Hydrogen & Alternative Fuels

Delivered by Invest Northern Ireland

Northern Ireland

Emmet Lagan

Lagan Energy Engineering

Lagan energy engineering

NI Net Zero Exchange

Lagan energy engineering

Hydrogen Integration

Enabling Hydrogen Growth at Scale

Emmet Lagan Technical Director

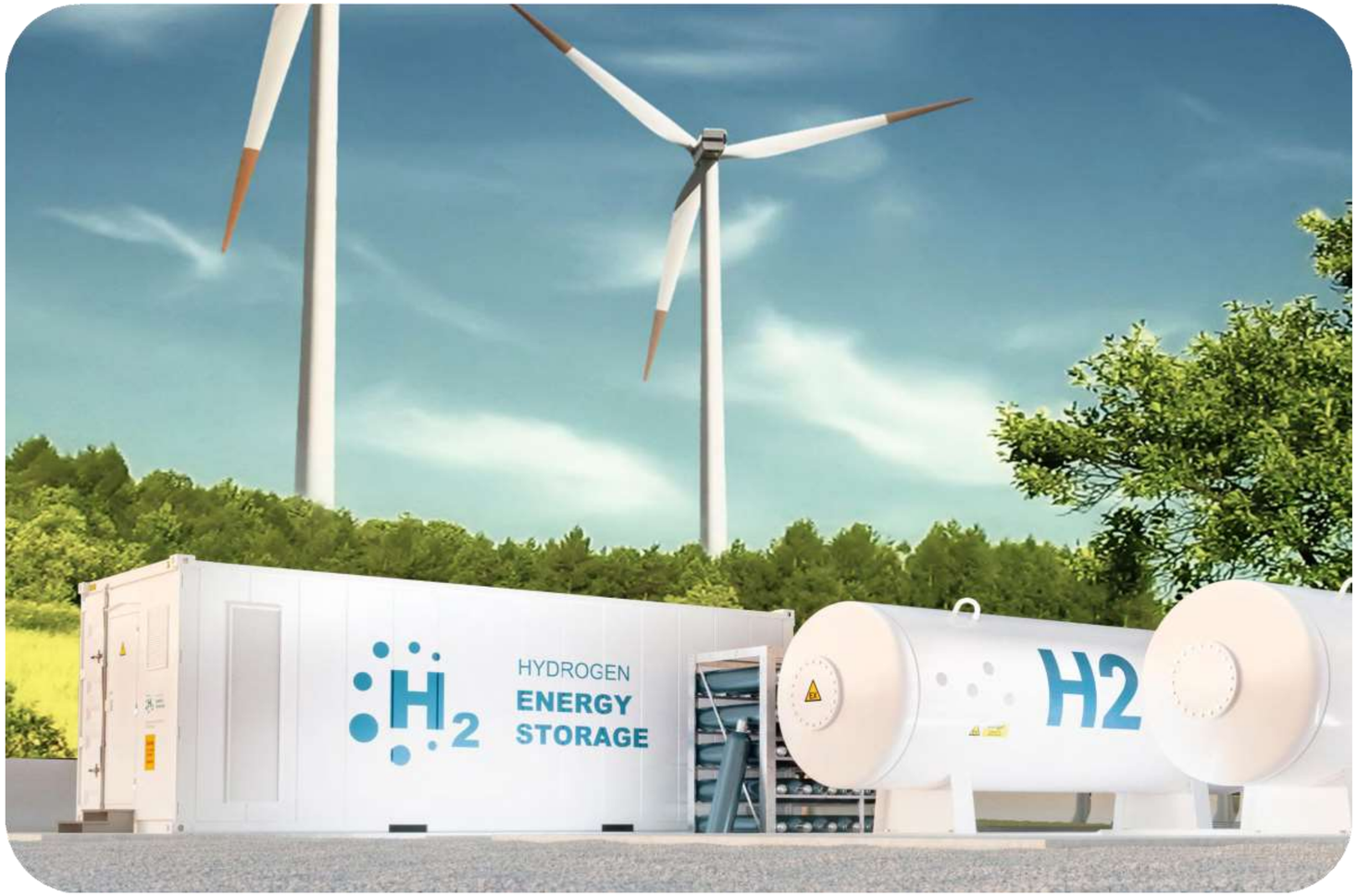
laganenergyeng.com

Your Partner in Energy and Beyond

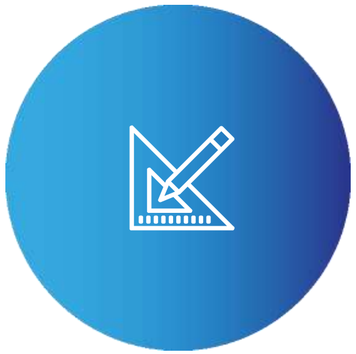
ENERGY

HEAVY IND.

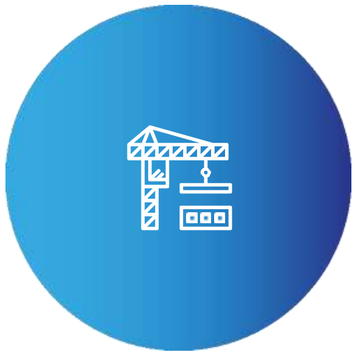
DATA CENTRE



Our Service Offering

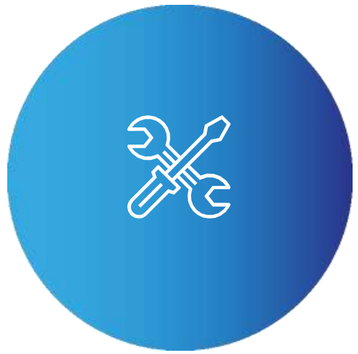


Design your solution

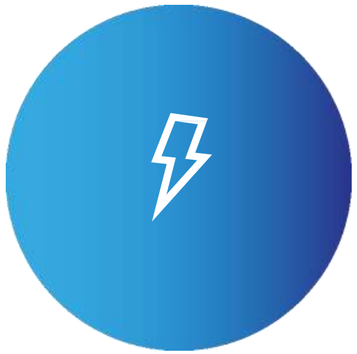


Construct your project

Commission your system



Maintain your assets



Operate your system

Offering you an A-Z value proposition

- Digital Tools
- Master Plans
- TCO* – infrastructures & fleets
- Road maps
- Technical & Regulatory Consultancy

- Due Diligence
- Pre-Feasibility & Feasibility Studies
- Conceptual Design
- Power System Development & Economics
- Environmental Impact Assessment & Licensing

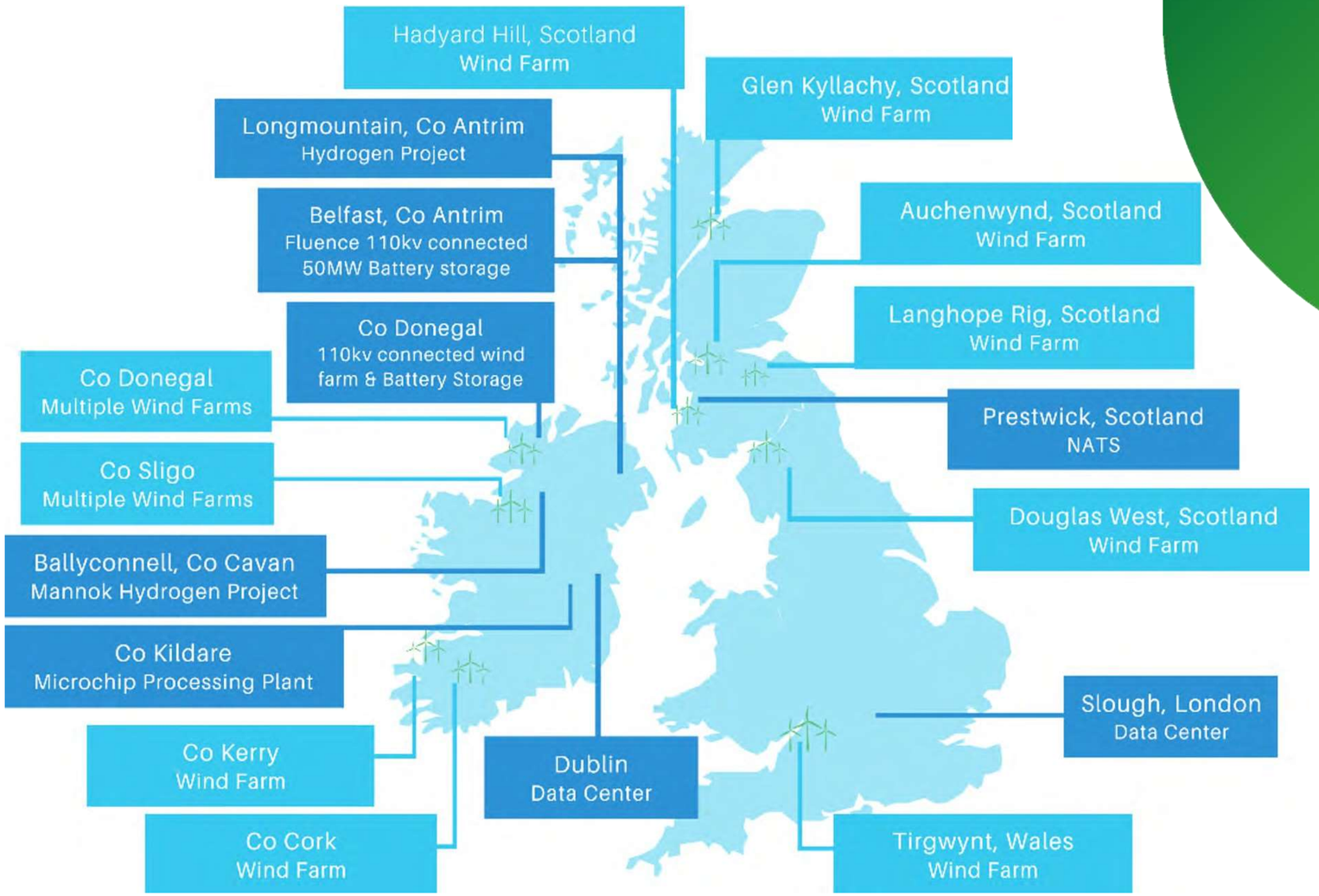
- Dismantling
- Waste Management
- Soil Remediation
- Site Redevelopment

