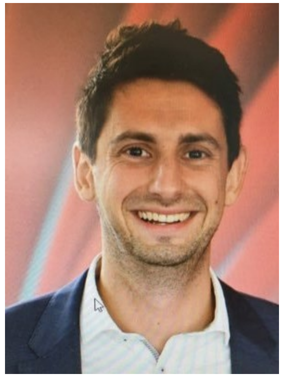
SUSTAINABLE PLACES 2022
Sep. 6 - Sep. 9, 2022 | Nice, France

Energy Communities
-
Results and lessons learned from the IElectrix H2020 project

Gemira Martinez
IElectrix PMO



Sven Tischer
IElectrix Technical Director

Co-funded by
The European Commission

IElectrix

The project in a nutshell

Indian and European Local Energy CommuniTies for Renewable Integration and the Energy Transition

42 months
10.7 M€

IElectrix Consortium

15 European partners
1 Indian partner

Coordinator: ENEDIS L'ELECTRICITE EN RESEAU

Technical Director: e·on Hálózat

DSO-coordinated real-scale demonstrators implementing embedded electric island systems and microgrid

5 Demonstrations
4 countries

1 May 2019

Design, specification, manufacturing & shipment

On-site implementation of the demonstrations

Experimentation & exploitation of the demo results

31 Oct 2022

Time extension

28 Feb 2023

Distribution System Operator: Enedis, e·on Hálózat, e.dis, Energie Güssing

Research Centres and Universities: Comillas Universidad Pontificia, circe, burgenland Forschungs- und Innovations GmbH, RWTH Aachen University

Suppliers: Life is On Schneider Electric, Atos

Research and Consulting firms: GECO Global, Merit Consulting House, Smart Innovation Norway

DSO in charge of replication: HEDNO

SMEs: Hypertech energy labs, Odit-e

Energy agency

Indian DSO: Tata Power-DDI

Moew.e demo – Germany

STROM Güssing demo – Austria

HELGA demos – Hungary (x2)

Shakti demo – India

Pilot projects in brief

5 real-scale demonstrators

Moew.e Demo - Germany, Friedland – MV grid

Rural area with massive renewable generation — Battery storage and flexibility to postpone grid reinforcements of the MV grid

STROM Güssing Demo - Austria, Güssing - LV grid

Rural area with existing Local Energy Communities— Battery storage and Demand Response to reduce peak load, voltage variations and optimise self consumption and self sufficiency

HELGA Demo - Hungary, Zánka & Dúzs - MV grid

Zànka: Touristic area with high peak load/Dúzs: Small rural area with maximum PV hosting capacity reached — Battery storage and Direct Load Control to reduce peak load and voltage variations due to RES, increase RES hosting capacity and optimise RES local consumption

Shakti Demonstrator — India, Delhi – LV grid

Urban area with increasing integration of PV installations — Microgrid with islanding capability and Demand Response to improve resilience, quality of the Local Energy Community supply and maximize local RES consumption

Support

Germany

Austria

Hungary(x2)

India

IElectrix

Main experimentation results and lessons learnt from the demonstrations

Community engagement and energy awareness

GECO Global Green Energy Consultancy

SMART INNOVATION NORWAY

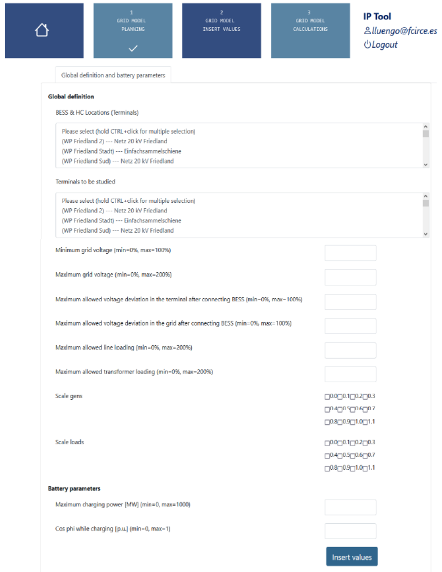
Commissioning event

BESS
500kW/1MWh

e.dis

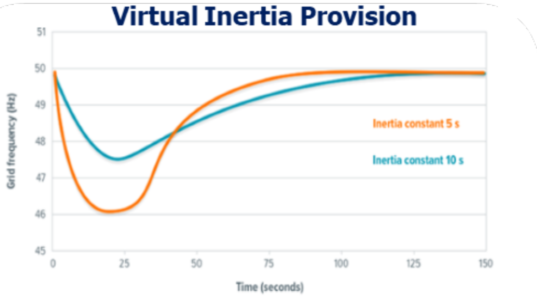
Evaluation of business case & benefits of integrating mobile battery systems into networks that would otherwise require reinforcement

