# DEVELOPMENT OF THE ENERGY HUB GEDERlab AT UNIVERSITAT POLITÈCNICA DE VALÈNCIA FOR ENCOURAGING THE INTEGRATION OF RENEWABLE ENERGY RESOURCES

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European Association for the Development of Renewable Energy, Environment and Power Quality (EA4EPQ)

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## 1. INTRODUCTION

In response to the urgent challenge of climate change, renewable energies stand out as essential tools for mitigating its impacts, offering clean and sustainable alternatives to fossil fuels [1]. While solar, wind, hydraulic, and biomass energy sources present significant advantages such as lower environmental impact, abundance, and energy independence, challenges like intermittency and infrastructure costs persist [2]. Initiatives like the GEDERlab energy hub at the Universitat Politècnica de València, developed by a multidisciplinary team (www.geder.es), headed by PhD. Guillermo Escrivá-Escrivá, aim to address these challenges by exploring the technical and economic feasibility of renewable technologies and optimizing energy storage, management, and environmental impact. Beyond research, GEDERlab seeks to implement its findings in real-world applications, exemplified by the INASOLAR project [3] in a rural Valencian municipality, where a renewable-powered microgrid aims to promote sustainable development and address electricity supply issues. This approach not only addresses local challenges but also offers a scalable model to revitalize rural communities globally, bridging the gap between technological innovation and sustainability for a more resilient and equitable energy future.

## 2. GEDERlab ENERGY HUB

This section provides an overview of the GEDERLab, a facility at UPV used in the INASOLAR project [3].

### *2.1. 2.1 kW peak PV installation*

Solar panels: 9 SERAPHIM SRP-310-E11B (Fig. 1)

Charge controller: Schneider Conext MPPT 60 150

Inverter: Schneider Conext XW+

Fig. 1. GEDERlab photovoltaic panels

### *2.2. 1 kW wind installation*

Turbine: Vertical-axis GV-1kW (Fig. 2)

The wind turbine can operate at wind speeds ranging from 3-25 m/s, equipped with an automatic shutdown system if the wind speed exceeds 50 m/s.

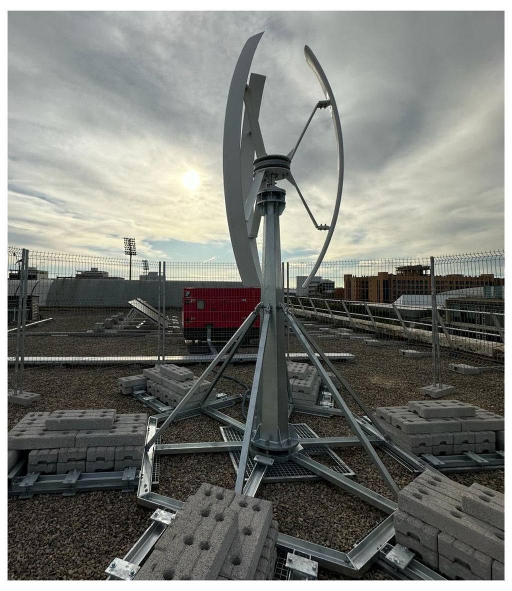

Fig. 2. GEDERlab wind turbine

### *2.3. Biomass installation*

A diesel generator with a synchronous generator is installed (Fig. 3).

GEDERlab is equipped with a Raywin 4D24G motor and a Stamford 10 kVA alternator.

Fig. 3. GEDERlab diesel generator for biogas simulation

### *2.4. Micro-hydraulic installation*

2 tanks x 500L. 2 pumps x AstraPool 200M, 1.5 kW, 26 m3/h, 10 m.w.c. 2 turbines x Saloria TF-600, 0.3 kW (Fig. 4)

Fig. 4. GEDERlab micro-hydrauilic turbines

### *2.5. Batteries*

Type: AGM batteries

Battery array: 8 high-performance Vision EVL16-400A-AM, 6V 400Ah (Fig. 5)

Total energy storage capacity: 19.20 kWh

Fig. 5. GEDERlab batteries

### *2.6. Recording and data acquisition*

**Load bank**: ITECH IT8617 enables simulating up to 5.4 kVA of power with a power step resolution of 0.4 W.

**Meteorological station**: Davis Vantage Pro2

**Data collection and measurements**: All data generated by renewable energy sources, and meteorological variables are recorded in a database.

