European Commission

RE-EMPOWERED
Renewable Energy EMPOWERing
European & InDian Communities

Clean energy for EU islands Workshop Brussels 2025

RE-EMPOWERED Project

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#CleanEnergyIslands

Overview

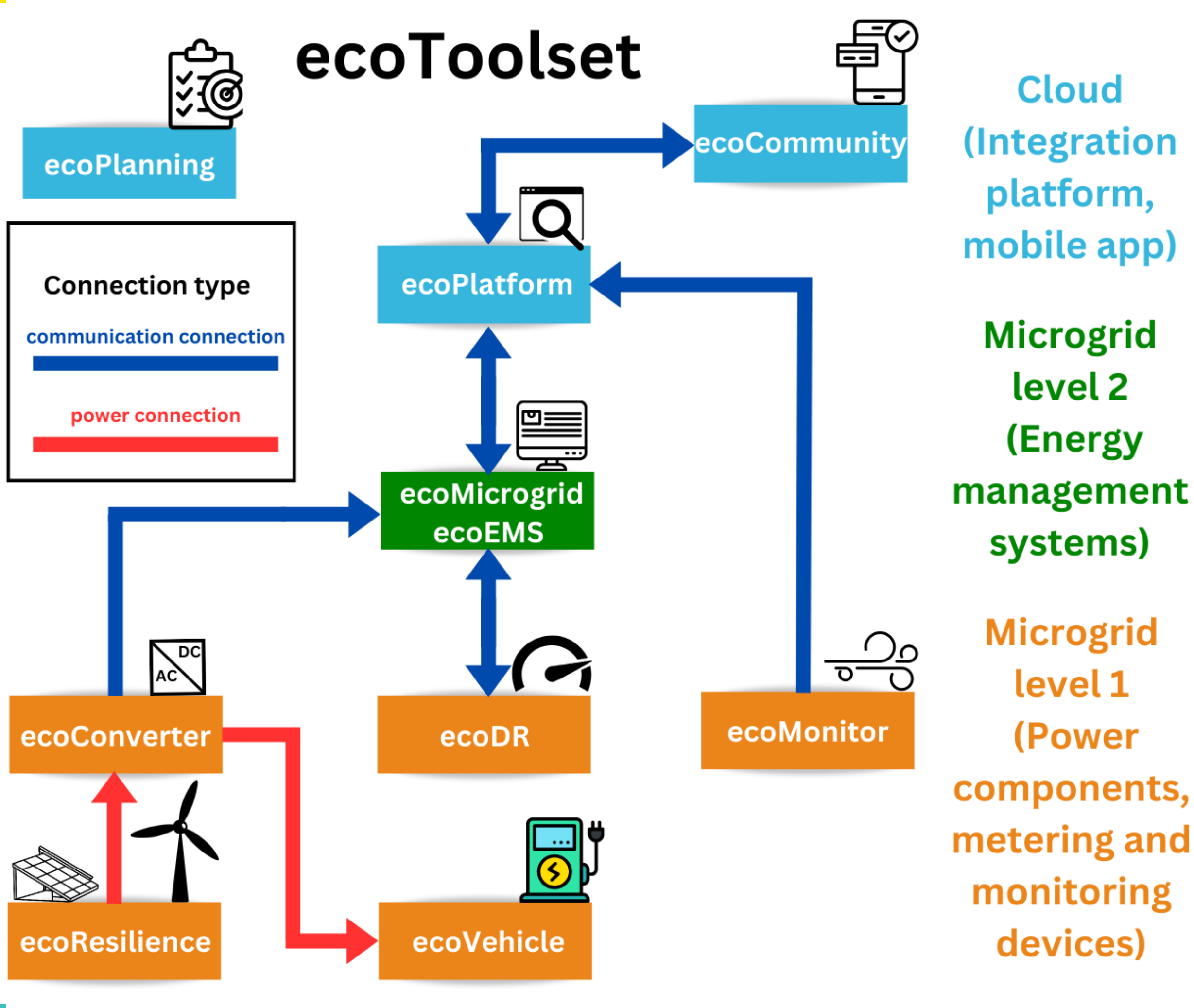
Partners					
European			Indian		
1	ICCS - NTUA (European Coordinator)	Greece	8	Indian Institute of Technology Kharagpur (Indian Coordinator)	
2	Imperial College London	United Kingdom	9	Indian Institute of Technology Bhubaneswar	
3	Danmarks Tekniske Universitet	Denmark	10	Visvesvaraya National Institute 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

