



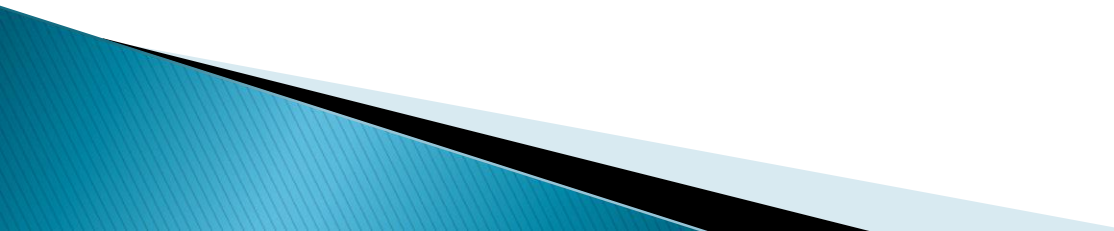
Comhairle nan Eilean Siar

Outer Hebrides Local Energy Hub

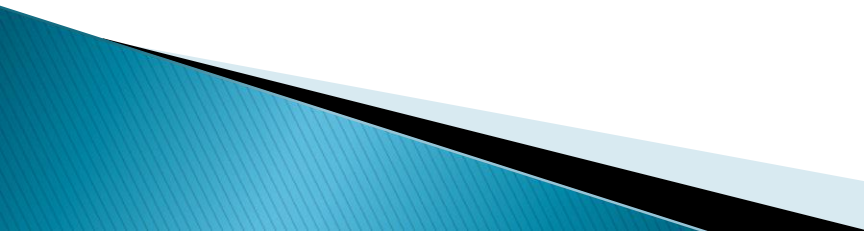
OHLEH - Delivering a Circular Economy



What is OHLEH?

- ↻ Outer Hebrides Local Energy Hub (OHLEH) was developed to maximise the potential of constrained electricity generation by utilising the existing infrastructure at Creed Park Waste Management Facility on the Isle of Lewis
 - ↻ OHLEH demonstrates how different renewable energy technologies can be integrated using a local microgrid to support local energy economies and circular supply chains
 - ↻ OHLEH develops green disposal routes for local sources of organic waste and provides access to green hydrogen and green oxygen
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Creed Park Waste Management Facility

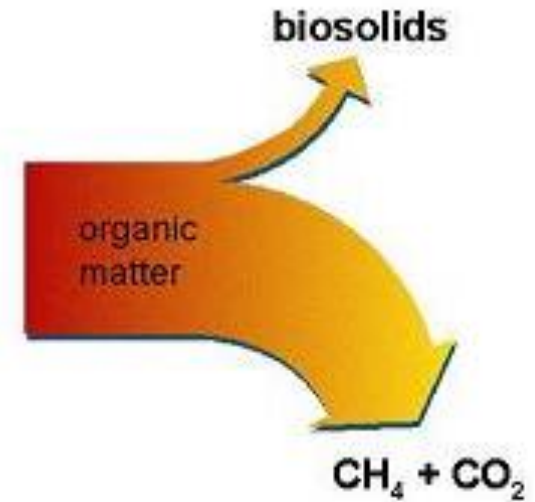
- ↻ Constructed and commissioned in 2006, it was the first Anaerobic Digestion (AD) plant in the UK to use 'dry' AD technology to treat municipal organic waste
 - ↻ Food and garden waste collection service provided to 11,000 household in Lewis and Harris (3k tonnes per annum)
 - ↻ Designed with extra capacity for potential treatment of fish waste from the local salmon farming industry
 - ↻ Combined Heat and Power system used to generate electrical energy and heat from biogas
 - ↻ Grid connection would be constrained if plant was operating to capacity
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Creed Park Anaerobic Digester