### *2.7. Control system* (Fig. 6)

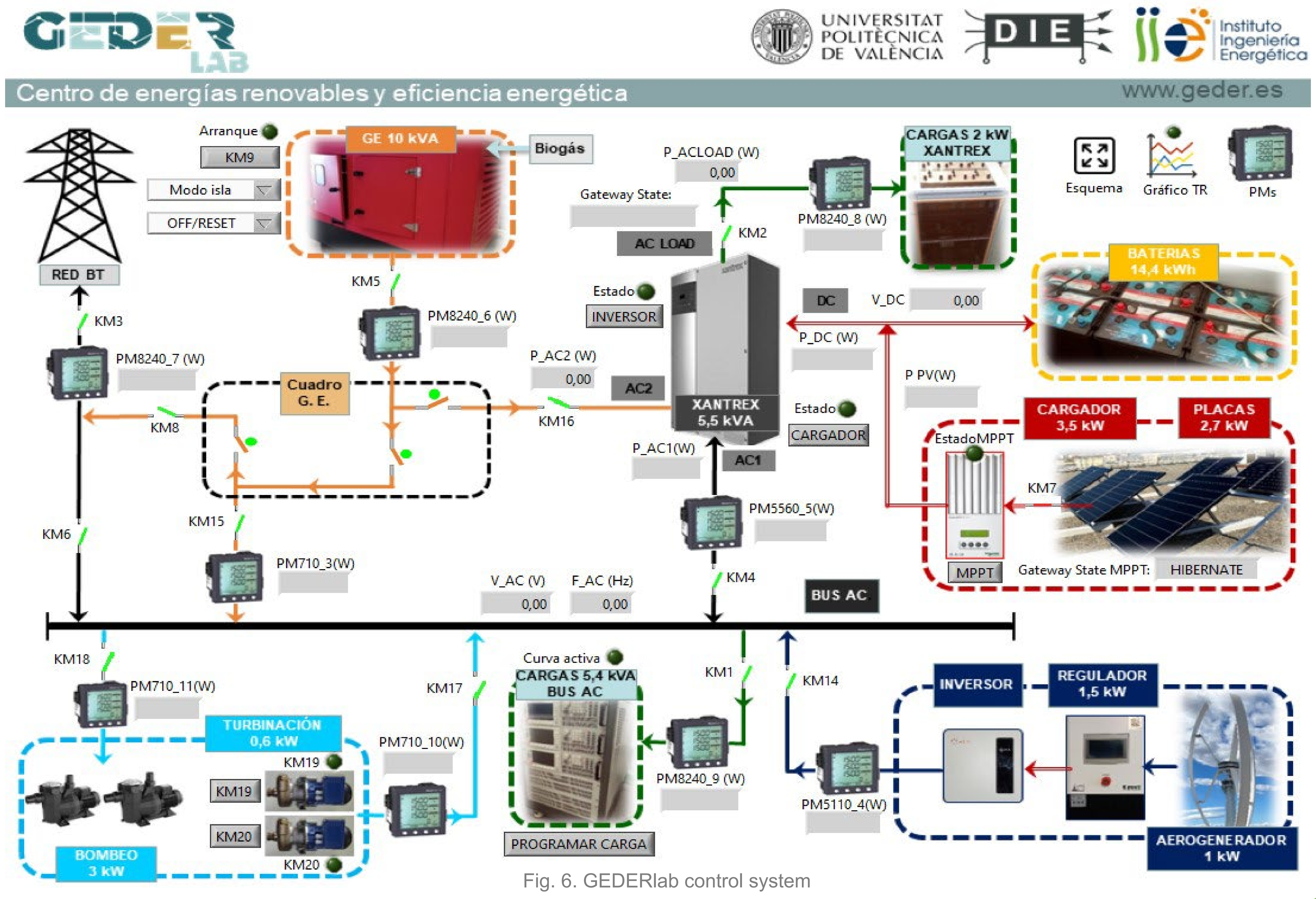


Fig. 6. GEDERlab control system

## 3. STUDY CASE: RESOURCE ALLOCATION IN A RURAL MUNICIPALITY

PV, biogas and grid will be utilized. The aim is to assess the technical feasibility of resource allocation using the resources available in the municipality of Aras de los Olmos [4] (Fig. 7). Once the hydroelectric and wind power plants are implemented into the municipality's energy mix, a more resilient system will be in place.

