BUILDING OUTPOST OF THE NEW.

„Rigrid" Project as first Polish step towards self-regulating and "green" smart grid system

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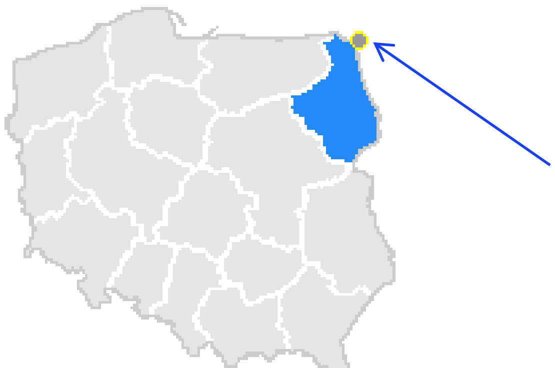
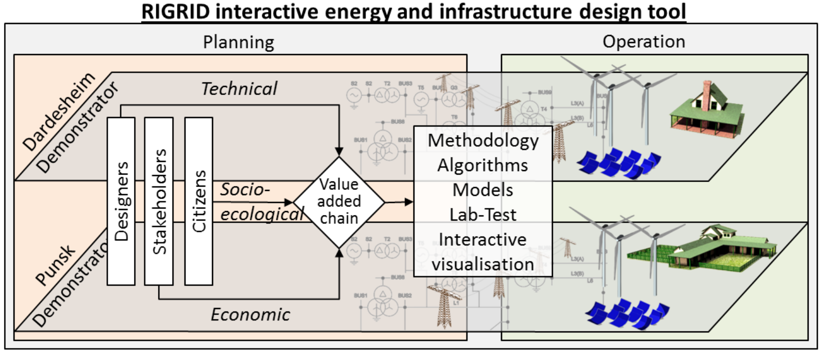
The goal of the RIGRID project was to develop and test new interactive energy and infrastructure design tool for optimal planning and operation of new emerging energy infrastructures in rural areas.

LOCATION AND PURPOSE



PUŃSK MUNICIPALITY
Area 138.37 km²
(agricultural area: 79%, forestland: 11%)
Population 4 213 people
30.4 people / km

RIGRID interactive energy and infrastructure design tool



RIGRID addresses the main objectives of the ERA-Net Smart Grid Plus initiative through the development of methodologies, tools and demonstration in the field of smart grids regarding three research layers:

TECHNOLOGY:

- Guaranteeing the security of supply to the highest degree possible
- RES and the CO2-free supply integration
- Improvement in reliability of the supply
- Power quality kept within permissible limits

