HyDEX

Accelerating the new hydrogen economy in the Midlands

@Hydex
Midlands
#hydex

Celebrating the HyDEX programme

Thursday 7 November 2024
The Museum of Making, Derby

Funded by UKRI Research England

Lead academic partners ERA ENERGY RESEARCH ACCELERATOR · Keele University · MIDLANDS INNOVATION

Agenda

Celebrating HyDEX

Time	Morning session
9.30am	Registration and refreshments
10am	Welcome – Professor Mark Ormerod, Deputy Vice-Chancellor, Keele University
10.10am	Celebrating HyDEX – round-up of highlights of the programme. Professor Martin Freer, Academic Chair, HyDEX
10.35am	HyDEX influencing hydrogen policy
10.45am	Hydrogen innovators – projects, Q&A
11.45am	Refreshments – networking break
12.15pm	HyDEX skills and panel discussion

Time	Afternoon session
1.15pm	Lunch, plus showreel and videos
2.15pm	Keynote: The future of hydrogen in the Midlands. Sally Brewis, Head of Regional Development, Cadent
2.35pm	Panel discussion: The future of hydrogen in the Midlands • Panel chair: Sarah Windrum, Cluster Development Lead – Horiba-Mira • Professor Martin Freer, Academic Chair – HyDEX • Kelly Manders, Regional Development Manager – Cadent Gas • Matt Barney, Chief Hydrogen Business Officer – GeoPura
15.10pm	Closing remarks. Beyond the HyDEX legacy

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Welcome

Professor Mark Ormerod

Deputy Vice-Chancellor and
Provost of Keele University

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A round-up of HyDEX highlights

Professor Martin Freer
Academic Chair, HyDEX

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Celebrating HyDEX

UK and international collaborators in HE and key sectors

HyDEX achievements

Celebrating HyDEX

Successfully raised the profile of hydrogen as a sustainable fuel for a variety of industry sectors across the Midlands

Increased resources available to businesses through the development of hydrogen skills and training programmes, and infrastructure of key academic partners

Worked with partners and businesses to raise millions of pounds in funding for future research and development across multiple sectors

Co-funded multiple small-scale projects as first steps towards creating a hydrogen economy in the region

HyDEX achievements

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Policy

- Led a series of Industry roundtables
- Wrote the EU-UK policy report
- Supported Net-Zero Transition Commission
- Developed the Local Authority Hydrogen Toolkit
- And the Midlands Hydrogen Rail Study

Collaboration

500
organisations engaged with HyDEX demonstrators

200+
H2 jobs
supported in the Midlands

Created the
HyDEX Off-Road Network (HORN)

Facilitated
international partnerships in Europe and Asia

Supported Green H2 at the Touch Rugby World Cup

HyDEX achievements

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Skills and training

11 micro-internships

82
attendees
at H2 summer and winter school

400+
businesses
received direct training

Research and development

20
new H2 products and services supported

35
new externally funded R&D programmes

11
SMEs supported with the HyDEX Innovation Fund

£200m
secured for H2 R&D

HyDEX achievements

Aston University
BIRMINGHAM UK

Aston University highlights

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HyDEX innovation projects

- Supporting three SMEs with feasibility studies and/or modelling including:
  - Enhancing Fuel Cell design
  - A facility to process forestry waste to hydrogen
  - Hydrogen produced from gasification used to produce green ammonia

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UNIVERSITY OF BIRMINGHAM

University of Birmingham highlights

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Hydrogen Rail Study

- A study of hydrogen rail in the Midlands developed by UoB, Vanguard and ARUP.
- Co-produced with rail sector stakeholders through workshops and interviews.
- Launched at Alstom Litchurch Lane Site, Derby.

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Cranfield University highlights

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HyDEX demonstrators

- **The HyPER pilot** test-bed facility for business.
- **Turquoise hydrogen production pilot demonstrator.** Produces solid carbon as a by-product used in batteries and soil enhancement.

