CRES – Centre for Renewable Energy Sources and Saving
Department of PV Systems & Distributed Generation

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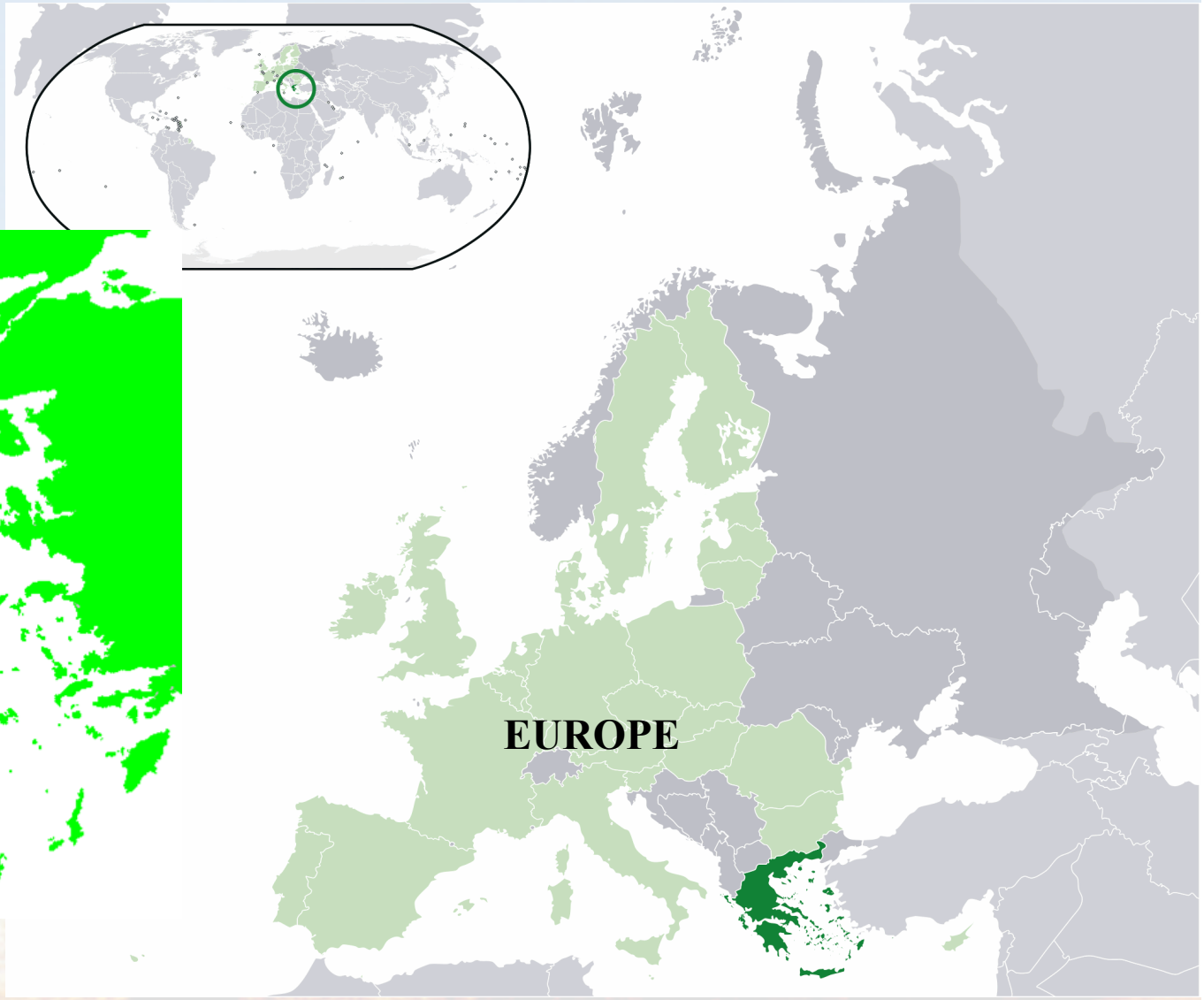
Greek Experience with Microgrids
Results from the Gaidouromantra site, Kythnos Island

Stathis Tselepis, CRES, *stselep@cres.gr*
Contributors: CRES, NTUA, IWES, SMA

Location



GREECE

Description of the microgrid 1

The microgrid in Gaidouromantra, Kythnos was installed in 2001, in the framework of two European projects (PV-MODE, JOR3-CT98-0244 and MORE, JOR3CT98-0215).