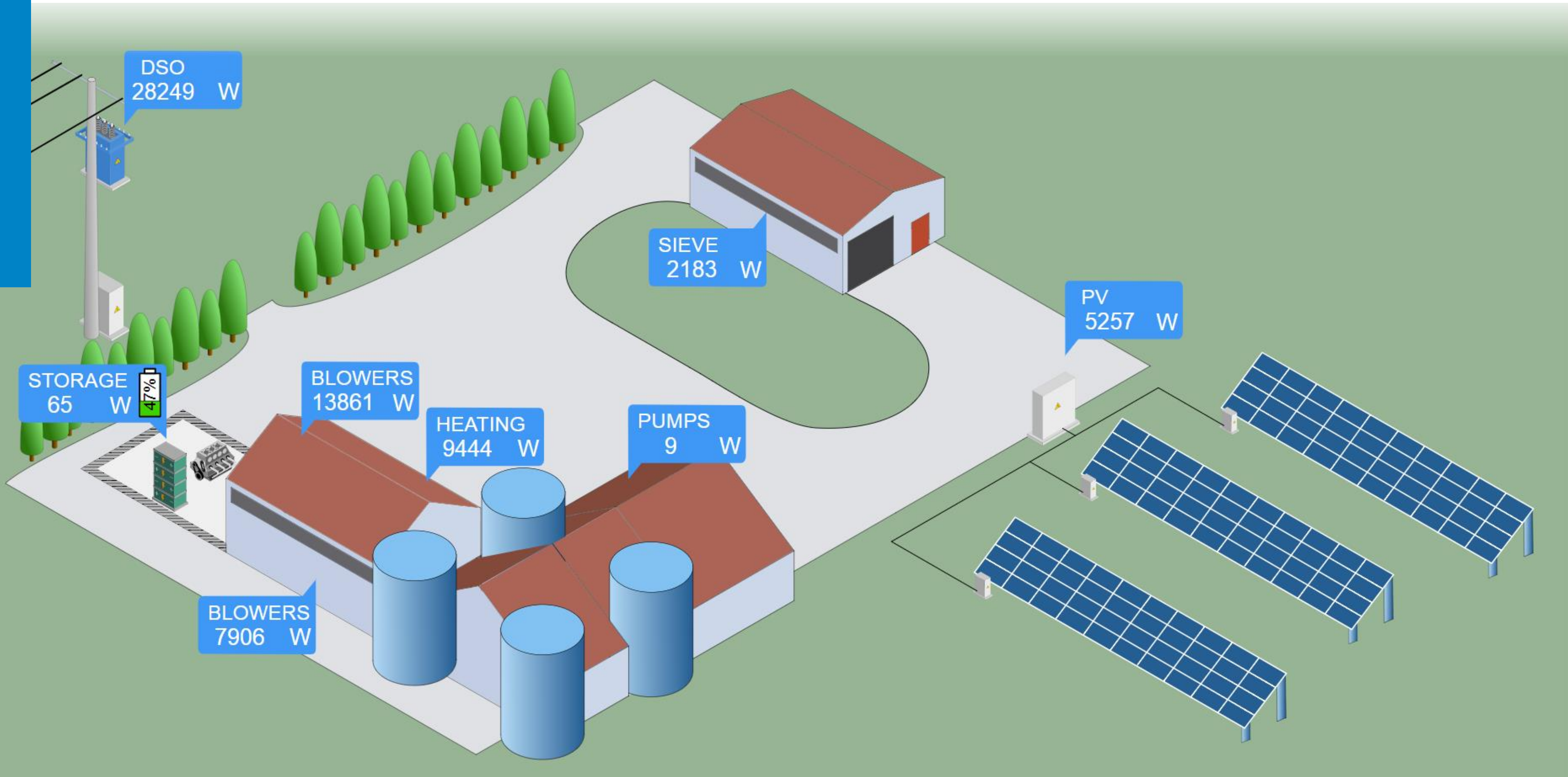
MARKETPLACE:

- Increased number of favourable electricity offers to the end users.

STAKEHOLDER ADAPTATION:

- Further development of the rural areas
- Overcomeing the socio-economic barriers to widespread user
- Incentive for attracting new residents

THE INSTALLATION



PROJECT KEY EXPLOITABLE RESULTS

TECHNICAL ASPECT

• determining the best distribution of new renewable energy installations,
• ensuring effective work of the microgrids,
• integration of renewable energy sources with the local power system,
• increased reliability of power supply - greater security and reliability of supplies for the commune.

ECONOMIC ASPECT

• encouraging new investors to develop local, ecological smart grids
• increasing the attractiveness of the region for new investments,
• an increase in the offer of favorable electricity for end users and, consequently, cheaper electricity.

