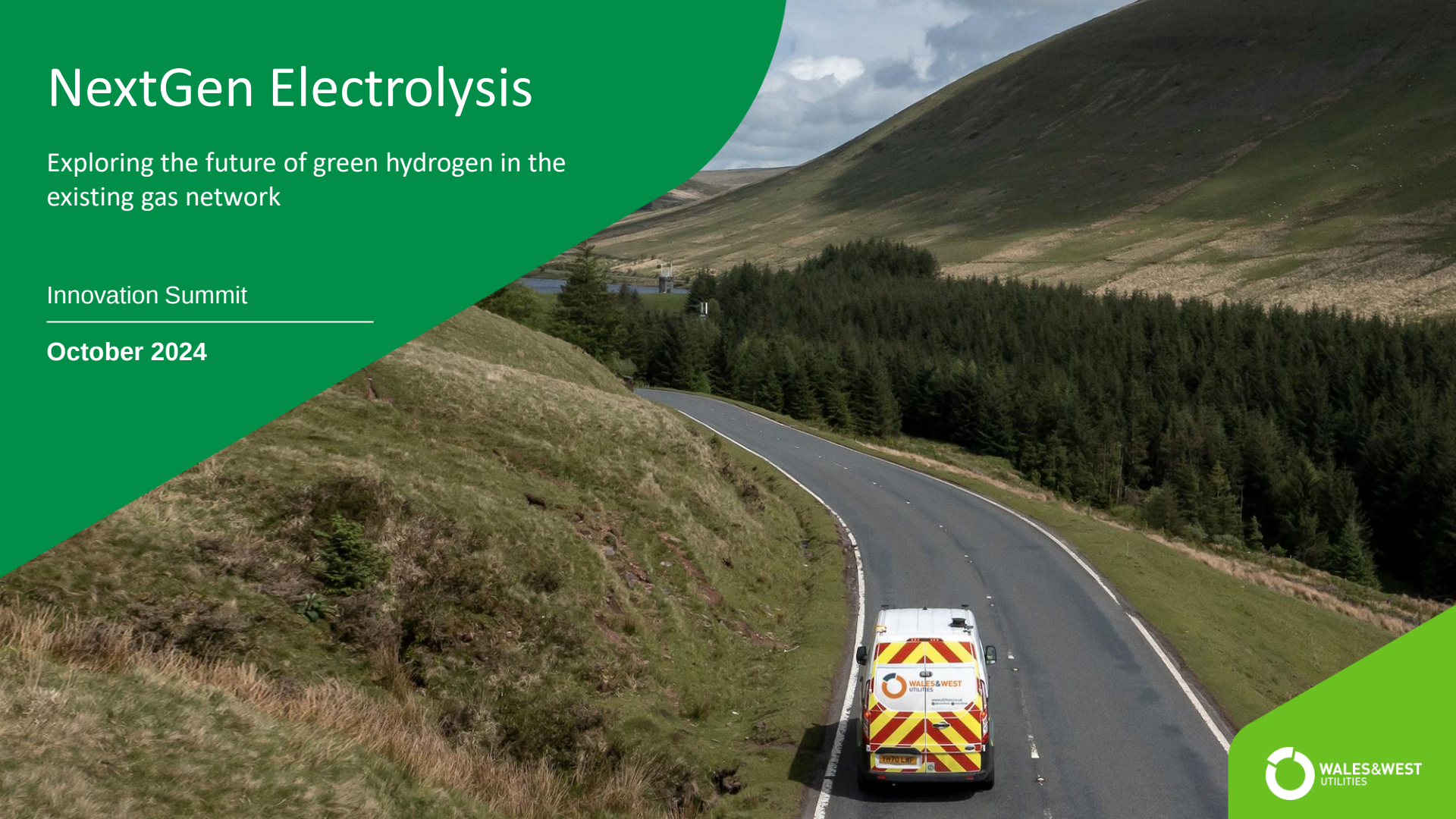
NextGen Electrolysis

Exploring the future of green hydrogen in the existing gas network

Innovation Summit

October 2024



WALES&WEST
UTILITIES

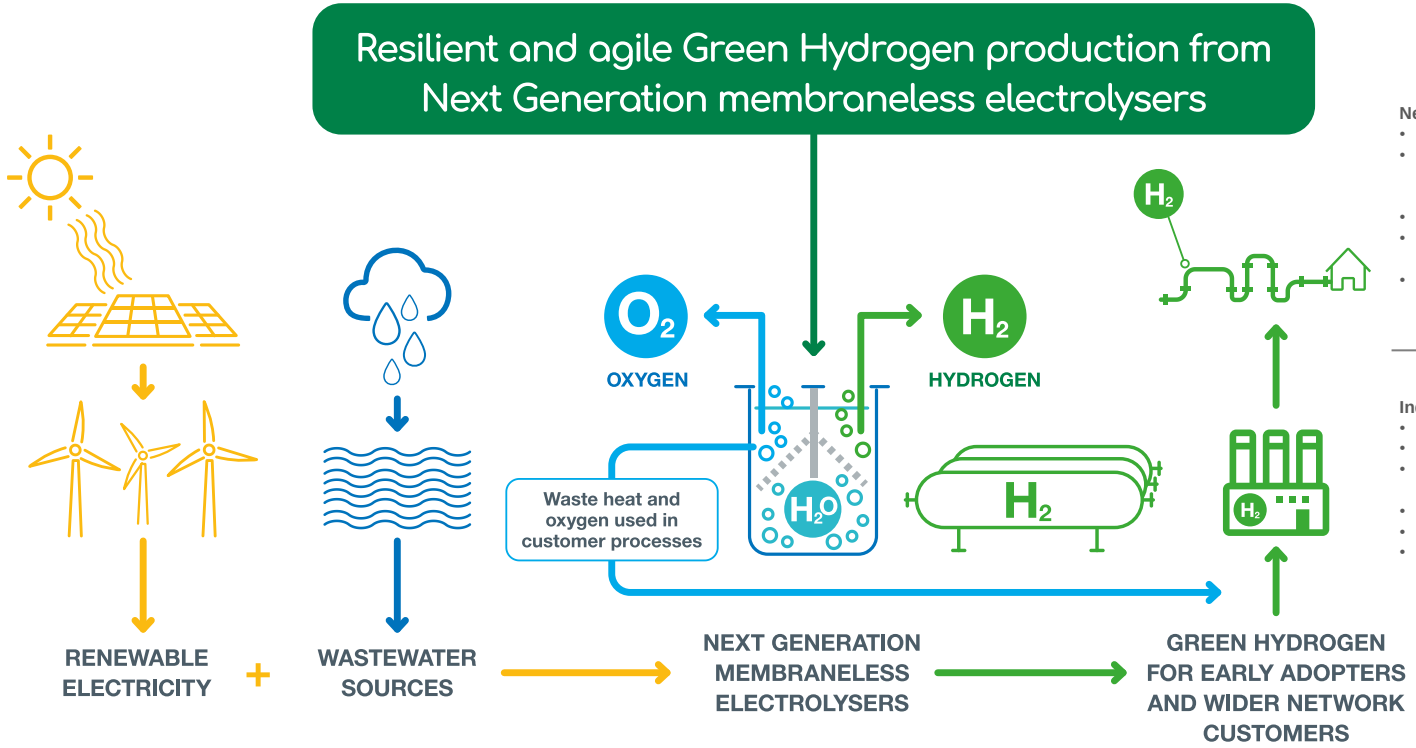
Project Concept

About Wales & West Utilities and HydroStar Europe

Wales & West Utilities (WWU) operates the extensive gas network throughout Wales and the south-west of England to transport gas to 2.5 million households and businesses. WWU invests £2m every week across the network, connecting new homes and businesses, and upgrading old metal gas pipes to new plastic ones to ensure communities receive a safe and reliable gas supply for generations to come.

HydroStar Europe is a dynamic and innovative company focused on developing the Next Generation of resilient hydrogen technologies which reduce operational barriers to wide scale green hydrogen uptake and lower hydrogen costs substantially.