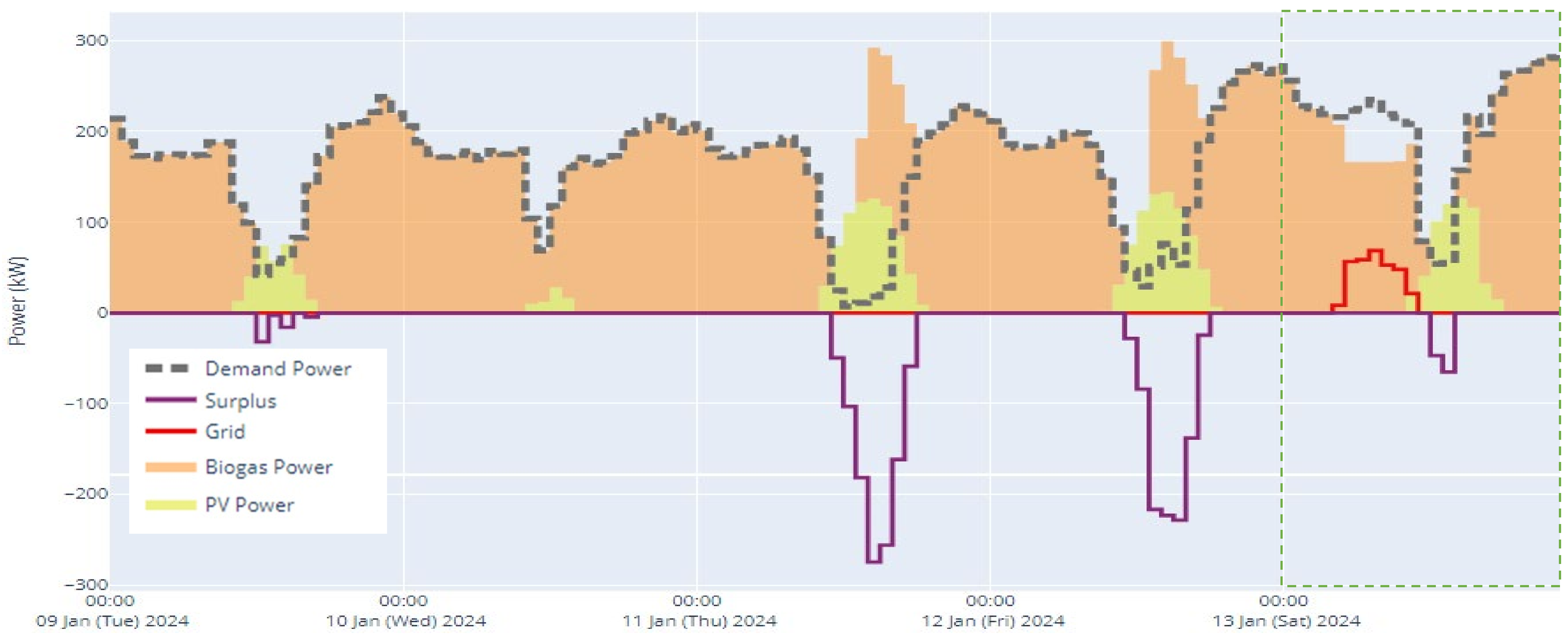


Fig. 7. Resource allocation in Aras de los Olmos

## 4. APPLICATION IN GEDERLAB

Based on the demand curve of January 13, 2024, the simulation performed in GEDERlab illustrates the technical feasibility of implementing the proposed resource allocation (Fig. 8). However, it highlights the importance of considering the limitations in power regulation, particularly in real generation plants.