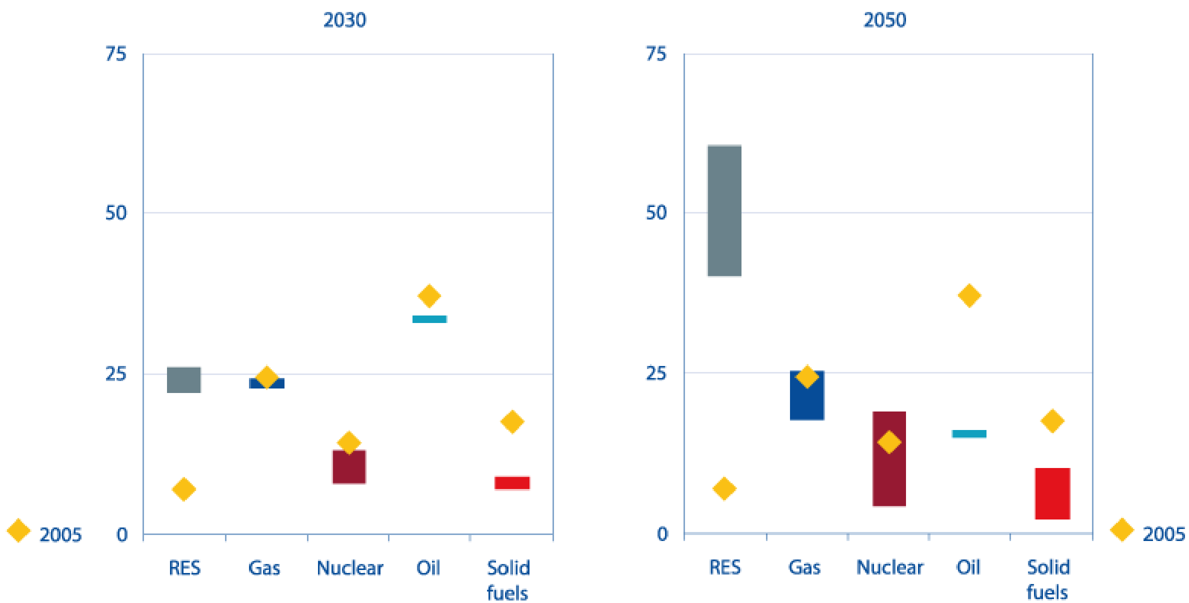
SOCIAL ASPECT

• increasing the social acceptance for new projects of smart energy networks based on RES,
• the possibility of participating in the investment planning proces for the residents
• creating new jobs at emerging investments, reducing unemployment,
• support in the economic and social development of the region,

ENVIRONMENTAL ASPECT

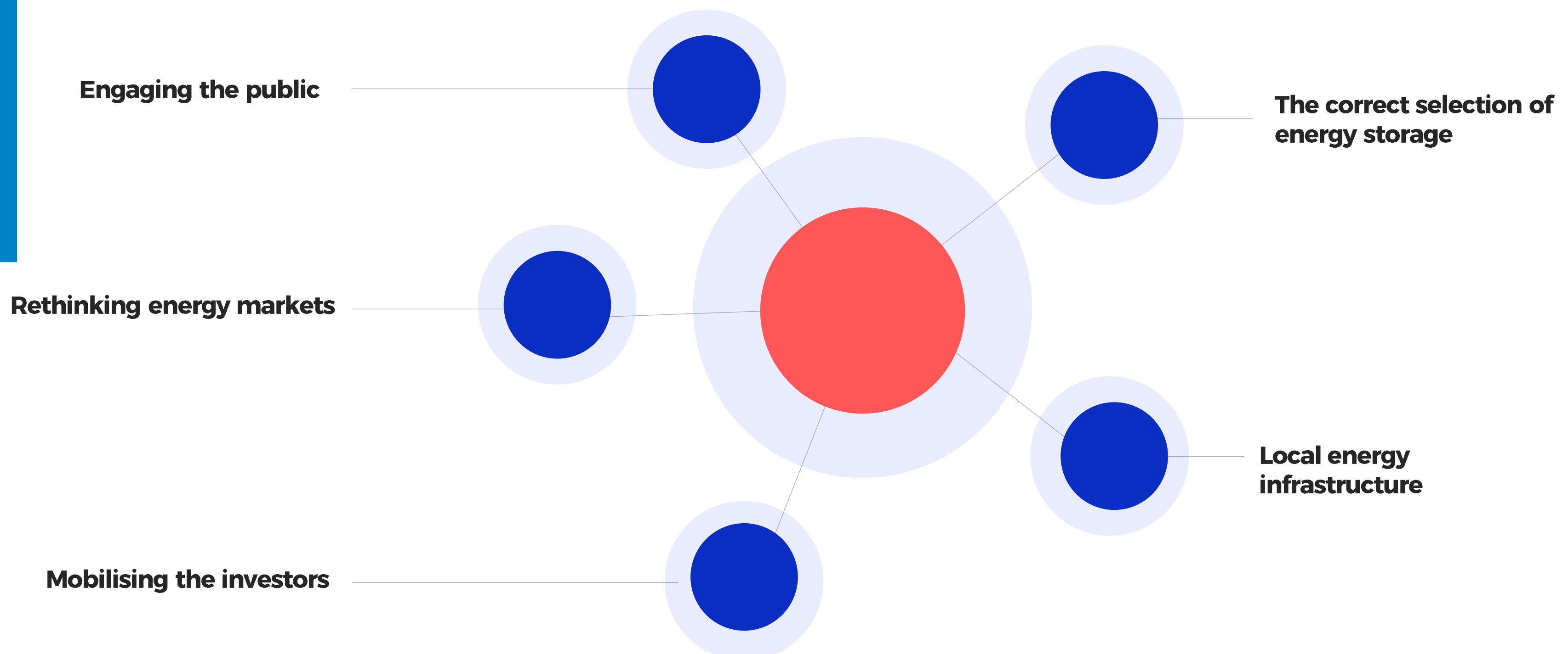
• reduction of CO2 emissions and carbon footprint - greater care for the natural environment and proper living conditions of residents.