NextGen electrolysis – Wastewater to Green Hydrogen



Network customers:

- Near term blending of up to 20%
- Distributed production helps customers connected to the local network to decarbonise
- Increased energy resilience
- Reduction in hydrogen production costs bringing this closer to natural gas costs
- Long-term sectors of 100% hydrogen within the network

Industrial customers / Early adopters:

- Decarbonisation of business operations
- Options of blended or 100% hydrogen use
- Focal point for potential micro cluster to enable wider decarbonisation in the future
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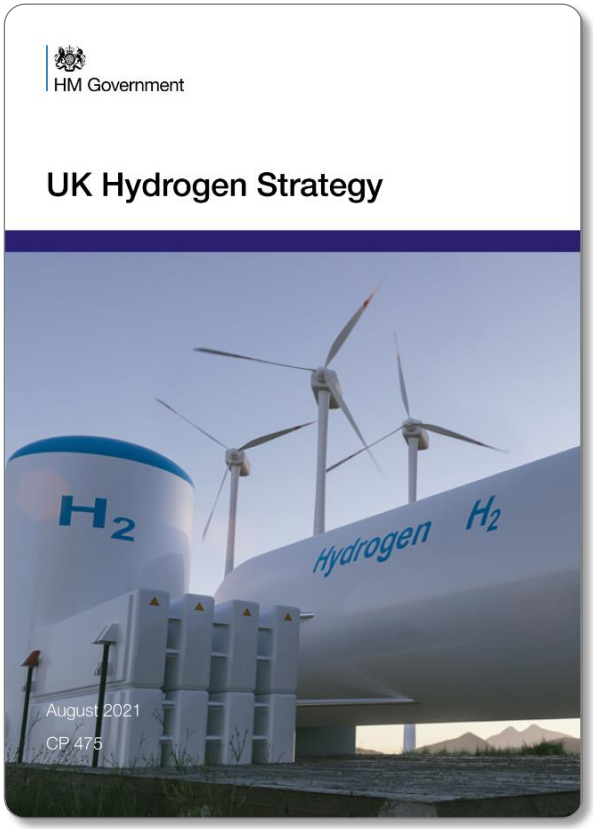
UK energy context

- The NextGen project breaks new ground; the distributed hydrogen production model shows how early users can decarbonise using hydrogen.
- Tapping into the UK's hydrogen vision, early adopters can catalyse demand for blended or 100% hydrogen networks, revolutionising decarbonisation across sectors.
- Backed by UK Research and Innovation, this work generates crucial evidence to supercharge UK Government policy, including the Net Zero, Hydrogen, and Industrial Decarbonisation strategies, whilst fuelling regional and local ambitions.



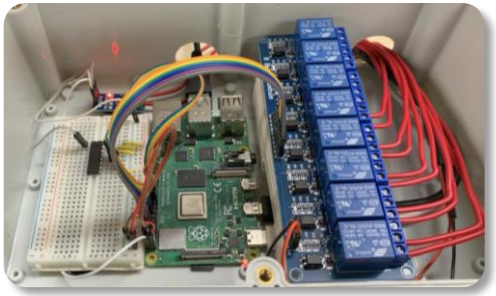
The Technology

Membraneless Electrolyser Technology

- Coaxial membraneless design to reduce the wear associated with flat plate electrolysis.
- Even a simple set up of electrodes can produce high-purity hydrogen from wastewater sources, when used in combination with the novel electrolyte.

Control System and Electrolyte

- The control system was developed in Alpha phase ensuring efficiency, electrode use, power levels and H2 purity.
- A patented electrolyte has been developed and work on adjusting the composition based on the wastewater chemical composition is being explored.
- Development of stacked AI control system has variable low power consumption when connected to solar, enables 10% extra hydrogen production.



Membraneless Electrolyser vs. alternative technology

	Alkaline	Proton Exchange Membrane	Membraneless
What is the water quality requirement of the device?	Ultra pure	Ultra pure	Impure water works effectively within the device
Does the device require a membrane to operate?	Ion exchange	Polymer electrolyte and composite	No membrane required
What is the electrolyte and working condition within the device?	Strong alkaline (harsh conditions and disposal)	Strong acidic (harsh conditions and disposal)	Benign green chemistry
What are the electrodes made from?	Rare metals	Rare metals	Stainless steel (recycled)
What is the pressure requirement for the device?	Medium	High	No pressure required
What is the carbon footprint of device manufacturing?	Medium	High	Ultra low
What are the maintenance requirements for the device?	Medium skilled	Highly skilled	Low level engineering

Testing

Water sampling and collection

Rainwater

River water

Seawater

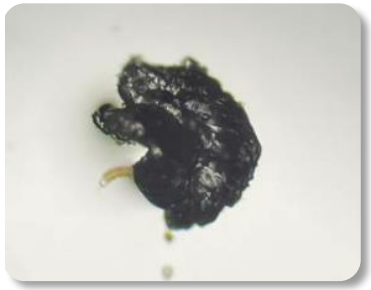
Effluent water

Mine water

Estuary water

- Water samples were collected across the UK and at potential demonstration sites.
- Basic tests were undertaken (pH, salt content, electrical conductivity, temperature) as well as microelement testing to help refine the electrolyte blend.