circe

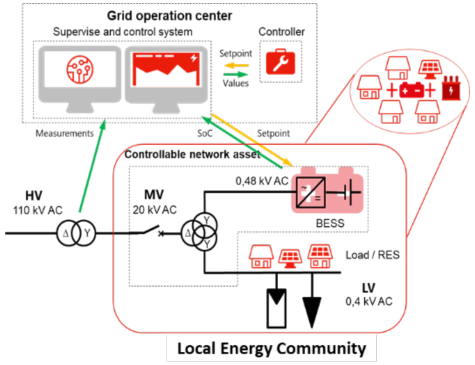


Web-based IP-Tool

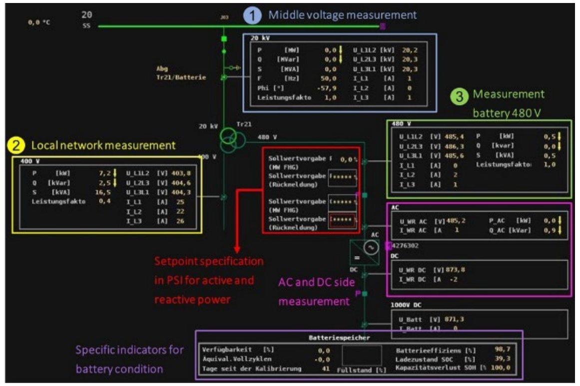
RWTH AACHEN UNIVERSITY



Low inertia power systems: Faster dynamics and larger frequency deviations and Rate of Change of Frequency (RoCoF)



Overview of technical solution



SCADA integration

Main results

Congestion management:

- Battery storage helps to avoid RES curtailment and prevent grid overloads if a suitable optimized operating mode is used (2-4%)
- Capacity of the battery storage has a great influence on avoiding RES curtailment
- Large RES curtailments can only be avoided to a limited extent as the storage dimension is relatively small regarding the capacity.

Improving local energy management:

- Battery storage can improve the local energy balance and reduce the CO_2 emission (20%) by increasing self-consumption (13%) and self-sufficiency (20%) of the community.
- This effect can be enhanced by optimizing the operating mode

Network stability:

- In a grid with a very high penetration of RES and no locally connected rotating mass, Battery storage can provide a frequency support, through virtual inertia
- In a simulation environment Rate-of-change of frequency (RoCoF) can be reduced by up to 40 % through the contribution of virtual inertia

Lessons learnt

Technical integration of storage into the grid:

- Interface DSO / BESS invertor: Issues in the Grid Connection Agreement
  1) Feed-in priority for renewable energies → unrestricted grid access is very difficult or even impossible
  2) The charging of the construction cost surcharge → (DSO driven) for grid reinforcement

  Contribution paid from grid customer to DSO for grid expansion

- DSO internally: Issues in the technical grid connection process
  1) BESS is still comparatively new and therefore not equally tested and known in the processes
  2) Challenge of installation and connection of a control unit by using BESS for grid-serving purposes
  3) Risk of regulatory cost recognition for DSO due to reserving its own capacity reduce the motivation for standardization

Main objectives

- Demonstrate the effectiveness of prototype **flexibility forecasting** and **scheduling** capabilities for local flexibility markets with a variety of assets including **energy storage systems**
- **Improve the resilience** of the local energy system, thanks to the **distributed reactive power control** of the local energy system

BESS integration/ operation

- Demonstrate the effectiveness of a **human-centric demand response** framework, enabling the transformation of passive energy consumers into active energy market participants

Demand Response framework

BESS specification

- ❑ 50 kW Inverter
- ❑ 100 kWh Battery capacity
- ❑ Installation 10/2021
- ❑ Integrated with 30 kWp PV

DR framework

- ❑ Prosumer integration with Smart Home Equipment
  - ❑ Smart Lighting
  - ❑ HVAC systems
  - ❑ DHW systems
  - ❑ Load/Ambiente monitoring

Main results

BESS application

- ❑ Procurement, installation and commissioning of a BESS system including set up of communication between measurement equipment and Demo EMS and storage of measurement data enables:
  - ❑ Self consumption optimization (To avoid RES curtailment)
  - ❑ Peak shaving (To avoid demand peaks affecting the grid operation)
  - ❑ Voltage regulation by reactive power management

