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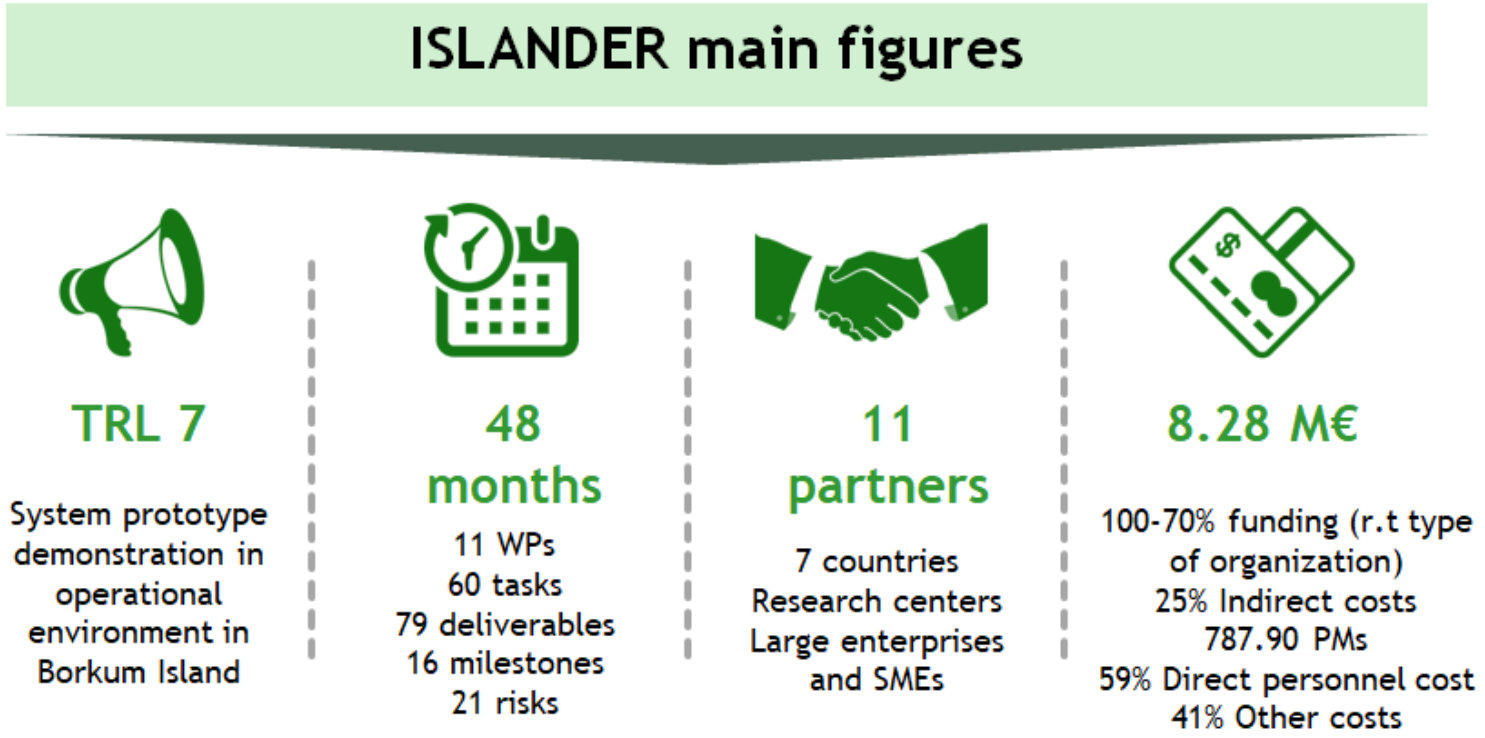
ACCELERATING THE DECARBONIZATION OF ISLANDS' ENERGY SYSTEMS

ISLANDER Project: The role of hydrogen in the Borkum island decarbonisation

IDENER, 26/04/2022

Project general overview (1/2)

- Start date - End date : 01/10/2020 - 30/09/2024



- https://cordis.europa.eu/project/id/957669
- https://islander-project.eu/

Project general overview (2/2)

- Consortium partners

Project main objectives

- **Develop an advanced smart IT platform** using latest mathematical optimization techniques, and which will flexibly manage Distributed Energy Resources (**DER**) coupled with Hybrid Energy Storage (**HES**) while also incorporating Demand Response (**DR**) and Local Power Balancing (**LPB**). This will provide a powerful approach to make the most of the renewable generation and to enhance the stability of the island's power network.
- **Develop improved multi-scale forecasting methodology** relying on comprehensive modelling of demand and supply and on the recent advances of machine learning, in order to deliver **high-accuracy forecasting** data at the multiple levels required by the optimisation algorithms running the smart IT platform.
- **Implement a methodology on the large-scale design of optimal distributed DER+HES systems** which, in combination with the planned smart IT platform, will **optimise** investment and operation **costs** to reach cost parity with fossil fuel energy sources in the island.