Total Budget (EU): € 5 005 178,75

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

Ecotools



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

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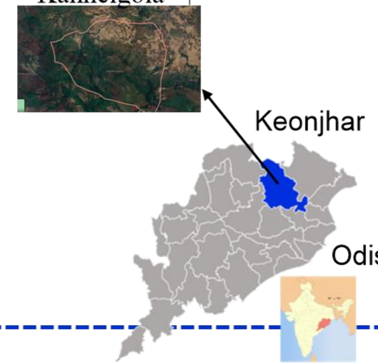
Demo sites

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):**
  - *Kythnos power system and Gaidouromantra microgrid (first microgrid in Europe)*
  - *Optimal operation and higher penetration of RES*
- **Keonjhar (India):**
  - *Isolated rural Villages*
  - *Existing renewable facilities will be upgraded to improve the living standards of the community. Biomass and biogas will be integrated*
- **Ghoramara Island (India):**
  - *Not interconnected island, residents live in very poor conditions, severe cyclonic storms every 5-10 years*
  - *Microgrid will be built to electrify more than 1000 houses of the island*

Ghoramara Island, West Bengal India



Bornholm island, Denmark


Kythnos island, Greece

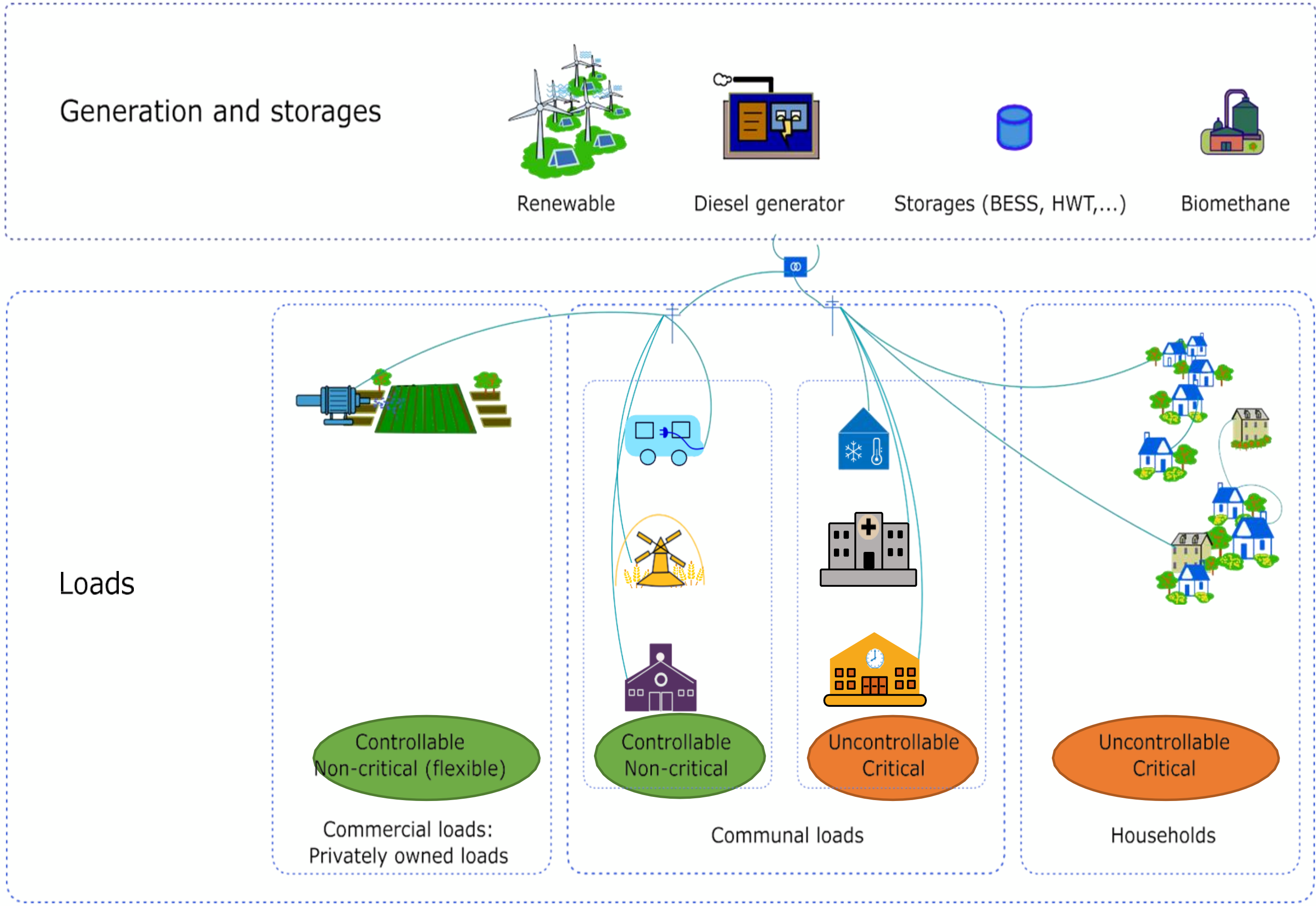
Summary of achievements

- *Social impact:*
  - ***650 houses** involving **2.500 citizens** obtained electricity access along with local market, police station and health center (Ghoramara, India)*
  - ***75 houses** involving **350 citizens** have been provided 24x7 electricity access rather than a 4-hour access they had previously. Starting of **new businesses**: small cloth shop and grocery shop (Keonjhar, India)*
  - *Formation of **cooperative society** to operate and maintain the microgrid of Keonjhar*

- ***10 innovative tools** have been developed and demonstrated in diverse demo-sites*
- *ecoMicrogrid tool (ICCS-NTUA and PROTASIS) is being **commercialized.***
- *Presentation in **more than 70 events. 8** scientific **journal** publications.*
  ***13** scientific **conference** publications. **Best Conference Papers Award** at the IEEE PES General Meeting*
- ***8 EU-India research visits** (knowledge exchange) have been executed*

Demand-side management (DSM)

- Demand-side management (DSM) supports the efficient operation of local energy systems and islanded microgrids
- Based on analysis of the RE-EMPOWERED demos, load classification has been performed
- DSM strategies have been tailored for all demo sites, containing
  - Day-ahead DSM planning based on algorithm generated **time slots**
  - Real-time DSM based on **price indications**
  - **Emergency actions** based on the microgrid optimization