- Basic processing of visible microplastics would be useful.
- High plastics content can passivate electrodes, reducing efficiency of electrolysis.



Microplastic

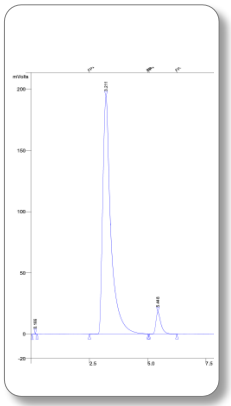
Lab Testing

Small scale testing at Cardiff University

- Basic electrode design without gas separation.
- No optimisation of the electrolyte blend.
- Testing showed an important part of maintaining high purity is the voltage level, and keeping voltage as low as possible whilst increasing current.

Gas Chromatography

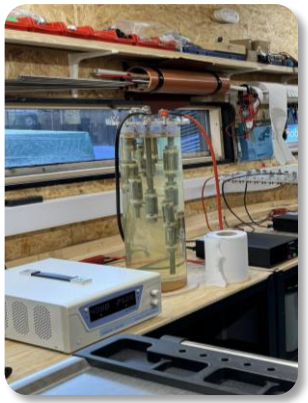
- At least 94% with all water types tested.
- 94.9% hydrogen from seawater tested.
- No chlorine gas was produced during the sea water testing.



Durham Site Testing

Control System Durham Site

- Control system testing or varying power to individual units and voltage level. Working on simulated renewable profile.



Electrolyser Testing

- Testing individual electrodes both in series and in parallel.
- Varying electrolyte composition as well as voltage and current.

Demonstrator Site Selection

Beta Site Selection

- Potential sites and partners for Beta demonstrators approached and assessed for suitability.
- Hydrogen use case established and assessment of the local WWU network to ensure there was blending potential and wider benefits within the use cases.
- Establish whether electrolyser electrical input from excess solar or wind is feasible.
- Discussions held with 10 potential customers, some with multiple sites.
- Sites down selected against a scoring matrix.

Benefits and Next Steps

Beta Sites

100% Hydrogen Site

Dŵr Cymru Welsh Water

Cardiff AAD site
CF24 5SB

1. **Targeted electrolytic capacity: 250kW |** *Powered by existing solar via private wire.*

Water source: Treated effluent water and sea water.

Hydrogen demand: For on-site office heat and hot water via boiler. Potential use in the drying process of digested sludge used as fertiliser on agricultural land.

Benefits/Evidence: Using 100% hydrogen on-site to completely decarbonise the site office as well as improving efficiencies through the use in industrial process. The site also offers additional benefits through colocation and use of the electrolyser's by-products.

Blended Hydrogen Site

Yeo Valley Organic

Cannington production site
TA5 2ND

2. **Targeted electrolytic capacity: 250kW |** *Powered by existing solar on site.*

Water source: Production process water, captured rain water, borehole/river.

Hydrogen demand: Up to a 20% blend with natural gas to existing Combined Heat & Power System for on-site power and heat.

Benefits/Evidence: Proof of concept of the ability to blend into the network. Initial use for an industrial customer provides a showcase for other industries.

WALES&WEST UTILITIES

Beta Phase Benefits

- WWU operates a relatively rural network with isolated pockets of industry particularly in west Wales and the south-west of England.
- The NextGen project is showcasing the possibility of a distributed hydrogen production model reducing the operational barriers for smaller scale hydrogen production.
- Further development of electrolyser technology as well as proof of concept at scale.
- Proof of concept in decarbonising early industrial users through hydrogen blending or use of 100% for on-site processes, heating and hot water. Scaling up to network injection in the future.
- This distributed production around industrial sites can be modelled and excess hydrogen has the potential to be blended into the local gas network in the future.
- Opportunity to significantly reduce the cost of hydrogen through colocation and use of the waste heat and O2 produced.
- Maximising the often curtailed solar and wind energy across the WWU geographical area to produce green hydrogen.

Thank you
Questions?

Get in touch:

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