Project concept

b. **Ultracaps + Batteries**

c. **Hydrogen-based storage**

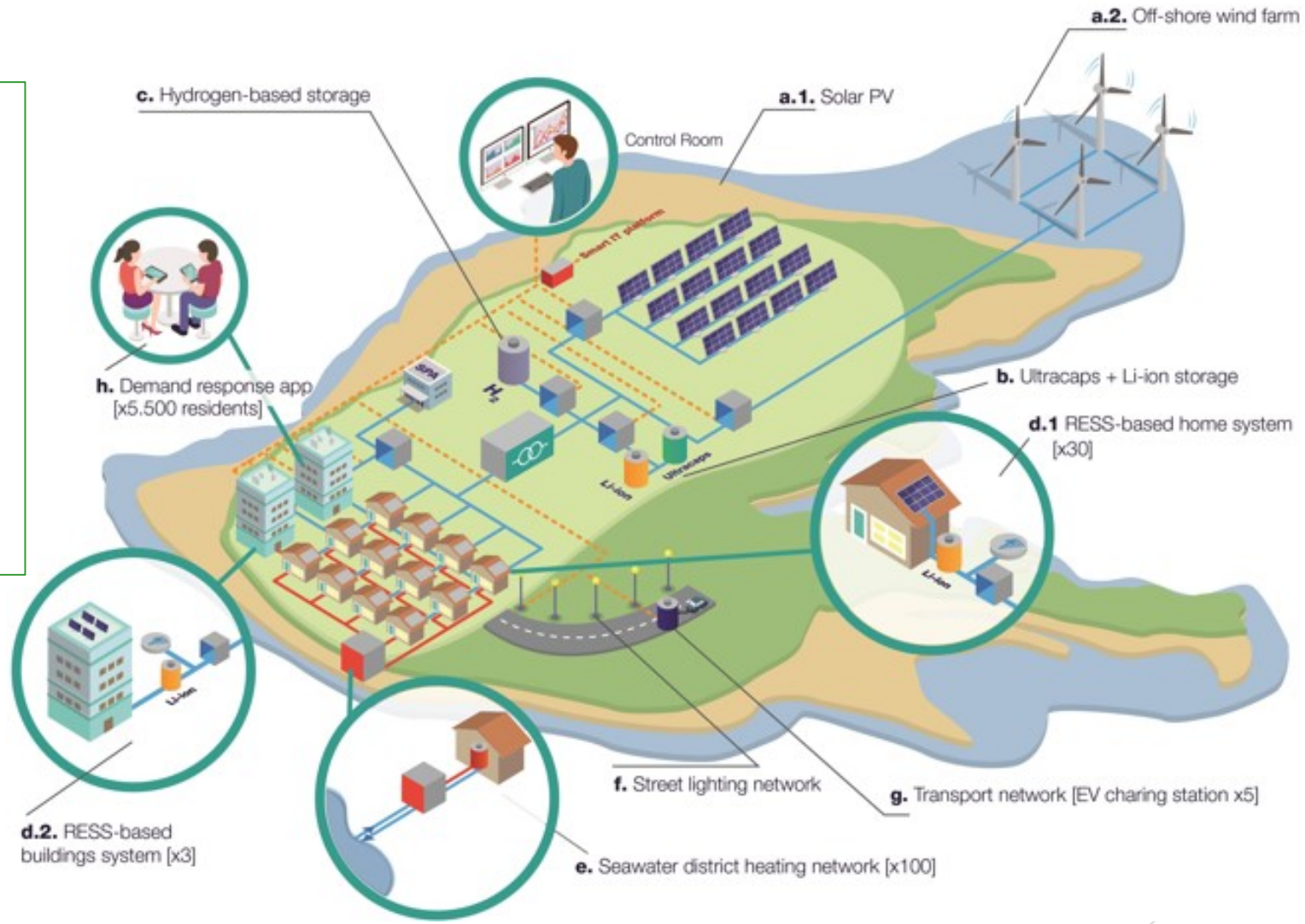
d. **RESS homes and buildings system**

e. **Seawater heating**

f. **Street lighting**

g. **EV charge stations**

-> ***Demand response*** <-



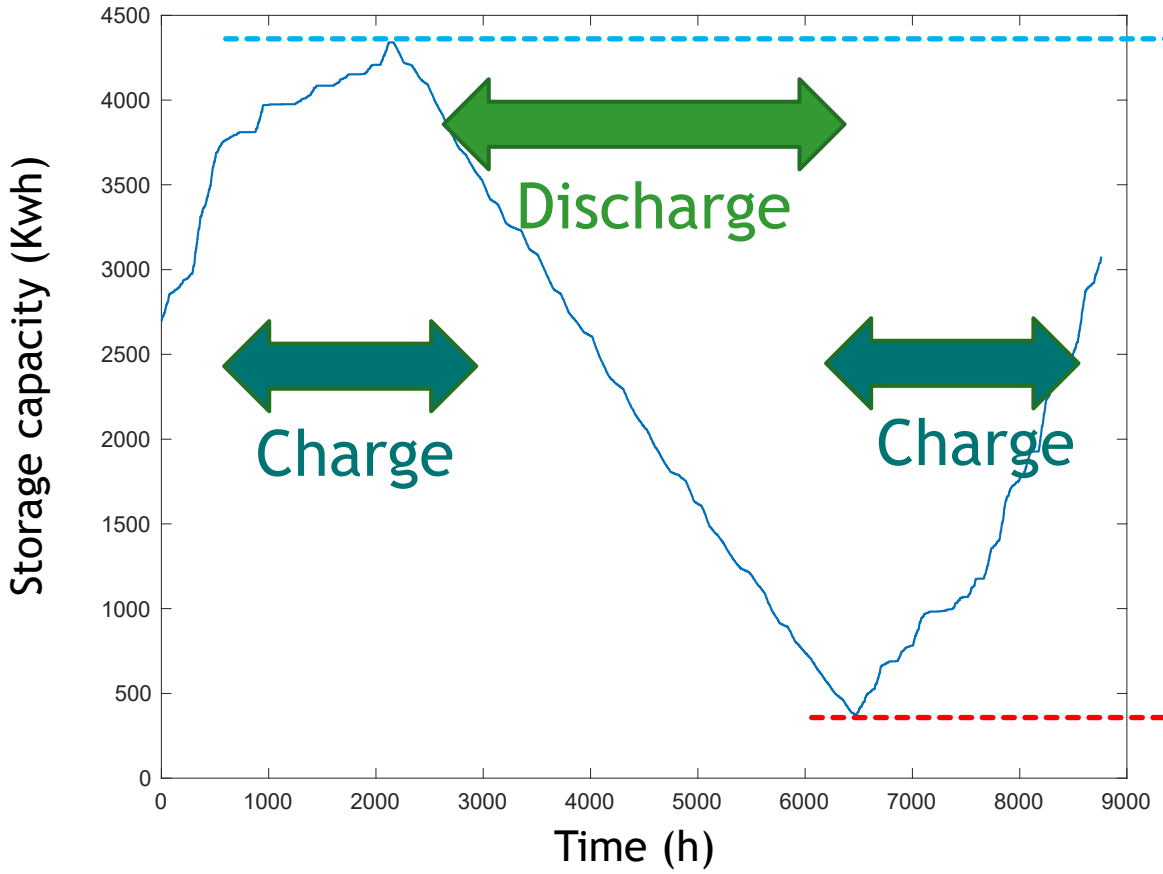
Hydrogen system. Seasonal storage (1/2)

- **Very promising energy vector for long periods.** Due to high CO2 emissions from non-renewable sources, a real alternative to traditional fossil fuels need to be implemented. Hydrogen is a friendly alternative for energy production with zero emissions, contributing to the descarbonisation. It can be stored and be used when required with no loss of performance.
- **Instability in the island population.** Tourist season usually increases the number of people on Borkum island during holydays periods. Energy consumption is heterogeneous and the energy buffer getting with the energy hydrogen storage support to withstand these peaks.
- **Energy storage and use when required by demand.** Borkum present a changeable climate combining windy, cloudy, sunny and cloudy. Weather may vary widely during the same day, and sometimes traductional renewable energy can not satisfy the energy needs for long periods

Hydrogen system. Seasonal storage (2/2)

(x3) consumption during spring and summer periods

Seasonal evolution: 1 full charge + 1 full discharge



H_2 storage **maximum** after Winter
(limit 144 kg H_2 = 4800 kWh)

H_2 storage **minimum** after Summer

Hydrogen system. General specs design

- Pilot plant system
- PEM electrolyser 25kW → around 10 Kg/day of hydrogen in a working day
  - Modular solution (5 modules 5 kW each one) advantage
  - Modular production 1 Nm^3 H_2/h
  - Possibility to add some ones depending on the available space inside the container
- Storage → capacity up to 144 Kg of hydrogen
  - 18 bottles per bundle (8) (bottle tanks 50 L)
  - Storage at 300 bar of pressure

