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Demo#1 (Maia, Portugal): Multi-technology industrial microgrid at Sonae Campus

Industrial park located in Maia, in Porto Metropolitan Area, that includes office buildings, a chipboard factory and the refrigeration systems of a logistics hub.

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The SINNOGENES project will implement a redox flow and thermal battery storage system, managed by an advanced microgrid energy management system with optimization tools and a RES dispatch center for local and external plant control, ensuring greater flexibility and autonomy for the industrial microgrid.

The integration of RES combined with energy storage will help maximize self-consumption, while increasing the system flexibility to optimize energy consumption, specially in industrial processes (power and heat).

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Co-funded by the European Union

This project has received co-funding from the European Union's Horizon programme under the Grant Agreement No. 101096992

Partners

Demo #1 – Maia, Portugal

Demo #1 is located within a large industrial campus that hosts diverse activities with varying energy demands. This multi-energy system integrates multiple technologies, featuring a Vanadium Redox Flow Battery (VRFB), a lithium-ion battery a Photovoltaic (PV) system, supporting efficient and sustainable energy management across the site.

A **control system** is being developed to **manage and dispatch multiple energy assets across the industrial campus**. It will integrate various technologies, including a redox flow battery, and thermal energy storage, ensuring real-time supervision and seamless coordination. The system will also assess the flexibility of these assets for future services such as ancillary services and congestion management. Performance will be evaluated based on key pilot indicators, driving efficiency and sustainability in industrial energy management.

Vanadium Redox Flow Battery

- Max Power: 10 kW
- Stored Energy: 40 kWh

Thermal Energy Storage

- Innovative thermal energy storage system will be developed in the project, with new materials

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Demo#2 (Soria, Spain): Smart Microgrid Integration at CEDER-CIEMAT

Connection of the electrical microgrid with the district heating system through **geothermal energy**. Integration of two fast-response energy storage prototypes for advanced **frequency and voltage control**, enhancing the system's stability and efficiency.

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Integration of the electrical microgrid with the district heating system through geothermal energy, supported by the development of an advanced control system. This facilitates the efficient flow of energy between the electrical and heating networks via the geothermal field, optimizing energy management.

Additionally, the demonstrator incorporates two fast-response prototypes: a flywheel and a supercapacitor bank, both capable of delivering large amounts of energy in a very short time. These technologies ensure advanced frequency and voltage control, significantly enhancing the stability, efficiency, and responsiveness of the system.

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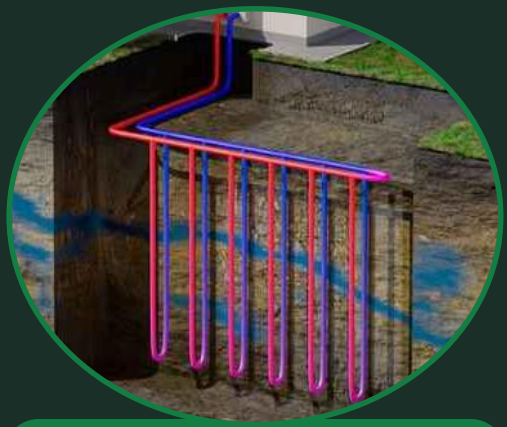
Demo#2 – Soria, Spain

Flywheel

- Max Power: 25 kW
- Stored Energy: 4.2 kWh
- Max Speed: 13.000 rpm

Fast-Response Energy System

- Integrated into smart microgrid
- Voltage support and frequency stability
- Short – term energy management (t < 15 min)
- Suppress power spikes (t < 10 s)

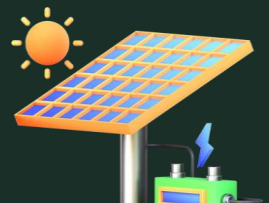


Geothermal Field

- Connected to district heating via geothermal heat pump
- Testing energy seasonal storage
- Integrated with electrical microgrid
- Real time & remote control system
- Optimization of management strategies

Ultracapacitor Bank

- Max Power: 120 kW
- Stored Energy: 0.77 kWh
- Nº Cells: 256



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Innovative Hydrogen Storage Solutions Empower Local Energy Systems at Demo#3 in Huesca, Spain

DEMO#3

1. Presentation and European Involvement

The SINNOGENES project, a European initiative, aims to revolutionize energy storage technologies by integrating electricity, hydrogen, and heating solutions, in line with the Paris Agreement and the UN's 2030 Agenda.