The microgrid in Gaidouromantra is autonomous. It is composed of a 3-phase low voltage grid, formed by battery inverters. The grid is composed of the overhead power lines and a communication cable running in parallel to serve the monitoring and control needs.

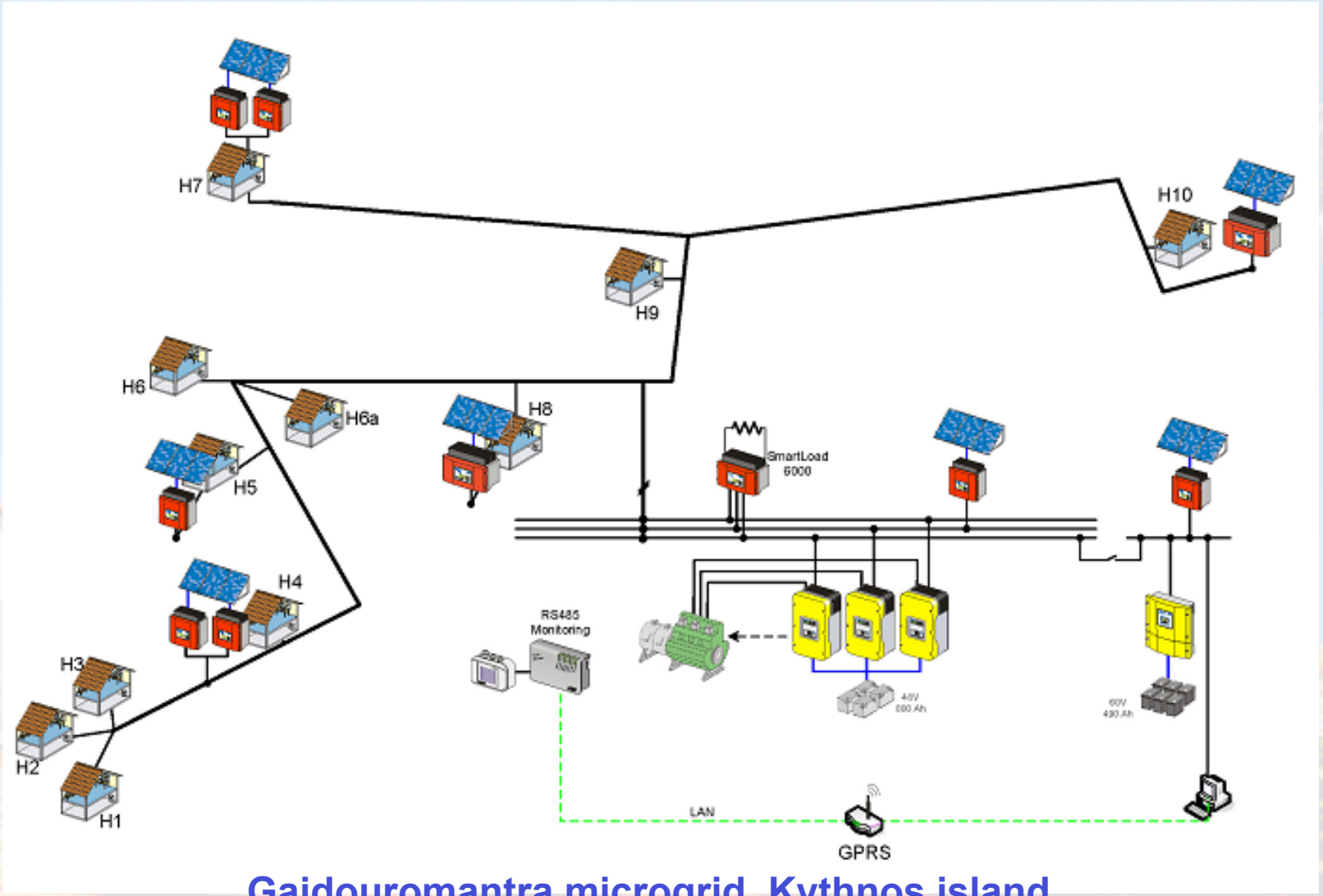
Total generation capacity: 3X5 kVA

Technologies involved: PV generatos, Battery storage, Diesel genset, intelligent load controllers

