This project has received funding from the European Union's Horizon 2020 research and innovation under grant agreement No 101018420.

EU-India Collaboration for Smarter Microgrids:

RE-EMPOWERED project

Renewable Energy Empowering European & Indian Communities

RE-EMPOWERED
Renewable Energy EMPOWERing European & InDian Communities

Panos Kotsampopoulos, Aris Dimeas, Alexandros Chronis, Georgia Saridaki, Nikos Hatziargyriou, *National Technical University of Athens*

Suman Maiti, Chandan Chakraborty, *Indian Institute of Technology Kharagpur*

Consortium

Partners					
European			**Indian**		
1	ICCS-NTUA (European Coordinator)	Greece	8	Indian Institute of Technology Kharagpur (Indian Coordinator)	
2	Imperial College London	United Kingdom	9	Indian Institute of Technology Bhubaneswar	
3	Danmarks Tekniske Universitet	Denmark	10	Visvesvaraya National Institute of Technology	
4	Bornholms Varme As	Denmark	11	CSIR-Central Mechanical Engineering Research Institute	
5	Protasis Sa	Greece	12	Indian Institute of Science	
6	Deloitte Advisory, S.L.	Spain	13	Indian institute of technology Delhi	
7	DAFNI	Greece	14	Lab Concern India (LCI)	

Duration: 42 months as of 1 July 2021

This work is financially supported by the European Union's Horizon 2020 Research and Innovation Program and the Department of Science and Technology (DST), India through the RE-EMPOWERED Project under Grant Agreement No 101018420 and DST/TMD/INDIA/EU/ILES/2020/50(c) respectively

Purpose

The main goal of RE-EMPOWERED is to develop and demonstrate solutions for energy transition of island and weakly connected energy systems, based on Microgrids exploiting multiple energy vectors. The benefits will be demonstrated leading to an increased share of renewable generation and higher energy efficiency of the wider local energy system.

RE-EMPOWERED will develop **a complete set of solutions for local energy systems** that will be demonstrated in four pilot sites, two European and two Indian, complementary in terms of size, organisational and technical maturity.

Solutions to be developed

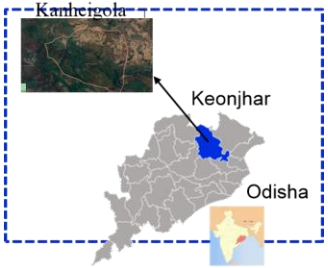
- **ecoEMS/ecoMicrogrid:** Energy Management Systems
- **ecoDR:** Smart Meter - Load controller
- **ecoConverter:** Power electronic converters for dc/ac microgrids
- **ecoVehicle:** Electric vehicle charger
- **ecoPlanning:** Energy planning tool
- **ecoCommunity:** Citizen engagement digital platform
- **ecoResilience:** Cyclone Resilient infrastructure for wind turbines and PV
- **ecoMonitor:** Water/air quality monitoring
- **ecoPlatform:** Cloud-based interoperable platform

Demonstration sites

4 demo sites, in EU and India. Demos range in size and technical maturity.

- **Bornholm Island (Denmark):**
  - Received the 2019 RESponsible Island Prize by the EC
  - Synergies of integrating energy vectors (power/heat) will be explored
- **Kythnos island (Greece):**
  - Fist microgrid in Europe
  - Digitalization and energy transition of Kythnos' energy system will be accelerated
- **Keonjhar (India):**
  - Isolated Villages
  - Existing renewable facilities will be upgraded to improve the living standards of the community
- **Ghoramara Island (India):**
  - Not interconnected, residents live in very poor conditions, severe cyclonic storms every 5-10 years
  - One Microgrid will be built to electrify several houses of the island

