SINNOGENES

SINNOGENES Press Release

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PRESS RELEASE

SINNOGENES, development in the Walqa use case: Innovative Hydrogen Storage Solutions Empower Local Energy Systems at Demo#3 in Huesca, Spain

The continued decarbonization of the energy sector using renewable energy sources provides opportunities for local energy systems (LES) and challenges for existing electricity networks. Mainland regions such as isolated villages, small cities or urban districts oftentimes have issues with weak or non-existing grid connections.

SINNOGENES focuses on developing a complete framework of methodologies, tools and technologies (SINNO energy toolkit) that will assist the transition to clean energy by providing innovative energy storage solutions and flexible power generation while ensures the compatibility of systems and the standards of distributed energy storage for participation in flexibility markets.

SINNOGENES will exploit the benefits that each innovative storage technology offers, to provide a portfolio of flexibility services. This will be demonstrated in six different pilot projects taking place in Portugal, Spain, Germany, Greece and Switzerland, while a detailed scalability and replicability analysis will prove the wide impact of SINNOGENES project innovations at pan-European level.

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One of the Spanish pilots is located at the Walqa Technology Park in the northeastern Spain, near the Pyrenees. The technology park, an initiative of the Government of Aragon, includes four buildings that are rented out and several other buildings that are owned by private companies, providing jobs for approximately 700 people. Despite its limited connection to the national grid, Walqa benefits from on-site renewable energy generation, including wind turbines and photovoltaic panels, and serves as testing ground for hydrogen production technologies.

Figure 1. Walqa technology park (aerial view)

- The Walqa Technology Park has a large renewable energy production. To maximize this resource, minimize the surplus of unused energy and reduce acquisition costs from the electricity grid market, a use case has been developed within the framework of the European SINNOGENES project. This initiative

allows the development of the necessary tools to optimize energy management and enhance efficiency.

The Aragon Hydrogen Foundation will evaluate, in an operational environment, the effectiveness of combining new hydrogen-based energy storage solutions into energy systems and grids, aiming to enhance grid performance by providing flexibility services. This will involve managing energy assets and integrating hydrogen storage solutions within the electricity-hydrogen grid system for optimal operation.

Demo case overview

The use case involves the integration of Power-to-Gas technologies within a Local Energy Community (LEC). The LEC utilizes electrolyzers to manage the fluctuating renewable power generation to ensure its optimal utilization. The electrolyzers produce

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hydrogen during periods of renewable energy surplus, which is stored and later used to supply a Hydrogen Refueling Station (HRS) for fueling hydrogen-powered vehicles.

To achieve the objective, the use case employs an automated dispatch module that dynamically controls the power output of the electrolyzers. This enables the LEC to balance renewable power production, ensuring that excess energy is converted into hydrogen for storage and later use in the HRS.

The dispatch module considers the availability of renewable energy sources, hydrogen production requirements for the HRS, and wholesale market electricity prices to make optimal decisions regarding energy purchases and sales. The system model for optimal dispatch is being developed, considering equipment dynamics (such as response times, intermediate operating states and recharge levels and intervals), as well as degradation and efficiency. Additionally, a forecasting module for wholesale electricity market price is being integrated, based on historical, explanatory demand and supply factors (e.g., oil prices, gas prices, OMIE historical and OMIP futures markets).

By effectively managing the Power-to-Gas potential, the use case aims to improve the efficiency of the LEC, increase the flexibility of the electric grid, and maximize the utilization of renewable energy resources. It demonstrates the integration of storage solutions into the energy system, showcasing the cost-effective and sustainable utilization of renewable energy through Power-to-Gas technologies.

Challenges and solutions

During the development of the solution, several challenges have been encountered, such as:

- **Ensuring compatibility:** Addressing the compatibility between the deployed technology and the existing infrastructure in Aragon Hydrogen Foundation, which involves differences in infrastructure standards, communication protocols and technical specifications. These challenges have been resolved conducting detailed assessments and collaborating closely with local stakeholders to address infrastructure gaps developing adaptation strategies to ensure seamless integration.
- **Network connection losses**: This caused difficulties in reading and recording data. This problem is being solved by the technicians in close collaboration with the infrastructure managers to improve network stability and reliability.
- **Inefficient optimization of the tool's code**: This resulted in slower performance and inaccuracies in some results. The software development team has addressed

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this by improving and debugging the code, as well as rewriting some parts of the HTML code for greater efficiency and speed.

However, these difficulties have been mitigated strengthening the use case and increasing confidence in the system performance.

The proposed solution is based on the results obtained from the European E-LAND project, in which a first approach to monitoring the park was developed. A 3D visualization platform has been built on this solution together with a blockchain platform, improving the existing architecture in combination with the four modules described below.