Engaged **with 250 organisations**

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Keele University

Keele University highlights

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Hydrogen Awards and Summit

- Keele hosted the Hydrogen Innovation summit and the UK Hydrogen Awards 2024.
- Recognising the achievements of universities and businesses across the hydrogen value chain.

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Loughborough University

Loughborough University highlights

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Hydrogen Schools

- Delivered the Hydrogen Summer and Winter Schools.
- Training on emerging hydrogen research and innovation, along with visits and site tours of the HyDEX demonstrators.
- A total of 82 attendees, including industry researchers, academics, public sector and overseas students from South Korea.

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University of Nottingham
UK | CHINA | MALAYSIA

University of Nottingham highlights

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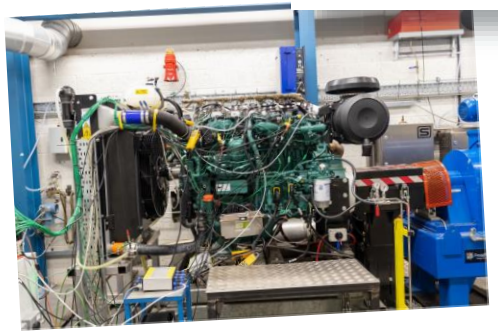
HyDEX demonstrator

- The Flex Fuel Engine Demonstrator
- Retrofit solution for heavy duty diesel engines that can run on hydrogen or ammonia
- Secured funding for further development with partners



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WARWICK
THE UNIVERSITY OF WARWICK

University of Warwick highlights

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HyDEX innovation projects

- Supporting 2 SMEs to improve their technologies including streamline production process.
  - Adapting a chemical reactor for hydrogen production
  - Improving a Fuel Cell membrane

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Building international partnerships

HyDEX has built links with partners in:

- **Korea** – Korea University of Technology and Innovation (KoreaTech) and Chungnam Techno Park.
- **Singapore –** building links with universities and companies on sustainable aviation fuels (SAF).
- **China** – Beijing Tsinghua Industrial Development Research Institute.

Our international partners are keen to work with Midlands' businesses on hydrogen innovation projects.

Influencing policy

Nick King
Marketing Manager, HyDEX/ERA

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Accelerating hydrogen adoption in industry

- HyDEX has undertaken a report with industry, examining the challenges and opportunities facing industry re the use of hydrogen.
- Over summer 2024 we interviewed numerous industry leaders to obtain their views.
- The report examined the sectors of aerospace, road transport, industry, construction, quarrying and agriculture.
- Download this report: https://bit.ly/AccelerateHydrogen

The report has produced specific and overarching recommendations for each sector, including:

- ✓ Joining up thinking on hydrogen across various government departments.
- ✓ Improving public understanding of hydrogen benefits and costs.
- ✓ Development of hydrogen skills.
- ✓ Clarity on deployment of hydrogen infrastructure.
- ✓ Financial incentives to reduce reliance on fossil fuels.

UK-EU hydrogen policy report

- ERA & HyDEX have been running UK-EU hydrogen summits, looking at opportunities for collaboration between UK and EU.
- A hydrogen summit was held at the end of April at IMEChE in London with Lord Callanan, energy minister.
- A further summit took place in Brussels in July featuring Rosalind van der Vlies, Clean Planet Director of the European Commission.
- We are launching a report on 12 November, calling for closer collaboration between the UK and EU, including setting up a UK-EU Hydrogen Taskforce in Hydrogen.

The Hydrogen Taskforce would:

- ✓ Introduce common safety standards.
- ✓ Support UK-EU crossborder projects including pipelines and storage facilities.
- ✓ Establish a UK-EU hydrogen market.
- ✓ Share best practice – perhaps building on the EU's Hydrogen Valley programme.