ENERGY SYSTEM OF THE FUTURE: SAFE, COMPETITIVE, DECARBONISED, SELF-REGULATING.

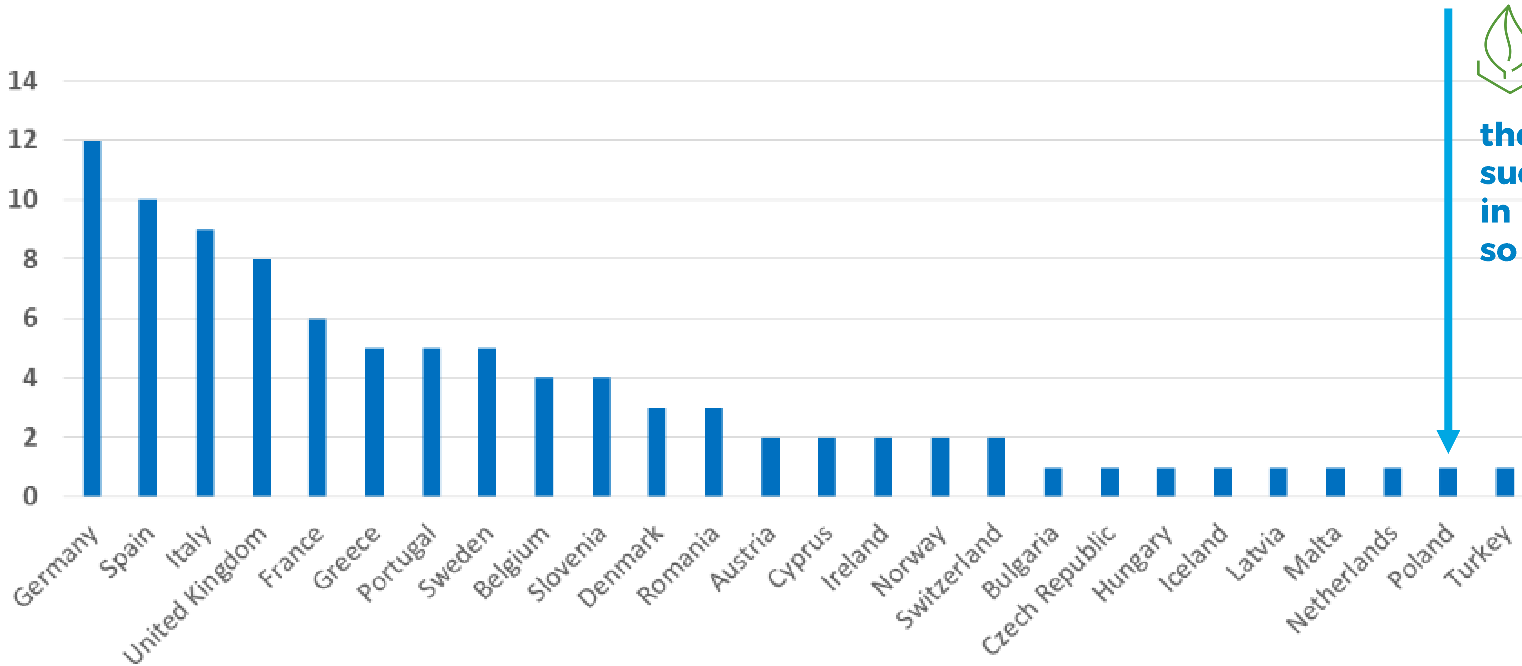


EU decarbonisation scenarios — 2030 and 2050 range of fuel shares in primary energy consumption compared with 2005 outcome (%) (Energy roadmap 2050 Luxembourg: Publications Office of the European Union 2012)

THE MAIN LESSONS LEARNED AND BARRIERS TO INNOVATION



EUROPEAN SMART GRID RESEARCH BY COUNTRY



RURAL INTELLIGENT RIgrid

the only one such project in Poland so far

R & I ACTIVITIES FOR THE FUTURE

Work on energy storage facilities and network cooperation.