To achieve optimal dispatch, four modules are being developed:

- **Module 1**: **Electricity market tool**. This module has already been developed and implemented. It generates an estimation of the price of energy on the wholesale market, with an accuracy of one hour for a few days, depending on the hydrogen storage available.
- **Module 2: Building an HRS load prediction**. The electrical and hydrogen loads are not only read and visualized but also predicted to optimize their use in the coming days.
- **Module 3: Optimization engine**. The optimization engine employs an automated dispatch module that dynamically controls the power output of the electrolyzes This enables LEC to balance the renewable power production, ensuring that excess energy is converted into hydrogen for storage and subsequent use in the HRS. The dispatch module considers the availability of renewable energy sources, hydrogen production requirements for the HRS, and wholesale market electricity prices to make optimal decisions regarding energy purchases and sales.
- **Module 4: Power Purchase Agreements and sustainability module**. This module makes it possible to make better use of the energy produced by distributing it among the various electricity consumers, so that they can not only benefit from a reduction on the electricity bill but also have a positive impact on the reduction of CO2 emissions thanks to the reduced demand from the national electricity market.

The development of the tool, which will enable the management of renewable energies, the visualization of power and hydrogen load data, and the integration of all modules is well advanced, with the results presented below:

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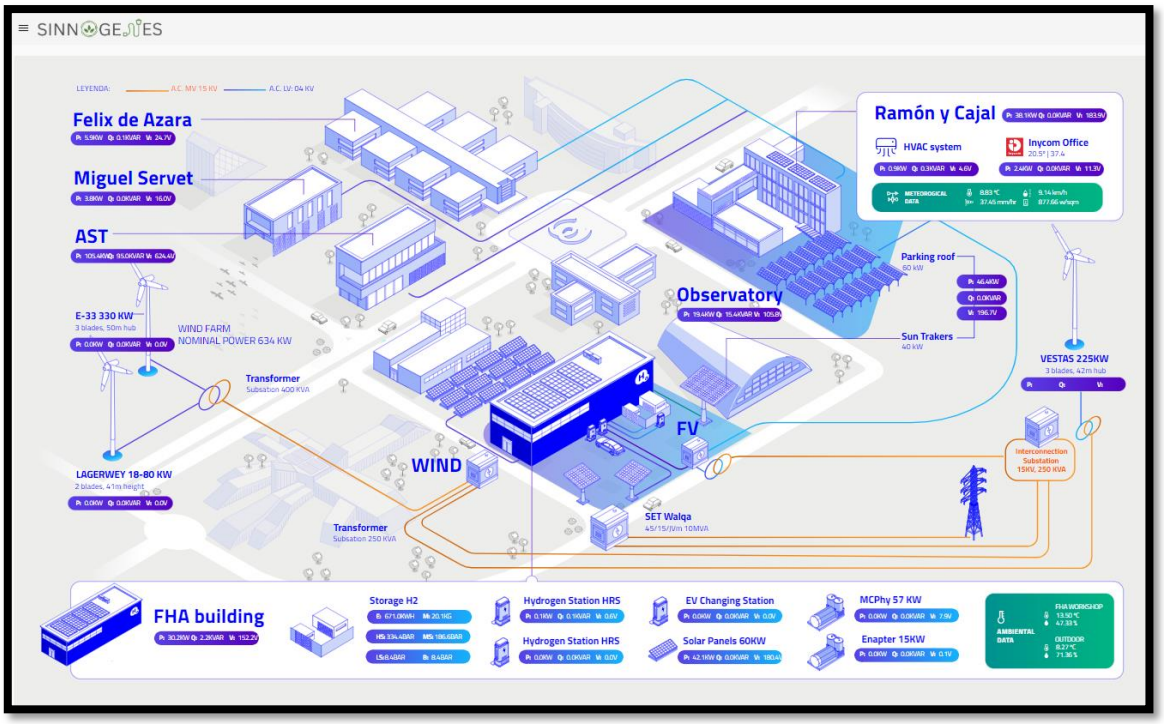

Figure 2. Tool's visualization.

Figure 3. Active power of individual assets and summation of all.

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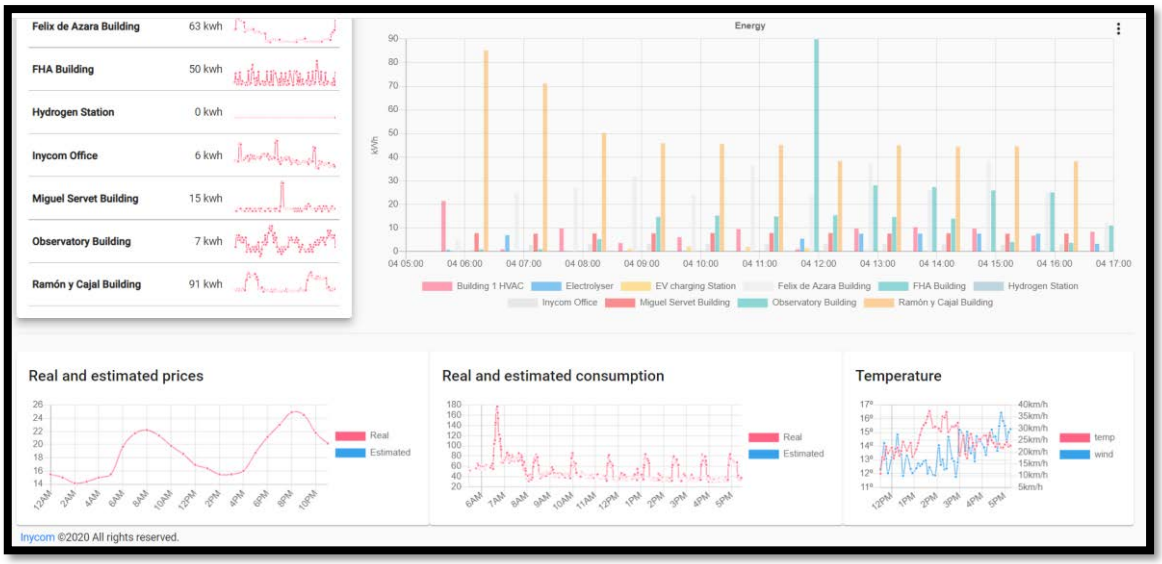

