FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

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


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**Programme Review Days 2019**
Brussels, 19-20 November 2019

# PROJECT OVERVIEW

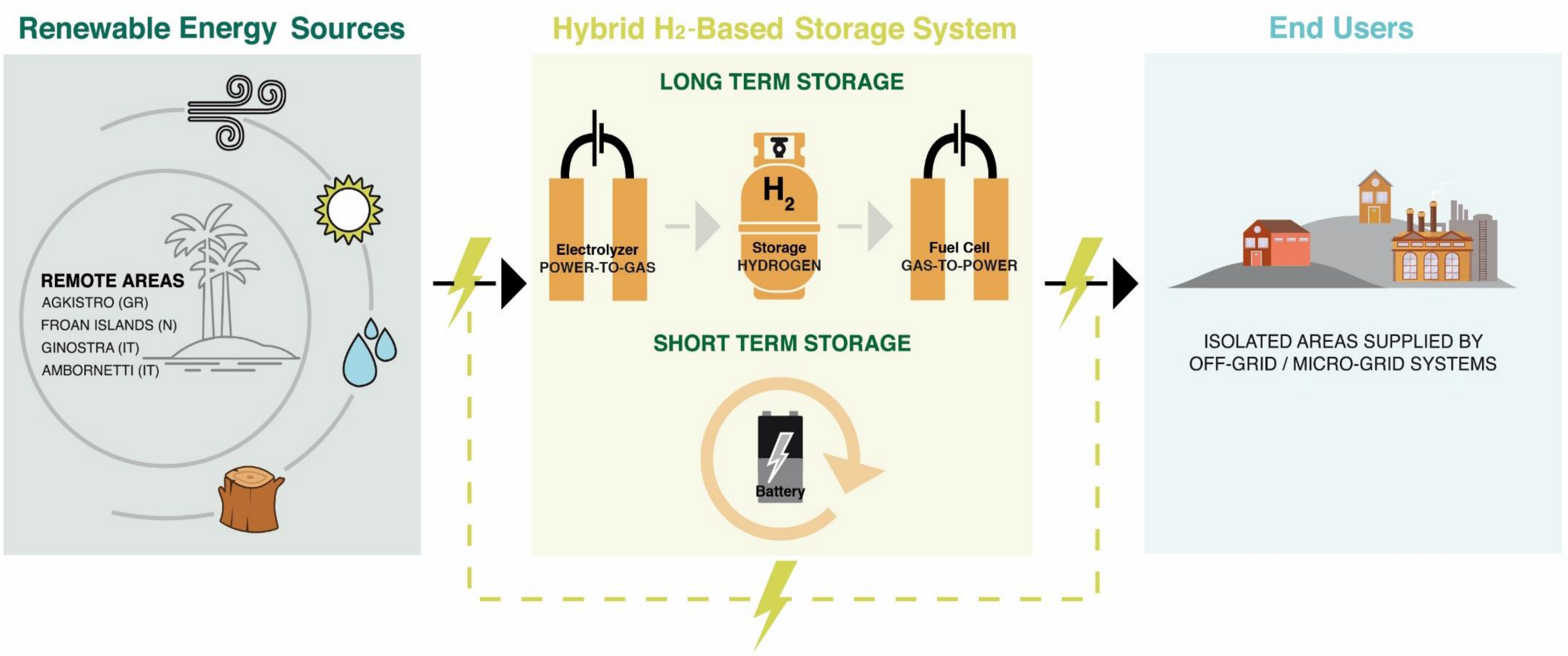
- Call year: 2017
- Call topic: FCH-02-12-2017: Demonstration of fuel cell-based energy storage solutions for isolated micro-grid or off-grid remote areas
- Project dates: 01.01.2018 – 31.12.2021
- % stage of implementation 01/11/2019: 30 %
- Total project budget: 6’761’557.50 €
- FCH JU max. contribution: 4’995’950.25 €
- Other financial contribution: 0 €
- Partners: POLITO, BPSE, HYG, POW, EGP, HOR, IRIS, TE, ENGIE-EPS, SINTEF, CERTH

# PROJECT SUMMARY

## REMOTE

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

REMOTE demonstrates the technical and economic feasibility of two fuel cells-based H2 energy storage solutions (integrated P2P, non-integrated P2G+G2P systems), deployed in 4 DEMOs, based on renewables




**TECHNOLOGY**

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

**OBJECTIVE**

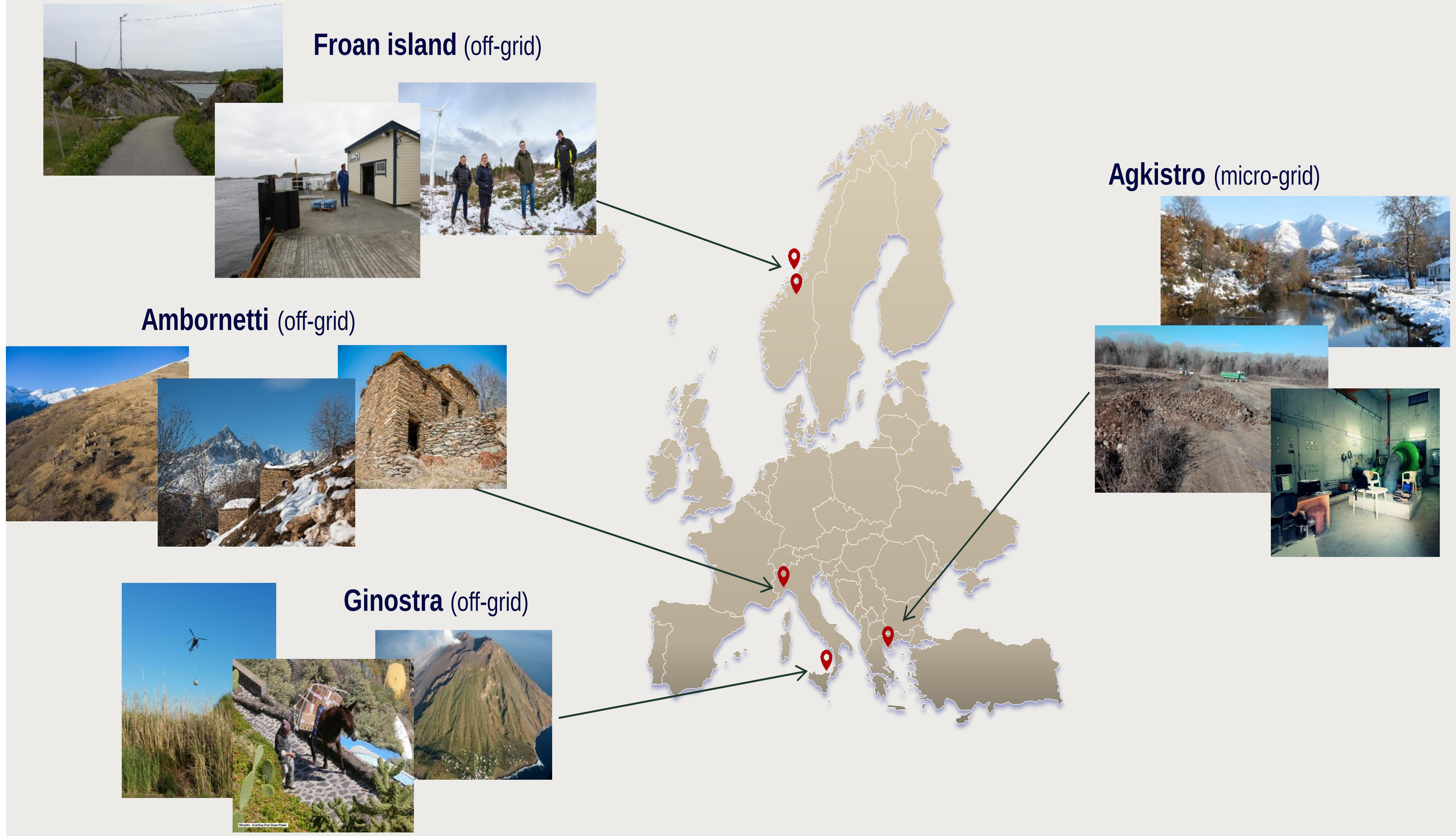
Demonstrate **4 hydrogen-based P2P energy storage systems** located across **3 different countries** (Italy, Greece, Norway) and **different types of remote areas** (from a Mediterranean island to an Alpine region).