The battery storage market is evolving quickly, especially as more solar energy is being dispatched into the electric distribution grids across the E.U. Utilities and regulatory agencies are implementing storage requirements after the fact, which is costly. The information gathered in this project will help others to understand the present economics and operating challenges.

In addition, it is anticipated that other revenue streams or benefits will drive the battery storage industry, just as others have been discovered by adopting automated metering infrastructure (AMI) systems and system control and data acquisition (SCADA) systems. Many electric utilities and investor-owned facilities also wrestled with economic justification issues in the early stages of AMI and SCADA implementation, but these now have been implemented in a majority of utilities and private investors.

DEPLOYMENT PROSPECTS OF THE MOST PROMISING SOLUTIONS

SOFTWARE ASPECT – EMACS SYSTEM

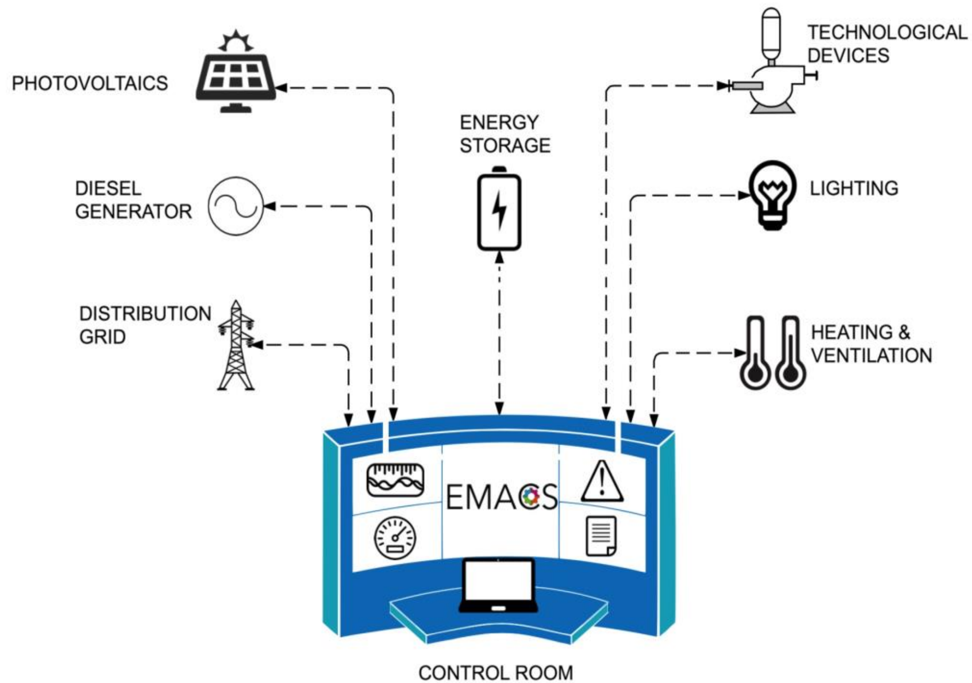
EMACS

Energy Management and Control System developed for the needs of the RIGRID project.

EMACS is a response to problems related to integration, processing and presentation from many sources of information into one cohesive system.

Based on many years of experience of the team in the industry and energy industry, it was possible to create a system combining the advantages of:

- the classic SCADA system
- Internet of Things platform
- a system for modeling / designing microgrids
- Business Intelligence software



SOFTWARE ASPECT - IMPLEMENTATION

EMACS **IMPLEMENTATION**

The implementer decides on which model to use at the stage of developing the concept / design, during the site inspection.

METHOD ONE
involves making regulatory decisions by the central controller, and afterwards sending control signals to local controllers located in micro sources, energy storage devices and controllable loads using cellular network.

In both situations system holds supervisory role providing feedback in the form of reports and trends for further analysis and gives for operator the ability to change algorithms parameters.

METHOD TWO
assumes that the individual local controllers has implemented several algorithms and communicate with each other, and on this basis take regulatory actions by themselves.

SYSTEM ARCHITECTURE

- distributed energy generators (gas engines, CHP, fuel cells),
- renewable energy sources (sun, wind, biomass),
- energy storage (batteries, hydrogen).

SOFTWARE ASPECT – SYSTEM FEATURES

WIDE-RANGE

Main features include:

- monitoring and control of any technological processes.
- collection of current data (measurements),
- data visualization,
- alarming,
- data archiving
- reporting.