Figure 4. Energy consumption/production: Real and estimated prices/Temperature

Implementation

The use case is being developed in the Walqa Technology Park.

Since the project began, the work carried out has focused on the development of the Blockchain platform (INYCOM) based on the RE100 initiative. This involved creating the necessary chain codes to apply this technology to trace the origin of renewable energy applied to the different assets existing in Demo Site 3, i.e., Huesca.

The platform is operational and integrated into the solution being developed for the tool. In parallel, two task groups have been formed, one focused on the hardware upgrade and fine-tuning of the physical infrastructure of the pilot, and the other focused on improving the architecture of the existing system. In parallel, the INYCOM team has worked on the necessary developments for the connection with SINNO MIDDLEWARE according to the use case, deploying and setting up an instance for the connector with the Sinno Toolkit.

Related with the **hardware**, the list of equipment has been updated in line with the latest improvements in the FHa infrastructure, conducting relevant visits (INYCOM) for the installation of sensors and equipment, with the implemented changes being as follows:

- The wind turbines are undergoing modification, and they are expected to be connected to the system when operational (anticipated last quarter of 2024).

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Figure 5. Wind turbines installation (2024)

- A new analyzer has been installed for monitoring the newly installed self-consumption solar panels (March 2024).
- An 80 kW electrolyser (FHa) and its corresponding analyzer (INYCOM) have been installed for monitoring. Likewise, the correct integration of the 15 kW electrolyser into the system has been verified.
- Regarding the H2 storage systems, the proper functioning of the pressure sensors has been verified, and the entire system is currently displayed correctly with four sensors (buffer, high, medium, low pressure) (INYCOM).
- It has been verified that the analyzer monitoring the 350-bar HRS is functioning correctly, and the installation of the necessary equipment for its inclusion in the system is planned once the new 700 bar HRS is installed (INYCOM).
- New temperature and humidity sensors have been installed inside the rooms near the HRS as well as outside, along with the corresponding Gateway (INYCOM). All these new signals have been connected to the EMS as well as to the associated database.

Related to **software and system architecture** improvement, INYCOM has significantly enhanced the existing solution by completely redesigning and improving the architecture. The current solution is now based on a robust and secure architecture. The main tasks carried out include the following:

- Blockchain Platform Integration: Developed front-end views and pagination and integrated them with the Blockchain API for data queries.

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- Device Integration for Demo 3 (Huesca): Modified and installed scripts on devices used in the demo site to enable their integration with the Blockchain platform.
- Blockchain Integration Testing: Conducted thorough testing to ensure seamless integration with the Blockchain platform.
- Migration to AWS.
- Pipeline Management: Managed deployments from development to production environments and executed validation tests.
- Front-end Adaptation: Adapted the front-end to align with new architectural requirements and improvements.
- Email Notification System Implementation: Developed a system that sends alerts when there are connection drops from devices actively sending data. The system checks daily at midnight and notifies if no data has been sent in the last 24 hours.

Over the last months, several analyzers have been verified and installed. The HRS 700 is still in the testing period and is not yet supplying any vehicles, but it is expected to be commissioned soon and will allow the number of vehicles supplied to be increased. The monitoring system is being developed in line with all measurement systems and checks of measurements and calculations.

Figure 6. HRS

Results and Impact

There is progress to be made, but the project is responding very well to initial expectations. Several milestones have been reached, such as those presented below:

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- Increased energy use,
- Increasing self-consumption and self-sufficiency,
- Reducing the need for energy from the Spanish grid,
- Look for the KPIs and see what was expected to be obtained and say what has already been achieved.

Testimonials

"*Our pilot site is located in a technology park with different stakeholders. It is on the edge of the Spanish's distribution power grid, which means it can be easily overloaded. There is an important penetration of local generation by means of renewable energies, mainly solar photovoltaics and power windmills,"* says Pilar Gascón, responsible of the pilot of Walqa Technology Park in Spain.

She explains that the Spanish pilot seeks to test different solutions to increase the monitoring of the different assets and the intelligent systems – to control all the assets in a coordinated way, improving not only energy efficiency but also saving expenditure in energy generated outside of the technology park in combination with HRS management and optimal dispatch.

PARTNERS

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