Located at the Walqa Technology Park in Huesca, Spain, Demo#3 exemplifies SINNOGENES' vision by incorporating innovative Power-to-Gas storage technology into a Local Energy Community. Power-to-Gas technology focuses on producing hydrogen for mobility and other various applications. It does not involve re-electrifying hydrogen with fuel cells or injecting it into the gas distribution network.

The key partners involved are the Aragon Hydrogen Foundation (FHa), Inycom, and Schneider Electric, contributing expertise and state-of-the-art technology.

2. Facilities Involved at FHa

The Aragón Hydrogen Foundation is utilizing its advanced hydrogen facilities and expertise to implement and validate Inycom's innovative optimization tools at Demo#3.

Key facilities include:

- **Renewable Energy Sources**- The site integrates 160 kW of photovoltaic systems.
- **Electrolysers**- A 15-kW Anion Exchange Membrane (AEM) electrolyser and a 60-kW alkaline electrolyser.
- **Hydrogen Storage**- A versatile storage setup includes: 11 kg in buffer storage, 23 kg in HRS350 cascade storage, and 62 kg in HRS700 cascade storage.
- **Two Hydrogen Refuelling Stations (HRS)**- The site integrates 160 kW of photovoltaic systems.

The Energy Management System optimizes energy production, consumption, and storage by converting surplus renewable energy into hydrogen through electrolysis. This system enables efficient energy storage for later use, including supplying Fuel Cell Electric Vehicles. It also adapts to fluctuating renewable energy availability and market electricity prices.

3. Used Technologies and Progress

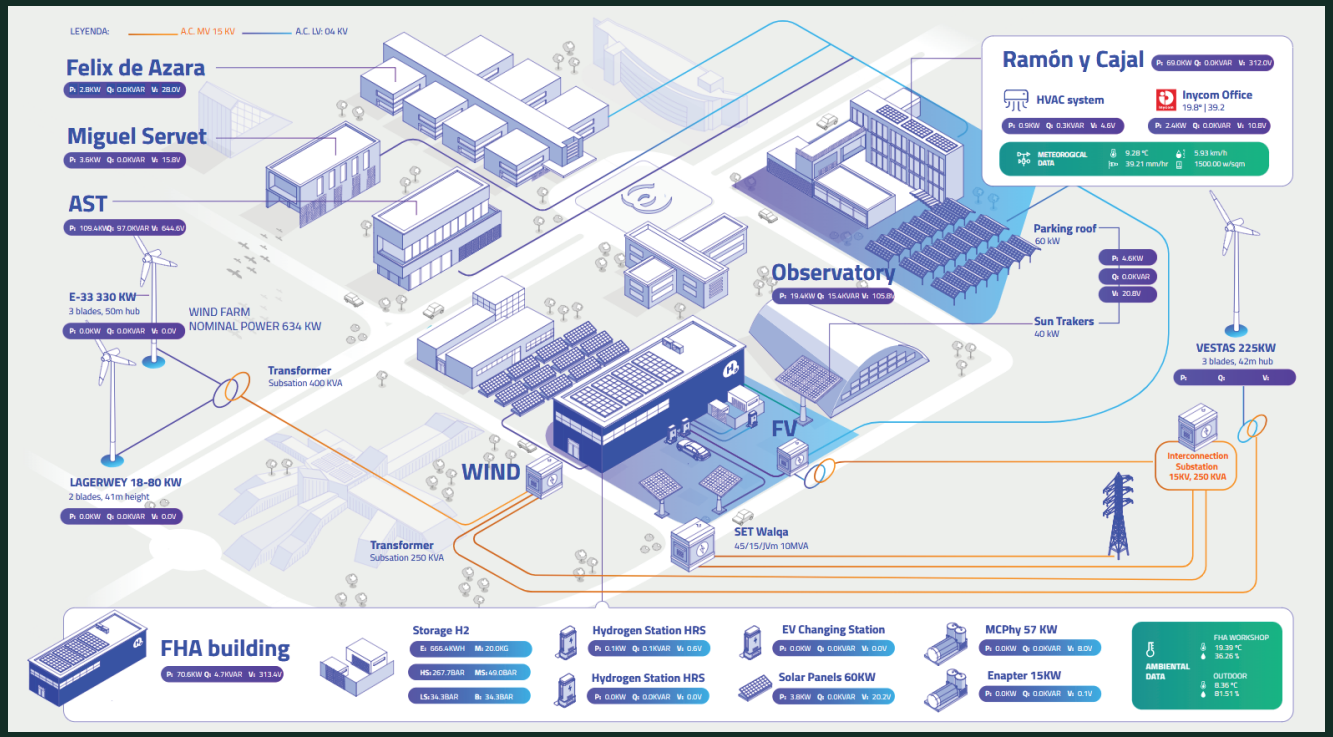
For being able to archive optimal dispatch 4 modules are being developed:

