RES4LIVE

ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

Smart Control Strategies for Optimal Environmental Conditions and Minimum Energy Requirements in Livestock Facilities

Stelios Kalogridis[a], **Michael Moraitis[b]**, Athanasios Balafoutis[b], Bas Paris[b,c], Nikolas Ipiotis[a], Michail Savvakis[a], Dimitris Manolakos[c], Dimitrios Tyris[c]

[a]Plegma Labs, [b]iBO/CERTH, [c]AUA

Plegma Labs

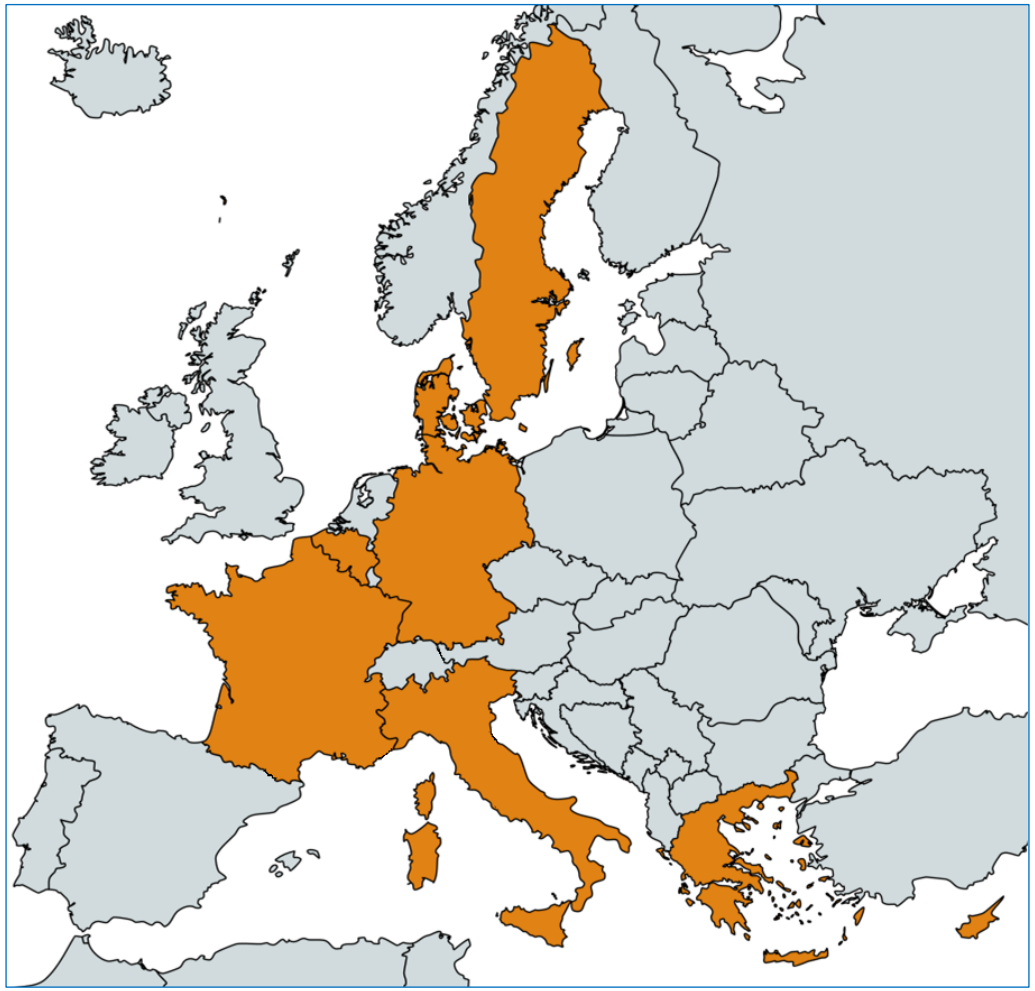
CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS
iBO

ΓΕΩΠΟΝΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
AGRICULTURAL UNIVERSITY OF ATHENS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