- Strategic O&M Engineering
- Simulators & Training
- Operation Support Solutions
- Modification, Renovation,Lifetime Extension
- Power System Operation & Control

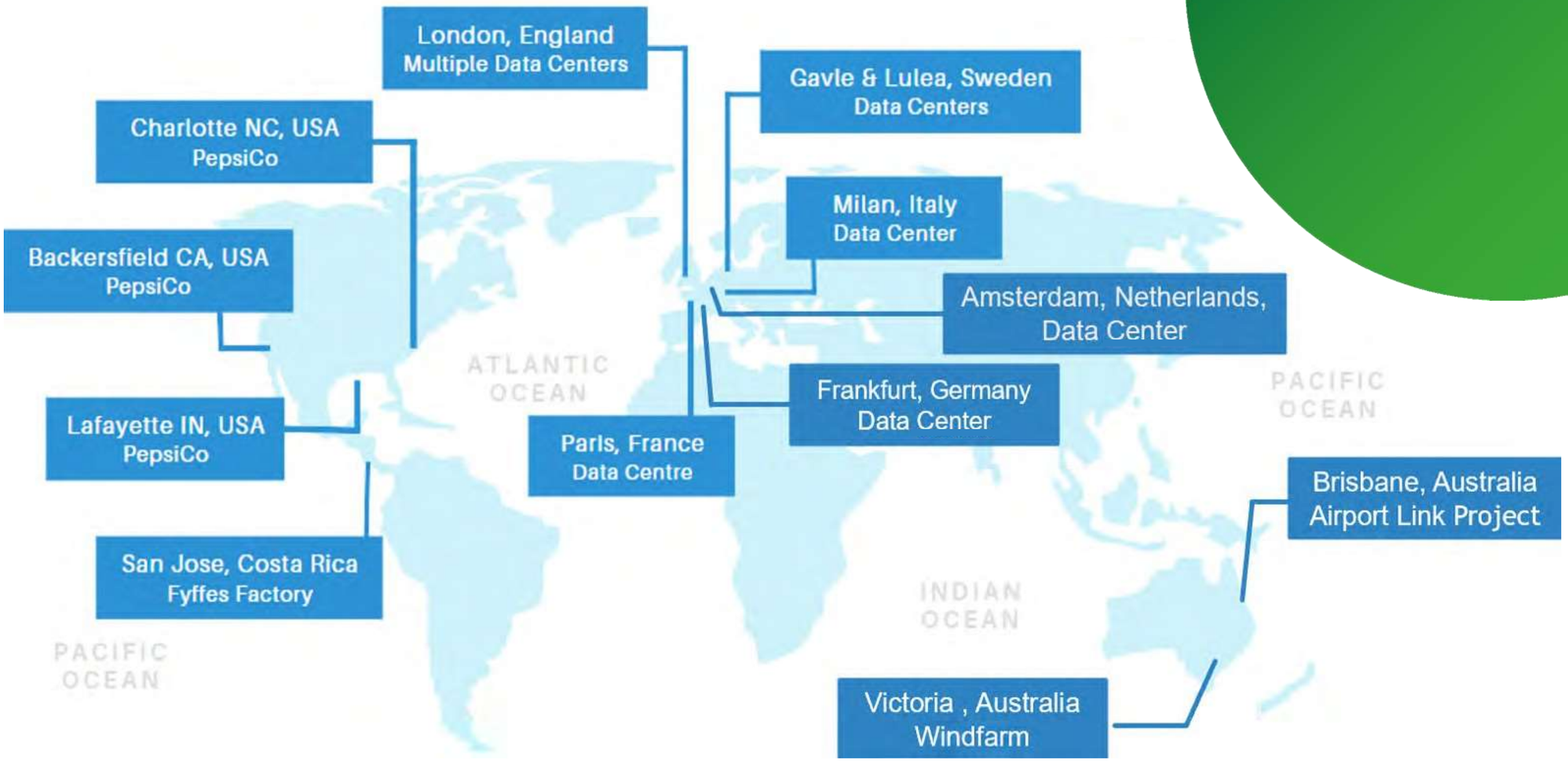
- Support to permitting
- Front-End Engineering Design
- Basic & Detailed Design
- Complete tendering & bid comparison
- EPC / EPC-Management
- Owner's or Lender's Engineering
- HAZOP – HAZID
- Quality Assurance & Quality Control
- Project & Contract Management
- Site Supervision & Commissioning

*TCO : Total Cost of Ownership

Ireland & UK Locations



Global Locations



Longmountain Hydrogen Project

Longmountain Wind Farm hydrogen project is a first of its kind in the UK and Ireland for green hydrogen production at large scale wind generation.

CLIENT	Energia Renewables
LOCATION	Northern Ireland
PERIOD	2019 – 2022
CAPACITY	1 MW electroliser Design and Build
SERVICES PROVIDED	Design and Build

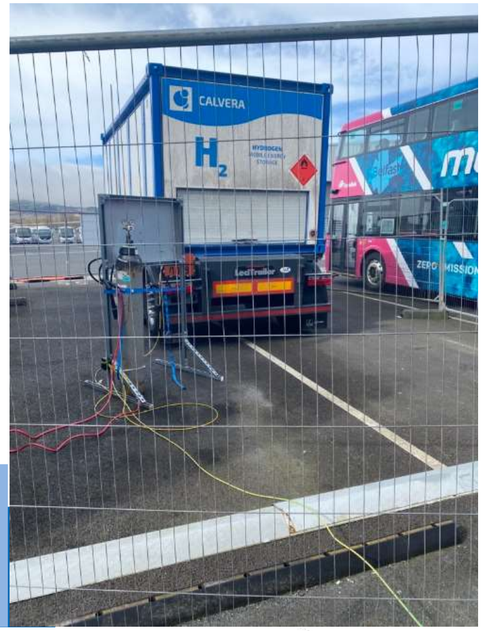
- Principal Contractor for the design and build of the Civil and Electrical BOP including SCADA and GCC
- Ensure grid code compliance once final install complete.
- Assist client with compiling employers' requirements for tender.
- Participate in HAZZOP and HAZZID meetings to achieve full compliance for operational phase.
- Execution of all electrical studies to include, harmonics, load flow, short circuit,
- Maintain responsibility of CDM regulation on site.
- Fully comprehensive handover file.
- ATEX zone competent persons - Compex

Translink/Energia Hydrogen Refueling station

Translink have acquired 25 Hydrogen Busses. Lagan Energy were contracted to Design and Build the installation.

CLIENT	**Energia -Translink Milewater transport centre**
LOCATION	Northern Ireland
PERIOD	2019 – 2022
CAPACITY	Hydrogen Refueling Station Design and Build
SERVICES PROVIDED	**Design and Build**

- Principal Contractor for the design and build of the Civil and Electrical BOP including SCADA
- Complete the Lightening Protection design.
- Assist client with compiling employers' requirements for tender.
- Participate in HAZZOP and HAZZID meetings to achieve full compliance for operational phase.
- Execution of all electrical studies to include, harmonics, load flow, short circuit,
- Maintain responsibility of CDM regulation on site.
- Fully comprehensive handover file.
- Provide Engineering

