

# Hybrid Energy Storage demonstrator in the



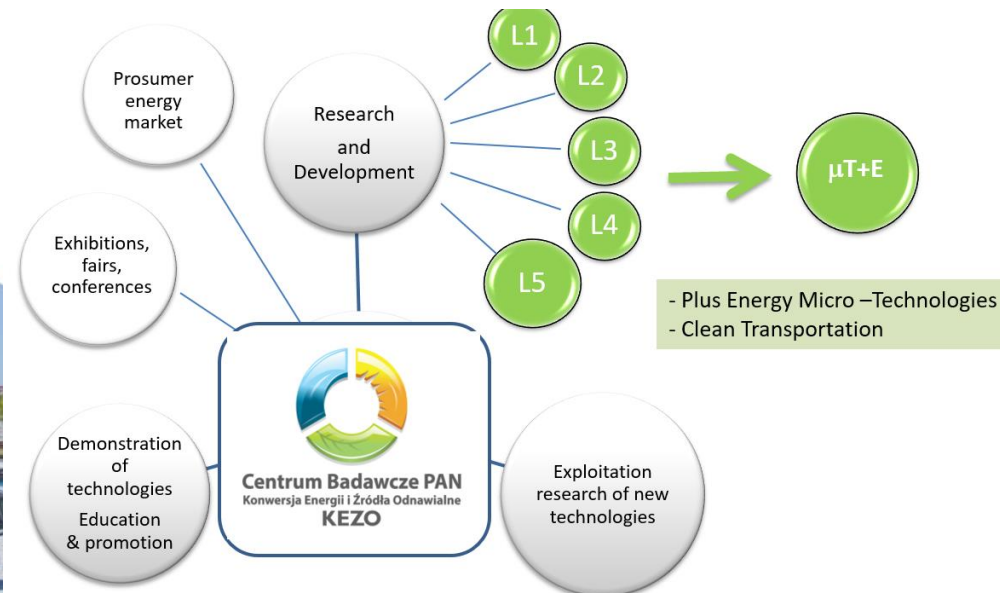
**KEZO** Energy Conversion and  
Renewable Resources  
**PAS Research Center**

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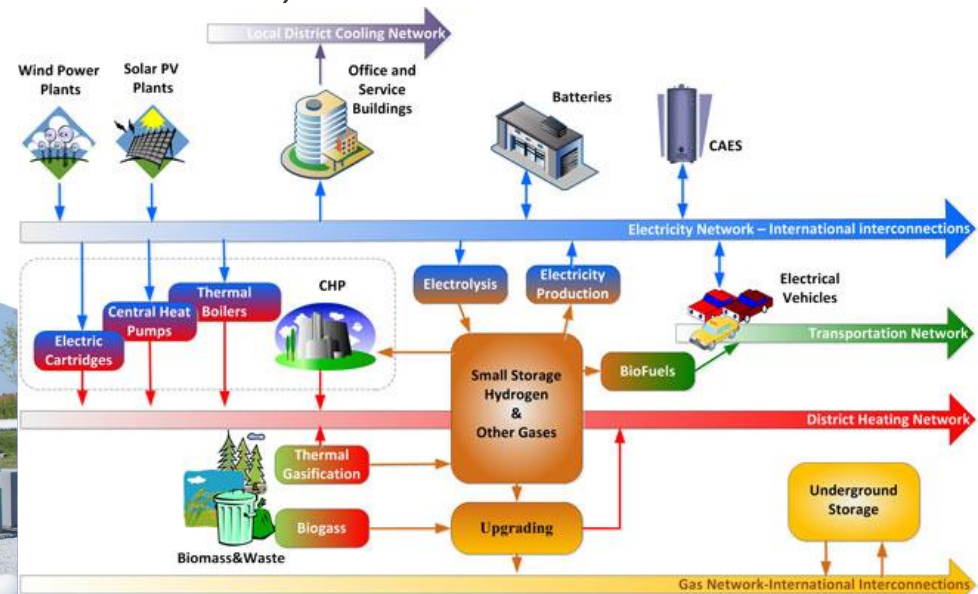
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- Operating since 2015 in Jablonna (near Warsaw), Poland
- Perspectives
  - Set of laboratories
    - Wind tunnel, solar simulator, CHP and others
    - R&D and testing of new technologies
  - Living lab – energy system
    - Demonstration of new technologies in the operating environment
  - Promotion and education facility





- Electrical
  - PV installations (180kWp) stationary, tracker
  - Small wind turbines (18kW) HAWT, VAWT
  - EV charge point (50kW)
  - Energy storage (148 kWh, 48 kW)
- Thermal
  - Heat pumps (ground source, air-source)
  - Solar collectors
  - Boilers (gas, biomass)
  - Storage (tank, borehole)
- CHP (gas, pellet)