ecoTools interactions for DSM

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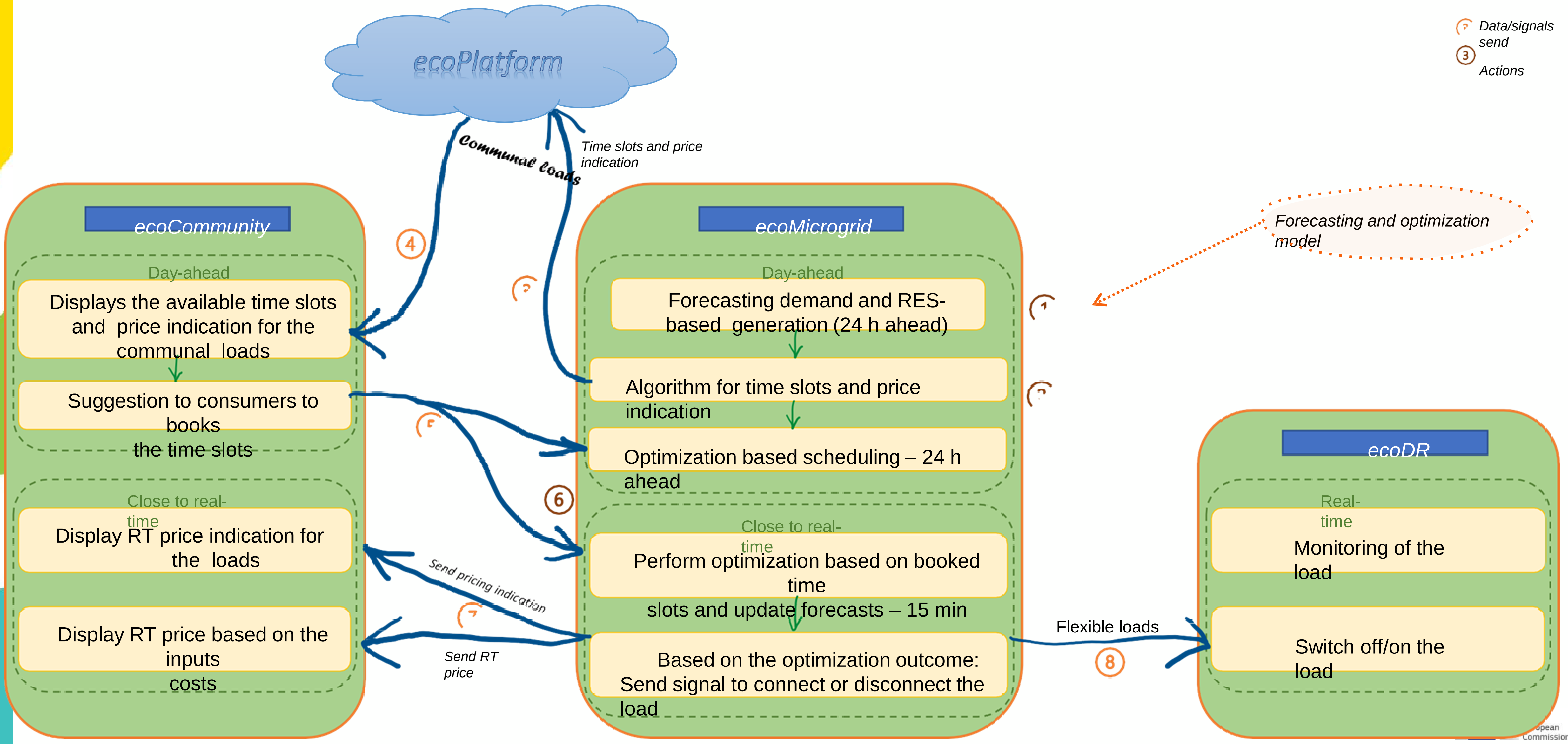