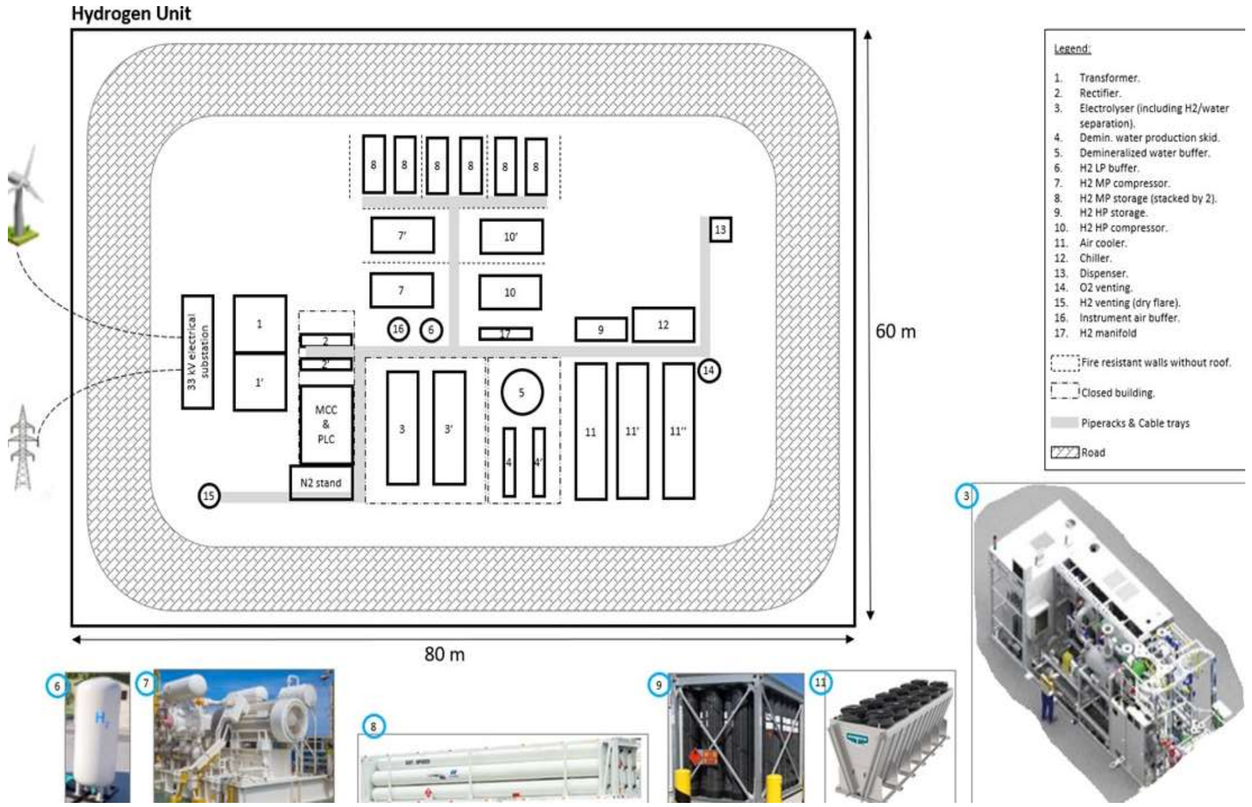


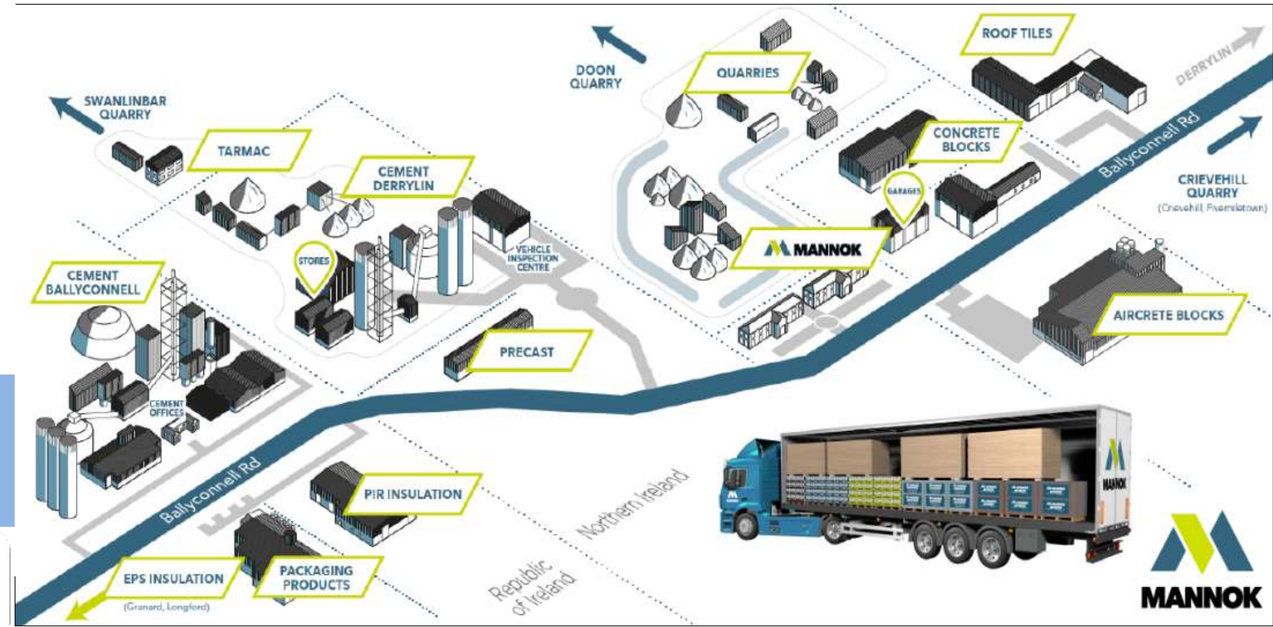
Mannok Green Hydrogen Valley

Mannok intends to decarbonize its cement plants and quarry fleet with green H2 powered by electricity from existing wind farms

CLIENT	**Mannok Holdings**
LOCATION	Ireland-UK borders
PERIOD	2021 – 2022
CAPACITY	Between 5MW and 50MW
SERVICES PROVIDED	**Pre-Feasibility Study and FEED Study**

- Assess potential location of H2 system
- Review H2 and O2 use in the cement industry
- Explore connection before or after the meter to qualify H2 as green-H2
- Techno-economic analysis: mapping H2 demands vs wind production baseload & curtailment vs LCOH
- Techno-economic optimization of H2 production: electrolyser vs storage sizing vs LCOH
- Develop design basis
- Prepare conceptual design, layout, high-level description of key equipment, interface & tie-ins)
- Preliminary CAPEX & OPEX estimation





Our offering to you

- Lender's approval – Why?
- Dedicated Hydrogen Specialists in house
- Global Geographical Reach
- Partnerships with Global Leaders
- **We’ve sustained the growing pains, so you don’t have to.**

Lagan energy engineering

Thank you

Contacts

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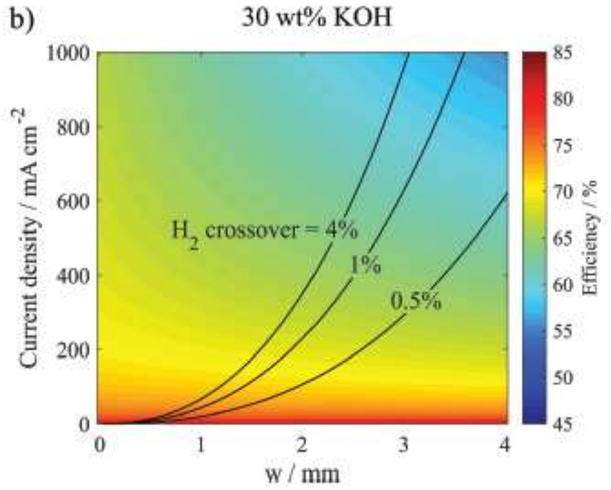
John Harrison

B9 Solutions

NI Net Zero Exchange

B9 Flow-Field Electrolyser



Affordable electrolysis made possible

- 3-D printing technology
- Electroless Coating
- Modular Design
- No membrane = lower-cost, reduced failure modes
- Readily available materials

Milestone 1: Lab scale validation ☑

Milestone 2: 10kW stack **Aug 2024**

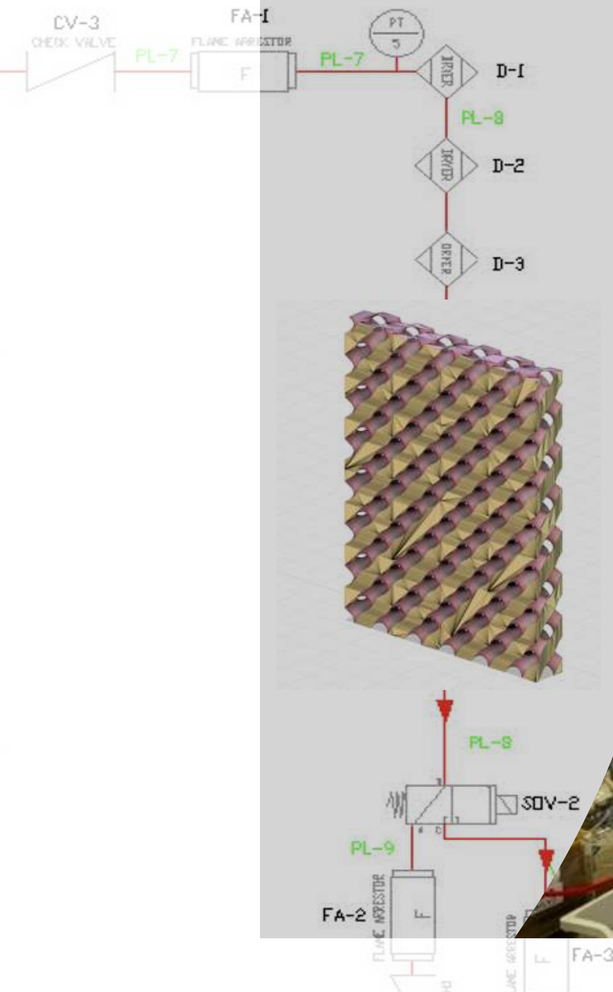
Milestone 3: 100kW commercial unit **QTR 1 2025**

B9 ENERGY ®
B9 TECHNOLOGIES

FAST

B9 ENERGY ®
B9 TECHNOLOGIES

FAST



Keiran Doherty

Lagan MEICA

NI Net Zero Exchange

Lagan MEICA

MECHANICAL | ELECTRICAL | INSTRUMENTATION
CONTROL | AUTOMATION

Belfast Demonstrator Oxygen & Hydrogen Project

Lagan MEICA

MECHANICAL | ELECTRICAL | INSTRUMENTATION
CONTROL | AUTOMATION

Delivery of innovative design and build MEICA solutions for the water and wastewater industry

Optimising existing wastewater processes

Deployment of Green Hydrogen and Oxygen technologies to benefit the wastewater industry

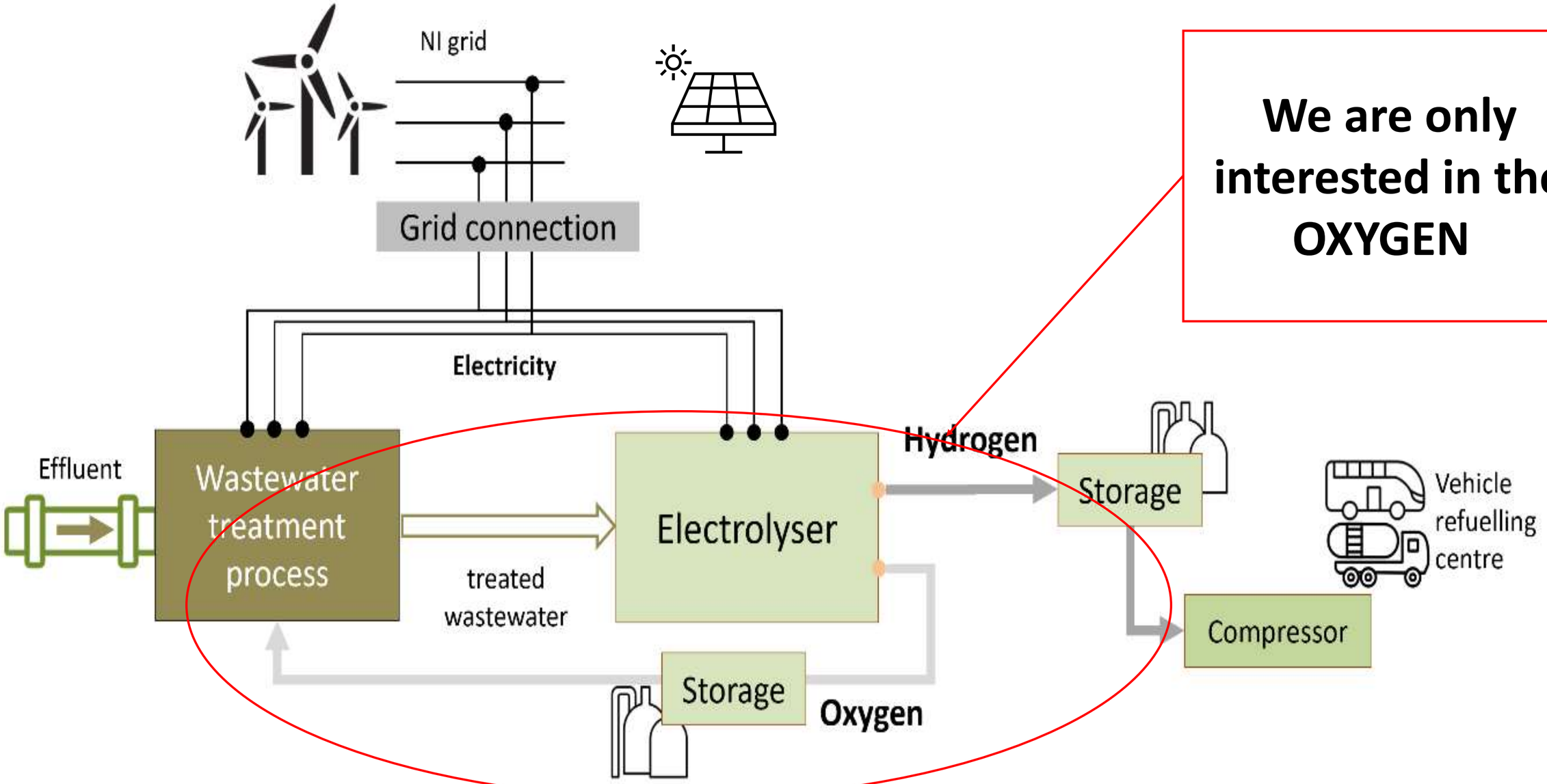
Secondary treatment processes involving air: power hungry