A few words about our Project

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION



Horizon 2020: 01/10/2020 – 30/09/2024

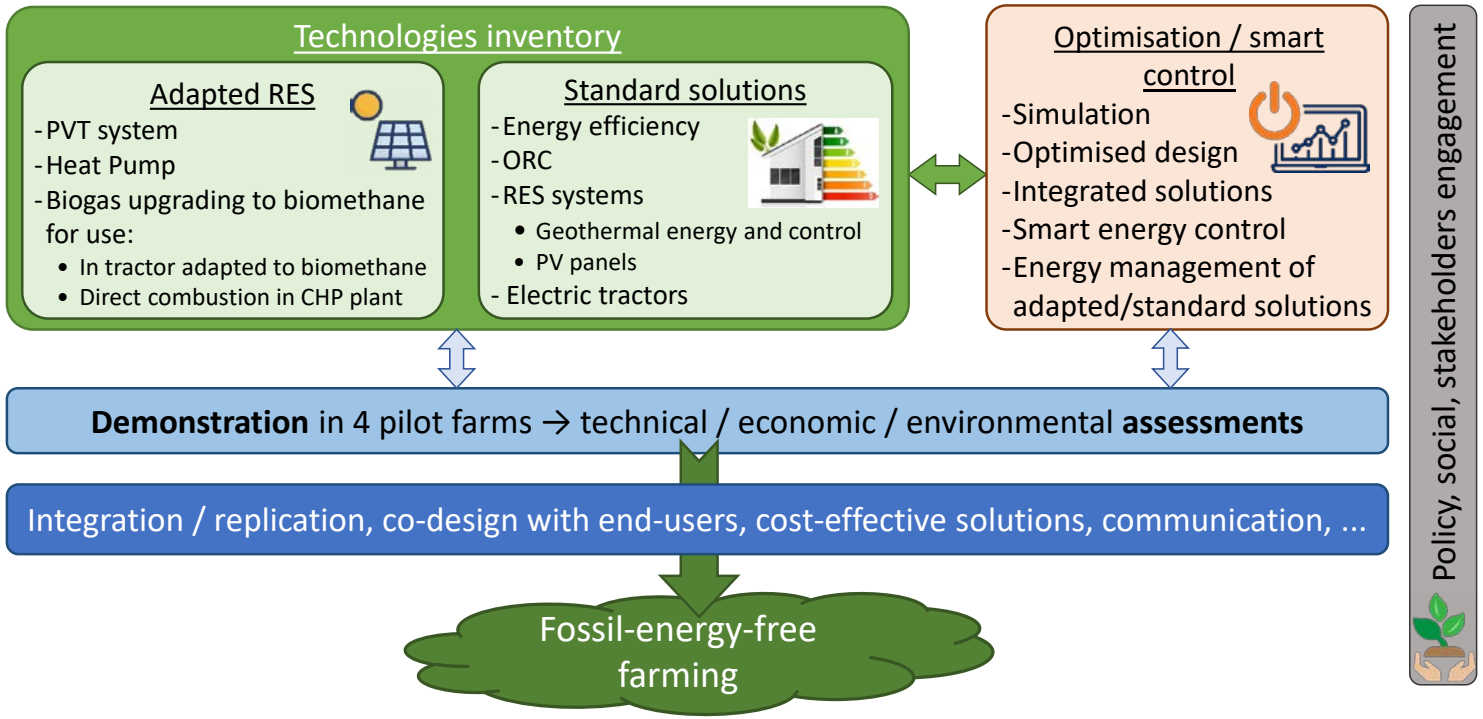
17 Partners from 8 EU countries

AUA CERTH PLEGMA LABS PSYCTOTHERM	**GREECE**	**BELGIUM**	EV ILVO UGent TERRA EUREC
UNIBO GOLINELLI EAAP	**ITALY**	**GERMANY**	ATB LVAT
AU	**DENMARK**	**FRANCE**	CRMT
MG Sustainable	**SWEDEN**	**CYPRUS**	CETRI

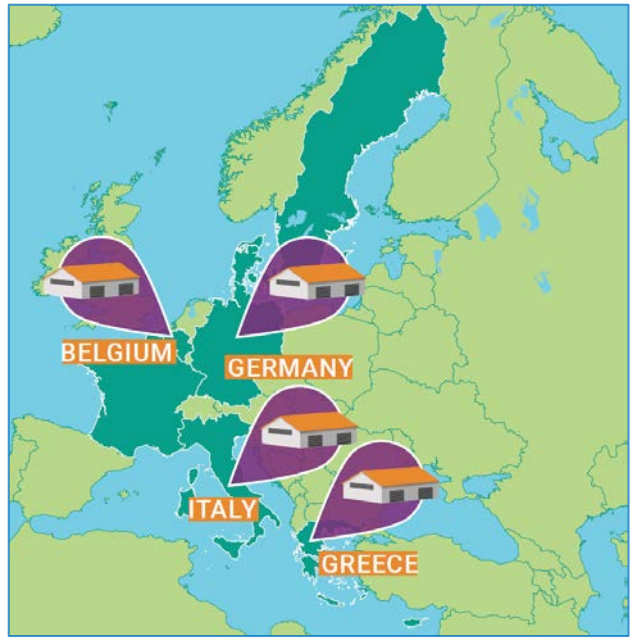
www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