**DEMONSTRATION SITES**

**4 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.



# PROJECT PROGRESS/ACTIONS

## Detailed analysis of the technical and business cases of the 4 DEMOs of P2P systems based on H2

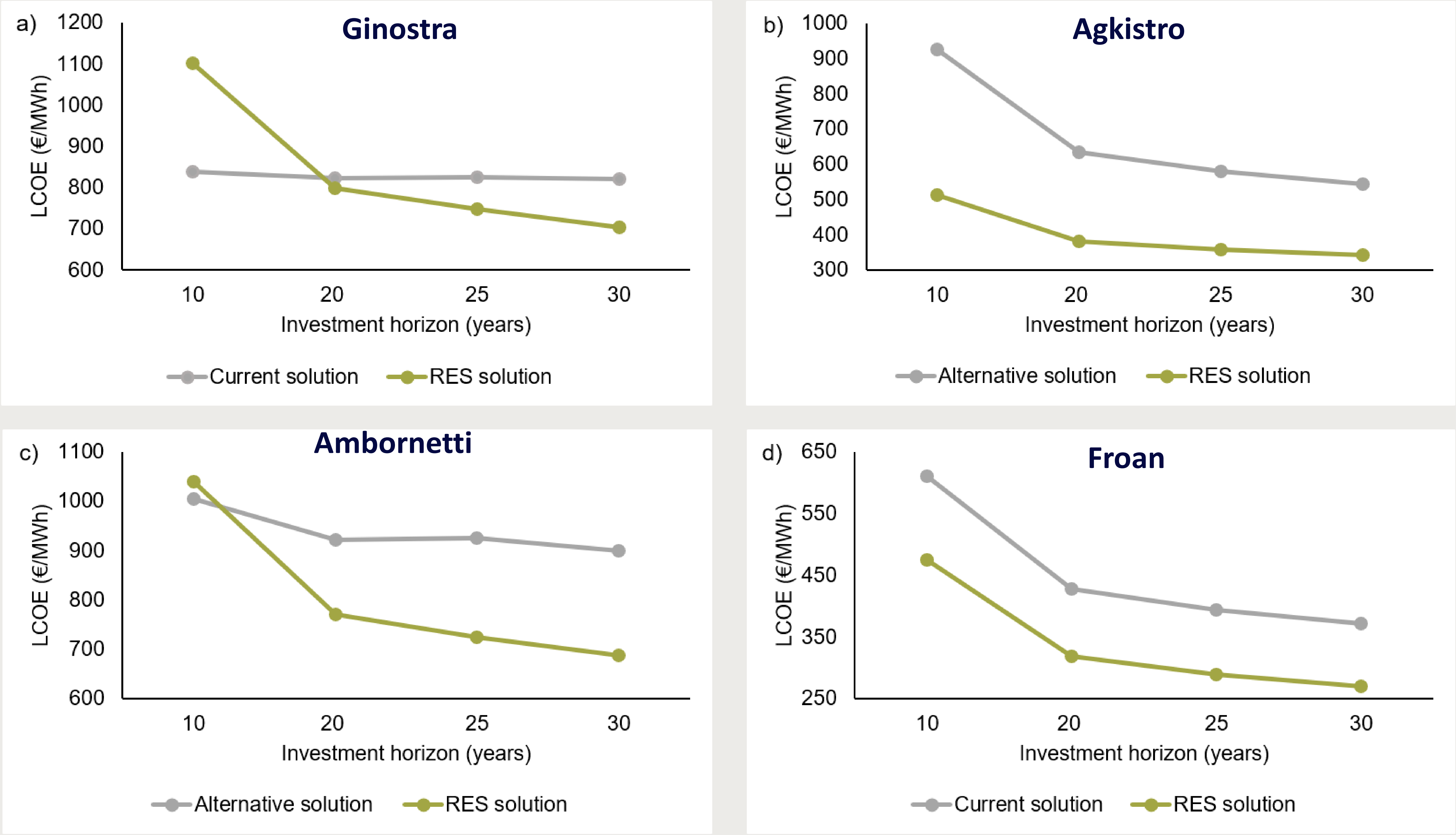
**Achievement to-date**

PROJECT START VALUE

25% 50% 75% 100%

PROJECT TARGET VALUE

| | Ginostra | | Ambornetti | | Froen | |
|---|---|---|---|---|---|---|
| Load directly covered by RES | 82.0 MWh | 47.8 % | 303.9 MWh | 87.1 % | 77.6 MWh | 61.2 % |
| Load covered by P2P (battery + $H_2$) | 82.0 MWh | **47.8 %** | 45.1 MWh | **12.9 %** | 43.5 MWh | **34.3 %** |
| Load covered by external source | 7.6 MWh | **4.4%** | 0 MWh | **0%** | 5.7 MWh | **4.5%** |
| Total load | 171.6 MWh | 100% | 349 MWh | 100 % | 126.8 MWh | 100% |