Over aeration is costly and produces greenhouse gases

Oxygen is expensive

Belfast Demonstrator WwTW

Lagan MEICA
MECHANICAL | ELECTRICAL | INSTRUMENTATION



We are only interested in the OXYGEN

H2 O2 pilot plant

Lagan MEICA
MECHANICAL | ELECTRICAL | INSTRUMENTATION
CONTROL | AUTOMATION

Why Hydrogen?

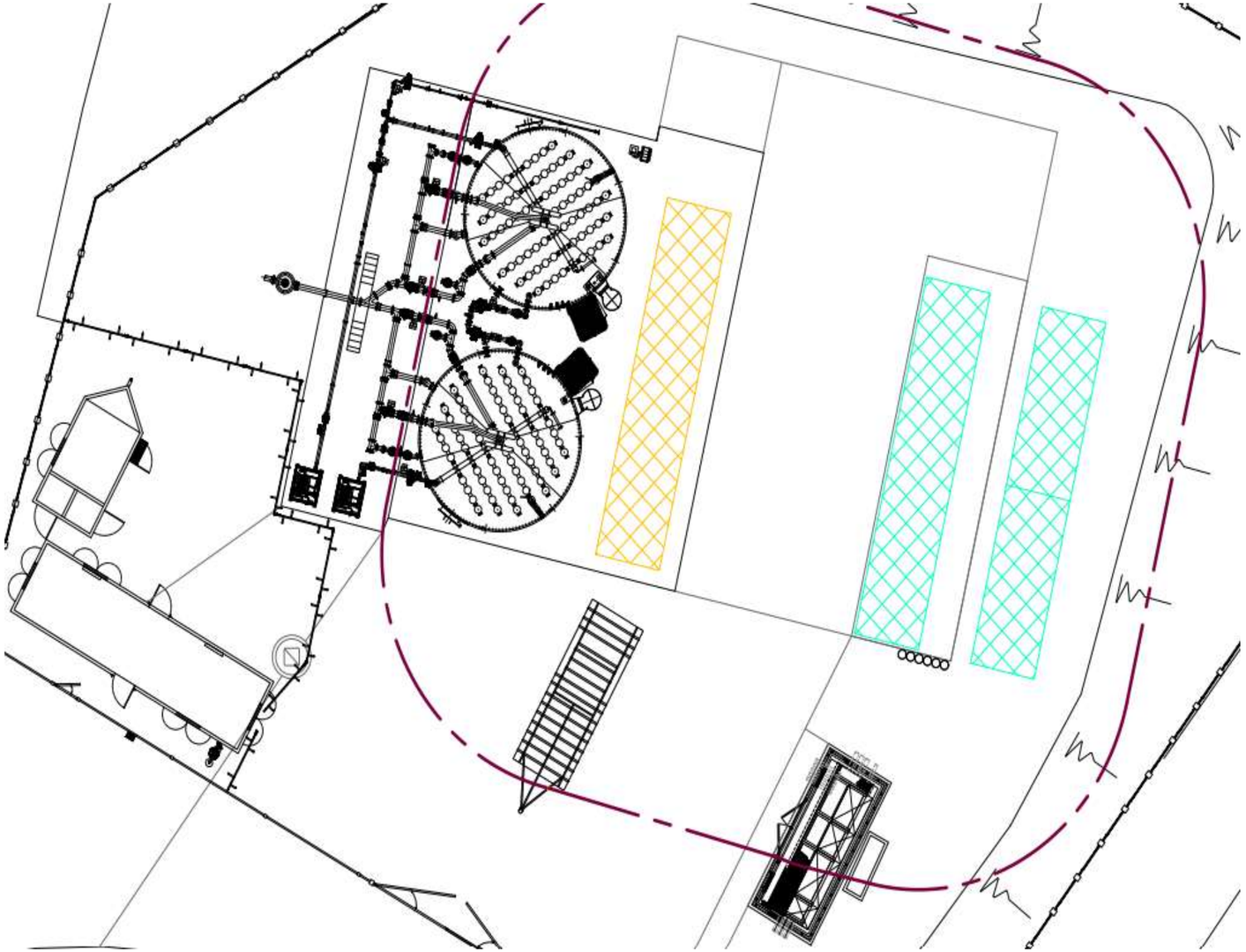
1kg Hydrogen = 8 kg Oxygen

Project Aims

- Lower electricity
- Increase plant capacity
- Reduced sludge
- Compress hydrogen

Site layout to accommodate the Oxygen trial

Lagan MEICA
MECHANICAL | ELECTRICAL | INSTRUMENTATION
CONTROL | AUTOMATION



The liquid Oxygen delivery system

O2 trial interim results

15% reduction in secondary treatment
31% faster reaction phase
13% saving in energy
15% reduction in sludge produced

Therefore:

- More energy efficient secondary process
- Reduced sludge treatment, transport and disposal costs

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CONTROL | AUTOMATION

Blending OXYGEN is advantageous !

Viable commercial model using revenue stacking

- Hydrogen sales .
- smooths out solar and wind generation to the grid

- Better plant performance
- less sludge production
- Less greenhouse gases

WE ARE ACTIVELY DOING THIS, NOT JUST TALKING ABOUT IT!

Questions

Lagan MEICA

MECHANICAL | ELECTRICAL | INSTRUMENTATION
CONTROL | AUTOMATION

Paul Monaghan

Mannok

NI Net Zero Exchange

MANNOK

Invest Northern Ireland

NI Net Zero Exchange – Hydrogen & Alternative Fuels

17th to 22nd March 2023

Paul Monaghan

Head of Sustainability

A World First

FUELFLEX® Pyrolizer

Significant Development in Carbon Emisson Reduction

FLSmidth

MANNOK


FUELFLEX® Pyrolizer

KILN COAL DISPLACEMENT

RETROFITTING KILN TO FURTHER INCREASING LEVELS OF COAL DISPLACEMENT WITH ALTERNATIVE FUELS

SATELLITE BURNER

- Commission – Q1 2024
- 30% Coal Displacement

JETFLEX® DESIGN

- Commission – Q1 2025
- 30% Coal Displacement

TOTAL 60% KILN COAL DISPLACEMENT BY 2026

FLSmidth

MANNOK

Strand 1 Development Expenditure (DEVEX)

ASSETS

SLIEVE RUSHEN
WIND FARM

Using Unused
Curtailed Capacity ≤14%

FUTURE STATE

PHASED SCALE UP ≤50MW TO DECARBONISE MANNOK INDUSTRIAL BASE

+CCU Produce Synthetic Fuels (Internal/External Applications)

5MW H_2 PLANT

PRIVATE WIRE FEED INTO ELECTROLYSER

Compression, Storage & Hydrogen Refuelling Station (HRS)

OUTPUT

FRONT END ENGINERRING DESIGN
(FEED STUDY)

CO_2

GOAL

DECARBONISE

Decarbonise 70% Of The Total 4ML Diesel Annually
(10,720 t/CO2)

OFF-TAKERS

HYDROGEN FLEET
OXYGEN CEMENT

Waste Heat Recovery

LOCATION

MANNOK BUILD
NI INDUSTRIAL BASE

Readily Available
Water Supply

PRE-FEASIBILITY STUDY	NZHF APPLICATION	NZHF FEED STUDY	TENDERING PROCESS	PROJECT DELIVERY
Oct 2021 to Mar 2022	May 2022 to Sept 2022	Apr 2023 to Feb 2024 (Live)	Q2/Q3 2024	2026

MANNOK

NET ZERO BY 2050

MANNOK

Ed Archer

Ulster University

NI Net Zero Exchange

Ulster University

Hydrogen Capability at Ulster University, Northern Ireland.

Dr Edward Archer

Northern Ireland advanced composites design and manufacturing Industry

The Airbus A220 carbon fibre composite wings are designed and made in Belfast, Northern Ireland, U.K., in a dedicated wing manufacturing facility run by global Tier 1 aerostructures manufacturer Spirit AeroSystems .