HyDEX Local Authority toolkit

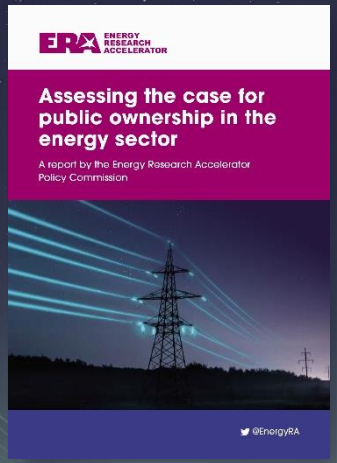
- HyDEX has developed an online toolkit for local authorities to help decision making.
- The toolkit provides information for local authorities interested in developing hydrogen, on:
  - Hydrogen for transport
  - Hydrogen production
  - Hydrogen storage
  - Skills
- The toolkit can be found at www.hydex.ac.uk/toolkit

Assessing the case for a publicly owned energy company

- ERA launched a policy commission looking at the case for a publicly owned energy company.
- Brought together experts from industry, academia, government finance.
- Produced a report and launched in Westminster.
- Many recommendations appeared in political party manifestos including Labour and Lib Dems.
- Visit: https://bit.ly/ERApubenergy

The report recommended:

- ✓ Establishing a new Net Zero Delivery Unit.
- ✓ Investing in early-stage clean energy technologies.
- ✓ Invest through the UK Infrastructure Bank, not a new National Wealth Fund.
- ✓ Limit GB Energy to local area energy planning and procurement of transmission assets.



Hydrogen innovators

Kat Mycock
Business Engagement Officer
HyDEX

Celebrating HyDEX

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HyDEX Innovation Fund

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11

SMEs supported

Total fund

£200,000

4 funding rounds

Projects awarded £5,000 to £20,000

Focus technology development

Funded:

- Academic consultancy
- IP advice
- Mentoring
- User Research

Duration:

3 to 16 months

Starting June 2023 to end November 2024.

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HyDEX Innovation Fund: **Outcomes**

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8

hydrogen technologies/ services improved by TRL 1+

6

new international markets entered

5

jobs created

5

companies have upskilled their workforce

2

have secured additional funding

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Martin Stanley,
GreenCo &
Amirpiran Amiri,
Aston University.

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Keele UNIVERSITY

MIDLANDS INNOVATION

GreenCo Energy

Low and Carbon Negative Hydrogen and Clean Biofuels

"from waste problems we create biofuel opportunities"

Feasibility study
hydrogen production from waste biomass

Carried out by:

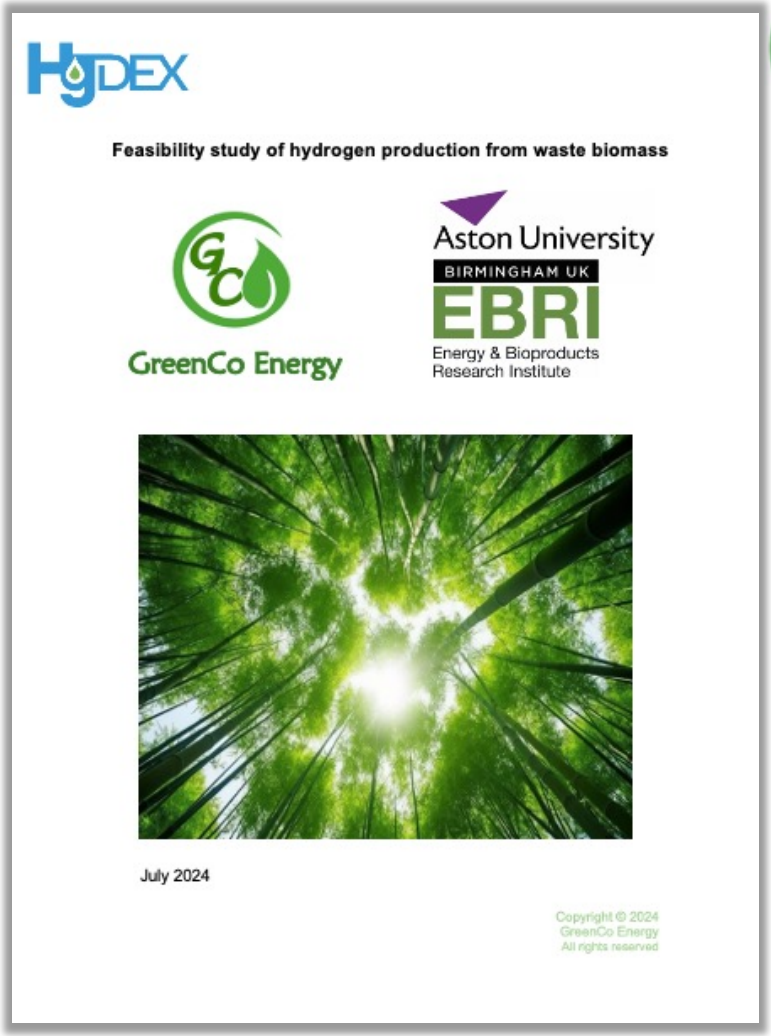
- Dr Amirpiran Amiri, Senior Lecturer
- Kazeem Ayodeji Mohammed