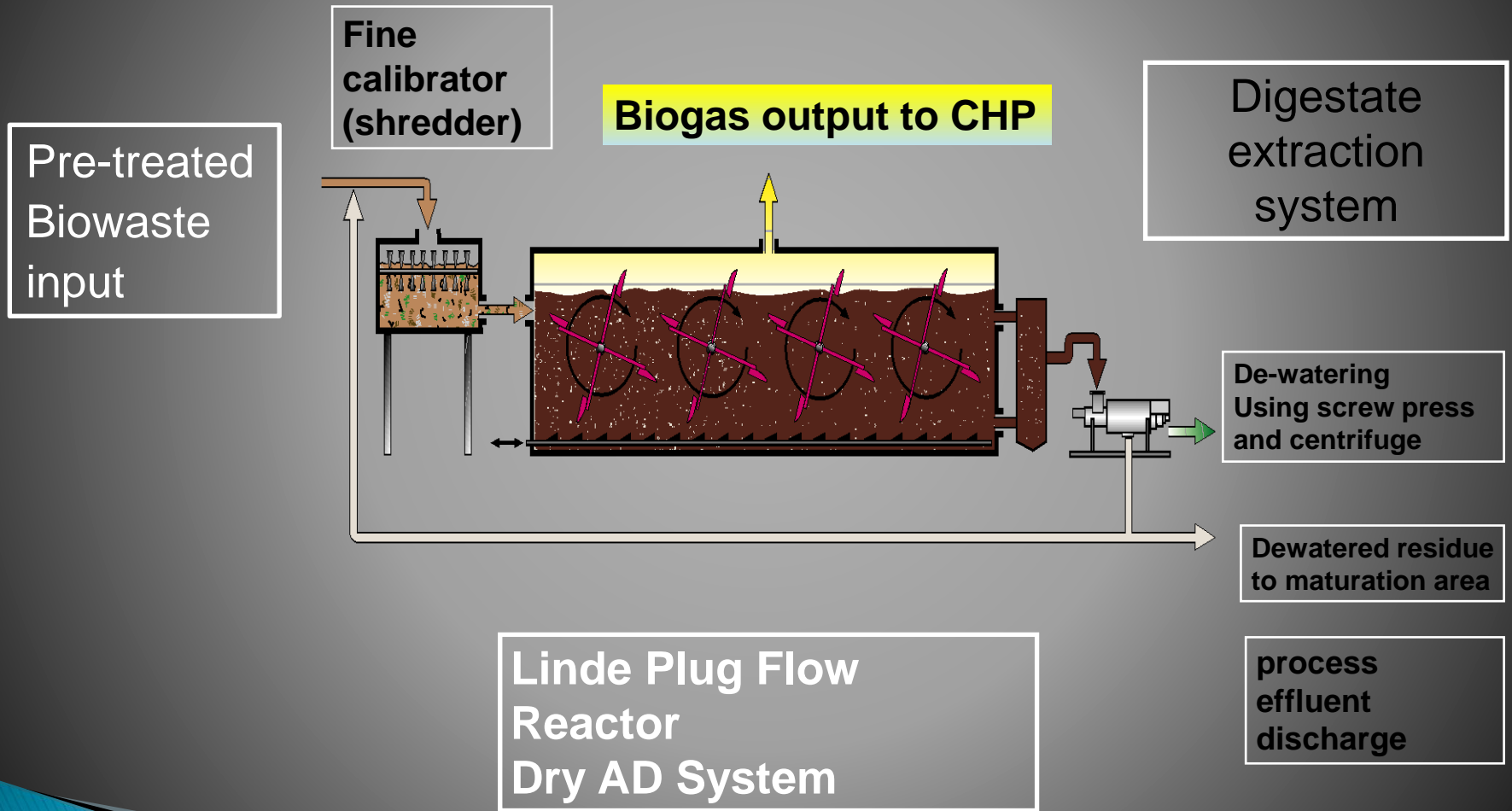
Why AD?

- ↻ Anaerobic treatment of organic waste breaks down bio-solids, producing Biogas which is used to fuel a Combined Heat and Power (CHP) system.
- ↻ “Dry AD” system is more robust than traditional batch AD and very tolerant to feedstock variation

Anaerobic treatment



The Digester – how it works



Creed Park Anaerobic Digester

The importance of food waste

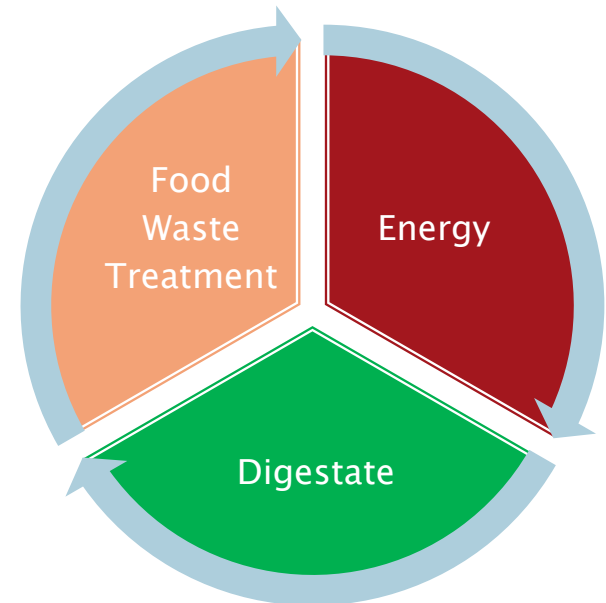
- ↻ “If food waste were a country, it would have the third-biggest carbon footprint after the US and China”
United Nations Food and Agriculture Organisation
- ↻ The contribution of food wastage emissions to global warming is almost equivalent (87%) to global road transport emissions