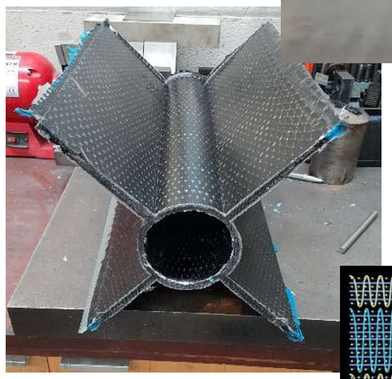
Ulster University

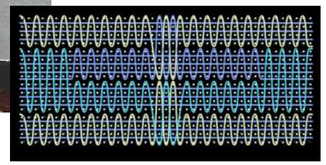
SPIRIT AEROSYSTEMS

AIRBUS

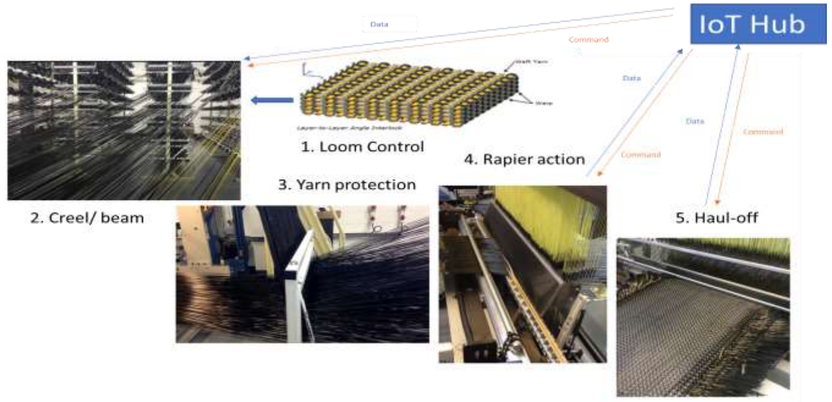
Ulster University

Advanced Materials for Hydrogen Storage and Transportation





- Composite design strategies for advanced applications.
- Design and development of bespoke dry fibre materials using application driven methodologies.
- Development of advanced fibre placement manufacturing technologies suitable for hydrogen storage tanks and transportation.
- Digital twin development for composite technologies.



Northern Ireland HyTech project

Investment of c.£21m levered by £15m co-funding from the NI Complementary Fund

Involves development of a Hydrogen Technology Accelerator via AMIC and the roll out of a series of Hydrogen Demonstration Testbeds in Mid and East Antrim.

Ulster University

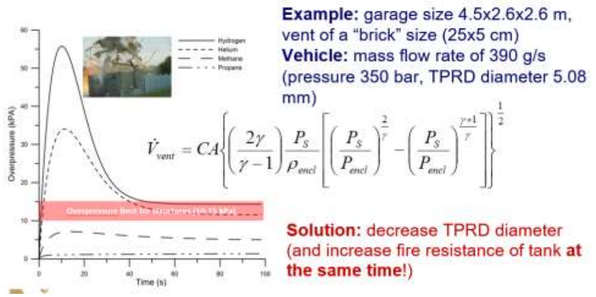
Prof Vladimir Molkov

HySAFER

- **Fundamental** and **industry-driven** research, consultancy, knowledge and technology transfer (BSI/CEN/ISO/UN) in the area of safety, primarily hydrogen systems and infrastructure – Materials/Manufacturing knowledge.
- **Key provider** of hydrogen safety research, research-led education, and training **globally.**
- Develops models and tools for assessment of hazards and associated risks following unscheduled leaks and loss of containment.
- HySAFER thrust is on theoretical and numerical studies.

The pressure peaking phenomenon

Unique for hydrogen only (revealed at Ulster)



$$\dot{V}_{vent} = CA\left\{\left(\frac{2\gamma}{\gamma-1}\right)\frac{P_S}{\rho_{encl}}\left[\left(\frac{P_S}{P_{encl}}\right)^{\frac{2}{\gamma}} - \left(\frac{P_S}{P_{encl}}\right)^{\frac{\gamma+1}{\gamma}}\right]\right\}^{\frac{1}{2}}$$

Example: garage size 4.5x2.6x2.6 m, vent of a "brick" size (25x5 cm)
Vehicle: mass flow rate of 390 g/s (pressure 350 bar, TPRD diameter 5.08 mm)

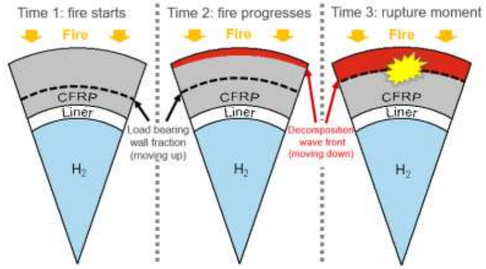
Solution: decrease TPRD diameter (and increase fire resistance of tank **at the same time**!)

Explosion free in fire TPRD-less 700 bar tank

Benign hydrogen microleaks and resin burning

Failure mechanism of composite tank

Fire scenario



When decomposition front meets wall load bearing fraction location, the tank fails to withstand internal pressure and ruptures

Ulster University

Thank You

e.archer@ulster.ac.uk

Ulster University

David Rooney

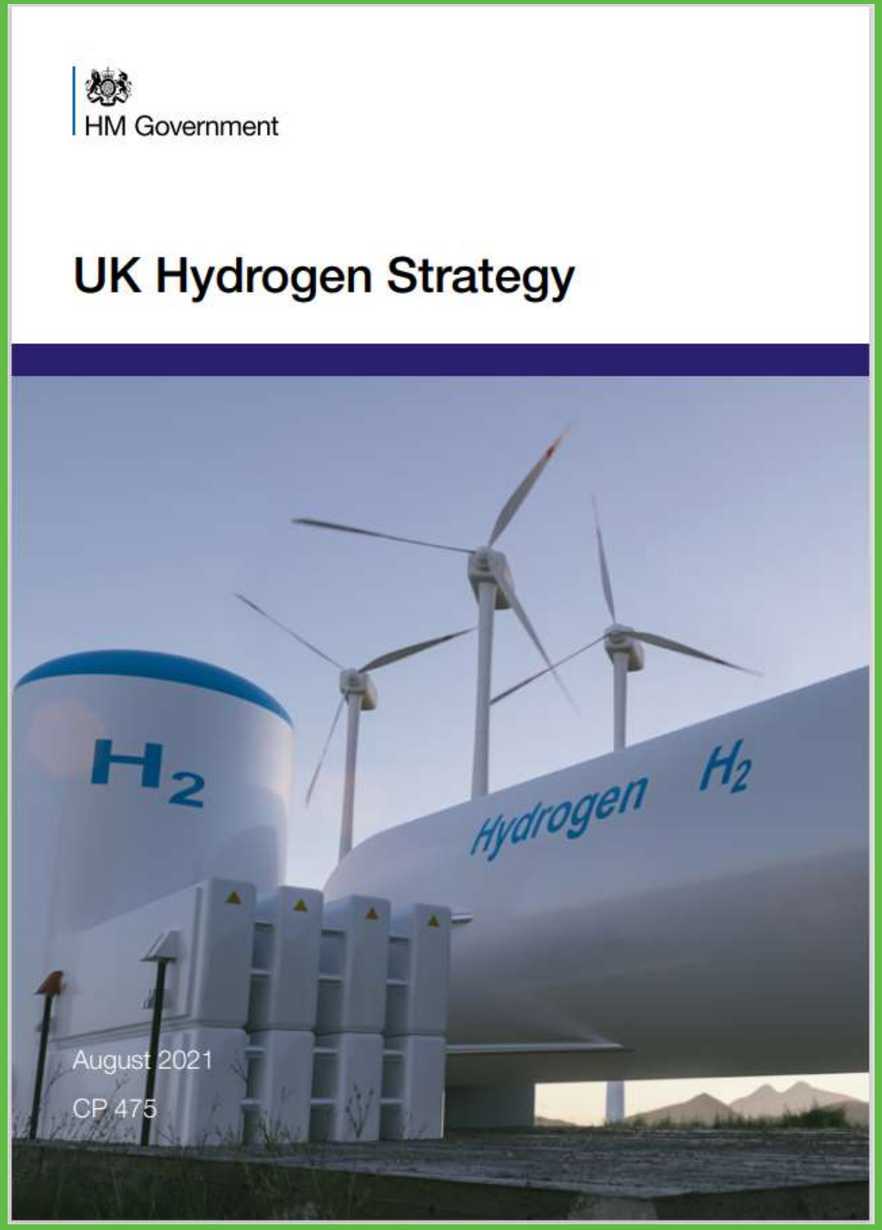
CASE

NI Net Zero Exchange

SHAPING A
BETTER WORLD
SINCE 1845

QUEEN'S UNIVERSITY BELFAST

Hydrogen: Opportunities for collaboration and commercialisation



Up to

10GW

ambition by 2030, up to 6GW from electrolytic hydrogen

£960 million

Green Industries Growth Accelerator (GIGA) fund

Up to

35%

of UK's energy consumption could be hydrogen by 2050

27GW

of potential hydrogen projects identified in the UK pipeline (through to 2037*)