GreenCo Energy Project:

1. Deploy new ”autothermal steam reforming” technology in the UK
2. Circular economy framework – “waste problems to biofuel opportunities”
3. Produce low and carbon negative hydrogen
4. Without creating any harmful emissions – direct impact local communities.

EBRI | 4 Key Phases:

1. Optimal plant/facility location
2. Techno-economics /syngas, hydrogen production
3. Feedstock chemical composition analyses
4. Hydrogen upgrading technologies to support commercialisation



1. Optimal plant/facility location

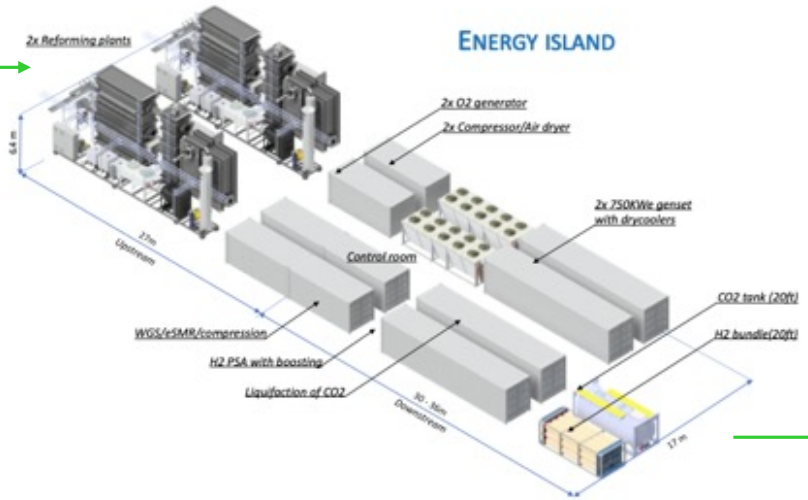
Why Berkswell?

- ‘An Area of Search’ for Waste Management Facilities
- Sister site to Tyseley Energy Park (6.8m)
- Centre of Excellence, low & carbon negative hydrogen
- Birmingham International Airport (3.5m)
- NEC & Train Station (4.3M)
- Motorway corridors

- Plant location, layout / utilities
- Site location boundaries selection
- Topography
- Geology
- Soil survey
- Spatial plant requirements:
  (inc Ammonia Plant)
- Traffic flow

2. Techno- economics /syngas, hydrogen production

Vegetation Management provides feedstock input 12,500 tonnes



nium

HyDEX funded feasibility
Hydrogen to Ammonia

	kg/hr	Kg/day	Kg/year
Hydrogen	50	1,200	394,200
Carbon Dioxide food/industrial grade	1,404	33,696	11,069,136