Creed Park Anaerobic Digester

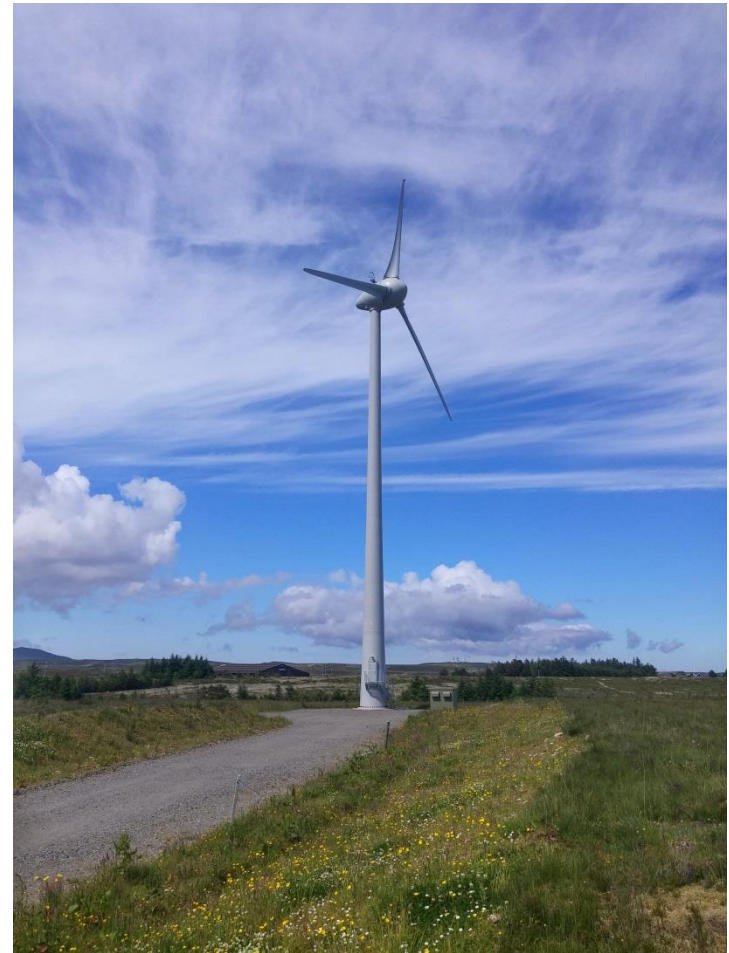
The importance of food waste

- ↻ The use of food waste as part of the AD feedstock produces an organic based digestate which is rich in Nitrogen, Potassium and Phosphorous.
- ↻ Digestate has a longer nutrient release than manure and is high in organic carbon.
- ↻ PAS110 was achieved in 2020 and local soil improvement trials are ongoing.



Creed Park Wind Turbine

- ↻ Constrained to 225kW due to limited local grid capacity
- ↻ Commissioned at 300kW by developing a heat store to provide a source of hot water for the AD process
- ↻ OHLEH microgrid allows generation to be used for hydrogen and oxygen production



Combined Heat and Power (CHP) System

- ↻ Biogas captured from the AD process
- ↻ CHP engine used to generate electrical energy and heat
- ↻ Electrical energy is used to power the facility or fed to the local grid
- ↻ Heat is used to maintain the AD plant at 57°C and provide heating for the building
- ↻ Grid connection would be constrained if plant was operating to capacity



OHLEH Hydrogen project

- ↻ Hydrogen electrolyser was commissioned in 2010 as part of the Hydrogen Hebrides project
- ↻ Alkaline Electrolyser with high pressure hydrogen storage
- ↻ One of the first Hydrogen fuelling stations in Scotland with capacity for fuelling HICE or Fuel Cell vehicles