More than

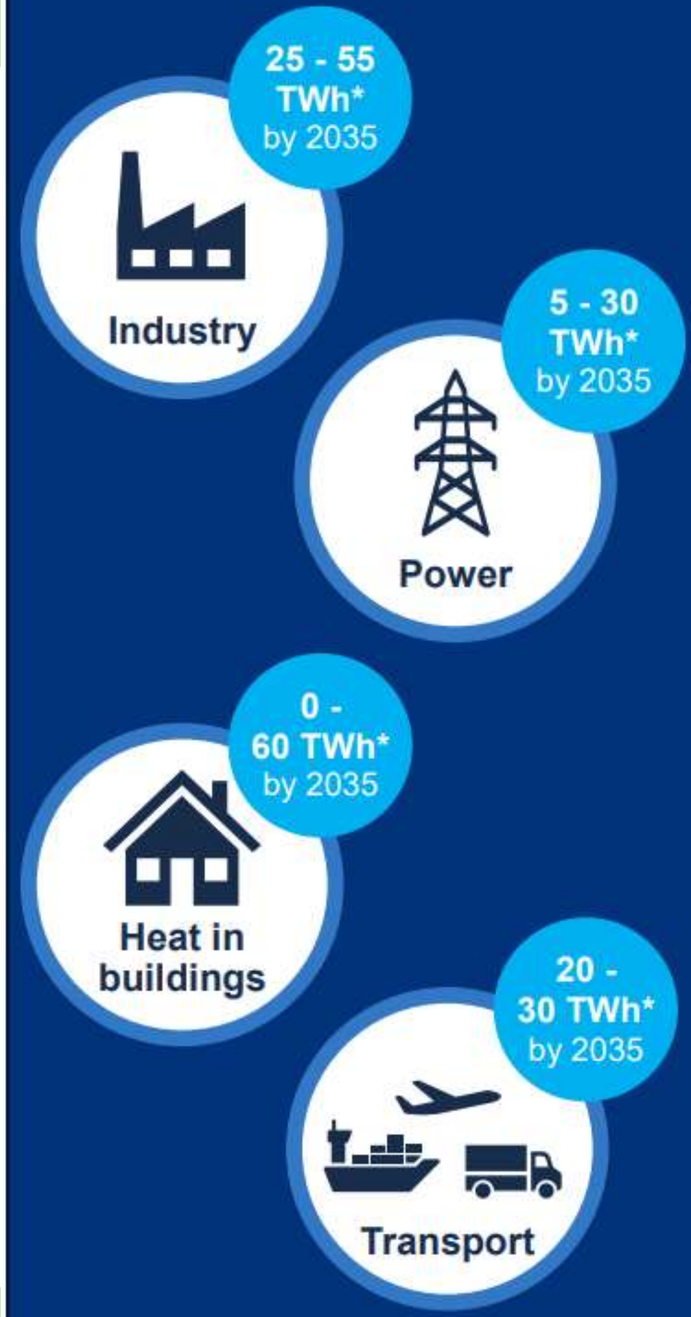
£150 million

will be spent from the Net Zero Innovation Portfolio on hydrogen innovation

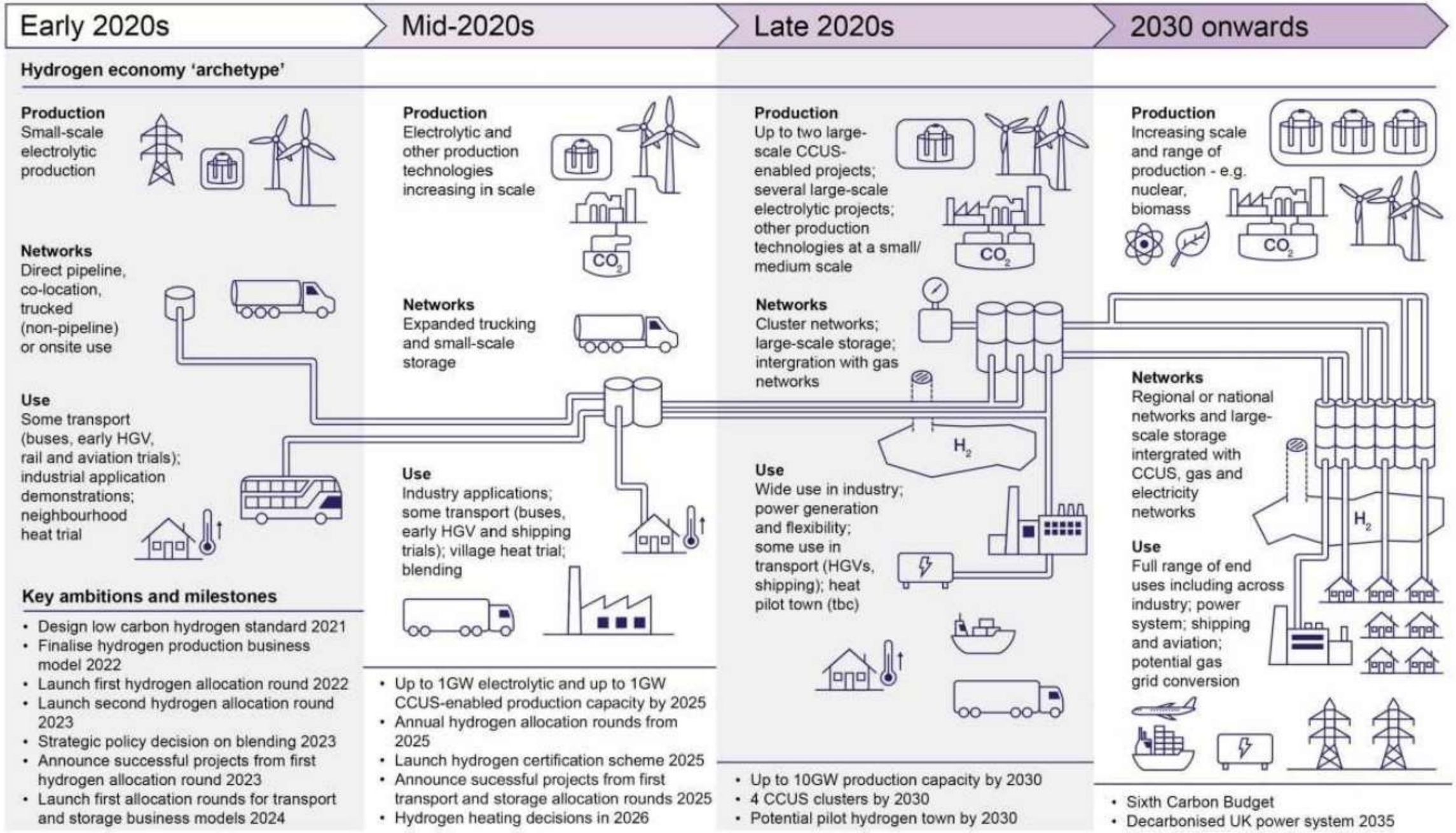
Up to

£18 billion

private financial capacity available from UK Infrastructure Bank for sectors including H2



Hydrogen Economy Roadmap



First Electric Tram, Dublin (16th May 1896)

In 2020, Wrightbus, Queen's University Belfast and Translink developed a world-leading single deck hydrogen vehicle

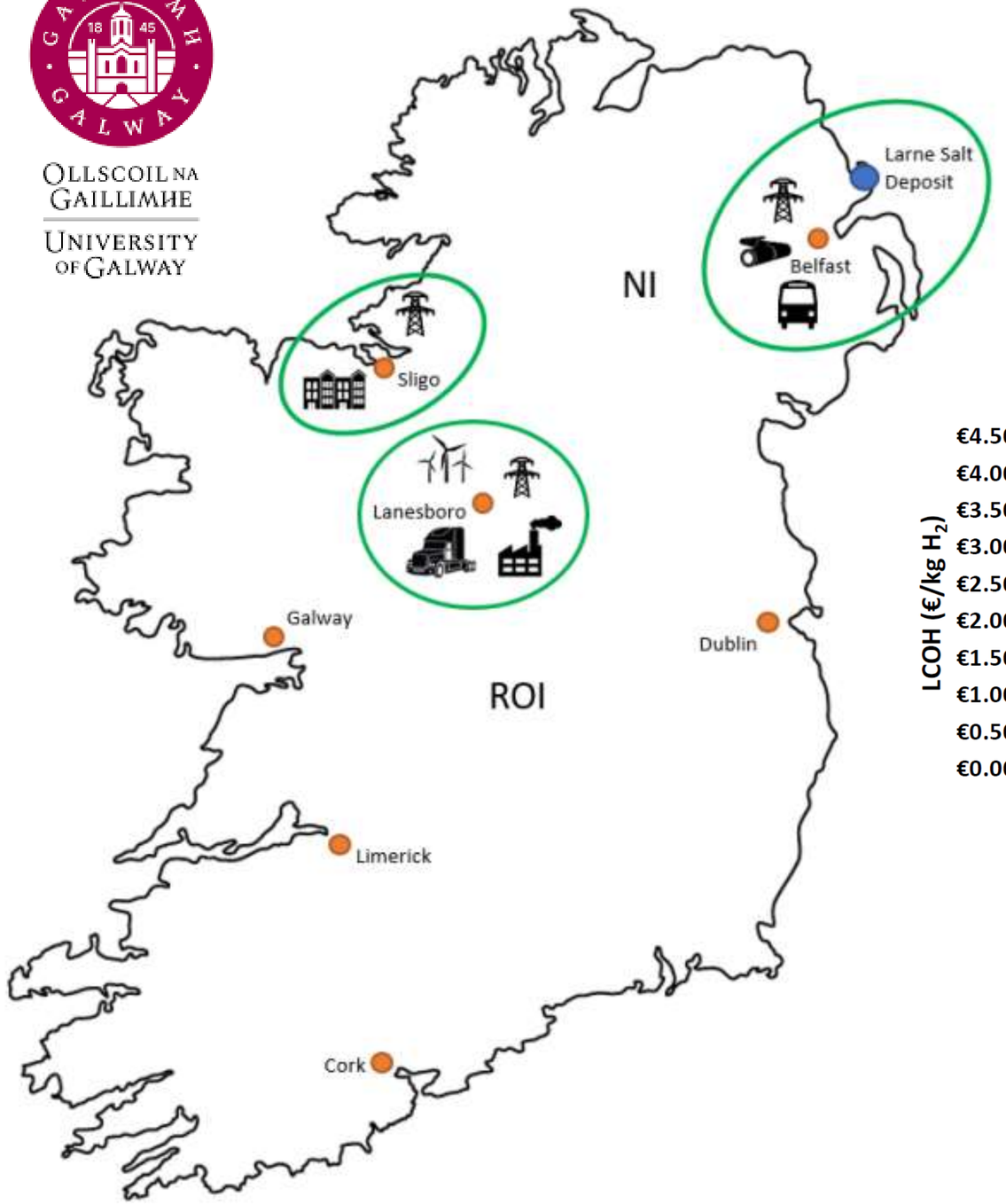
Together they delivered platform capable of a 1000km range while carrying up to 90 passengers.

