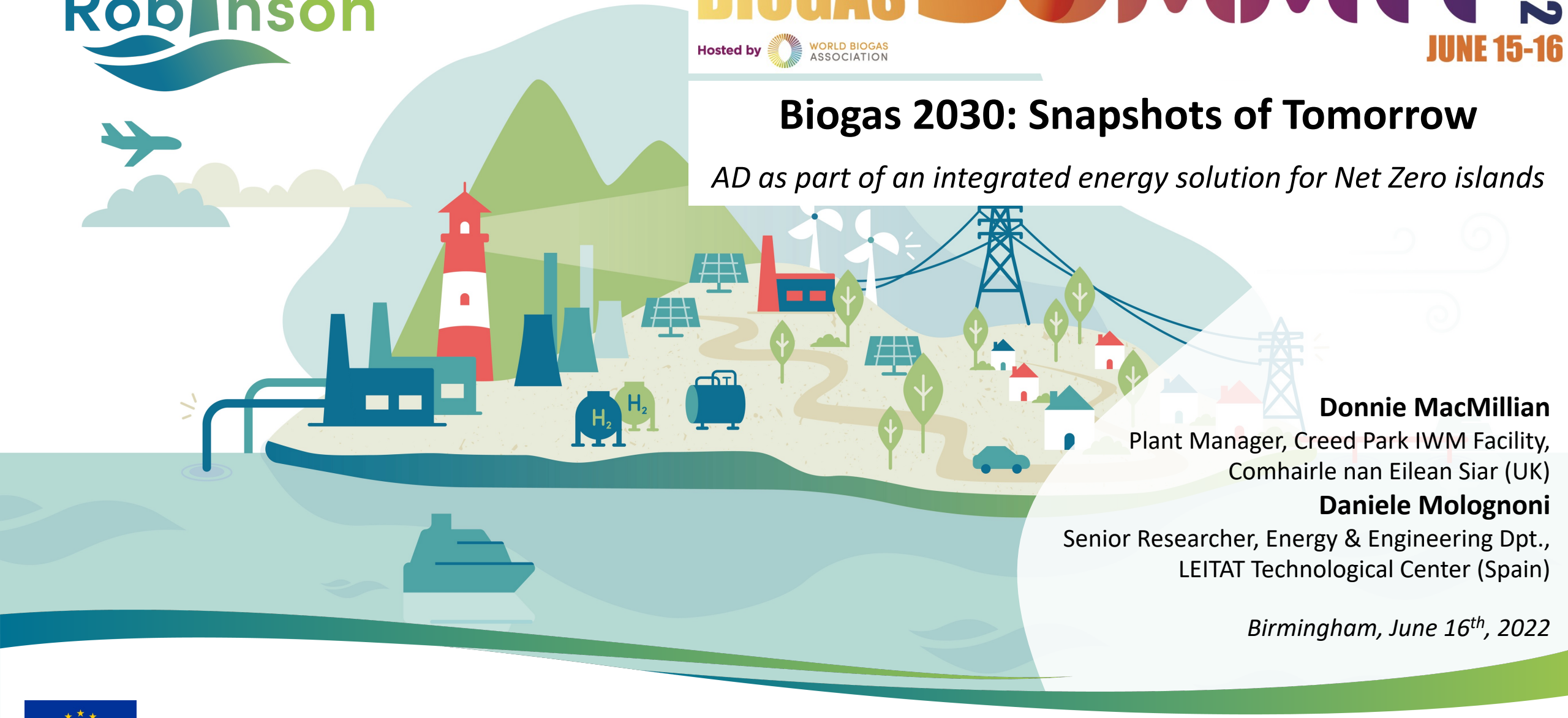
THE WORLD BIOGAS SUMMIT 2022

Hosted by WORLD BIOGAS ASSOCIATION

JUNE 15-16

Biogas 2030: Snapshots of Tomorrow

AD as part of an integrated energy solution for Net Zero islands



Donnie MacMillian
Plant Manager, Creed Park IWM Facility,
Comhairle nan Eilean Siar (UK)
Daniele Molognoni
Senior Researcher, Energy & Engineering Dpt.,
LEITAT Technological Center (Spain)