Ghoramara Island, West Bengal India



Bornholm island, Denmark

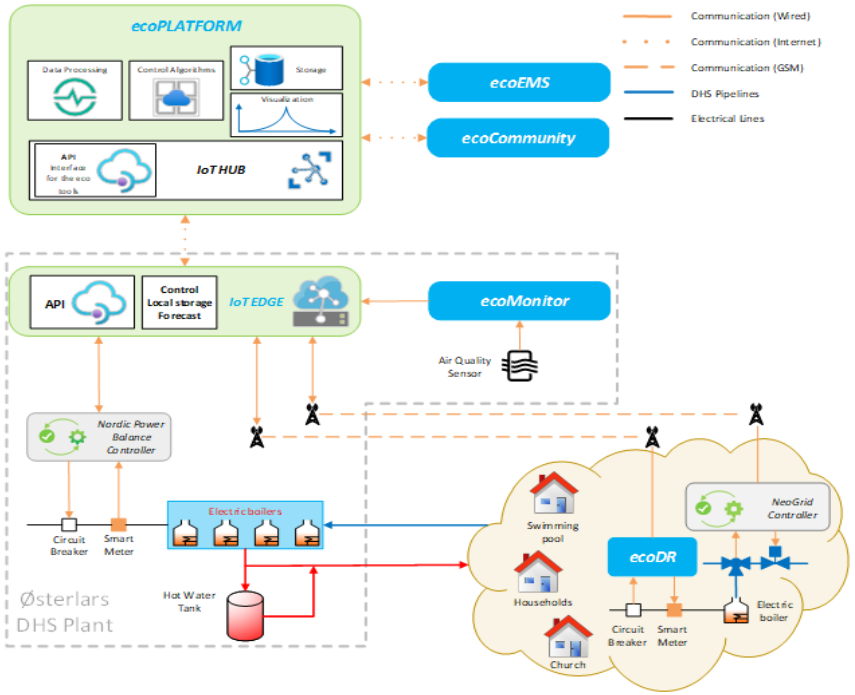

Kythnos island, Greece

Bornholm Island (Denmark)

- Østerlars heat plant : 4 MW boiler fueled by locally produced straw, four 0.6 MW electric boilers (EBs) for reserve and peak loads, and a 1,500 m3 hot water storage tank with a capacity of 80 MWh. Those are the heat sources that provide the heat to the local DHN.

- The demo will provide means for integrating more electricity from RES, in a community that already has a high penetration of RES.

- Electric Boilers will be activated when there is excess production from PV to avoid RES curtailment. The excess PV power will be provided as heat to the District Heating Network, leading to a reduction of the utilization of the straw boiler.

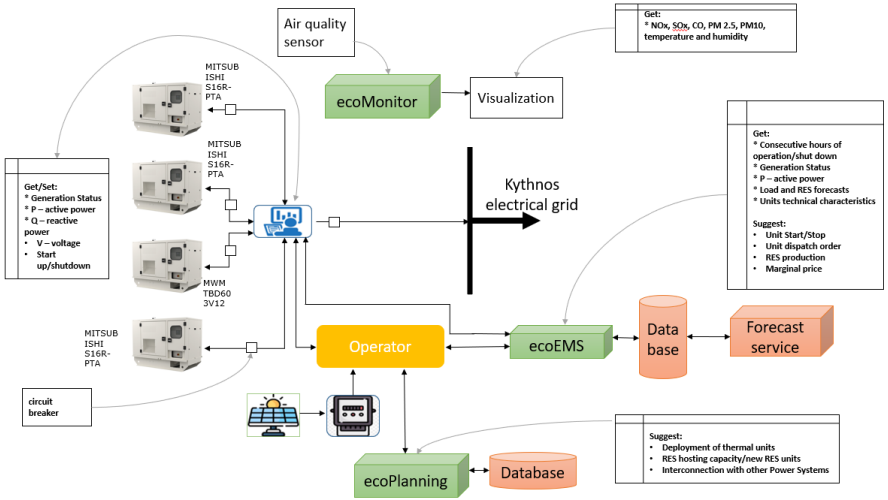


Kythnos Power System (Greece)

Kythnos demo site consists of two independent sites. The first site refers to the island's power system (Kythnos power system) and the second site refers to an off-grid system, the Gaidouromandra microgrid.