Hydrogen demand - vehicles

- ↻ OHLEH provided an opportunity to add Hydrogen Internal Combustion Engine (HICE) technology to a new Comhairle Refuse Collection Vehicle (RCV)
- ↻ The conversion costs for the RCV are similar to adding HICE technology to a van but at a much smaller percentage of the vehicle cost
- ↻ RCV has high consumption so higher potential carbon savings
- ↻ HICE allows the vehicle to operate on diesel-only mode so the vehicle can continue to be used even if the hydrogen tank is empty and there is no “range anxiety”

New Hydrogen demand - vehicles

- ↻ Best “bang for buck” is to use hydrogen as a replacement Refuse Collection Vehicle fuel.
- ↻ Our Ulemco converted HICE RCV uses hydrogen generated from the waste it brings to site



Outer Hebrides Local Energy Hub (OHLEH)

- ↻ Built-infrastructure with potential for improvement, OHLEH provided an ideal opportunity to develop deliverable, innovative and sustainable solutions
- ↻ OHLEH provided the opportunity to obtain support and commitment from the local salmon industry that would help support and sustain local production and local jobs
- ↻ Financial support from Local Energy Challenge Fund was essential for this project to succeed as hydrogen economy is still at gestation period.

Capture of pure Hebridean Oxygen

- ↻ Oxygen from electrolysis is usually vented as a waste
- ↻ OHLEH identified an existing island market for high-purity oxygen for industrial and medical applications
- ↻ The high local market value is due to ferry transport restrictions and the cost of transporting small cylinders of gas
- ↻ OHLEH is the first electrolyser to combine oxygen and hydrogen capture



Lessons learned (and shared)

- ↻ The biggest legacy of a project like OHLEH is gaining and sharing knowledge
- ↻ OHLEH has generated interest from all over the world, including Scandinavia, Chile, Ireland and Germany.
- ↻ Flensburg University were so interested that they based a five week placement on the OHLEH project in Stornoway for 17 Masters and PHD students.
- ↻ OHLEH helped to grow existing links to University of the Highlands and Islands (UHI) providers of the only dedicated Hydrogen (SCQF level 7) PDA in Scotland

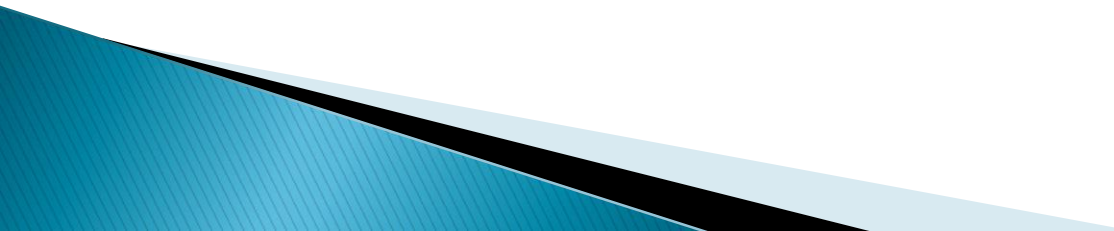
Lessons learned (and shared)

- ↻ OHLEH has not been without technical challenges but every challenge provided a new learning opportunity
- ↻ Despite (or perhaps because) the 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
- ↻ Learning to deal with the consequences of virtual collapse of gas output was an *interesting* experience
- ↻ Bringing the AD plant *back to life* was challenging but rewarding and we now know what to do to maintain balance going forward

Lessons learned (and shared)

- ↻ The Creed AD Plant operates at Thermophilic temperature (57°C), this is efficient but stability can be difficult to maintain
- ↻ Changing to Mesophilic (mid-30°C) would be more stable and could allow more fish waste to be processed but modelling has shown that gas yields would reduce significantly
- ↻ Redesigning plant and making significant operational changes will always be difficult but when you operate in a remote island location it can be very challenging
- ↻ Maintaining a positive partnership relationship with all project partners is essential for success helping to ensure that solutions to unexpected problems can be found quickly

