	https://orizon-ate.gr/vraveusi-monadas-apothiskeusis-udrogonou/

EUROPEAN DEFENCE AGENCY
News and Events What we do Who we are
Home > News and Events > Events > Second Conference: Consultation Forum for Sus

09 JULY 2018

Second Conference: Consultation Forum for Sustainable Energy in the Defence and Security Sector Phase II (CF SEDSS II) - Warsaw, Poland (16/17 October 2018)

ICE 2019
International Conference on Electrolysis

2nd International Conference on Electrolysis 2019

CET CHEMICAL ENGINEERING TRANSACTIONS
VOL. 76, 2019
AIDIC

Flexible and Scalable Energy Management of Islanded Renewable Energy Sources Storage Systems

Alexandros Kafetzis, Chrysovalantou Ziogou, Kyriakos Panopoulos, Simira Papadopoulou, Panos Seferlis, Spyros Voutetakis

1. Introduction

REMOTE

Home About

Deliverables

- REMOTE – Deliverable D2.1 : Analysis of the economic and regulatory framework of the technological demonstrators;
- REMOTE – Deliverable D2.2: Technical specification of the technological demonstrators;
- REMOTE – Deliverable D2.5: Control strategies of the 4 DEMOs;

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