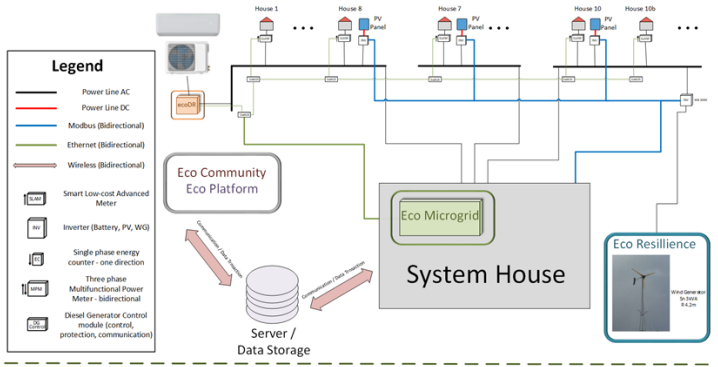
- Kythnos power system: *Peak load*: 3.118 MW, *No. of electricity customers*: 3,353, *Installed capacity of fossil fuel (diesel) Generation*: 5.2 MW , *Installed capacity of renewable energy generation units:* 908.65kW.
- Suggestions on the optimized and efficient operation of Kythnos power system i.e. optimal dispatch of the generation units of the Kythnos power system based on RES and load forecasting will be made.
- Simulations that support the decision-making process regarding the deployment of new electricity generation units (conventional and renewable) on the electric systems of NIIs and the interconnection between NIIs will be performed.
- Monitoring of the air quality will also take place.

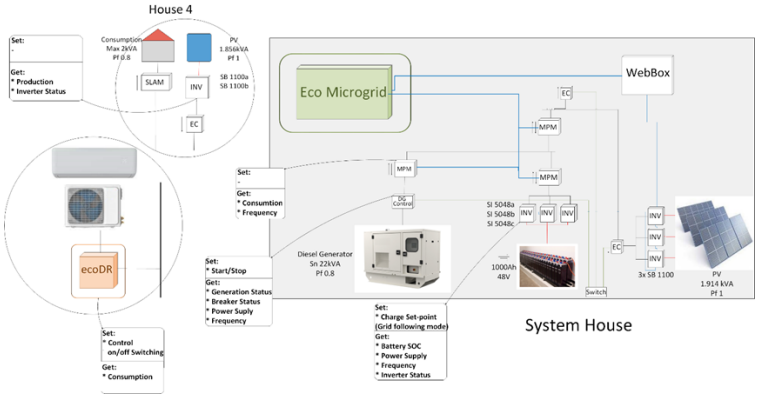
Kythnos island demo site



Gaidouromantra Microgrid (Kythnos, Greece))

- Gaidouromandra (in Kythnos) operates the first microgrid in Europe, installed in 2001 in order to electrify 14 vacation houses.
- It includes PVs, a battery energy storage system (BESS) and a diesel generator (as a back-up source).
- The optimized and efficient operation of the microgrid will be ensured by providing optimal dispatch of the resources of the microgrid. A hardware solution will be implemented in the field.
- A smart meter/load controller for demand side management. Flexible loads will be controlled by the energy management system.
- A cloud-based platform will be used to collect and manage the data from Gaidouromantra site.
- A digital platform for raising citizen engagement will be used (app for mobile phones, showing consumption, used for demand side management).
- A small wind turbine will be manufactured by NTUA and installed in Gaidouromantra.





Ghoramara island (India)

- Population of 3,000 residents.
- The following energy sources will be added in Ghoramara island to provide electricity to 1100 houses along with school, shops and health center: PV 240 kWp, Wind Turbine 10 kWp.

-2 larger microgrids (155 kW + 75 kW) using commercial equipment.

-20kW microgrid using RE-EMPOWERED developed technologies.