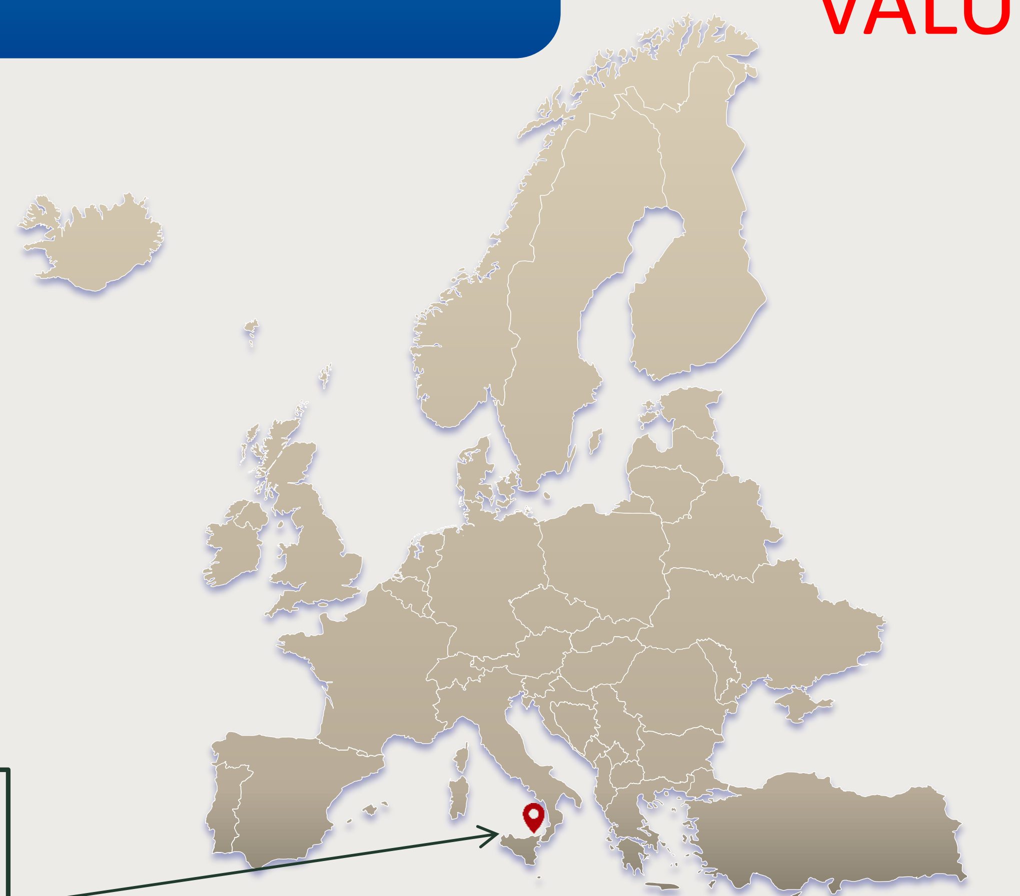


# PROJECT PROGRESS/ACTIONS

## DEMO 1: Ginostra (Island, South Italy)

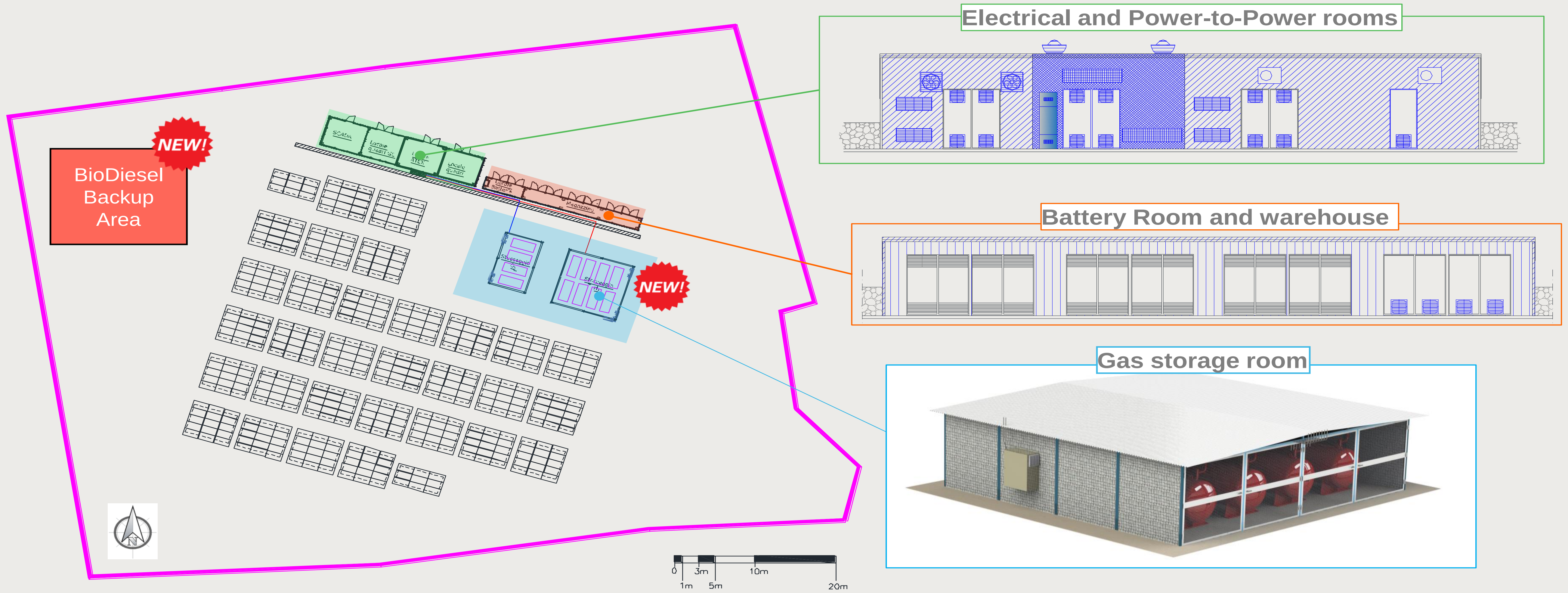
**Achievement to-date**

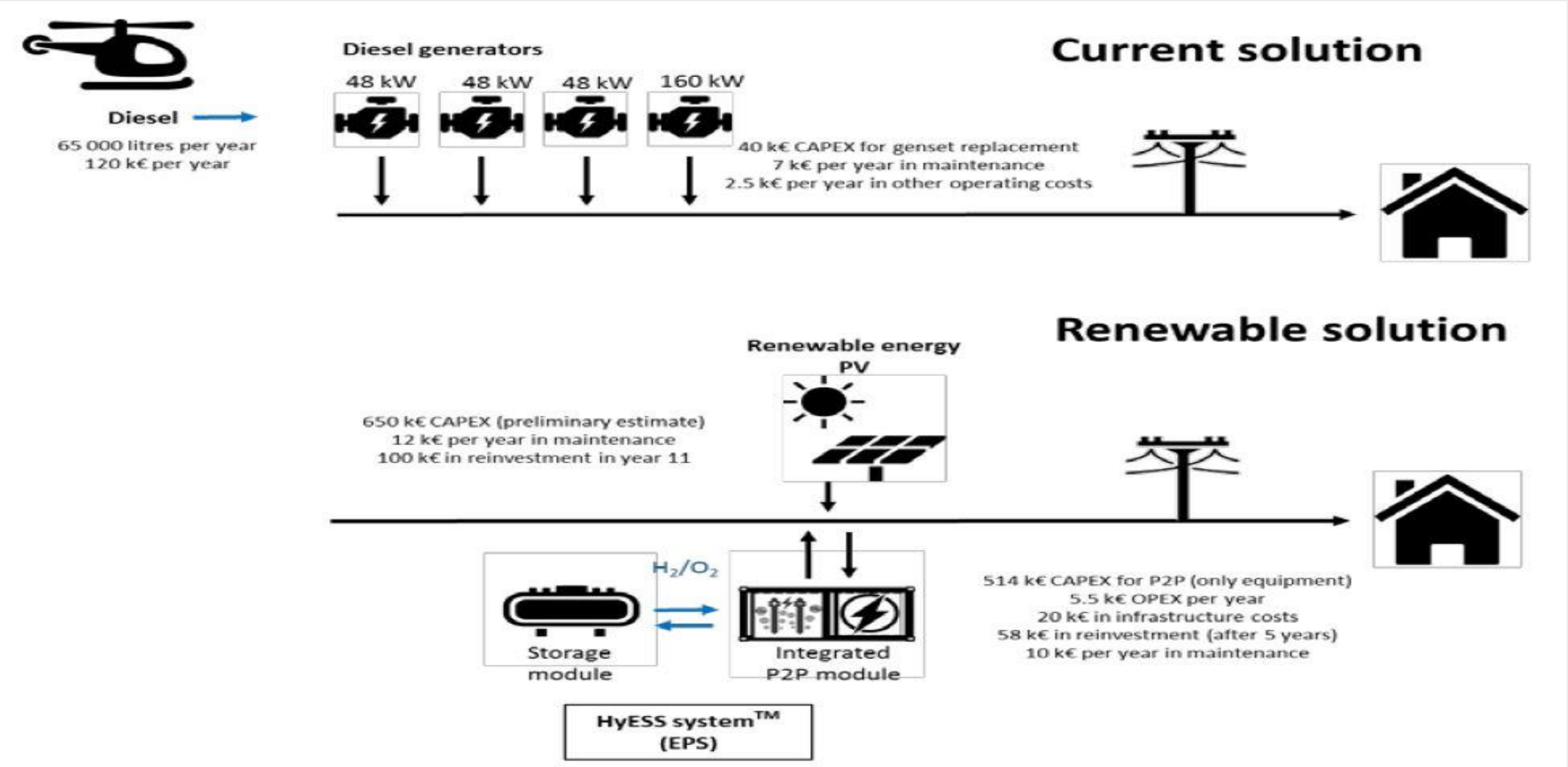
PROJECT START VALUE — 30% — 50% — 75% — 100% — PROJECT TARGET VALUE



**Ginostra** (off-grid)

**RES**: 170 kW PV
**P2G**: 50 kW (ALK)
**G2P**: 50 kW (PEM)
**H2 Storage**: 21,6 $m^3$