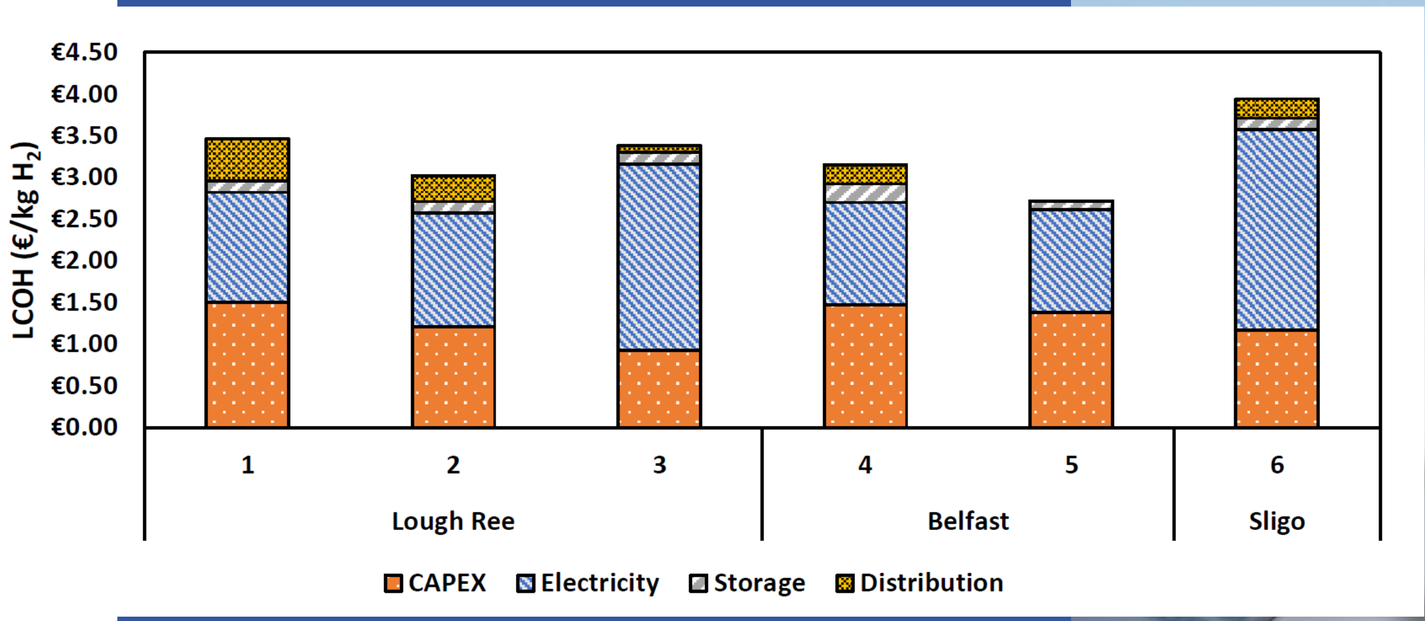
QUEEN'S UNIVERSITY BELFAST

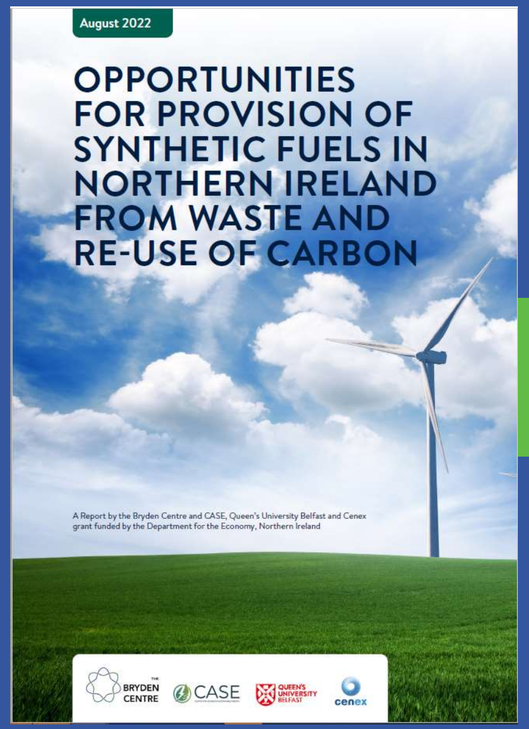
Titanic launch, Belfast, 31 May 1911

- UKRI Strength in Place Fund (c£55m) award to Artemis Technologies consortium
- Queen's researchers informing:
  - Computational modelling
  - Titanium/composite hybrid joints
  - Collision avoidance
  - Long range underwater sensing

The importance of storage and distribution



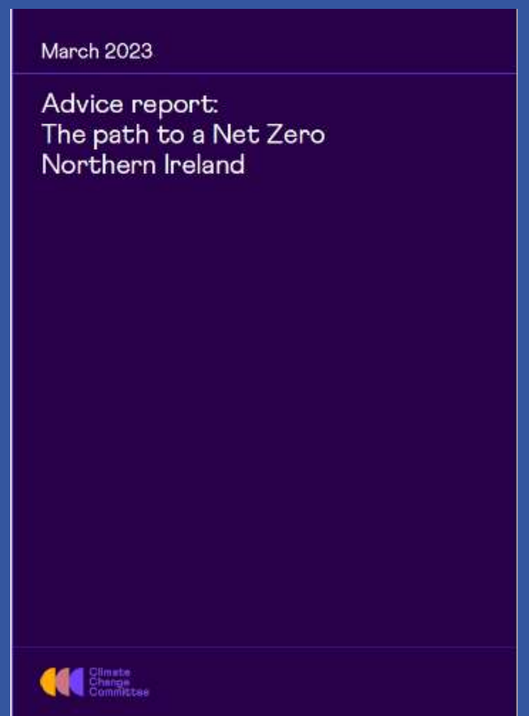


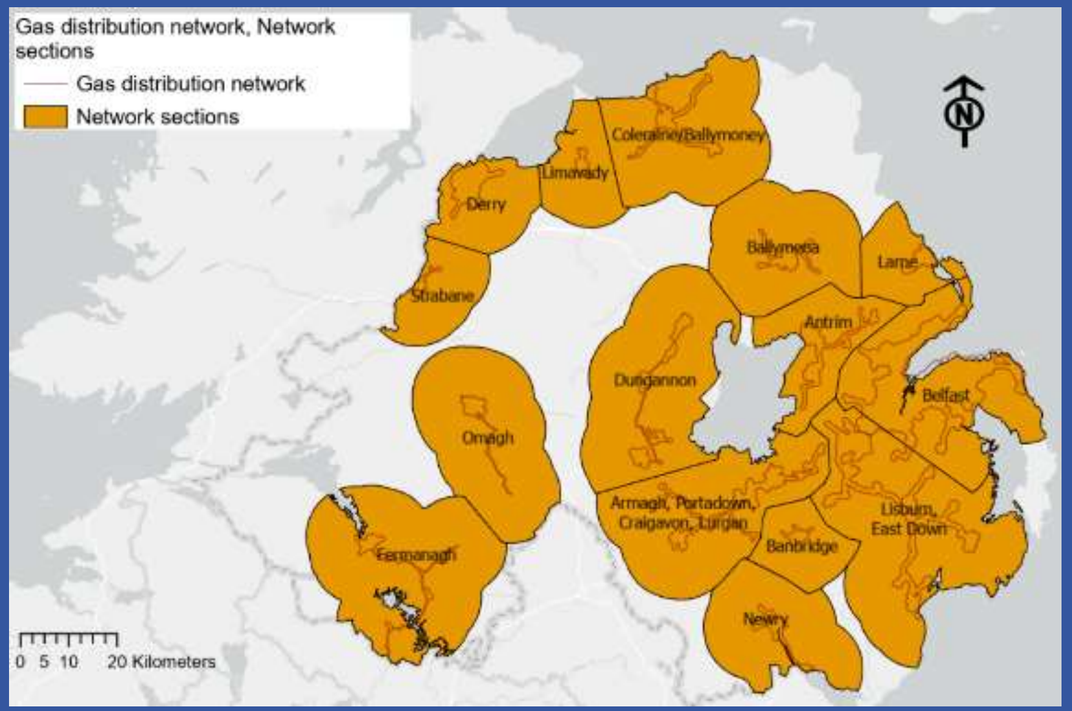


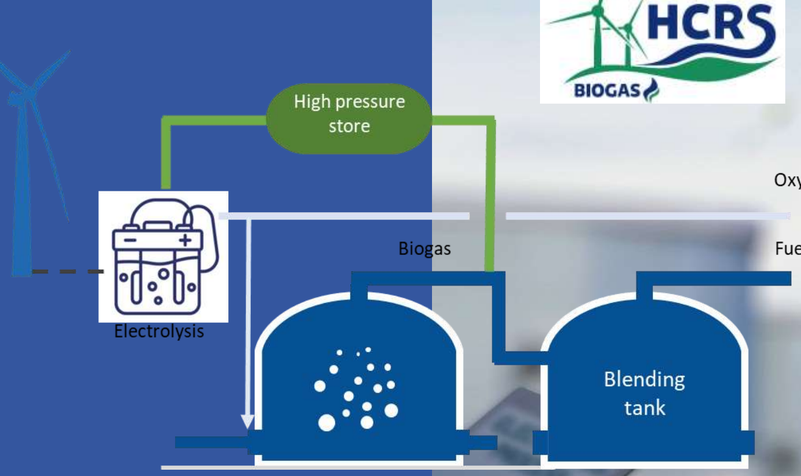
Sector	Relative Opportunity	Potential Agri-fuel Type
Road Transport	Low	Renewable diesel, e-Diesel, Bio-methane
Rail	Low	Renewable diesel, e-Diesel
Agriculture, Mining & Construction	Moderate	Renewable diesel, e-Diesel
Marine	High	Renewable diesel, ammonia, bio-methanol, e-diesel
Aviation	High	Sustainable Aviation Fuel (SAF)