Birmingham, June 16th, 2022

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752

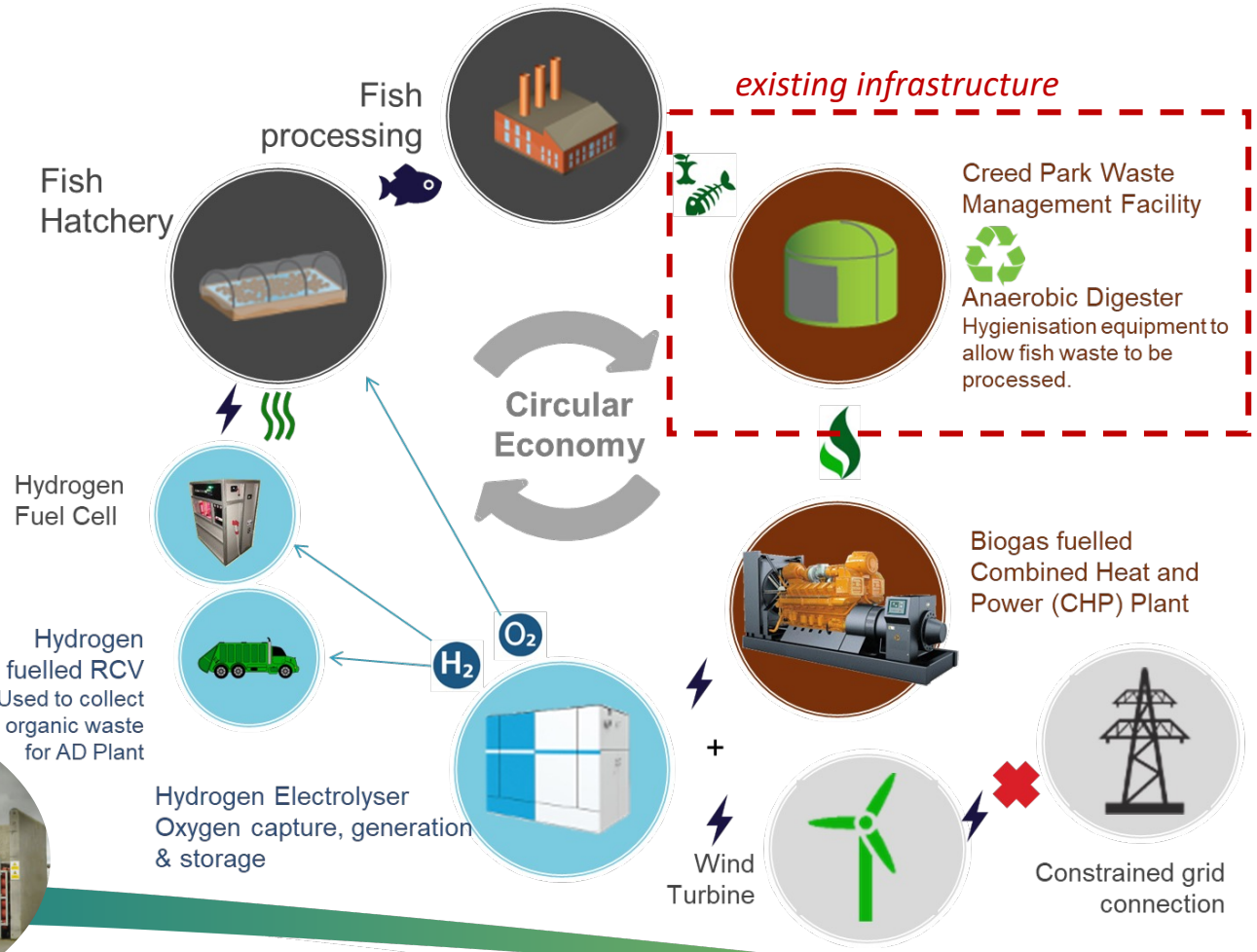
Background: Outer Hebrides Local Energy Hub (OHLEH)

Comhairle nan Eilean Siar

- OHLEH was developed to maximise the potential of constrained electricity generation by utilising the existing infrastructure at Creed Park Waste Management Facility, developing green disposal routes for local sources of organic waste
- OHLEH demonstrates how different renewable energy technologies can be integrated to support local energy economies and circular supply chains
- Creed Park Waste Management Facility is the first Anaerobic Digestion (AD) plant in the UK to use 'dry' AD technology to treat municipal organic waste, designed with extra capacity for potential treatment of fish waste from the local salmon farming industry
- Combined Heat and Power (CHP) system used to generate electrical energy and heat from biogas