**BT**: 600 kWh (Li-ion)



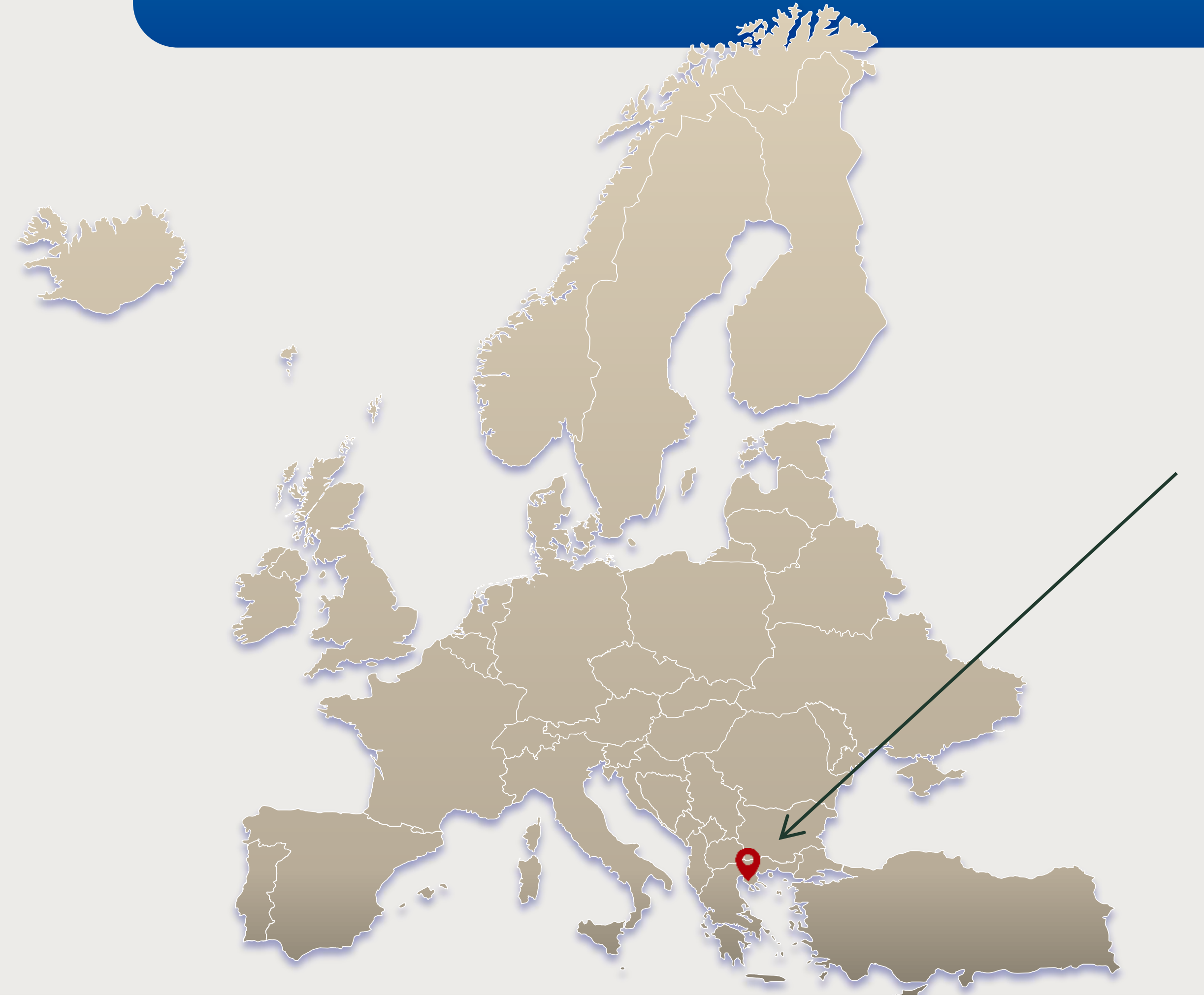




# PROJECT PROGRESS/ACTIONS

## DEMO 2: Agkistro (remote inland, Greece)

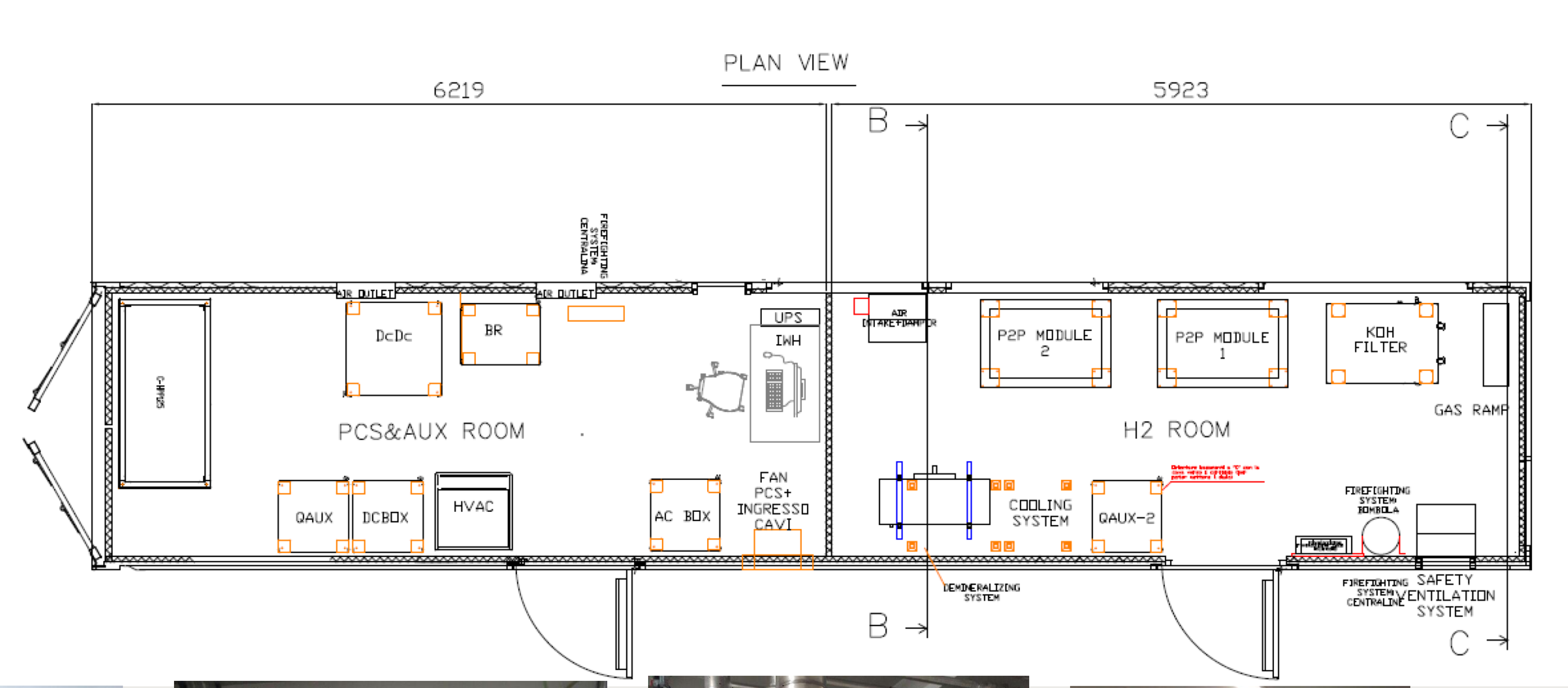
**Achievement to-date**

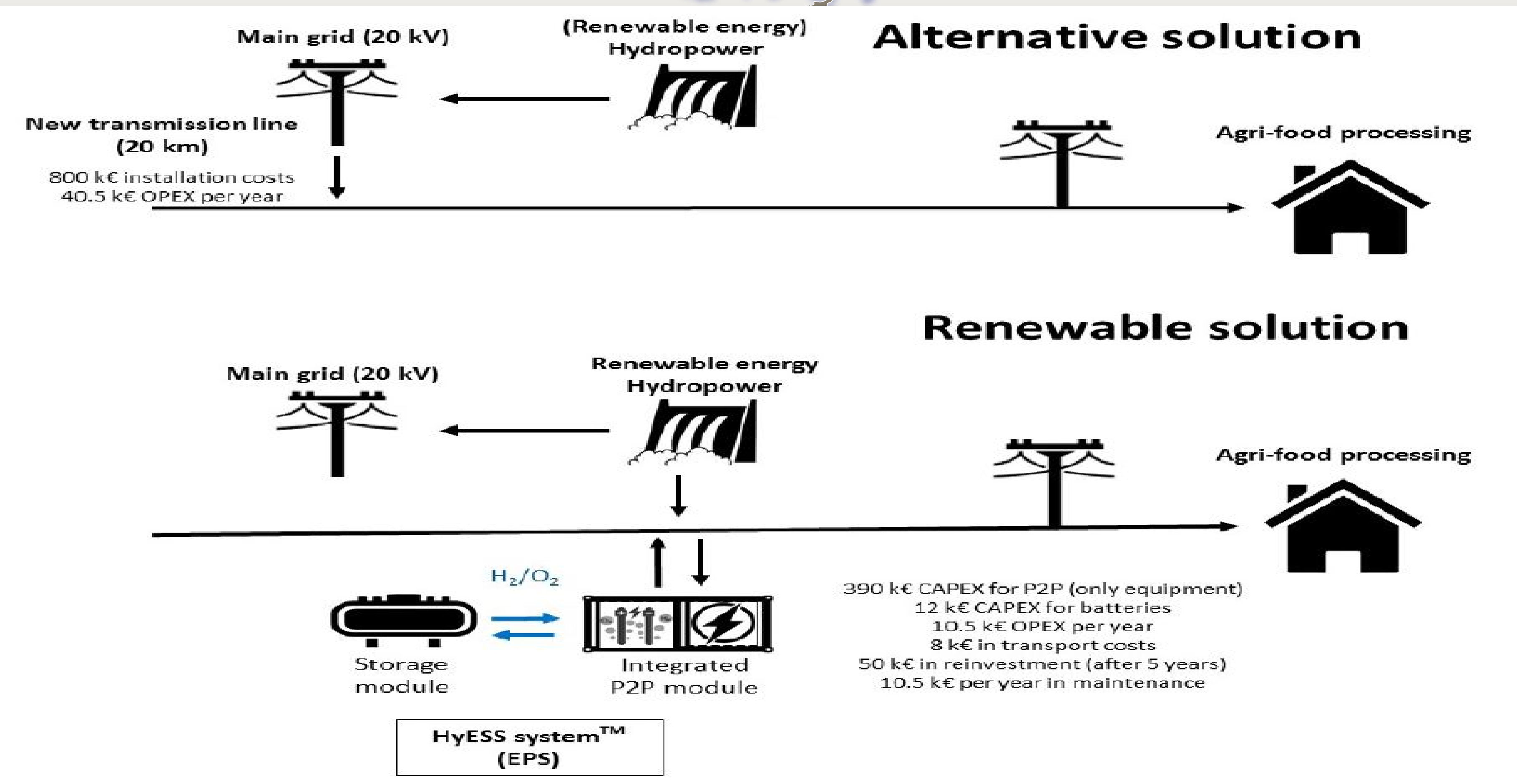
PROJECT START VALUE — 40% 50% 75% 100% — PROJECT TARGET VALUE

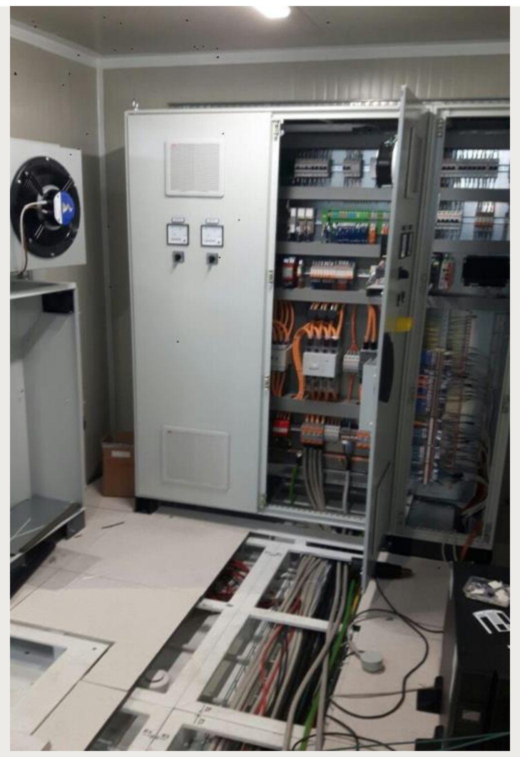