- PEM Fuel cell 15kW
  - Modular solution, possibility to increase the system (2 modules around 8 kW each one)
  - Consumption around 0.13 Nm^3 H_2/min per module
- Containerized solution 20ft (electrolyser & fuel cell) + storage in bundles
- System connected directly to the grid

Hydrogen system. Additional data

- Reaction time for electrolyser ~30 seconds
- Reaction time fuel cell ~30 seconds
- Safety system
  - Purge and ventilation lines are routed to a safe location
  - Hydrogen storage is safely guarded with low and high-pressure readings
  - Redundant hydrogen sensors for leak detection
  - In case that signal goes off from the defined threshold, safety relays will be triggered to activate a safety shutdown procedure

Fuel cell and balance of system

Hydrogen system. General requirements

- Electrolyser modular production: 1 Nm^3 of hydrogen as minimum.
- The system treatment plant operates with tap water (around 600 µS/cm), being able to adapt the water for electrolyser feeding conditions.
- Internet wireless connection.
- Each module shall be operated on independently of other modules, depending on needs at any moment.
- Hydrogen quality. After the purification system, 99.999% shall be obtained, with <5ppm oxygen and <5ppm H_2O.

Electrolyser and balance of system

Hydrogen system. Additional data

- Available area 10x12 m in Borkum island. Foundation base concrete
  - Nearby water connection available
  - Power lines near

Hydrogen system. Gantt chart

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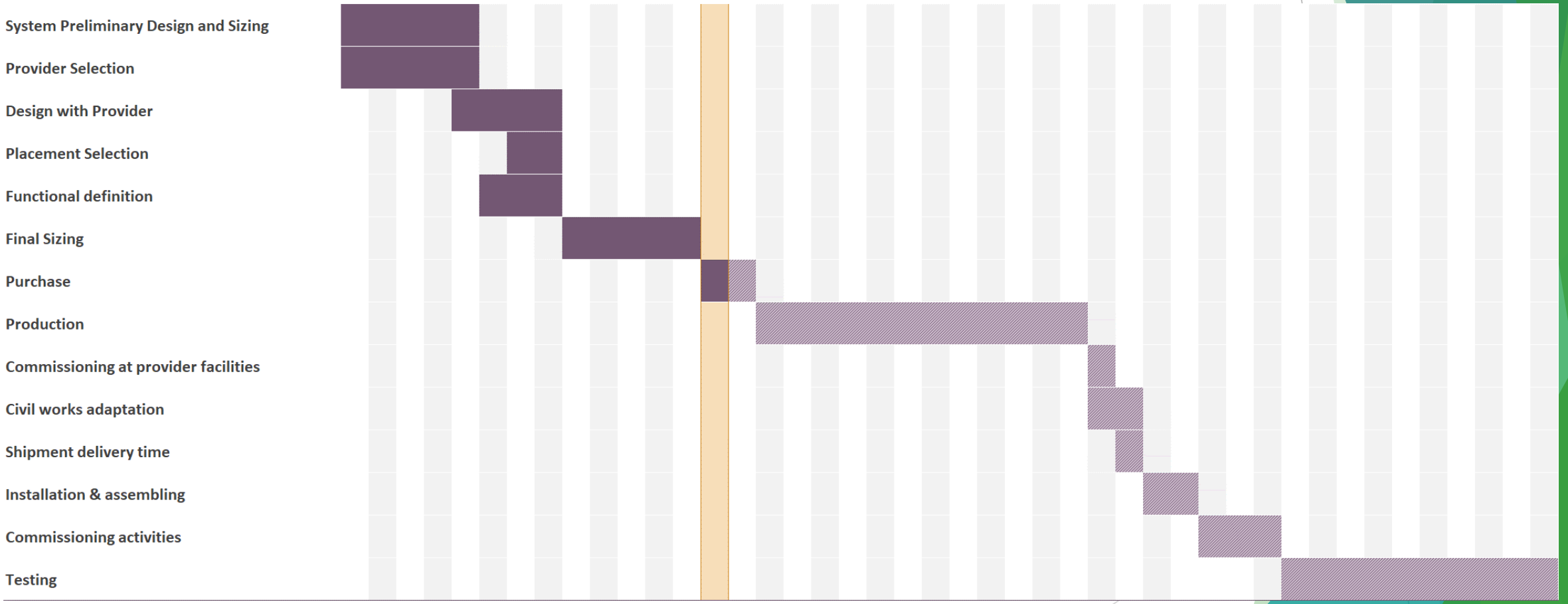
Gantt chart of the project execution



Thank you for your attention!