- Several power electronic devices will be developed/installed:

❖ Partial Power Converter to integrate PVs (for higher capture of solar energy during partial shading)

❖ SiC based dc-dc converter to integrate BESS

❖ Load Flow Controller to transfer power between 2 microgrids

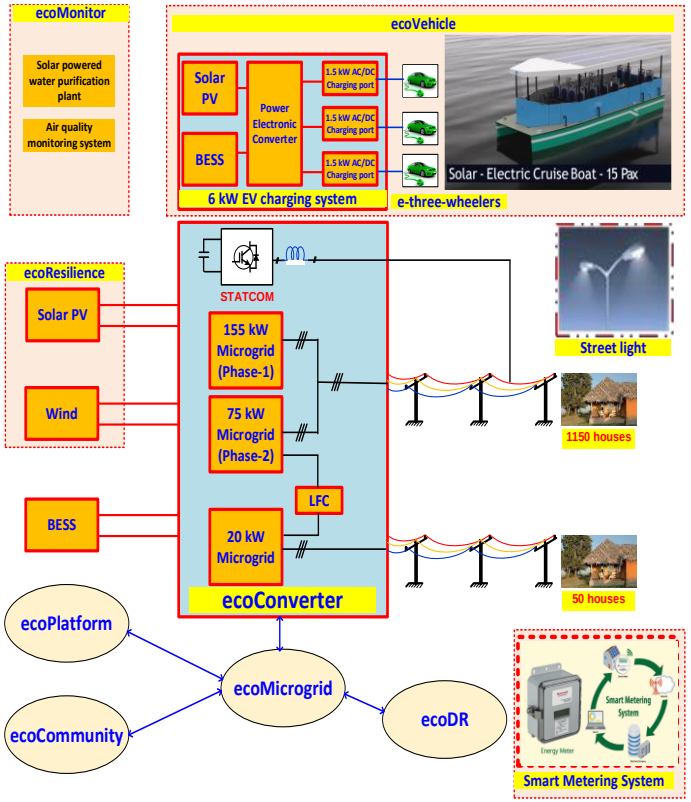
❖ Power Conditioner multilevel converter

❖ Charging station with local PV and BESS for Electric three wheelers Electric boat to carry 15 passengers

❖ Dimmable street lights

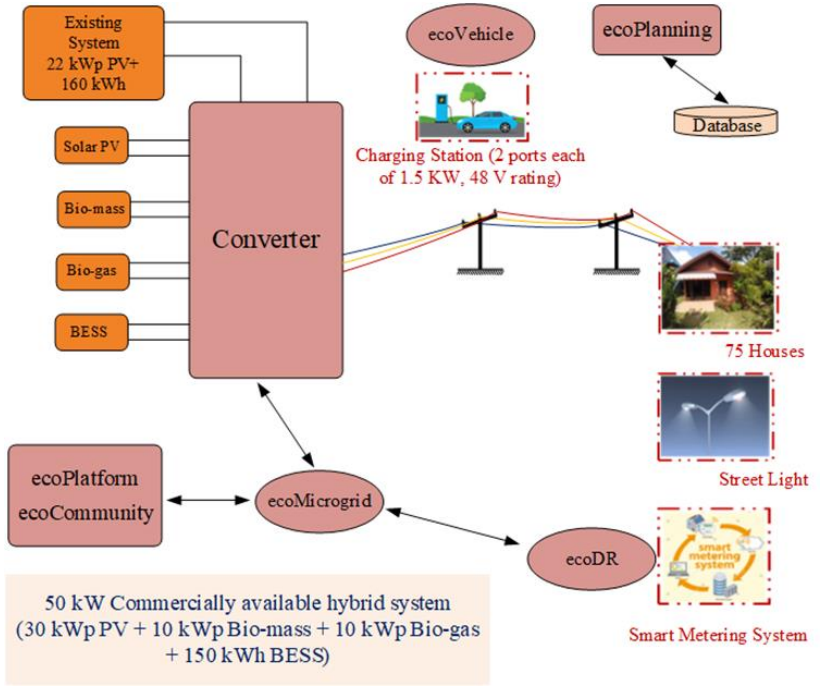
❖ Cyclone resilient structure for PVs and Wind Turbine

- Special focus will be given to optimization, demand side management, community engagement.