Background: Outer Hebrides Local Energy Hub (OHLEH)

Comhairle nan Eilean Siar



Highlights:

- Outer Hebrides Local Energy Hub delivering circular economy
- Partnership with Local Authority and local fish farm and fish processing industries
- First electrolyser to combine oxygen and hydrogen capture

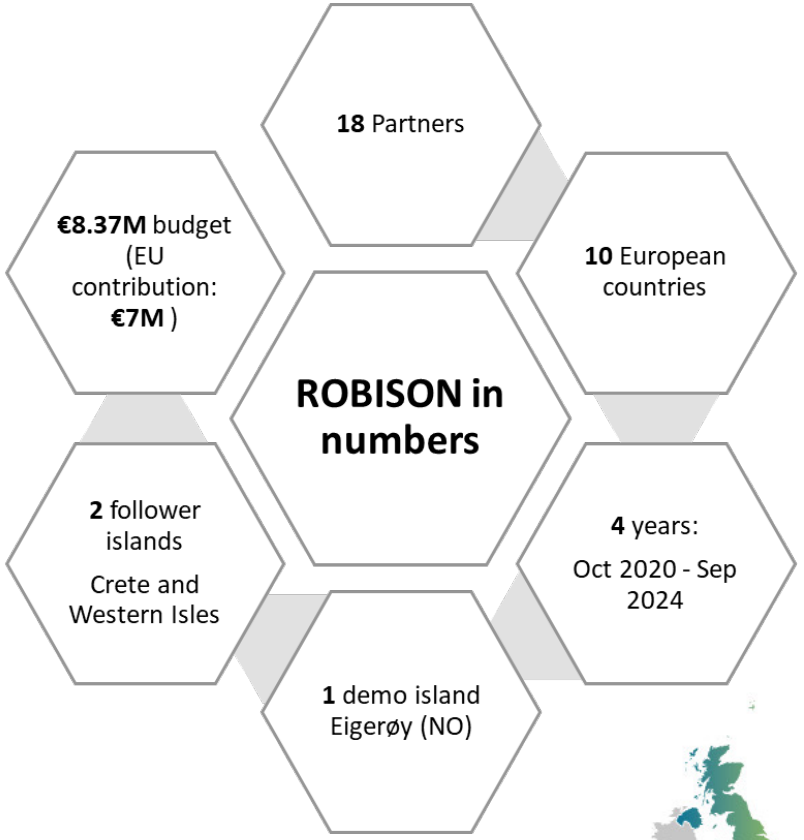
Outer Hebrides engaged as ROBINSON follower islands

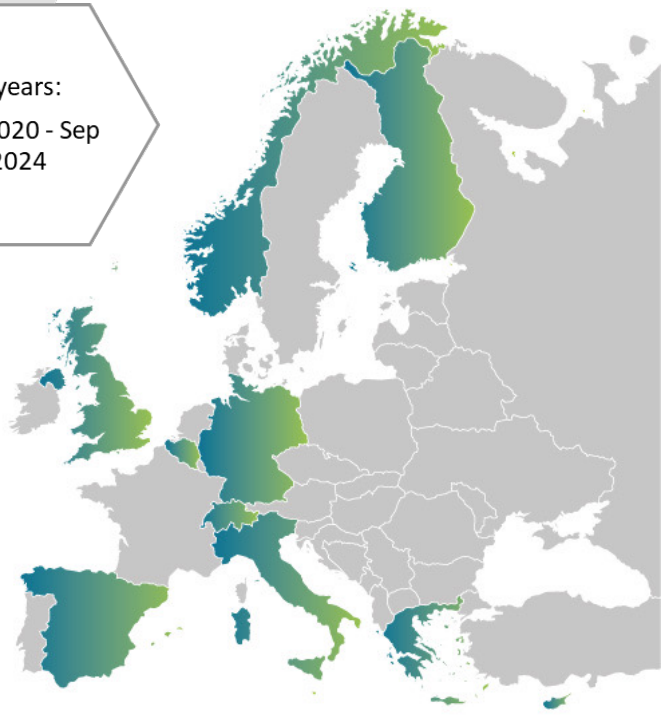
Comhairle nan Eilean Siar

- The biggest legacy of a project like OHLEH is gaining and sharing knowledge
- OHLEH has not been without technical challenges but every challenge provided a new learning opportunity
- Despite (or perhaps because) the AD plant operating in a stable manner for over nine years, the addition of a relatively small amount of fish waste was enough to upset the biomass
- The Creed AD Plant operates at Thermophilic temperature (58^{o}C), this is efficient but stability is difficult to maintain
- To maximise potential to process fish waste a change to Mesophilic (mid-30^{o}C) is inevitable
- The case-study of OHLEH was detected by **ROBINSON** project (Smart integ**R**ation **O**f local energy sources and innovative storage for flexi**B**le, secure and cost-effic**I**ent e**N**ergy **S**upply **ON** industrialized islands) as virtual replication island scenario, with **biogas production at the heart of the system**