SCALABLE

- client-server environment and multilayer architecture the system does not limit the size of controlled objects

EMACS

MODULAR

Individual functions are implemented through parallel services:

- **system server** responsible for downloading data from modules, processing and archiving of current data. Definition based on variables with assigned attributes regarding the value type, value source, communication path and the conversion function used. Alarm variables and events are a separate type of variable used to determine an alarm or event log from a monitored object.

- **MQTT broker - RabbitMQ software**. Used to support the MQTT protocol for data exchange in the publisher-subscriber model. Designed for remote communication on limited connections (thus very „light”). Works on the basis of the TCP / IP stack.

- **engineering station** - Remote configuration tool installed on the server or anywhere with a connection to the server. As the main editing and configuration tool in the system. Its level defines server service settings, notifications, reports, communication modules, portal pages, optimization modules and network planning.

- **communication modules - communication drivers - driver's language translator**:

  - IEC 61850 MMS client and server, GOOSE
  - IEC 60870-5-101 and 104
  - MODBUS TCP, RTU, UDP
  - OPC DA, AE, UA
  - DLMS / COSEM
  - M-BUS

- **web server** - a module for sharing data through a web browser

EMACS TODAY

- Electrum has already implemented the Emacs System on solar farms built for Modus company. Sofar it successfully provides trouble-free operation;
- Electrum is to implement Emacs system on several more solar farms for Renesola company;
- Emacs system attracts attention of other companies and is going to be implemented in more solar farms in Poland and Hungary for Electrum Service customers.

Work scenarios for the Rigrid installation

Scenarios (showcases) are used to show the situations that will occur at specific combinations of external and internal operating conditions of the system. In this way, you can simulate the way the system and software controlling it behave in real working conditions.

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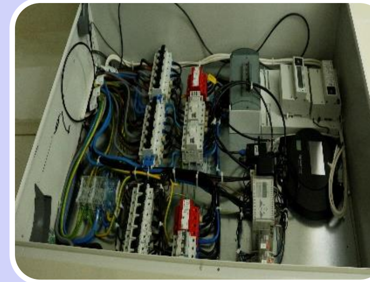
DESCRIPTION



The goal of scenario 1. is to show the monitoring function and the online visualization of the power system and data of its elements, such as power, frequency, voltage, etc. Thanks to monitoring, it is possible to analyze the parameters precisely and limit values of the system.

The goal of Scenario 2. is to find points of optimal operation of the microgrids. On the basis of obtained measurement data of microgrids and its components, the optimization algorithm calculates the most advantageous strategies of system operation.

The goal of scenario 3. is to present the operation of protection automation in a microgrid during island operation.

The optimal operation of generating units and microgrid has to be coordinated with control and protective mechanisms. In case of disturbance detection, the control and protection devices should automatically respond to the occurrence.

HARDWARE ASPECT

- Switchgear installation
- Connecting existing circuits together with battery energy storage system,
- PLC controllers - programmable microprocessor devices designed for controlling the work / measuring elements and devices. In this case, WAGO drivers were used.
- Telemetry configuration (transmission of measured values) in the area of demonstration installation. The works included comprehensive start-up of the facility, including commissioning and measurements.

THE PROJECT RURAL INTELLIGENT RIgrid

Aim

To design and demonstrate an innovative tool for the planning and the operation of energy power infrastructures in rural areas.

Approach

Creating a measurement and IT system that integrates monitoring, analyzing and optimizing of the whole installation in real time.

Supported by hardware, such system could then be characterized as an intelligent one (smart grid system).

Phases

- Requirements analysis
- Master-plan development
- Implementation of interactive energy and infrastructure design tool and demonstration.
- Evaluation
- Information and dissemination
- Project management.

Result

Energy & measurement & IT system, verified in a laboratory in real conditions.

The system with 2 options:

- to operate in parallel with the power grid or in island operating conditions, dedicated for the optimal planning

- efficient operation of integrated renewable energy equipment in rural areas, ensuring continuous and secure supply of energy.

BUSINESS, SCIENCE AND COMMUNITY WORKING TOGETHER

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Cu European Copper Institute Copper Alliance

RegenerativKraftwerke Harz

Fraunhofer IFF

Warsaw University of Technology

Windpark Druiberg GmbH & Co. KG

THANK YOU FOR YOUR ATTENTION

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