**Agkistro** (micro-grid)

**RES**: 0.9 MW Hydro
**P2G**: 25 kW (ALK)
**G2P**: 50 kW (PEM)
**H2 Storage**: 12 m$^3$
**BT**: 92 kWh (Li-ion)



# PROJECT PROGRESS/ACTIONS

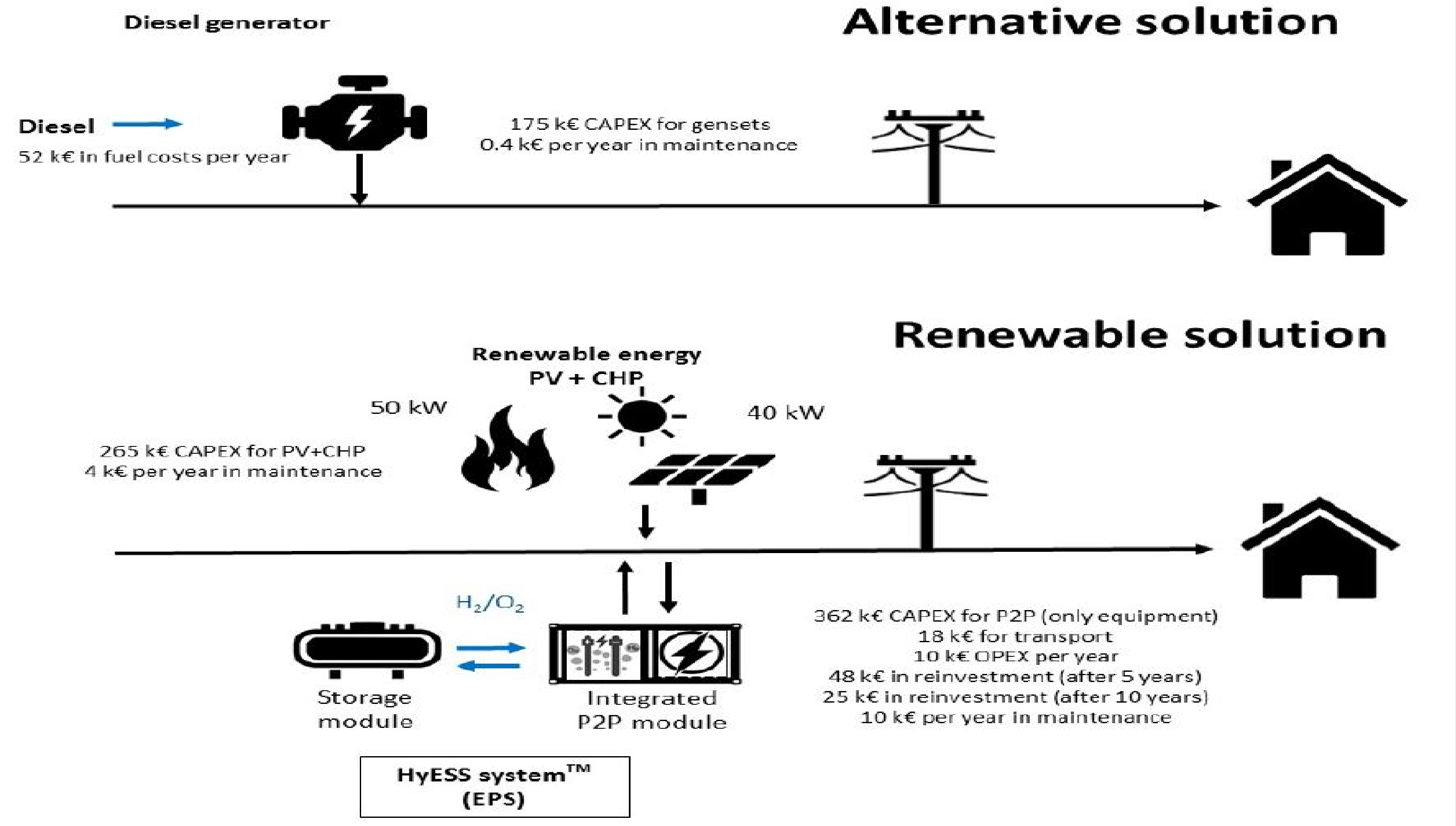
## DEMO 3: Ambornetti (remote inland, Alps in North Italy)

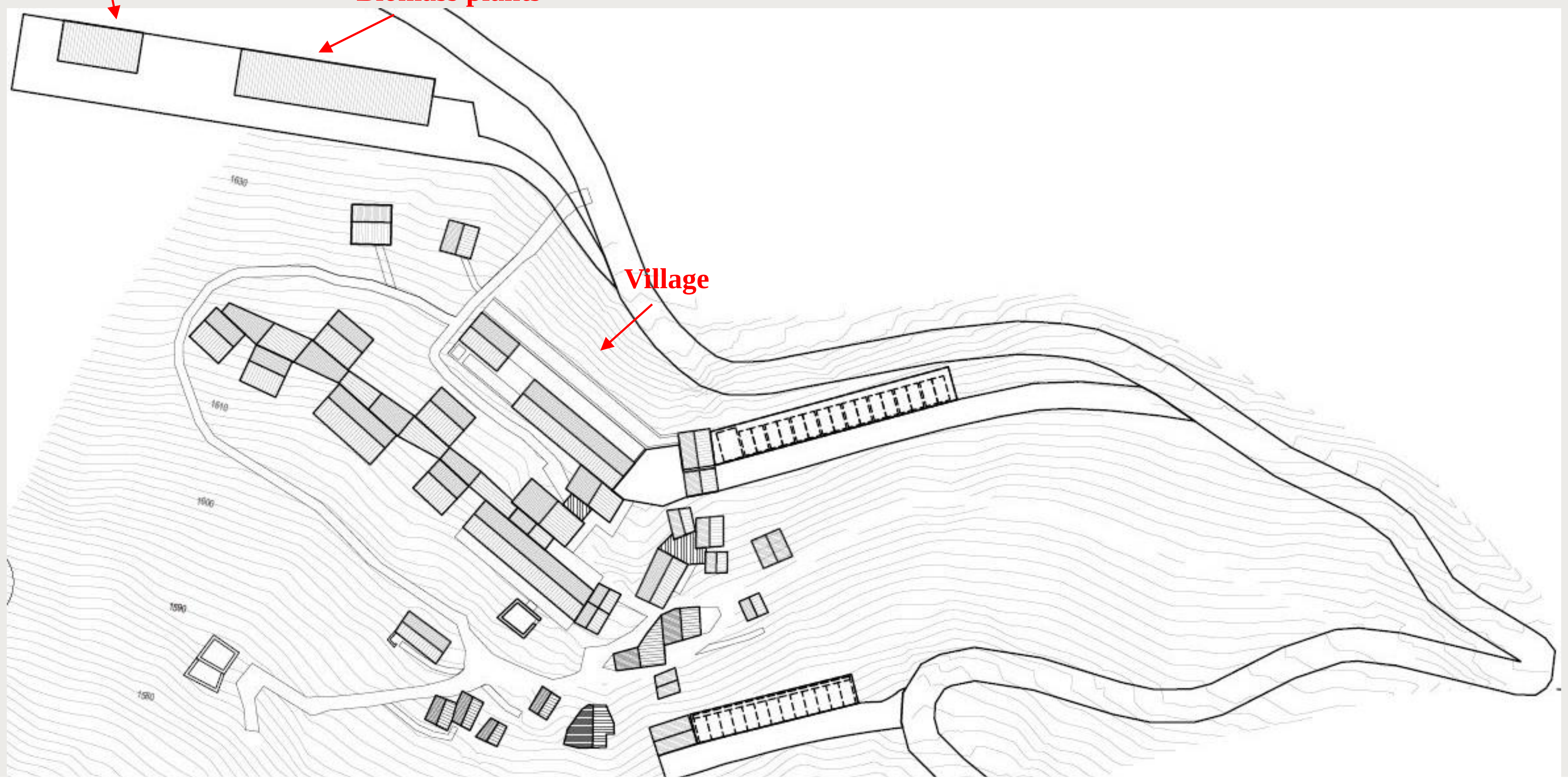
**Achievement to-date**

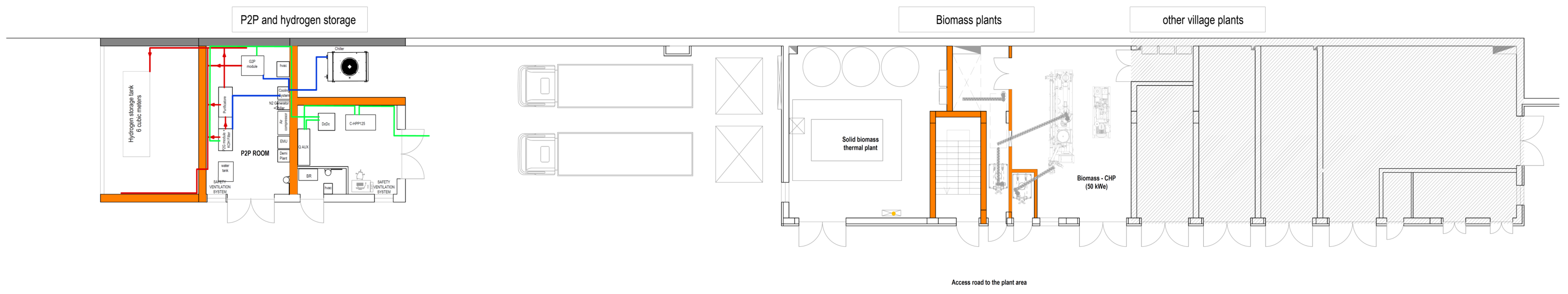
PROJECT START VALUE — 25% — 50% — 75% — 100% — PROJECT TARGET VALUE