A few words about our Project

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION



- Up to 100% of energy demand in livestock farms
- Strongly diversified in terms of farm types and locations



www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

A few words about our Project

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

Technologies inventory

Adapted RES
- PVT system
- Heat Pump
- Biogas upgrading to biomethane for use:
  - In tractor adapted to biomethane
  - Direct combustion in CHP plant

Standard solutions
- Energy efficiency
- ORC
- RES systems
  - Geothermal energy and control
  - PV panels
- Electric tractors

Optimisation / smart control
- Simulation
- Optimised design
- Integrated solutions
- Smart energy control
- Energy management of adapted/standard solutions

Demonstration in 4 pilot farms → technical / economic / environmental **assessments**

Integration / replication, co-design with end-users, cost-effective solutions, communication, ...

Fossil-energy-free farming

Policy, social, stakeholders engagement

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

Introduction
State of the art

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

- High demand for animal products and by-products
- Decreasing number of farmers in developed countries
- Industry focuses production on larger farms
- Consumers' preference in livestock goods produced under well-being production strategies

---

→ Need for the farming industry to adopt new practices towards efficient but also healthier breeding conditions

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

Introduction
Smart control systems

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

Main purpose

- Integration of heating/cooling systems, air quality, energy monitoring, lighting, etc. through smart devices (sensors, actuators)
- Large variety of factors to be monitored
- Continuous monitoring and adaptability are crucial

→ IoT combines several “smart” technologies and creates efficiencies, scalability and interoperability between them

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

Introduction
IoT in the livestock industry

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

- Most livestock farms are dependent on older/less efficient equipment
- The complete upgrade of legacy systems is cost prohibitive
- IoT solutions can be installed as standalone equipment and be paired with existing equipment
- Remote monitoring followed by actuation or early warning

→ Data collected utilized for data driven decisions and proactive actions to maintain an optimal environment for livestock

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

The proposed system
The two pillars

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

(a) Monitoring and data collection

- Various sensors and accompanying equipment
- Selection prerequisites: buildings/barns of interest, internet availability, installation points accessibility, legacy equipment, etc.
- Environmental sensing, Weather station, Energy consumption