ROBINSON in a nutshell

- ROBINSON aims to help **decarbonize (industrial) islands** by developing an intelligent, robust and flexible energy management system that **integrates technologies across different energy vectors (electricity, heat and gas**).
- The ROBINSON system will be **demonstrated on the island of Eigerøy, Norway**.
- **Virtual demonstrations** will be conducted for **Crete (Greece) and Outer Hebrides (Scotland)**.





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752

Project objectives

Technological

Optimise, validate and integrate innovative technologies

Develop and validate a modular and flexible Energy Management System (EMS)

Demonstration

Demonstrate the large-scale applicability of the ROBINSON system

Replication

Replication of the modular EMS and the concepts

Wide dissemination

Impacts

Human health and the environment

System cost-competitiveness

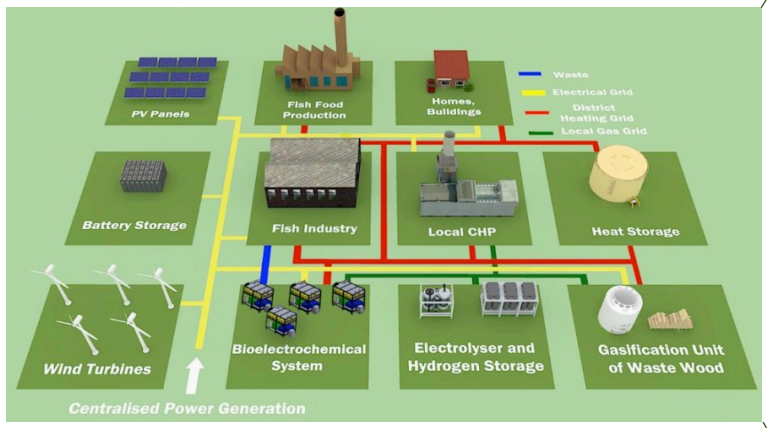
Business model

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752

Project concept

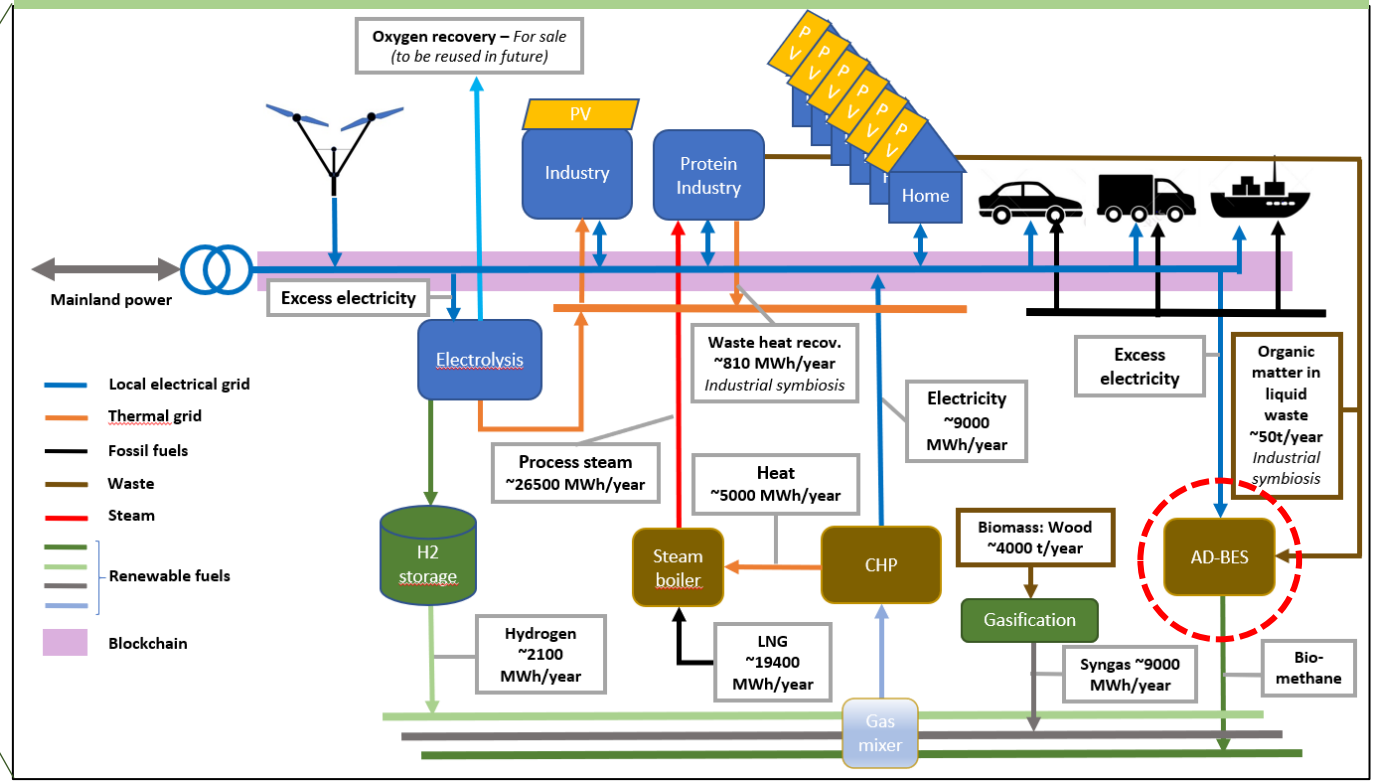
Keywords

- Energy management system (EMS)
- Different energy vectors
- Islands decarbonization
- Industrial symbiosis
- Waste valorisation



Thanks to ROBINSON, Eigerøy will move from being fully dependent on mainland and fossil fuel to an integrated, independent and low-carbon energy system!

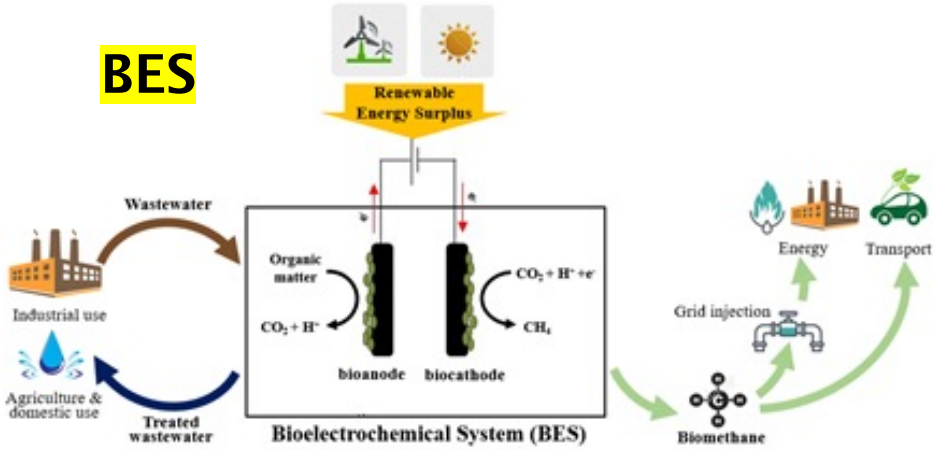
The ROBINSON concept applied on Eigerøy Island (Norway)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752

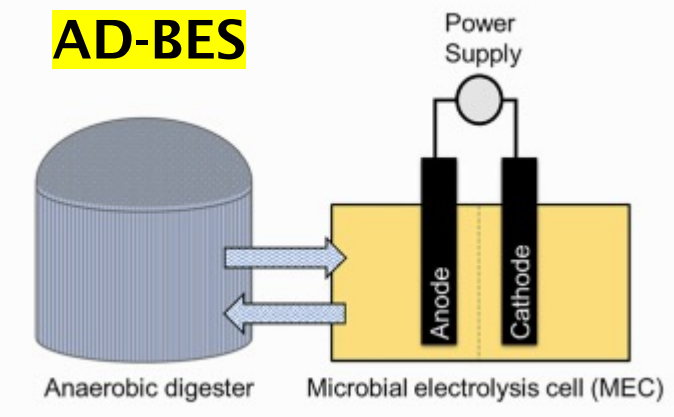
Bioelectrochemical improved Anerobic Digestion (AD-BES)