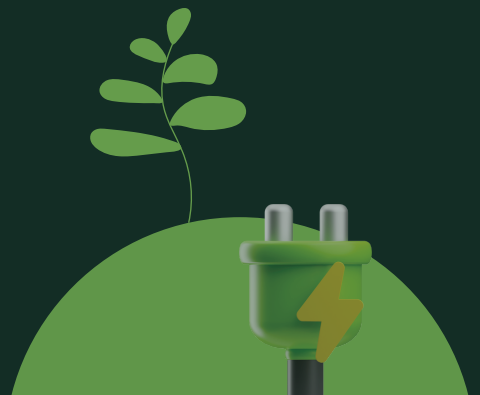
- **Module 1: Electricity market tool** - The system provides an hourly energy price estimate for the wholesale market, varying based on the availability of hydrogen storage.
- **Module 2: Building & HRS load prediction** - The electrical and hydrogen loads, including those of the two HRS (350 and 700 bar), are not only read and visualized but also predicted to optimize their use in the coming days.
- **Module 3: Optimization engine** - Local Energy Community (LEC) uses an automated dispatch module to dynamically control electrolyzes and EV chargers, balancing renewable power production, converting excess energy into hydrogen, and making optimal energy purchases and sales.
- **Module 4: Power Purchase Agreements and sustainability module** - It enables a better and more efficient use of the energy produced.

The tool for managing renewable energies, allowing visualization of power and hydrogen load data, and integrating all modules is in advanced development.

4. Next Steps

By collaborating with European partners and sharing insights from Demo#3, SINNOGENES promotes the adoption of innovative energy storage solutions across the EU. As for the next steps, the development of the solutions will be finalized, and the piloting and validation phase will begin. Together, these facilities and their seamless integration demonstrate how advanced energy storage technologies can enable a sustainable, flexible, and decarbonized energy future.





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Green energy and storage for the production process of sea buckthorn

The Sanddorn GmbH Herzberg (SAND), one of the Europe's largest sea buckthorn processors, is enhancing its energy-intensive production with an intelligent energy concept. By integrating solar thermal energy, heat pump, and hot water storage tanks, all managed by a smart energy management system, it aims to significantly reduce the CO_2 footprint of transforming sea buckthorn berries into juices, oil, peels and seeds.

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Decarbonization

Replacing fossil fuels with renewable energy sources and optimizing process water temperatures to minimize energy consumption.

Smart Energy Management

Implementing intelligent storage technologies to efficiently manage hot water tanks and heat pump operation, ensuring a consistent supply of the required pasteurization temperatures. The optimized operation strategy is guided by a DLR's custom-developed day-ahead forecasting tool.