**Ambornetti** (off-grid)

**RES**: 75 kW PV
49 kW BIO
**P2G**: 18 kW (ALK)
**G2P**: 85 kW (PEM)
**H2 Storage**: 6 m$^3$
**BT**: 92 kWh (Li-ion)



# PROJECT PROGRESS/ACTIONS

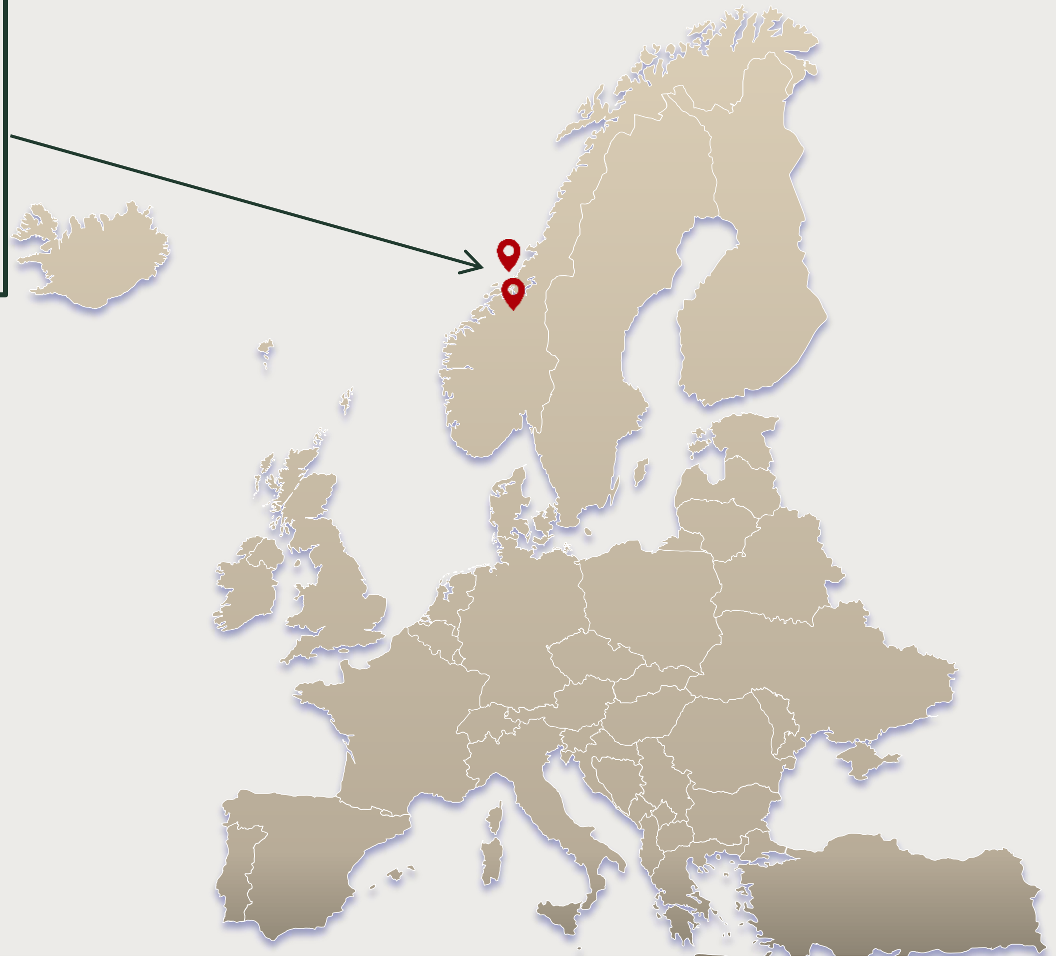
## DEMO 4: Froen Island / Rye shore (island, Norway)

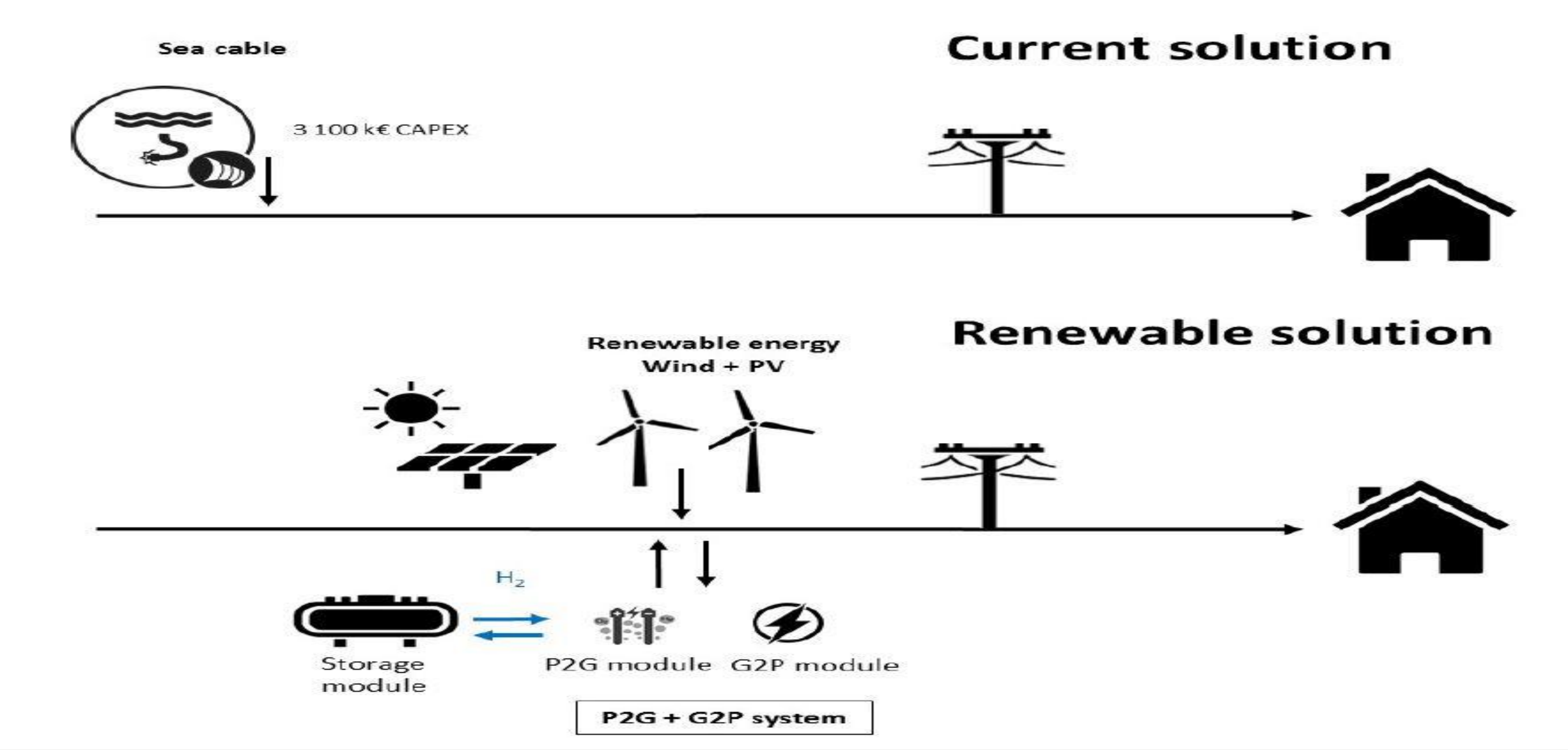
**Achievement to-date**

PROJECT START VALUE — 25% — 50% — 75% — 100% — PROJECT TARGET VALUE

**Froan island** (off-grid)

**RES**: 85 kW PV
225 kW Wind
**P2G**: 55 kW (PEM)
**G2P**: 100 kW (PEM)
**H2 Storage**: 37 $m^3$
**BT**: 550 kWh (Li-ion)