BES



- Bioelectrochemical system
- Electro-active bacteria
- Wastewater treatment
- Production of sustainable biofuels from CO_2
- Potential improvement of fermentation processes

AD-BES



- Improving anaerobic digestion process
- Reduction of CO_2 emissions related to waste treatment
- Higher process stability towards organic overloads
- Production of biomethane as energy vector
- Technology integration into ROBINSON EMS

Huang et al., 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752

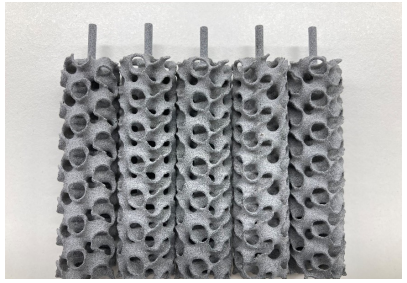
Huang Q et al. A critical review of microbial electrolysis cells coupled with anaerobic digester for enhanced biomethane recovery from high-strength feedstocks. Critical Reviews in Environmental Science and Technology 2020:1–40.

AD-BES lab development and technology up-scaling

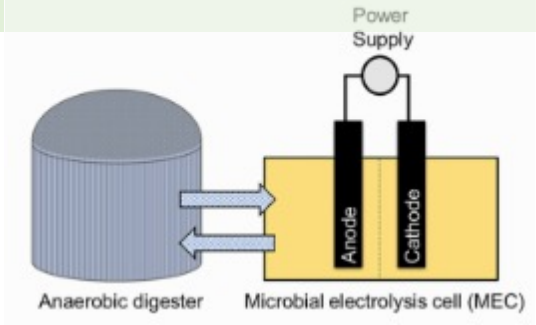
- Conversion of liquid waste **from fish processing industry into biomethane**
- Wastewater treatment efficiency > 85% adopting 35ºC and 9 days HRT
- **Biogas production of ≈1 m^3 $m^{-3}_{reactor}$ day^{-1}**, with **CH_4 content > 80%**