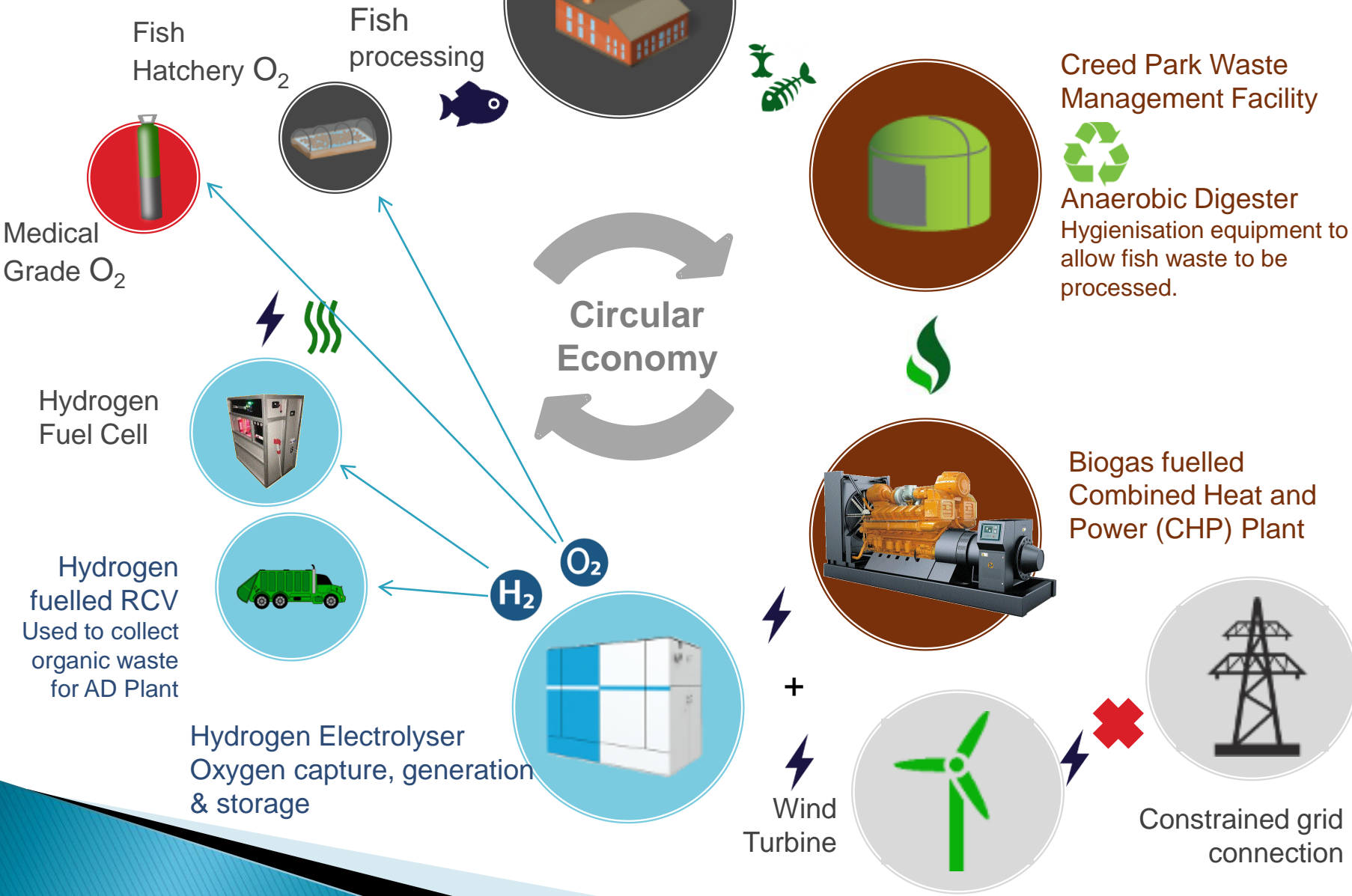
Future ambitions and opportunities

- ↻ The OHLEH project was able to build on existing technology that was intended for full operational use rather than an experimental or desktop modelling scale
 - ↻ Island solutions are made challenging by scale and location but having to adapt and make things work means that new technologies can be made to fit real world applications
 - ↻ Hydrogen will play an important part in the island economy, with significant projects linking in with wind energy and the potential to replace fossil fuels with locally produced green hydrogen
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Future ambitions and opportunities

- ↻ The next stage of development for OHLEH is to increase hydrogen production capacity and look to develop short and long term strategies to build the local hydrogen economy
- ↻ Partnership with UHI can bring training opportunities for students that will help to support future requirements for Hydrogen plant operation and maintenance
- ↻ Upgrading the refueller to 700 bar will help to future proof the facility
- ↻ Green Hydrogen as a direct replacement fuel for the ICE engines in the types of plant that would previously be used in waste management activities may provide a useful stepping-stone as fuel cell technologies evolve

Outer Hebrides Local Energy Hub Delivering a Circular Economy



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