Solar PV field

Wind turbine

# PROJECT PROGRESS/ACTIONS

## DEMO 4: Froen Island / Rye shore (island, Norway)

H2 tank 56m3 / 30bars

Fuel cell 100kW
Power equipment; interfaces;
Control, remote access
Micro grid 3x400Vac output

85kWp PV field

225kW
Wind turbine

Electrolyser 10Nm3/h


Batteries 550kWh

AC micro grid output
3x400Vac /50Hz
To : user's loads ( farm, etc )

# PROJECT PROGRESS/ACTIONS

## DEMO 4: Froen Island / Rye shore (island, Norway)

**The design approach is to have building blocks on the functions identified**

- Clear definition of the interfaces : electrical; fluids ( gas; water etc ) ; communication ( local; remote)
- Minimizing the interfaces and have them ‘universal ‘
  - ✓ Anticipating a range approach
  - ✓ Thinking scalability; flexibility
- Performing an HAZOP analysis
  - ✓ Reduction measures, preventions & list of actions will be considered in the detailed engineering
- Embedded softwares
  - ✓ Configurable parameters
  - ✓ Documented and re usables

# PROJECT PROGRESS/ACTIONS

## DEMO 4: Froen Island / Rye shore (island, Norway)

**All building blocks to be fully tested at the manufacturing plant**

- Use an industrial process
- Reducing the risks & time on site

**Mechanical format : Use standard containers (20ft)**

- Outdoor features, prepared for costal environment ( salt; min-max temp)
- Transport: known logistics & handling, international network
- Installation: quick, and cost effective ( soil preparation; reduced human resources on site; average skills levels)

**Maintenance plan taken into account**

- Use local human resources on tasks on skills 1 and skills 2 ( costs, effectiveness)
  - ✓ Skill 1 : No experience needed, but basic training needs to be received. Ex: farmer
  - ✓ Skill 2: Technician trained. Ex: Trønder
  - ✓ Skill 3: High skilled technician. Ex: manufacturer ( periodicity >1 year)
- Have remote monitoring access, with safety
  - ✓ Access to the data; parameters optimization; capitalization & upgrades
  - ✓ Support, troubleshooting

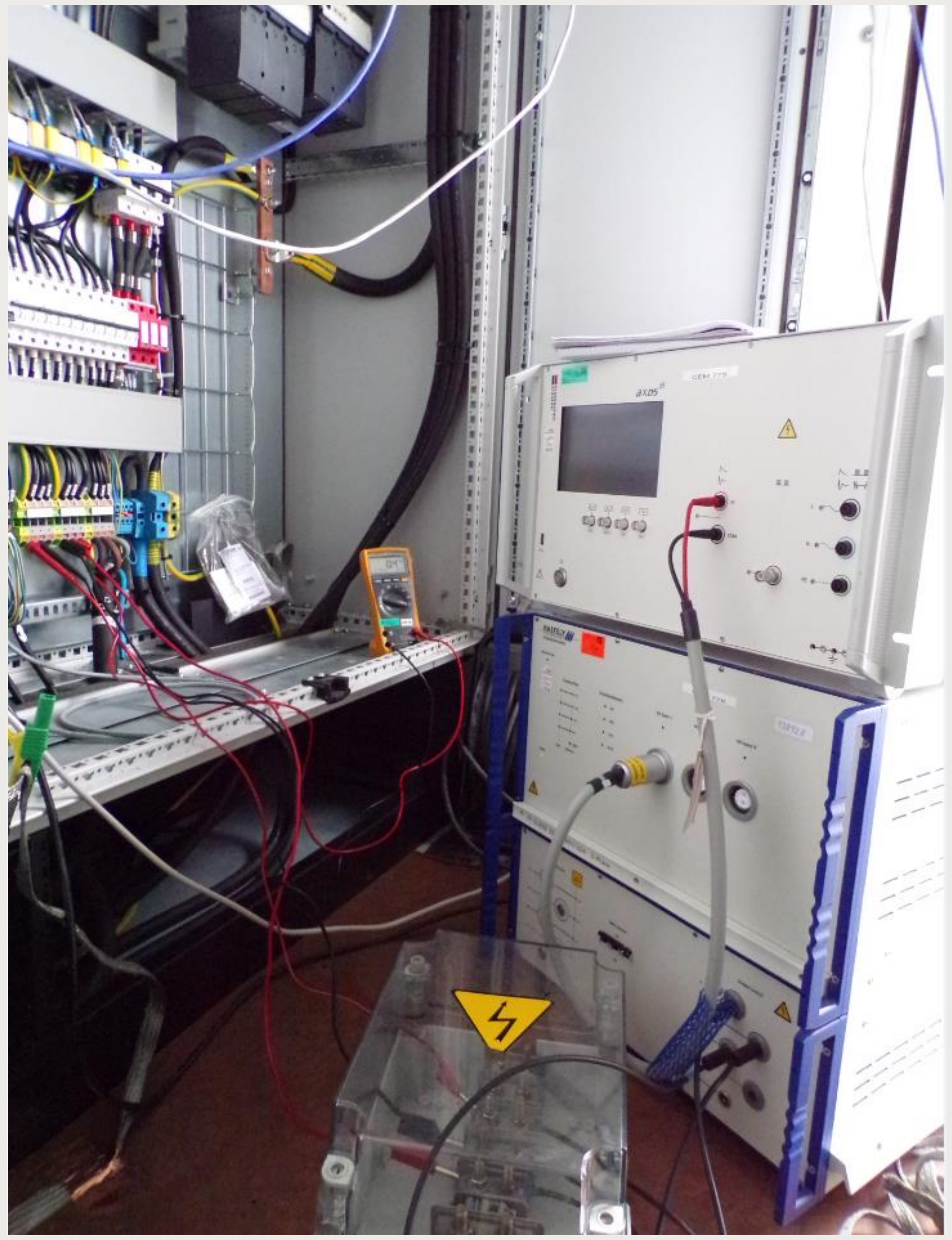
# PROJECT PROGRESS/ACTIONS

## DEMO 4: Froen Island / Rye shore (island, Norway)

## Looking into the future

- Integrate the CE marking on the design ,and have the building blocks certified
- Example on the FC container :
  - 2014 / 30 / EU  EMC Directive
  - 2006/ 42/ UE  Machinery directive

EMC: EN55011 Radiated emission measurement



EMC : EN61000-4-5
Surge immunity test

# PROJECT PROGRESS/ACTIONS

## DEMO 4: Froen Island / Rye shore (island, Norway)

## Looking into the future

**Collecting the data on site to close the loop with the initial sizing (KPIs)**

- Allows to validate the model used; to update it if gaps
- Allows to validate the economical benefit versus initial assumptions
- Proof of concept to other applications and future customers/users

**Industrial : buiding blocks defined, and documented**

- Real costs are listed and  and accurate baseline available ( BOM; labor)
- Initial design expenses not a burden for future similar projects
- Manufacturing process tested.  Improvements identified
- Data base for new components, suppliers

**Improvement of the companies/employees skills, and knowledge**

- Project management with mutiple partners, nationalities
- Activities and skills differents : working together to have the final installation working
- Open some of the companies employees from ‘national’ to ‘European’, and ‘ international’
- Project with an end customer, bringing a real &visible service

# EXPLOITATION PLAN/EXPECTED IMPACT

## Exploitation

For 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;
4. lessons learned, best practices and further needs for the technology.

For final users:

Replication in other off-grid and isolated micro-grids where competitive technologies (diesel generators) are not economically or environmentally viable.

## Impact

1. Reduction of the cost of energy to the final users;
2. To establish confidence in technology, business models and market readiness with end-users and authorities of isolated territories;
3. Demonstrate a viable solution and a replicable business case;
4. Supplier and user experience of installation/commissioning, operation, maintenance and use of electrolyser and fuel cell power generation in critical environment (cold in North Europe, volcano in South Europe).