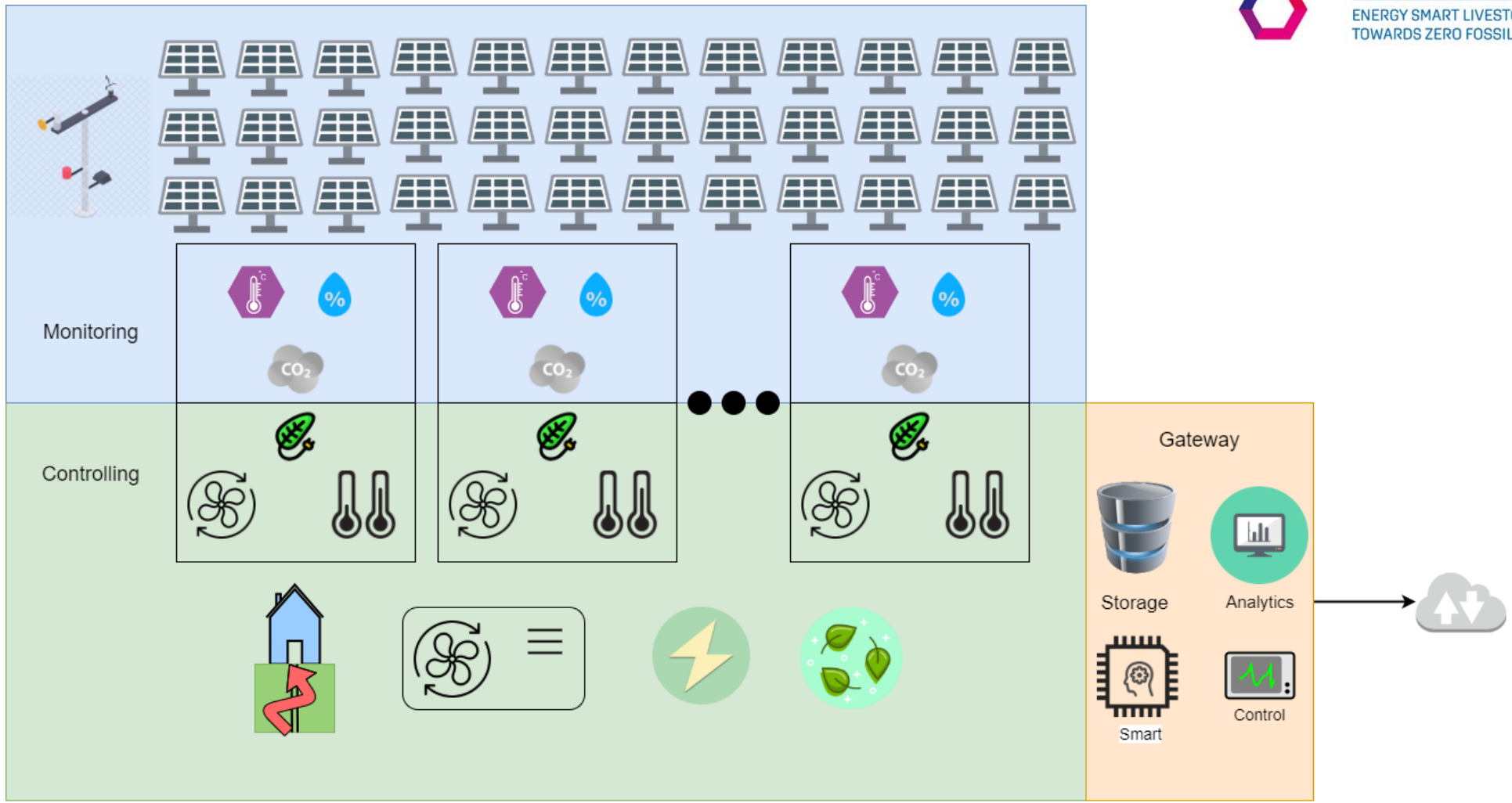
(b) Smart control

- Optimal environmental conditions
- Maximum penetration of the energy produced by the farms' RES units
- Reduction of the energy consumption

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

The proposed system

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION



www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

The proposed system
Monitoring and data collection

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