	KWh	KWh/day	MWh/year
Electricity	452	10,848	3.5

CIRCULAR ECONOMY

3. Feedstock chemical composition analyses

Creating feedstock menu for UK

Sample Nomenclature	Constituents
001 PLF Arb Med	Mixed species, origin often unknown
002 PLF Whole Tree (G50)	Mixed hardwood mainly Ash and Oak
003 PLF Clean Chip (G50) Fresh	Mixed Corsican and Scotts Pine
004 PLF Clean Chip (G50) dry 30% MC	Mixed Corsican and Scotts Pine
005 HWT Arb Fresh	Mixed, some species unknown, Contains some Holly and Laural
006 HWT Whole Tree (G50)	Species/origin unknown
007 HWT Clean Chip (G50) Fresh	Species/origin unknown

Carbon-based waste by sector sector:

- Green waste
- Municipal household waste
- Sewage sludge

Calorific values (MJ/Kg)

Feedstock	Calorific value (MJ/Kg)	
	HHV	LHV
001 PLF Arb Med	12.12	11.17
002 PLF Whole tree (G50)	15.00	14.03
003 PLF Clean Chip (G50) Fresh	16.52	15.30
004 PLF Clean Chip (G50) dry 30% MC	18.04	16.80
005 HWT Arb Fresh	12.77	11.86
006 HWT Whole Tree (G50)	14.71	13.73
007 HWT Clean Chip (G50) Fresh	15.44	14.32

Proximate analysis

Feedstock	Components (%)			
	Ash content	Moisture content	Volatile matter	Fixed carbon
001 PLF Arb Med	4.24	6.55	52.45	36.77
002 PLF Whole tree (G50)	1.04	4.06	71.18	23.73
003 PLF Clean Chip (G50) Fresh	0.07	4.69	80.12	15.13
004 PLF Clean Chip (G50) dry 30% MC	0.38	4.32	80.47	14.83
005 HWT Arb Fresh	1.81	4.45	81.22	12.52
006 HWT Whole Tree (G50)	1.00	4.32	80.20	14.48
007 HWT Clean Chip (G50) Fresh	0.93	4.33	74.38	20.35

Ultimate analysis

Feedstock	Components (%)				
	N_2	C	H_2	S	O_2
001 PLF Arb Med	4.96	31.2	4.74	0.00	59.1
002 PLF Whole tree (G50)	6.50	38.1	6.01	0.00	49.4
003 PLF Clean Chip (G50) Fresh	5.87	42.7	5.74	0.00	45.7
004 PLF Clean Chip (G50) dry 30% MC	0.28	46.8	6.10	0.00	46.8
005 HWT Arb Fresh	0.92	35.6	4.50	0.00	59.0
006 HWT Whole Tree (G50)	0.51	38.7	4.83	0.00	56.0
007 HWT Clean Chip (G50) Fresh	0.40	42.6	5.52	0.00	51.5

4. Hydrogen upgrading technologies to support commercialisation

Evaluating CO2 removal technologies

- Optimal integration (autothermal steam reformer)
- Energy efficiencies
- Retrofitting feasibility
- Thermal integration
- Operational complexity
- Overall cost

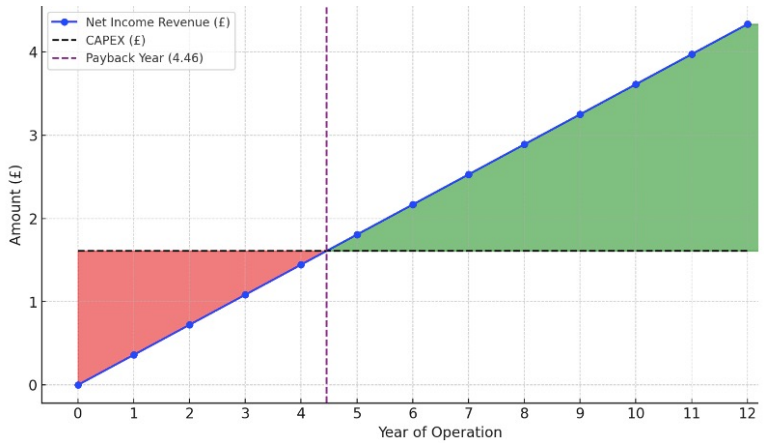
Comparative analysis identified **Polaris membrane** as optimal choice