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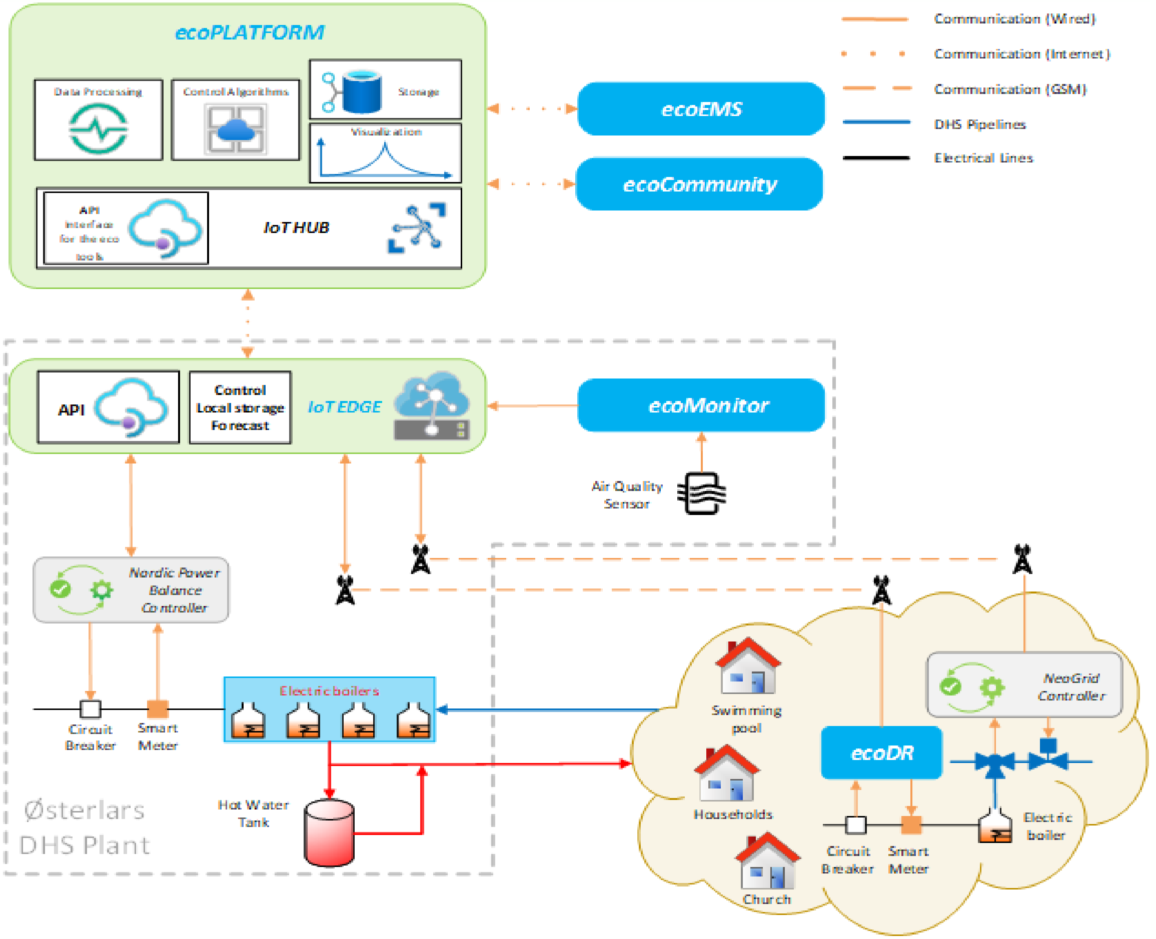
Bornholm Island (Denmark)