Demand Response application

- ❑ Installation and Commissioning of monitoring & control devices / Smart Home Equipment (HVAC, Domestic Hot Water, Total Load, PV generation, Ambient conditions,…) enables:
  - ❑ Continuous analysis of available flexibilities the participants can offer
  - ❑ Optimization of self consumption and self sufficiency
  - ❑ Provision of flexibility to the distribution grid (Load reduction/increase)

Lessons learnt

DR framework establishment:

- Continuous communication with participants is essential
- Benefit of participation has to be outlined properly
- Motivation of participants (electrical energy bill reduction, contribution to Energy Transition)
- Importance of easy and quick installation (Plug and Play solution) with less to no maintenance work necessary

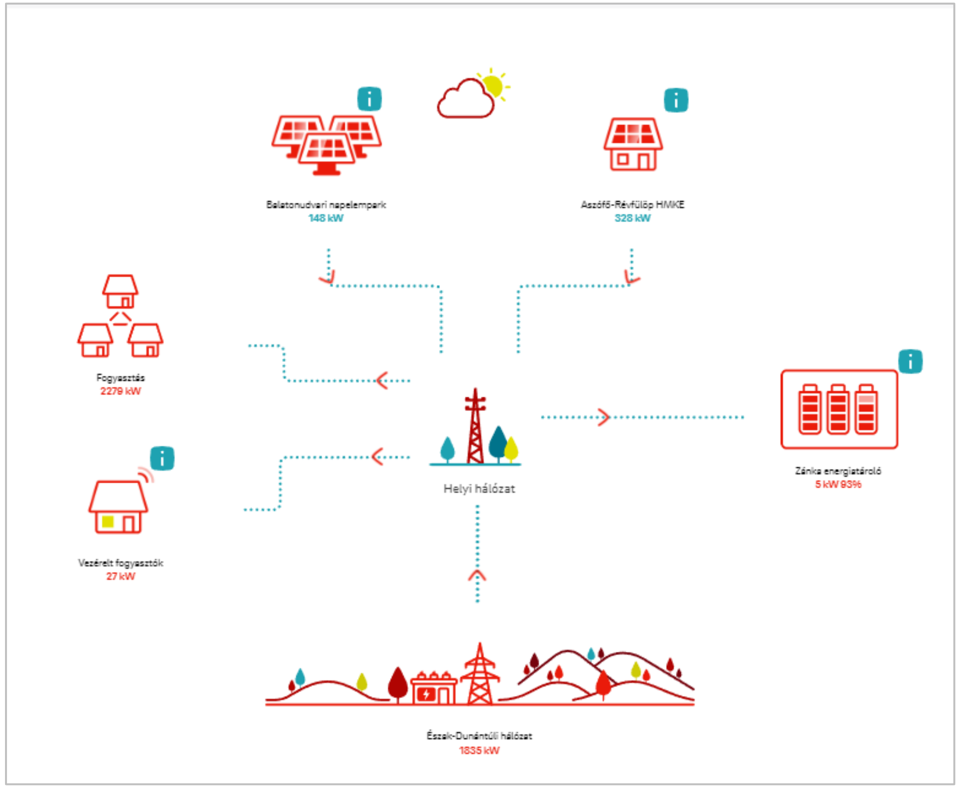
BESS integration:

- Detailed investigation of protective measures to be applied (depending on BESS capabilities and point of connection)
- Legal boundary conditions for implementing larger scale BESS (in public grids) and operating a BESS
- Proper definition of operation modes/conditions

DSO owned battery energy storage and DLC system for voltage management on MV line

Site A	Aszófő-Zánka MV line (EED)
Technical details of BESS	500 kW, 1233 kWh,
Advanced DLC 3 steps implementation	1. New schedule (105 devices) 2. New schedule with Smart Meters (55 devices) 3. Smart Meter control (86 devices)

Battery storage and advanced direct load control to reduce peak load and voltage variations due to RES, increase RES hosting capacity and optimise RES local consumption



Site B	Dombóvár-Hőgyész MV line (EDE)
Technical details of BESS	250 kW, 573 kWh
Advanced DLC 3 steps implementation	1. New schedule (63 devices) 2. New schedule with Smart Meters (20 devices) 3. Smart Meter control (22 devices)

Main results

Constraint reductions thanks to the demo system:

- In case of Zánka demonstration site the main objective was to reduce voltage drop, it was succesfully achieved - improvement by 0,8%.
- In case of Dúzs demonstration site the main objective was to reduce the PV's voltage increasing effect - it was reduced by 1%.