Criteria	Absorption (Chemical)	Absorption (Physical)	Adsorption	Cryogenic	Membrane (Polaris™)
Energy Requirement ($GJ/t\ CO_2$)	1.4 - 4.5 High (2.5)	0.34 - 2.7 Low-Moderate (4)	1 - 4.5 High (2.5)	0.395 - 4.5 Moderate (3.5)	0.5 - 1.9 Low (4.5)
Retrofitting Feasibility	Moderate (3.5)	High (3.5)	High (4)	Low-Moderate (2.5)	High (4.5)
Thermal Integration Feasibility	High (4)	Moderate (3.5)	Moderate (3)	Low (2)	Low-Moderate (2.5)
Operational Complexity	High (2.5)	Moderate (3)	Moderate (3)	High (2.5)	Low (4.5)
CO_2 Removal Efficiency	90-99% High (4.5)	85 – 99% Moderate-High (4)	91-97% Moderate-High (3.5)	>99% Very High (4.5)	>95% High (4.5)
Overall Cost ($£/ton\ CO_2$)	Moderate-High 65 -127 (2.5)	Moderate 15 – 135 (2.5)	Moderate 30-90 (3.5)	High 22 – 170 (1.5)	Moderate 24-39 (4.5)
Total Empirical Score	19.5	20.5	19.5	17	25

Summary: Techno- economics /syngas, hydrogen production

GreenCo Energy provided Aston University a unique circular economy-based model to produce low and carbon negative hydrogen as collateral on which to base and carry out the HyDEX funded feasibility study.

Analysis concluded that GreenCo Berkswell facility £15.8m CAPEX has ROI of 4.5 years.