FROM LABORATORY

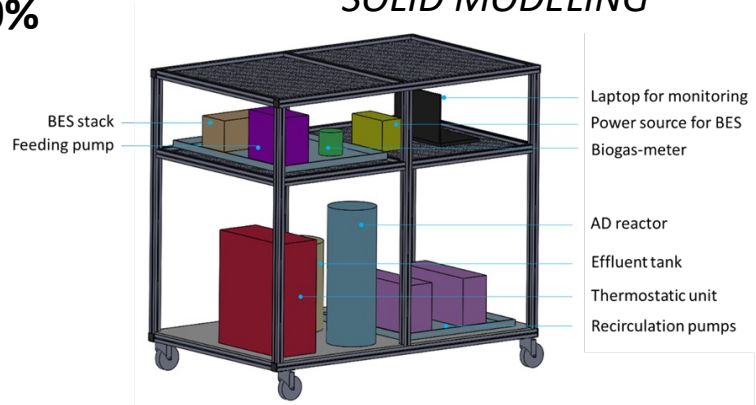
TO PILOT

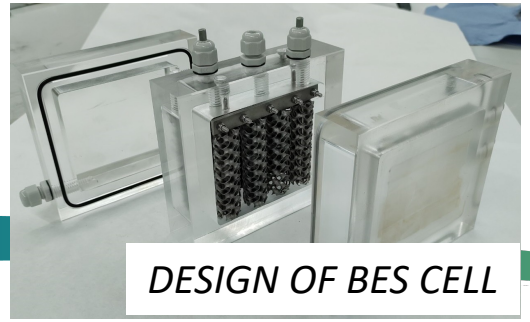


ELECTRODES 3D-PRINTING



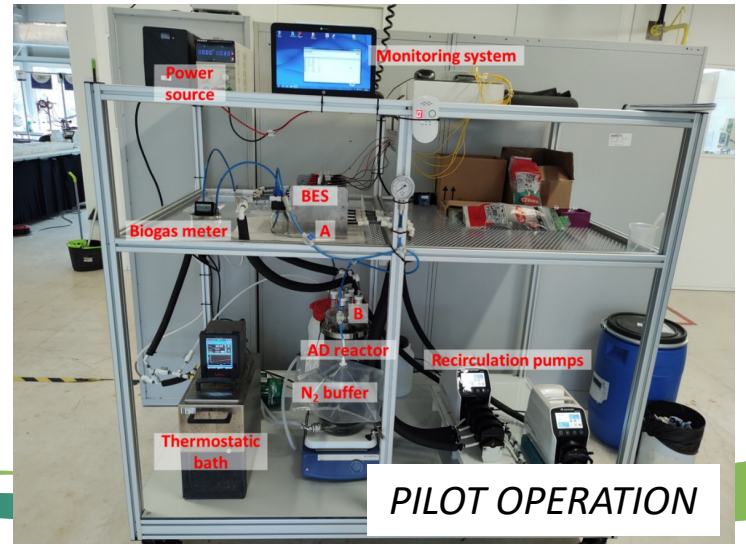
SOLID MODELING





DESIGN OF BES CELL

ELECTRODES INOCULATION



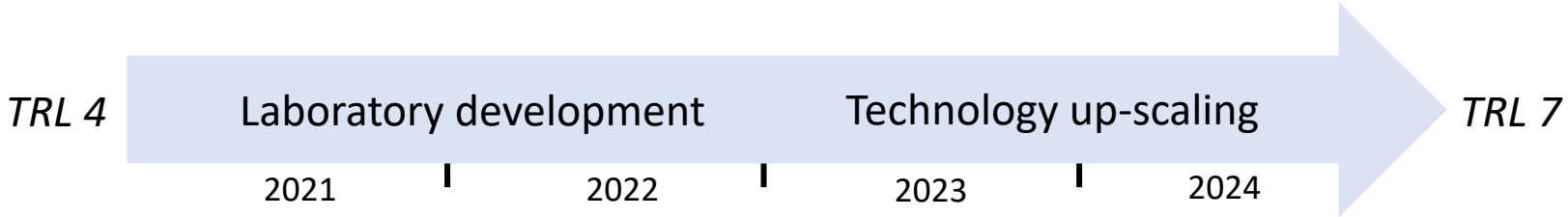
PILOT OPERATION

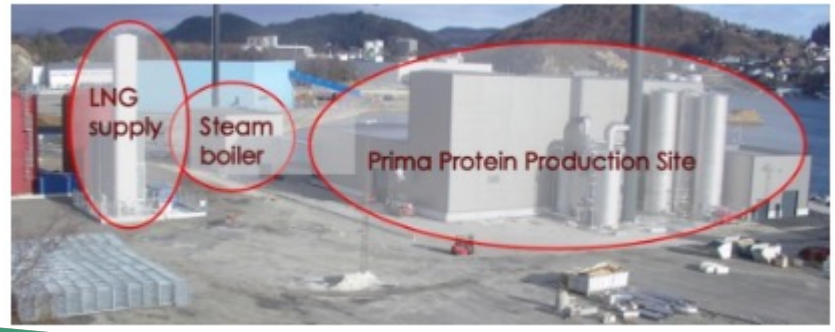
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752

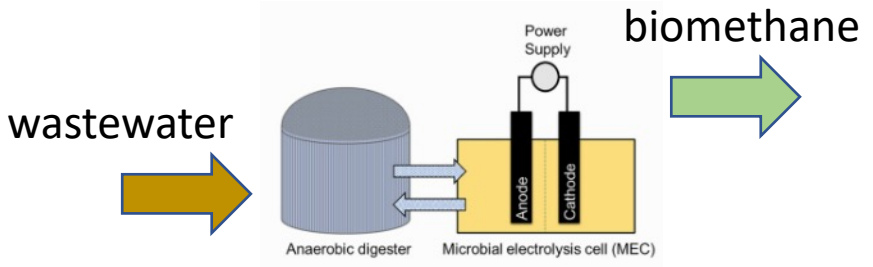
Next steps at Eigerøy

The AD-BES will be further <u>up-scaled to 1 m^3 scale</u>, achieving the following:

- Treatment of fish processing wastewater (PRIMA Protein AS, Eigerøy)
- Production of biogas near to biomethane specifications
- Combination of biogas with other fuels (LPG, H_2) to run a CHP unit







This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752

Thank you!

Donnie MacMillian
d.macmillan@cne-siar.gov.uk

Daniele Molognoni
dmolognoni@leitat.org

CONTACT
info@robinson-h2020.eu

www.robinson-h2020.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752