Keonjar(India)

- The demo site of Keonjhar has an existing microgrid of 22 kWp, which primarily supplying consumers during nighttime with limited capacity. As a part of the RE-EMPOWERED project, the existing microgrid will be upgraded to another 50 kWp to support the commercial applications in the demo site.
- 50 kW microgrid system: 30 kWp PV + 10 kW Biomass + 10 kW Biogas.
- Charging Facility for three wheelers, Smart Meters , Solar Dimmable Lights, Optimization, demand side management, community engagement.
- Development and demonstration of various energy sources integration, by means of high energy efficient converters and their control.
- Implemention of a livelihood program to complement its off-grid systems in selected remote villages, aiming to create support ecosystems to promote income-generating energy uses in agriculture and small businesses.
- Increase of population awareness and customer engagement, such that rural to urban migration can be minimized.



Project results so far & Next steps

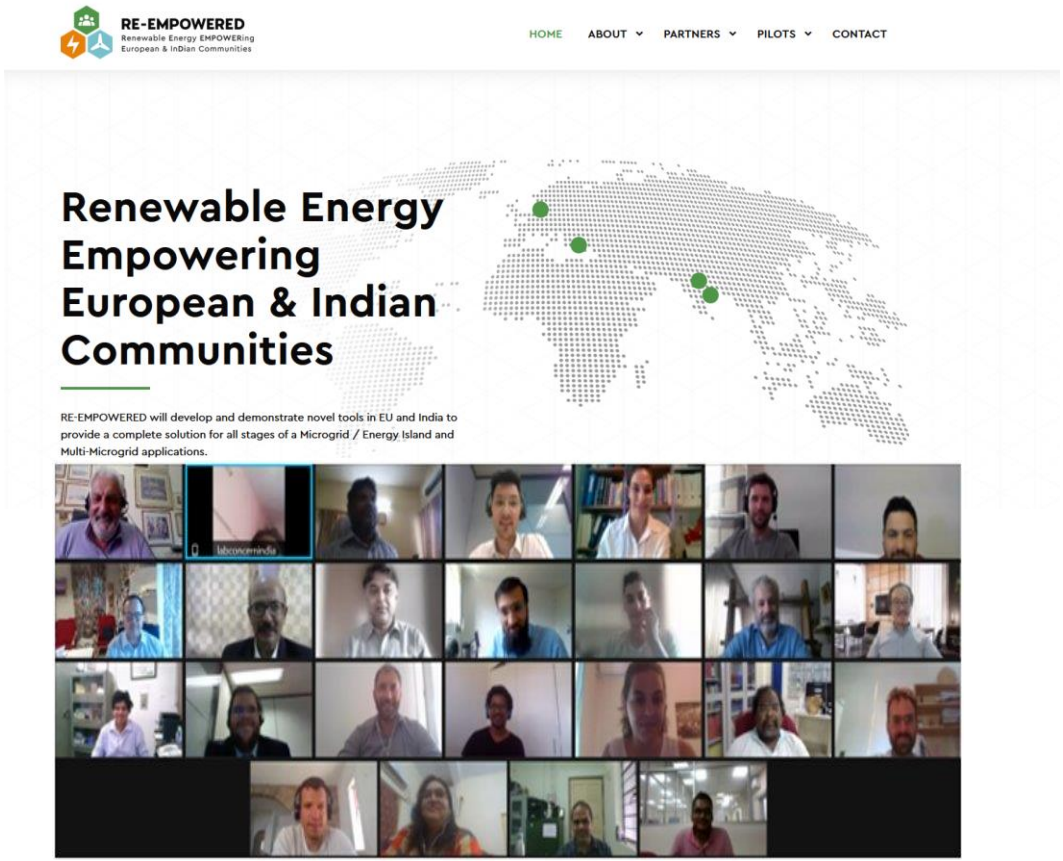
- Deployment and demonstration planning has been performed.
- Interconnection of the tools at the demo-sites via SGAM (Smart Grid Architecture Model) analysis was defined.
- Obstacles to innovation were identified.
- Relevant interoperability standards were analyzed.
- Use-cases have been defined
- Development of control algorithms in progress

- Next steps:

- Integration of the control algorithms in the tools

- Deployment and demonstration

Thank you for your attention!



Website:
https://reempowered-h2020.com/

Twitter:
https://twitter.com/reEMPOWERED_h20

LinkedIn:
https://www.linkedin.com/company/re-empowered-h2020-project