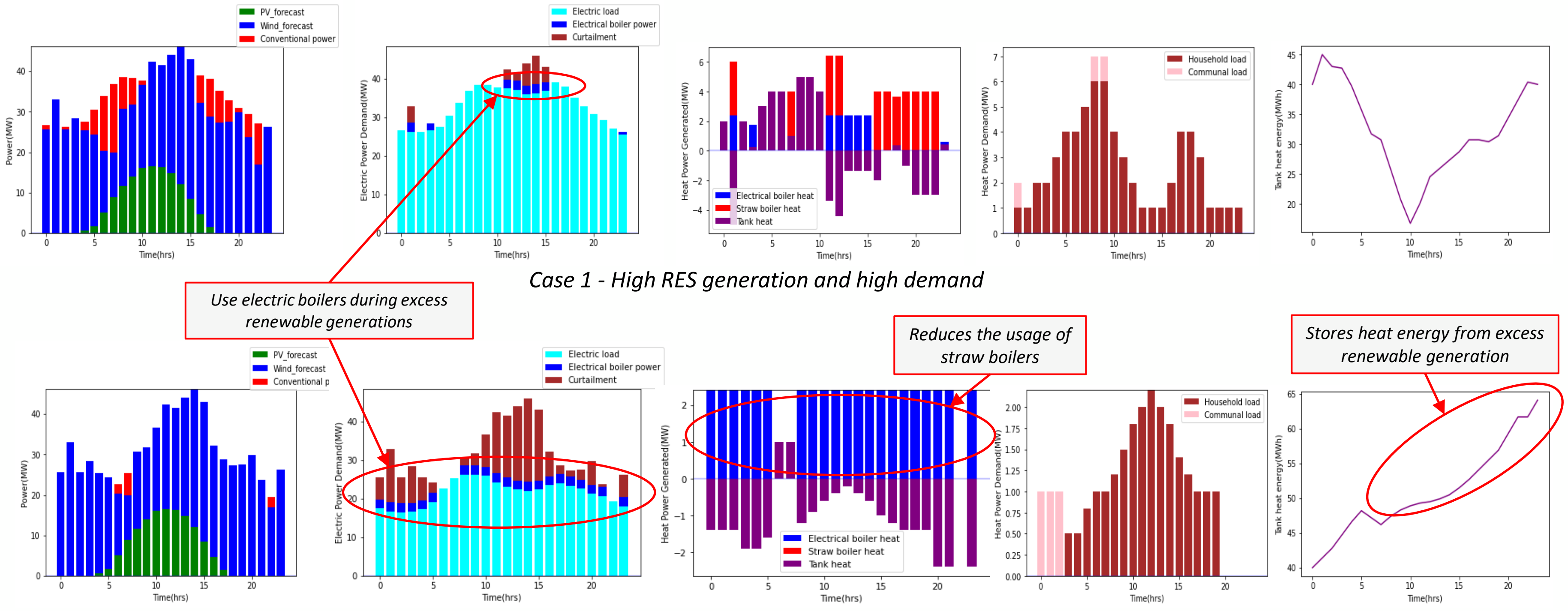
- Østerlars heat plant : 4 MW boiler fueled by locally produced straw, 4 0.6 MW electric boilers (EBs) for reserve and peak loads, and a 1,500 m3 hot water storage tank with a capacity of 80 MWh. Those are the heat sources that provide the heat to the local DHN.

- 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.



ecoEMS: Bornholm application

- **Simulation** -> The algorithms will be tested in the field next
- The objective is to **utilise the flexibility of the district heating network** to **reduce renewable curtailment** in the electrical system and **reduce the use of conventional generation**.



Case 1 - High RES generation and high demand

Case 2 - High RES generation and low demand

ecoEMS: Bornholm application

- The implementation of co-optimisations leads to the following advantages:
  - **Reduces renewable curtailment** during excess renewable generation
  - **Reduces the usage of straw boilers** by utilising the electric boilers
  - **Stores the heat energy** in the hot water tank during excess renewable generation
  - Effective utilisation of hot water storage and flexible heating demand to **minimise the operating cost**.

Table 1.1: Reductions in renewable curtailment, straw cost and emissions per day

Cases	*Case 1 (High load – High RES)*			*Case 2 (Low load – High RES)*		
Optimisation	*Independent*	*Co-optimisation*	***Change***	*Independent*	*Co-optimisation*	***Change***
Renewable Curtailment	42.7 MWh	25.9 MWh	**39.2 %** ▼	224.8 MWh	174.5 MWh	**22.4 %** ▼
Fuel cost of Straw boiler (EUR)	1146	846	**26.2 %** ▼	902	0	**100 %** ▼
CO_2 emissions from Straw Boiler (ton)	23.04	17.01	**6.03** ▼	18.14	0	**18.14** ▼
Gain in energy in the hot water tank (MWh)	0	0	-	0	23	**23** ▲

Approximate operational cost of Straw Boiler = 17.9 EUR / MWh
Approximate emissions of Straw Boiler = 360 kg CO_2 / MWh

Thank you for your attention!

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