# Risks and Challenges

**DEMO 4 (Froan Island, North EU):**

in order to wat for the permissions procedure for the wind farm installation in the Froan Island, the first installation will be done in the Rye inland site, with an existing windmill, and after the final goal is to move to an island site

**DEMO 1 (Ginostra, South EU):**

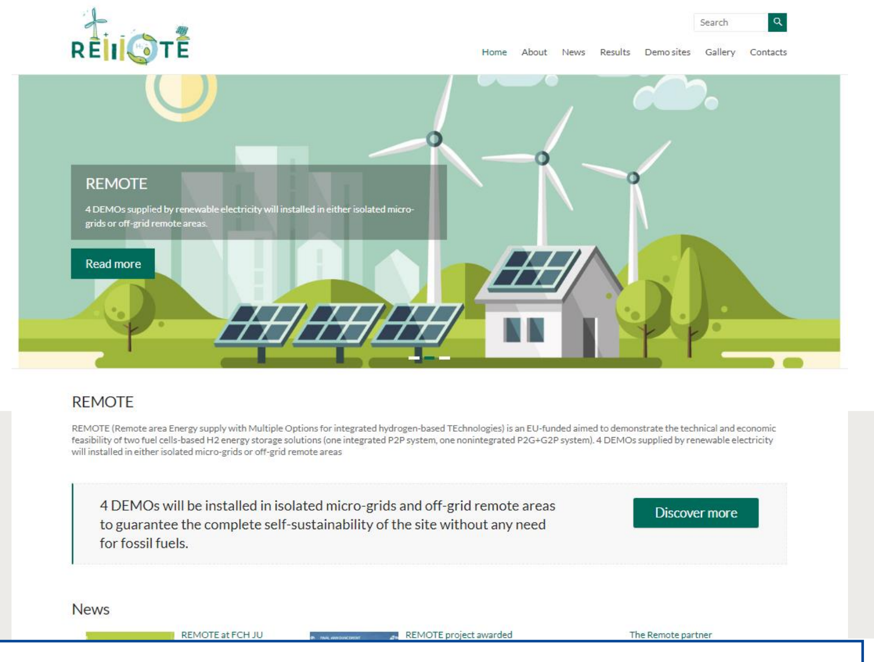
delay of the authorization certificate for land acquisition provided by the Regional Authority in Sicilia (Italy), and more safety requirements because of the volcano activity: the expected delay is of maximum 10 months, from M24 to M34, of the DEMO 1 start-up

**DEMO 3 (Ambornetti, North Italy):**

since the demo is collecting delay caused by the authorization certificate delivering, the partners involved propose to use the DEMO3 for the building site, in order to feed the loads required in the construction step, while waiting for the operation of the site

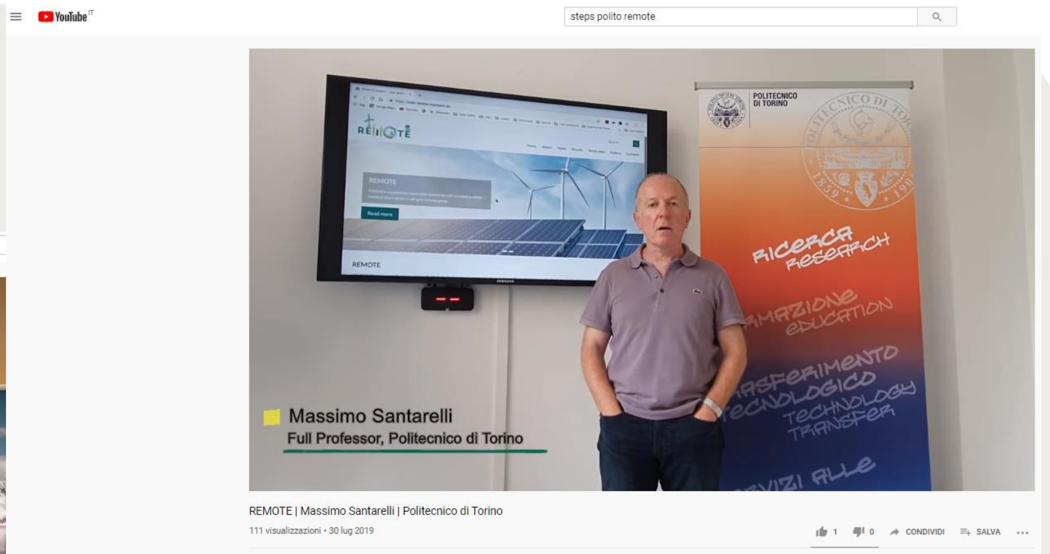
# Communications Activities

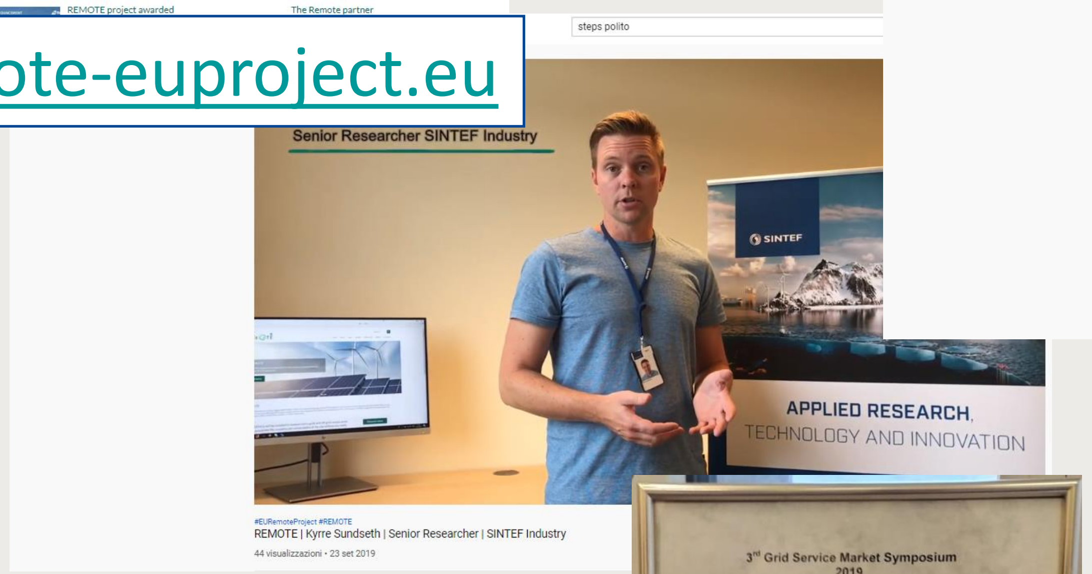
- **REMOTE website and social media channels**



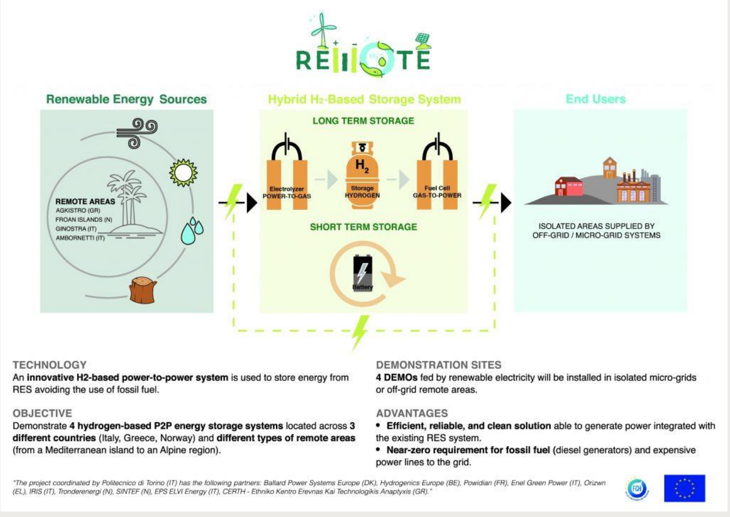

https://www.remote-euproject.eu

- **Partners presentation videos** (uploaded 1/month on Youtube Channel) and **infographic video** under development



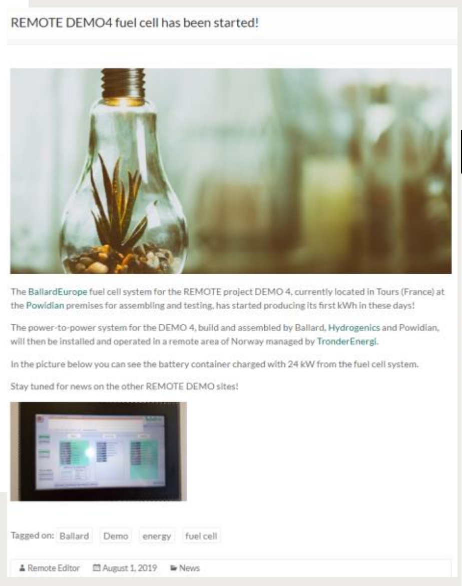

- REMOTE at **international conferences, workshops and locale events**:
  - EFS– Energy Sustainability Conference, Turin (IT), July 24-26th 2019.
  - Dublin Euro Conference 2019, Ireland, June 23-26th 2019.
  - Smart Villages, a common perspective through different visions, Courmayeur, Mont Blanc, Aosta Valley (IT), May 23-24th 2019.
  - Second International Conference on Electrolysis is held in Loen (N), June 9-13th 2019.
  - 3rd Clean Energy for EU Islands Forum, Stockholm (SW), May 14-15th 2019.
  - Consultation Forum for Sustainable Energy in the Defence and Security Sector Phase II, October 2018.
  - Technologies for off-grid remote areas, with focus on mountain locations, Turin (IT), May 18th 2018


- REMOTE awarded at **EFCF Lucerne**, during the event **3rd Grid Service Markets Symposium**, July 4th 2019, as the **Most Innovative Contribution** for the work "REMOTE project: techno-economical sizing of H2-based energy storage systems in remote areas".


- **Communication material** (infographic & brochure)

- **Press release** (2018), **local news** and news on the DEMO4 start-up in the lab

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