Maximum demand: 12 kVA

No of clients: 12 vacation houses

Description of the microgrid 2



Gaidouromantra microgrid, Kythnos island

Objectives of the demo case 1

Optimization of the operation in islanded mode using agent based control of non-critical loads at several houses

The primary goal can be separated in two sections the technical and the electrical:

- The technical goal was to install, check and optimize a quite complex system in a real environment
- The electrical goal included the minimization of the diesel generator usage and also the operation of loads during hours with PV energy excess

Objectives of the demo case 2

- Upgrades of the power converters under the More-Microgrids project with new ones capable to deal with the strenuous conditions of islanded mode control were realized
- Performance monitoring of the Gaidouromantra microgrid
- Implementation of an agent-based Load Controller system that can be used to monitor the status of the power line and take measurements of Voltage, Current and Frequency.

Highlight results (Performance monitoring of Gaidouromantra microgrid)

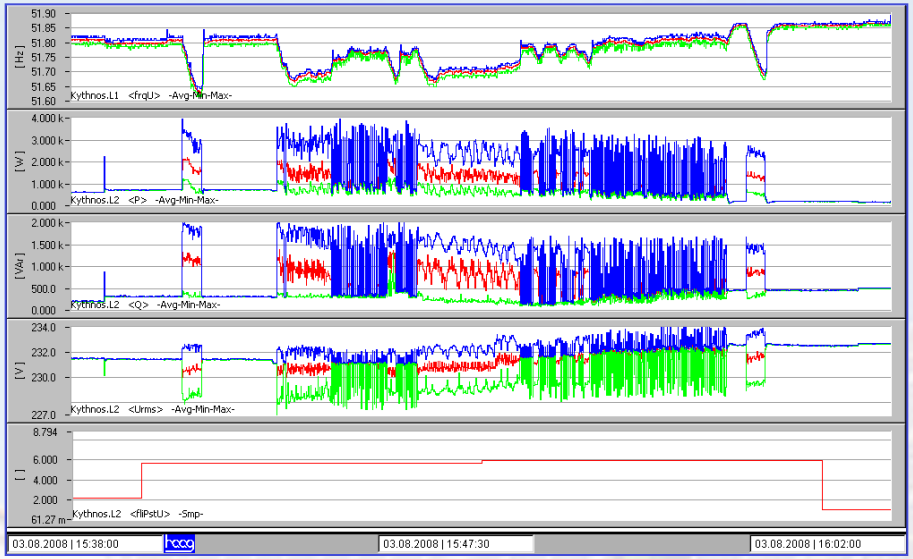
A monitoring system for distributed generators and loads in the microgrid was designed, installed and operated

Provided:

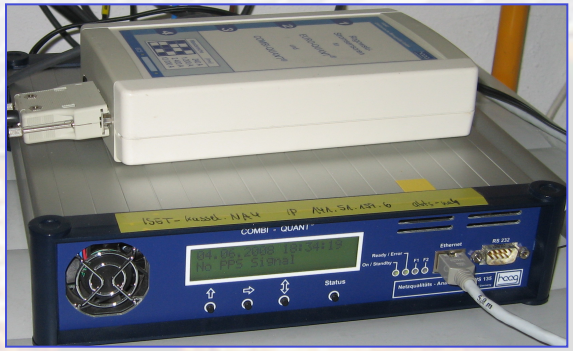
- Possibility for early detection of components malfunction
- Enhancement of reliability, performance and safety for power supply of customers
- Remote supervision of the microgrid system
- A data base for performance data was design and implemented

Highlight results (Performance monitoring of Gaidouromantra microgrid)

Power Quality Monitoring



Example of monitoring of frequency, voltage flicker, active and reactive power



Power quality analyser

Power quality evaluation according to EN50160 for a week in August 2008

- Grid frequency operation window was violated due to fact that frequency is used for energy management, PV inverter de-rating (>51Hz) and house disconnection (<49 Hz).