Environmental sensing

- Sensing sensitivity/application and longevity

Weather station

- Temperature, humidity, barometric pressure, wind speed/dir, etc.

Energy consumption

- Complexity of each facility, type/number of consumers to monitor

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

The proposed system
Monitoring and data collection

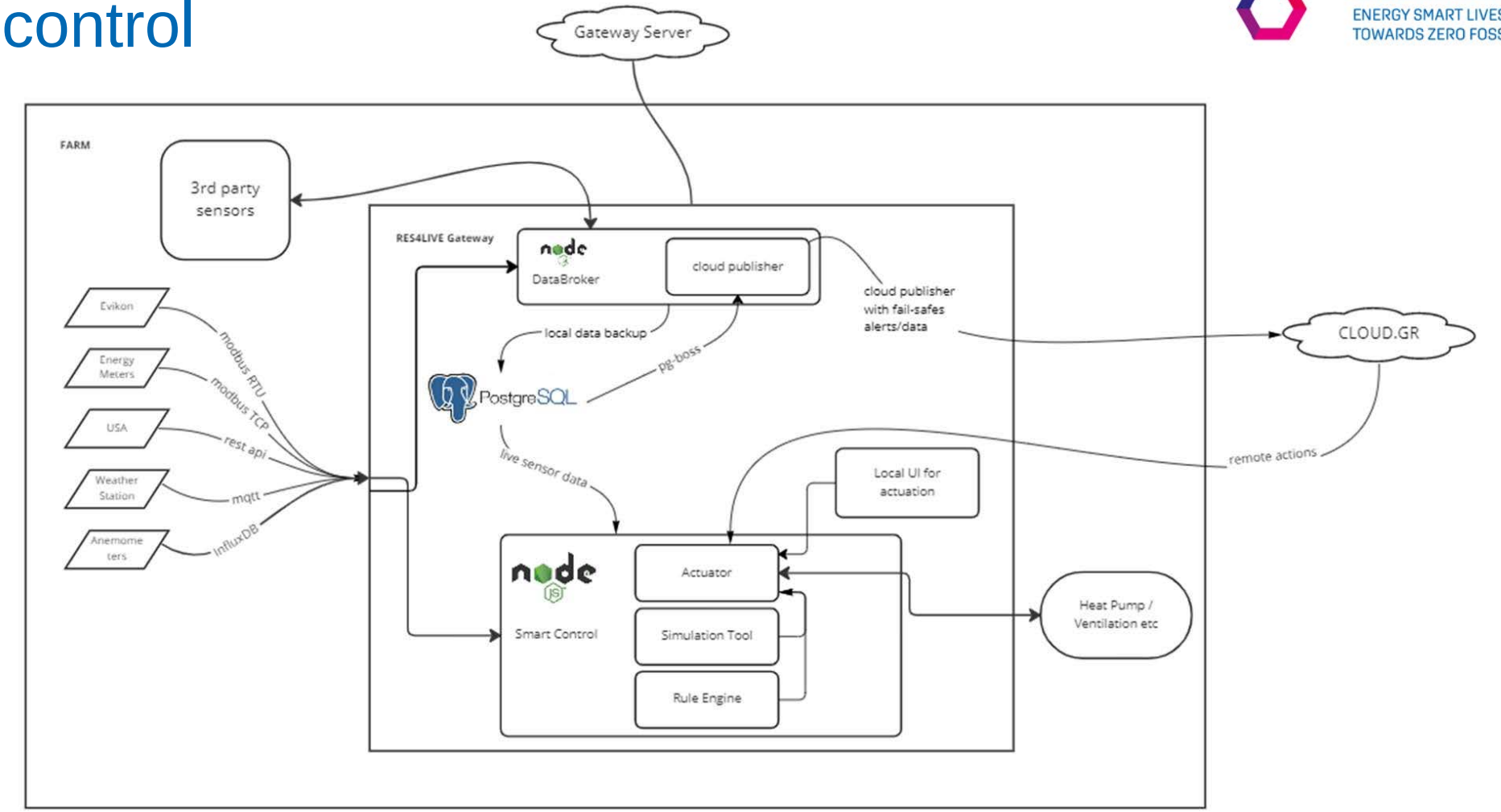
RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION






www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

The proposed system
Smart control



www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

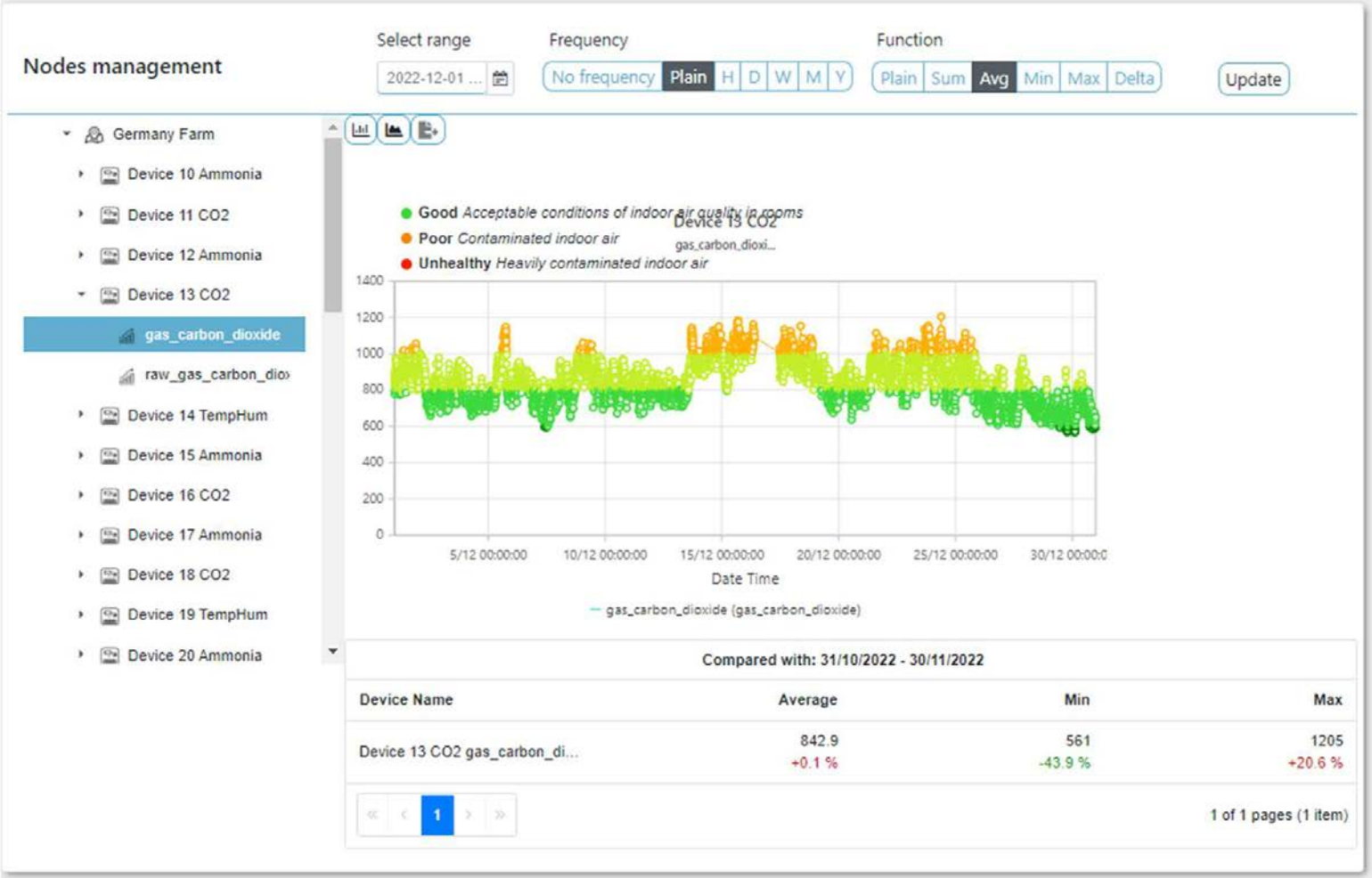
The proposed system
Smart control

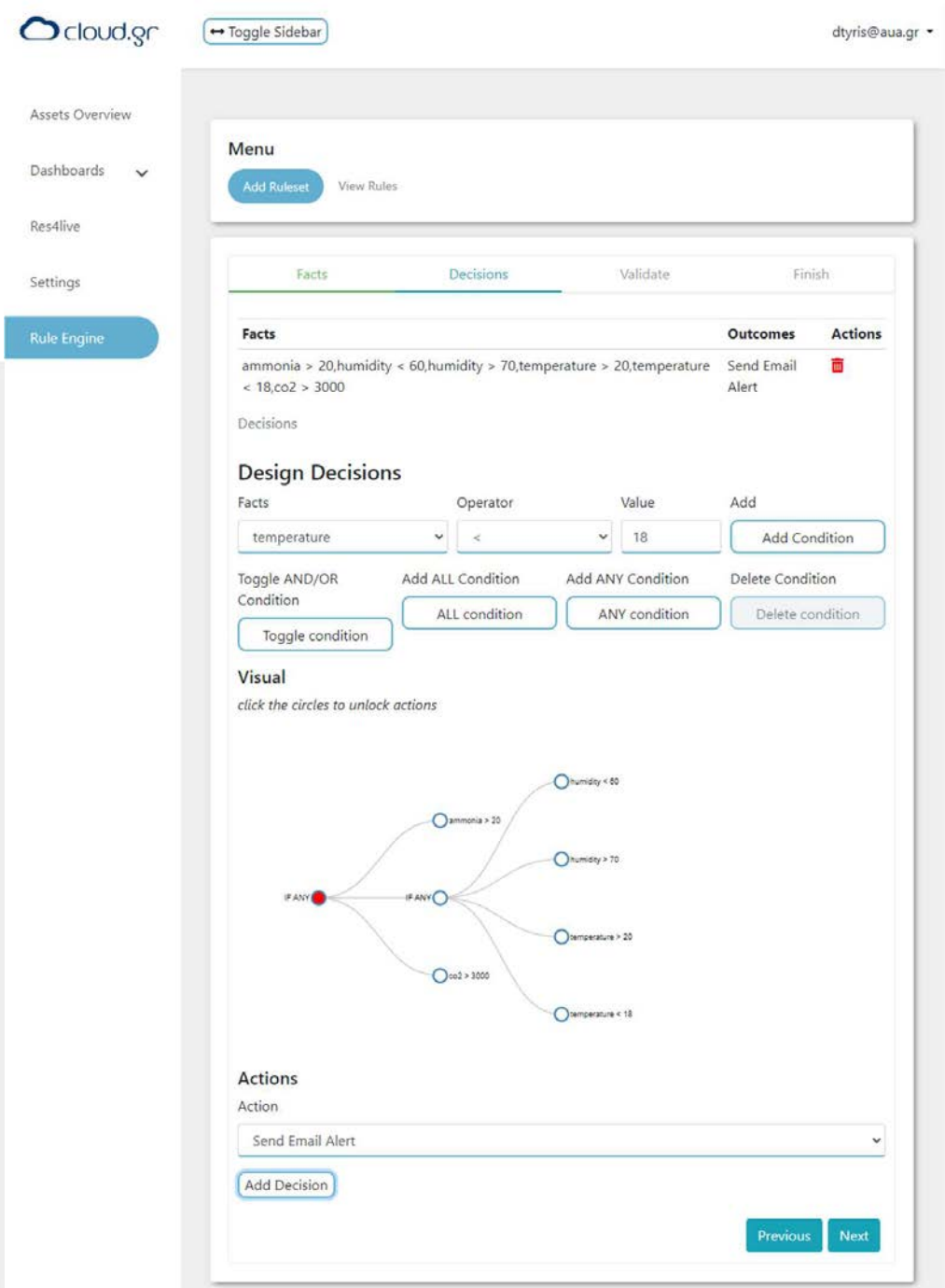
- Smart control module
  - Main components: Rule engine, Smart control algorithm, Local actuator listener, Cloud actuator listener
  - Gathers sensor data and utilizes it to determine the best actions towards the desired environmental conditions
  - Runs the rules every time new sensor data arrives
  - Sends control commands if needed (threshold levels)
- Rule engine
  - Apply meaningful rules set and defined by heterogeneous sources
  - Triggered by the incoming or requested data
  - i.e. prioritize the air quality over energy consumption if a hazardous gas exceeds a set threshold
  - Reduce the amount of data transferred in case of limited bandwidth