Creating an area of advantage

Northern Ireland







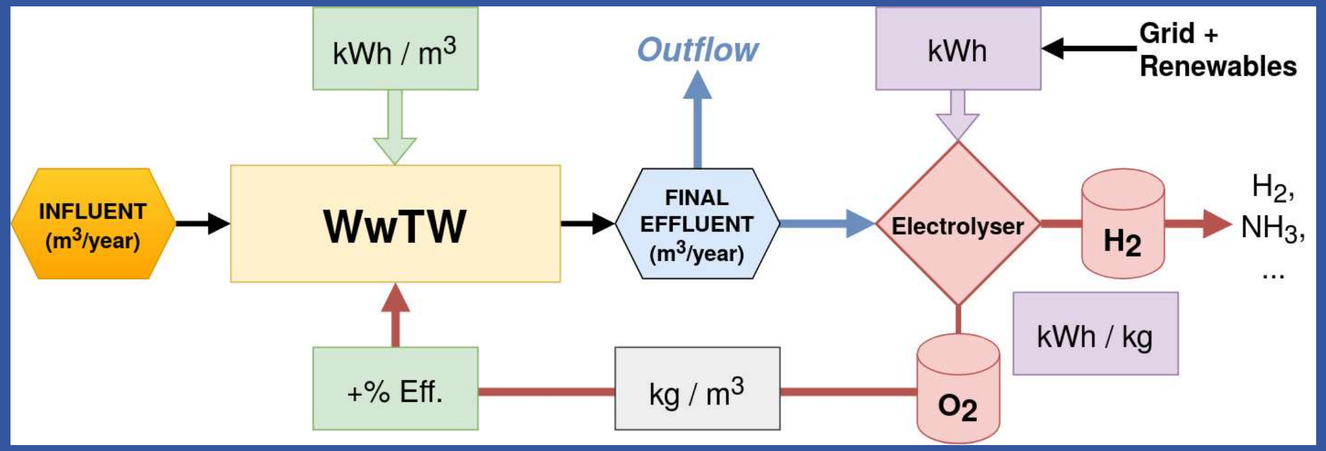
HCRS BIOGAS

CASE
CENTRE FOR ADVANCED SUSTAINABLE ENERGY

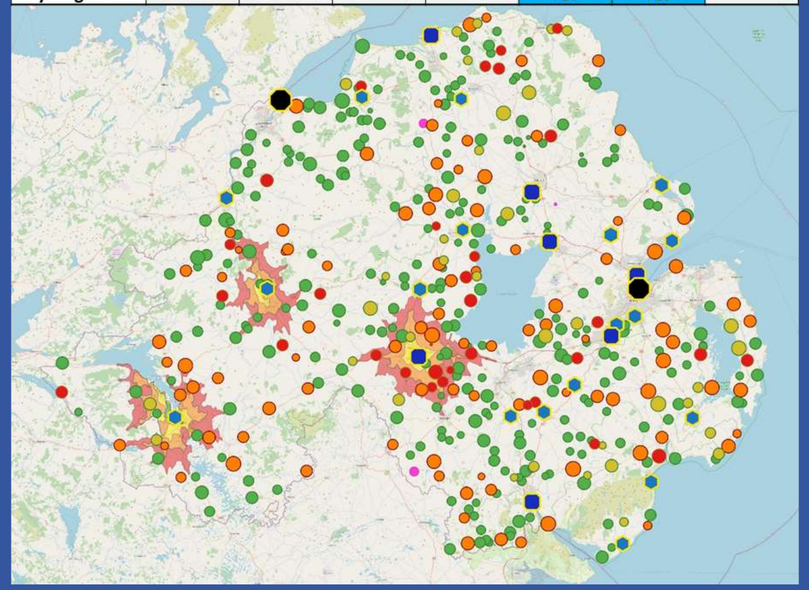
QUEEN'S UNIVERSITY BELFAST

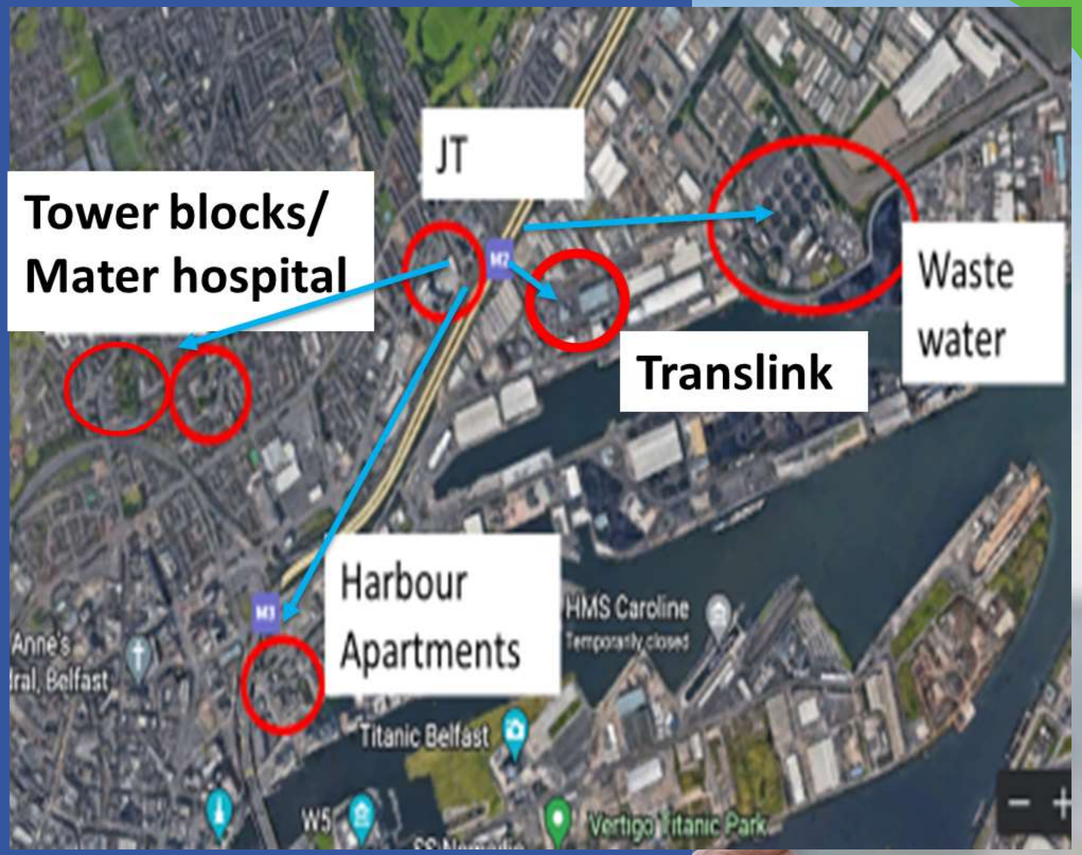
ADDING VALUE: System Integration

- District heating networks
- Electricity – arbitraging Day/ night price with fuel cells and electrolysers
- Oxygen



Cluster	0	1	2	3	4	5	6
O_2 Potential	LOW	MED	LOW	HIGH	HIGH	HIGH	LOW
Hydrogen Site					YES	YES	



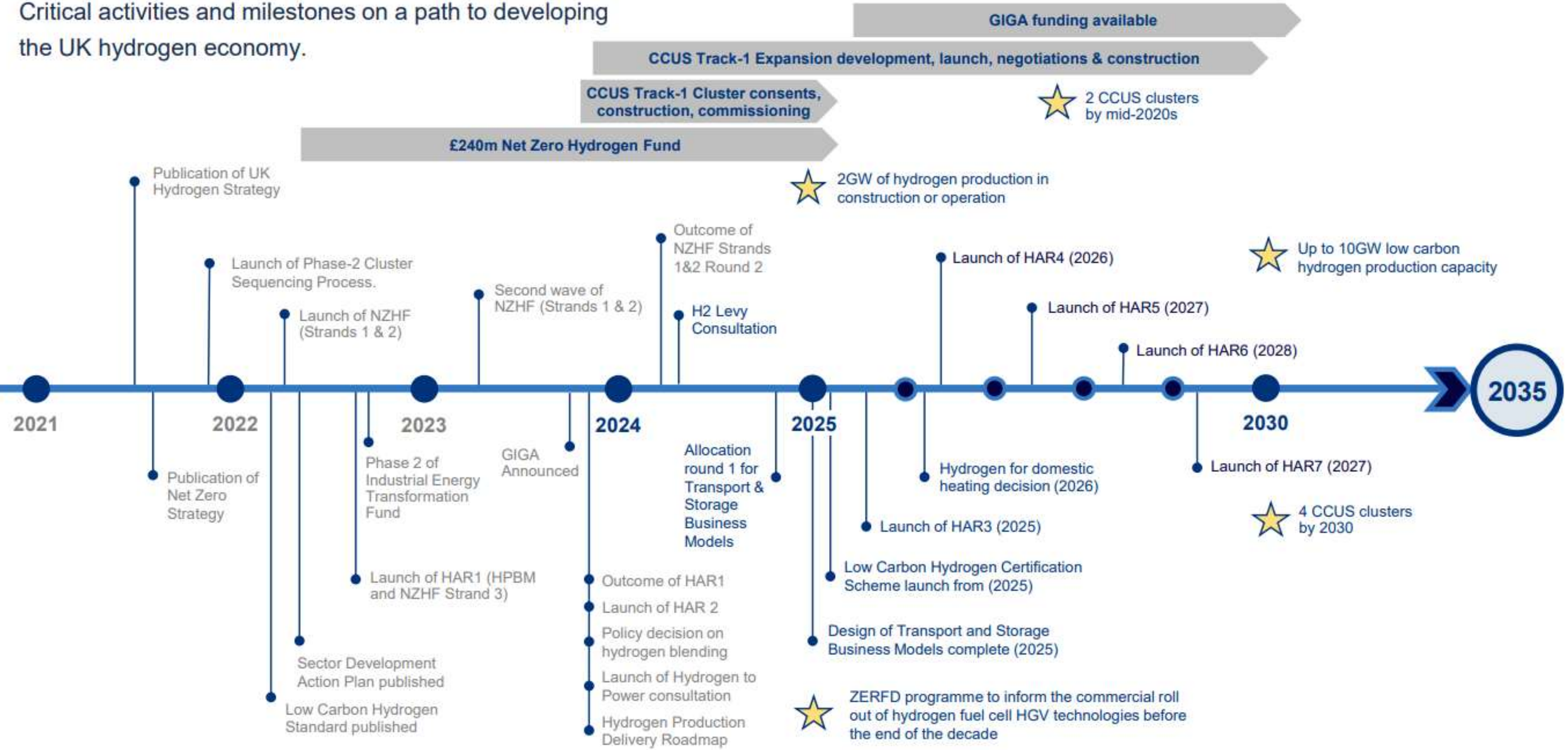


CASE
CENTRE FOR ADVANCED SUSTAINABLE ENERGY

QUEEN'S UNIVERSITY BELFAST

2035 Delivery Plan

Critical activities and milestones on a path to developing the UK hydrogen economy.



HAR – Hydrogen Allocation Round; **NZHF** – Net Zero Hydrogen Fund; **GIGA –** Green Industries Growth Accelerator.