- Higher values for voltage flicker for short times due to a pump operation.

- Voltage Harmonic U9 above threshold due to a cyclic load (refrigerator)

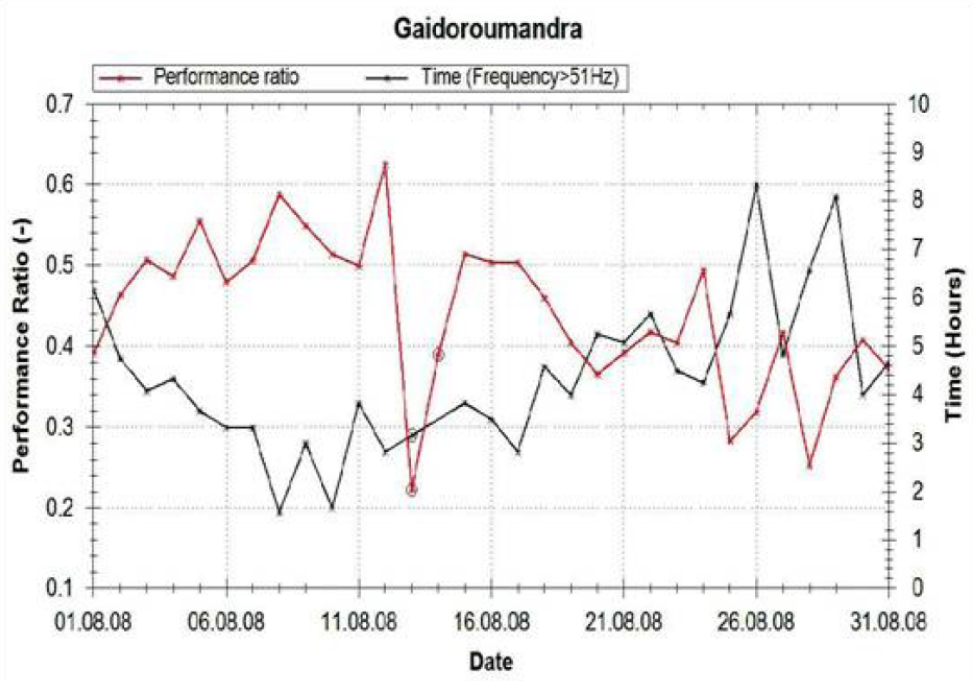
- Voltage Harmonic U6 above the limit, when the PV inverters were operating in de-rating mode.

Highlight results (Energy performance in August 2008)

The daily performance ratio was ranging from 0.2 – 0.6

To improve system's performance ratio:

- Excess energy in the system could be used for water pumping, water desalination, etc.
  Load controllers and energy use optimization would be important during high energy use periods
- or a larger battery would be required



Performance ratio and time duration with frequency over 51 Hz

Results

- Improvements and upgrades of the microgrid with the latest technology power devices
- Energy performance monitoring campaign: Microgrid specific standards for power quality monitoring will be needed (islanded operation)
- Good and reliable Agent based Intelligent Load Controller operation
- Most of the citizens accepted the system well and were very cooperative during the tests
- Capability of simulating static and dynamic operation of the microgrid
- Validation of simulation tests of the microgrid with measured data of the real system operation

Further Work

The following ideas may be the foundation of a future R&D project in Gaidouromantra, Kythnos Island:

- Continuation of the monitoring and supporting the maintenance and operation of the microgrid
- Development of the required safety, protection measures, communication and control of an active (bi-directional) Low voltage to Medium voltage transformer.
- Interconnection of the Gaidouromantra microgrid with the Kythnos island Medium voltage grid and optimization of the microgrid operation in islanded and inter-connected mode to make use of the discarded PV energy.