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Supported by:
Federal Ministry for Economic Affairs and Climate Action
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Partners

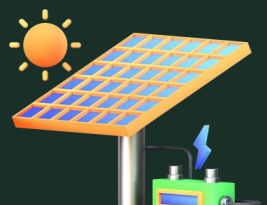
Meet our demos

- Demo site #1: Maia, Portugal, Industrial Park
- Demo site #2: Soria, Spain, Microgrid Facility
- Demo site #3: Huesca, Spain, Walqa Technology Park
- Demo site #4: Herzberg, Germany, SAND production site
- Demo site #5: Ikaria, Greece, Hydro-Pumped storage plant
- Demo site #6: Geneva Canton, Switzerland, Public Transport services

Demo #4
Decarbonization of sea-buckthorn processing plants

Technical description and implementation

1. **Analysis and optimization**: Evaluating and enhancing of the energy efficiency of sea buckthorn processing.
2. **Concept selection and component procurement**: Identifying the optimal energy solution and sourcing key components, including solar thermal systems, heat pumps, and hot water storage tanks.
3. **Installation and commissioning**: Integrating and deploying the selected components for seamless operation.
4. **Long-term testing**: Conducting extended trials with the smart energy management system to ensure optimal performance and efficiency.



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Green energy and storage integration on the island of Ikaria

The Hellenic Electricity Distribution Network Operator (HEDNO), as the non-interconnected islands operator, in close co-operation with the Independent Power Transmission Operator (IPTO), the TSO of Greece, the Centre of Research and Technology Hellas (CERTH) and CIRCE – Centro Tecnologico aim to increase the island's grid efficiency and decrease its environmental footprint by combining the existing Hybrid Power Plant (HPP) installation and the digital tools that are being developed during the project.

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HPP

A Hybrid Power Plant installation that utilizes water storage, hydroelectric energy production and wind potential to store and produce green energy

Digital Tools developed for the SINNOGENES project

- A Digital twin of the electricity grid of Ikaria
- An optimizer tool
- A load forecasting tool

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Meet our demos

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Demo site #5: Ikaria, Greece, Hydro-Pumped storage plant

Demo site #6: Geneva Canton, Switzerland, Public Transport services

Demo #5

Optimal utilization of the hydro pumped electricity production and storage in tandem with the RES of the island

Technical description and implementation

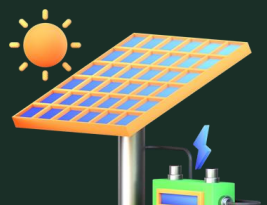
1. Implementation of the developed digital tools for efficient grid management

2. Study for provision of local Auxiliary services, such as frequency and voltage control from the HPP

3. Decarbonization by increasing green energy penetration

4. Time horizon:

- Short term (Intra day)
- Medium term (Day ahead)
- Long term (Planning)



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Demo #6 (Geneva, Switzerland): AI-enabled Green Hydrogen Public Transport Services

Integrating AI algorithms into hydrogen public transportation services in the Geneva Canton area of Switzerland, to reduce fuel energy consumption and minimize wait times.

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Key Technologies & Innovations

- Hydrogen storage and distribution
- Intelligent energy forecasting
- Smart mobility analytics
- Integrated urban transport energy management

Contributing to SINNOGENES' vision for a sustainable and highly intelligent transport ecosystem.

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Demo #6 – Geneva Canton, Switzerland

Demo #6 is located in the Champagne/Mandement area of Geneva, fully integrating hydrogen vehicles into an on-demand service, collecting specific vehicle data and establishing a convenient refueling method. The goal is to provide outer-city passengers with access to the center of the city.

A hydrogen-based energy system is being implemented to optimize storage and distribution within Geneva's public transport network.

The system integrates solar-powered electrolysis, producing hydrogen that is compressed and stored and then dispatched to refueling stations supplying public transport vehicles.

Advanced energy forecasting and smart consumption controls will ensure continuous supervision and optimization, balancing supply with demand across the network.

Green Hydrogen Refueling Station

- Electrolyzer with PEM (< 1MW power, 30 bars hydrogen output pressure)
- Piston compressor
- 500/520 bars storage container
- 350 bars filling gun (without cooling)