Improvement of network conditions thanks to the demo system:

- Grid voltage profile improvement in both demonstration sites.
- MV line load reduction in both demonstration sites.

Advanced direct load control system:

- The advanced direct load control system based on local conditions (before the demonstration it was optimized for regional aspects).
- New control method was developed using smart meters.

Lesson learnt

BESS integration:

- Lack of local expertise from supplier side can cause delay during the implementation phase.
- Long delivery times for non-European suppliers.
- Long development time of the control system (at least 6 months), and IT and electrical engineering expertise are required with close collaboration between the developer and the DSO.
- Connecting ICT systems poses a number of unforeseen challenges.

Advanced DLC system integration:

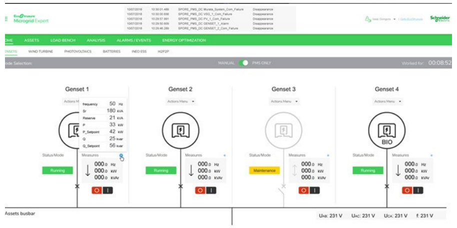
- It is difficult to provide a control that simultaneously satisfies network needs and does not disturb consumers.
- Seasonal update required in control tables.

An Urban LV Microgrid with islanding capability

Community engagement and energy awareness

Socomec BESS 200kW/274kWh

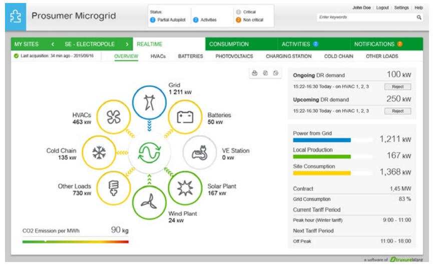
LV Energy Control Center Switchboard



Monitoring & control system (SCADA & PMS)

Innovative Solutions to improve resilience of the local energy community LV supply and maximise local Renewable Energy sources comsumption

MV/LV Smart transformer with OLTC



Energy Management System (EMS)

Renovated secondary substation

PV Panels

Smart meters

LV grid digitization software

Main results

- **Detection of significant voltage excursions on the LV network** thanks to the demo SCADA system
- **Reduction of voltage excursions** with a MV/LV transformer with On Load Tap Changer facility
- **Improvement of the resilience of the local LV energy supply** with the islanding mode of the urban Microgrid in case of unexpected MV power cuts or MV maintenance works
- **Implication and participation of the customers** into the demand response program. Half of the customers connected to the substation agreed to participate
- **Improvement of human and equipment protection** against electrical hazards at St Xavier School secondary substation with the implementation of a protection plan covering both on and off grid mode

Lessons learnt

Adaptability of a European system to the Indian environment:

- High level of costs to import equipment
- Delhi harsh and evolving environment depending on the time of year
  - Dusty and polluted : City with the worse air quality in the world
  - Hot (50°C) before the monsoon and humid during Monsoon
- Majors components of the demo system not available in India
  - Difficulty to repair / replace equipment in Delhi
  - Lack of local expertise

IElectrix

In conclusion

The use of a battery energy storage system

- Helps to avoid RES curtailment
- Can improve the local use of energy in a community
- Provides flexibility to the DSO
- Can reduce network losses & improve quality of energy supply
- Improves grid resilience

However the costs of implementation remain high and an assessment case by case is needed to evaluate the potential financial benefits in a given regulatory context.

IElectrix

Thank you for your attention

IElectrix

Consortium

Distribution System Operator
Enedis, e.on Hálózat, e.dis, Energie Güssing

Research Centres and Universities
Comillas Universidad Pontificia, circe, burgenland wirtschaftsagentur Forschungs- und Innovations GmbH, RWTH Aachen University

Suppliers
Life Is On Schneider Electric, Atos

Research and Consulting firms
GECO Global, Merit Consulting House, Smart Innovation Norway

DSO in charge of replication
HEDNO

SMEs
Hypertech energy labs, Odit-e

Energy agency

Indian DSO
Tata Power-DDI

Stay tuned with IElectrix

- Visit our website
  www.ielectrix-h2020.eu
- Follow us on Twitter
  Ielectrix_H2020
- Subscribe to the project Newsletter here

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 824392.