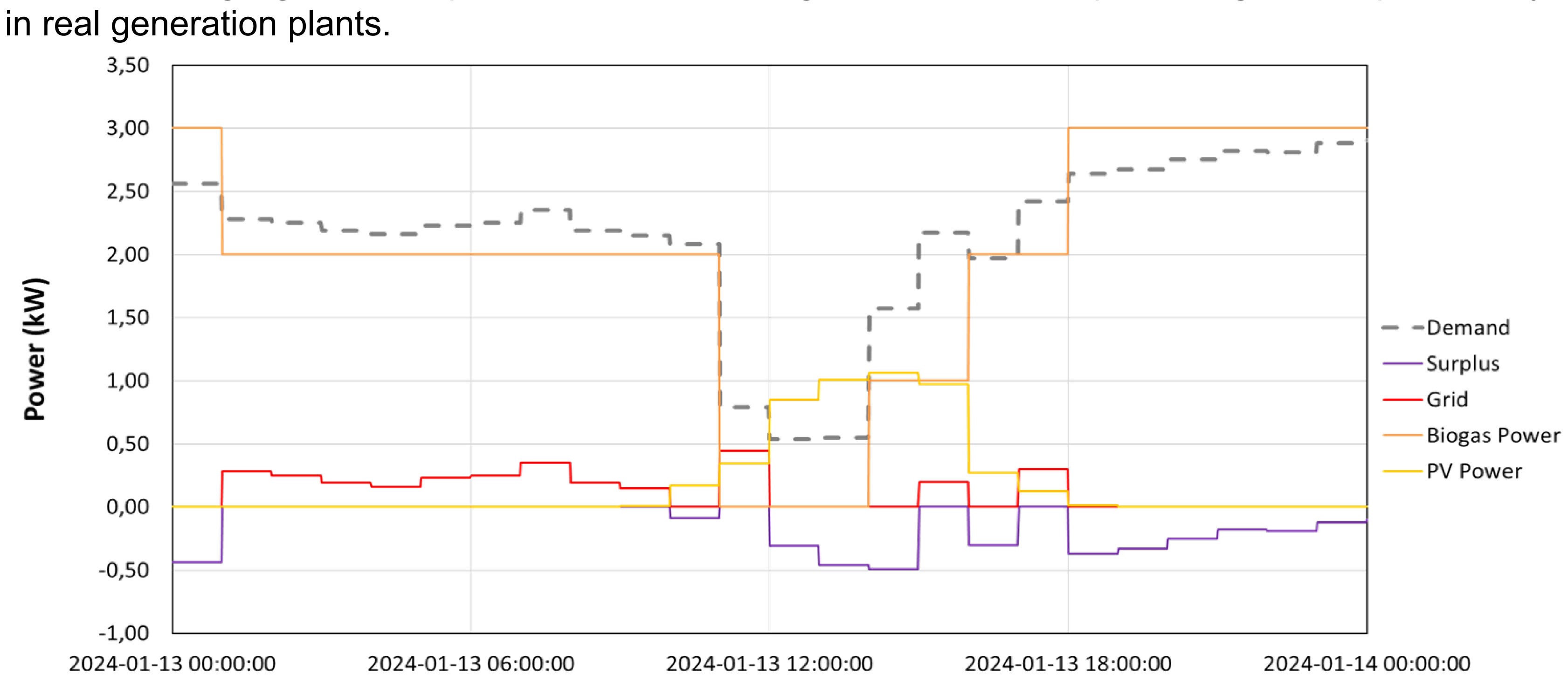


Fig. 8. Resource allocation GEDERlab

## 5. CONCLUSIONS

Renewable energies have emerged as crucial solutions to climate change. The energy hub GEDERlab, developed at UPV, serves as a pivotal testing ground, integrating renewable energies into an energy hub to analyze their technical and economic viability. Facing technological and energy management challenges, GEDERlab deploys a comprehensive system for developing efficient and sustainable energy grids, incorporating commercial equipment within a scalable architecture. Through theoretical resource allocation for municipalities and subsequent trials, GEDERlab showcases its capacity to test various scenarios and evaluate the feasibility of energy resource management strategies, while also identifying potential deficiencies in proposed systems.

**References:** **[1]** Olabi, A. G., & Abdelkareem, M. A. (2022). Renewable energy and climate change. Renewable and Sustainable Energy Reviews, 158, 112111. . **[2]** Hoppmann, J., Anadon, L. D., & Narayanamurti, V. (2020). Why matter matters: How technology characteristics shape the strategic framing of technologies. Research Policy, 49(1) **[3]** Project TED2021-130464B-I00 (INASOLAR). https://inasolar.webs.upv.es/ **[4]** Roldán-Blay, C., Escrivá-Escrivá, G., Roldán-Porta, C., & Dasí-Crespo, D. (2023). Optimal sizing and design of renewable power plants in rural microgrids using multi-objective particle swarm optimization and branch and bound methods. Energy, 284, 129318.

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