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

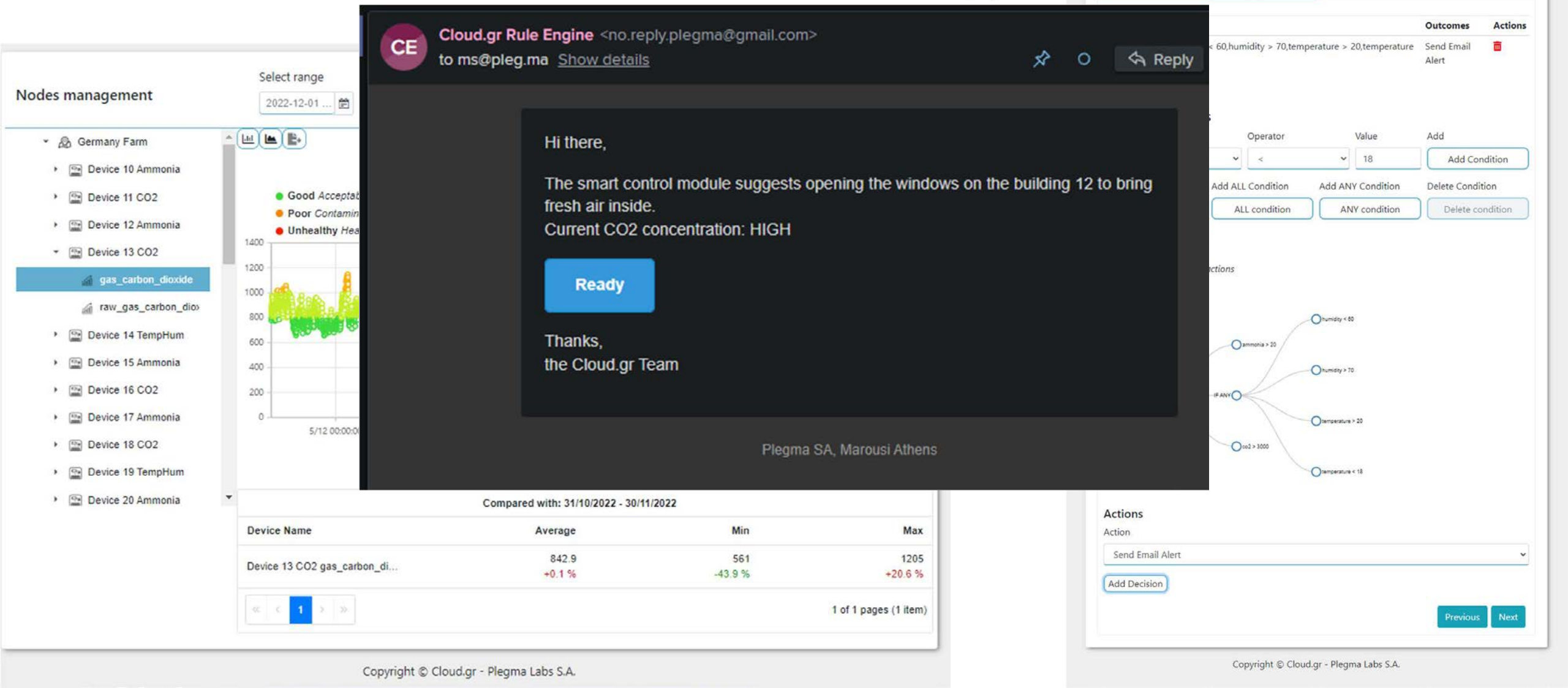
The proposed system

Smart control





The proposed system
Smart control



The proposed system
Smart control

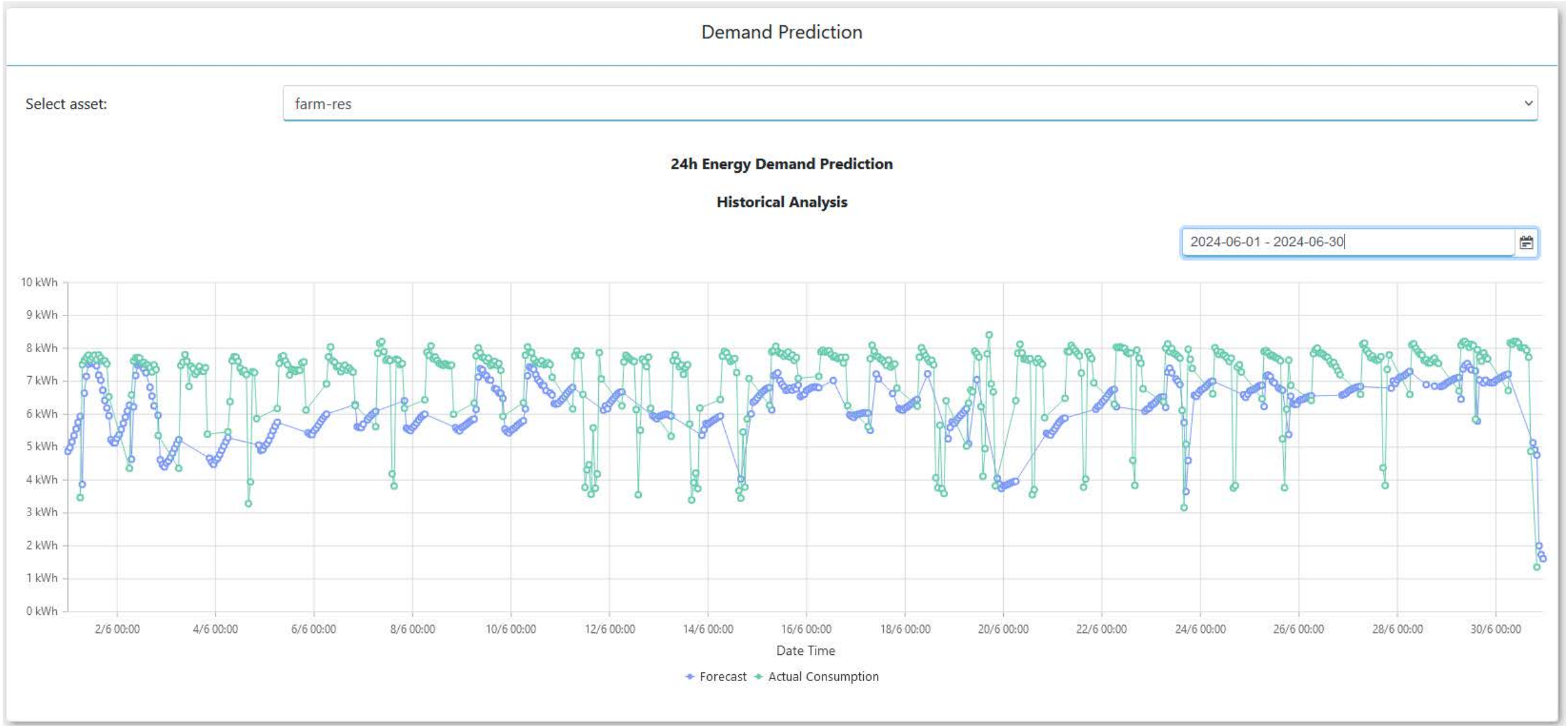
- Demand forecasting
  - Utilizes a RNN (Recurrent Neural Network) to predict the energy demand of the next hour based on last week's data

- Solar forecasting
  - Allows for scheduling of energy consuming tasks during periods of high production
  - Avoids wasting solar energy
  - Weather forecasts through third-party services and installed weather stations

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

The proposed system
Smart control

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION



The proposed system
Results

RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

Automatically controlled equipment

- Heat pumps through the smart control mechanism
- Complete ventilation system in two pilot farms
- Part of the ventilation system in the third pilot farm

Manual control through suggested actions

- Suggestions to open windows/doors within a specific room
- Increase the airflow and facilitate temperature and hazardous gases concentration control
- Alert through an email notification the assigned persons
- Expandable, supports any kind of relevant action suggestions in case of additional requirements

www.res4live.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785

Thank you!

https://res4live.eu/

m.moraitis@certh.gr

www.res4live.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785