- First wave – PV, second wave – energy storage
  - Enabling high RES penetration
  - Stabilizing the power grid
- Demonstration of storage technologies
  - Stakeholders: government, local authorities, industry
- Hybrid Energy Storage
  - Coordinated operation of technologies
- Control system development



- Vanadium Redox FLOW BATTERY (VRFB)
  - 12 kW, 100kWh
  - Long duration storage
  - Excellent cycling capability (20 000 cycles @ 100%DoD)
- Advanced Lead Carbon (ALC)
  - 12 kW, 24kWh
  - Lead-acid family
  - Optimized for cycling
- Lithium-Iron-Phosphate (LFP)
  - 24kW, 24 kWh
  - Li-ion family
  - Less prone to thermal runaway

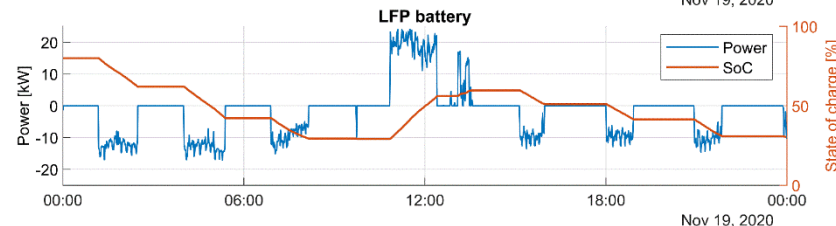
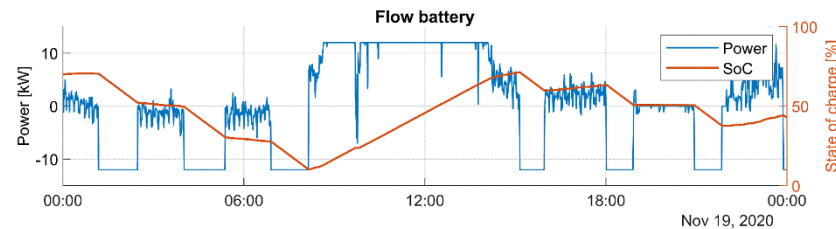
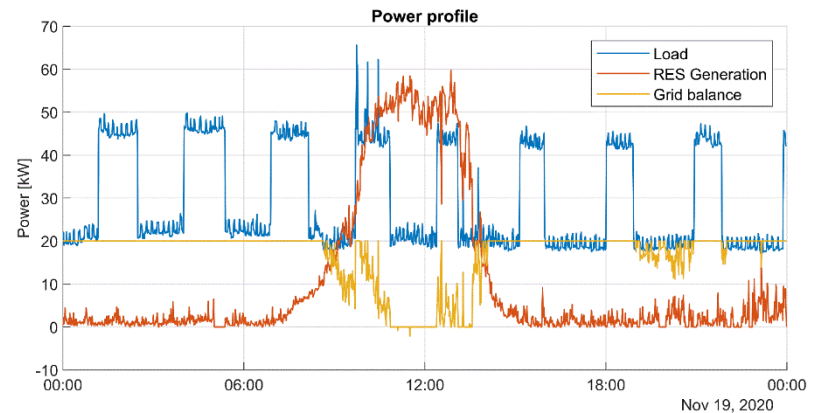


- Microgrid Controllers (cooperation with DEIF)
- Grid power control
  - Power feed-in management (energy balancing)
  - Grid-connected – islanding transition control
- PV monitoring (and curtailment)
- Energy storage charging strategy
  - Simple rules based on SOC



- Hybrid ESS - coordinated operation of at least two technologies
  - Long duration (i.e. VRFB)
  - High power (i.e. LFP)
- Development of smart control algorithms
- Multifunctional
  - Revenue stacking
- Long life
  - Degradation-aware optimization

• Project funded by National Centre for Research and Development, Lider X programme 2020-2022, 1 465 000 PLN  
 Manager: Krzysztof Rafał



- Cooperation with local authorities and community
- Application of new technologies for decarbonisation

The "**GREEN HEAT – towards collaborative local decarbonization**" project (acronym **GREENHEAT**) benefits from a € 1 319 998 mln grant from Iceland, Liechtenstein and Norway through the EEA Grants. The aim of the project is to contribute to elimination of fossil fuel fired boilers in Poland and presenting the feasible scenarios to decarbonize energy systems in Polish households.

Building on an expert knowledge, the project targets a very specific, real life challenge of extremely bad air quality in residential areas in Poland. Two specific objectives are:

- 1) to conduct the selected Pilot Case, in a chosen community in the city of Legionowo, and develop tailored business model with specific technology recommendations and an indication of potential investors and sources of financing to support the elimination of fossil fuel fired boilers;
- 2) to develop the methodology for further future implementation based on procedure during Pilot Business Case analysis;

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Project budget: € 1 319 998  
Funding: 100%  
Project duration:



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**Thank You for attention**

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