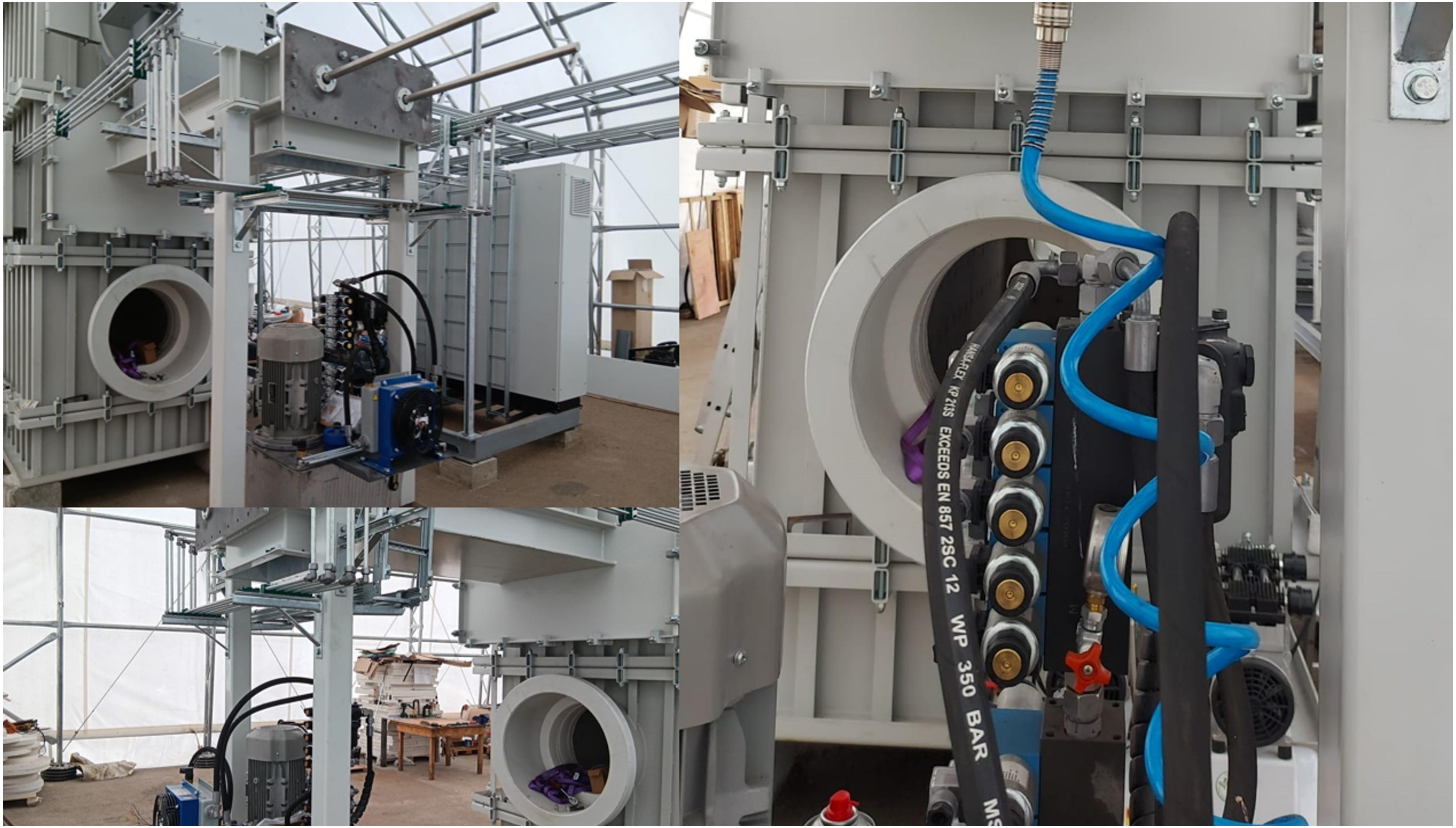
GreenCo Berkswell Financial Break-Even Analysis Energy Island

Feasibility underpinned GreenCo Energy configurable circular economy to deliver:

- Future ROI as little as 3 years
- Levelised Cost of Hydrogen (LCOH) approx. 80% lower than PEM electrolysis production
- Low LCOH (low and carbon negative) produced from locally sourced, low-grade feedstocks
- A “locality” based rollout model creating a network mesh (50km) of GreenCo Energy facilities, improving energy security
- Net zero sites for GreenCo Energy and customers


HYROGAS
Industrial pilot, Latvia


Linde
STOREX
STRUCTURES


EXCEEDS EN 857 2SC 12 WP 350 BAR


REFRION
COOL GENERATION

What's Next for GreenCo Energy…

Development Projects:

Sustainable Aviation Fuel | Marine Bunker Fuel | Gas Furnace Fuel

Looking for feasibility/projects:

- Manufacturing - looking to decarbonise office and workplace through net zero sites.
- Local Authority - utilise borough waste for decarbonising public transport and electricity for social housing
- Critical Infrastructure - electricity, rail, highways – integrate decarbonisation through O&M frameworks.. from the ground up approach.
- Construction – decarbonise through plant and machinery

Thank you **HyDEX** and **Aston University**

Decarbonising Our Future

Martin Stanley
CEO
e **martin@green-coordinate.com**
m **+ 44 (0) 7725 039320**

Kerry McLaughlin, Nium &

Amirpiran Amiri, Aston University.

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Clean Ammonia on Demand

Dr Kerry McLaughlin

Nium overview

We decarbonise ammonia with novel nano-technology

EMISSIONS

Nium: 0.107

2.0
1.5
1.0
0.5
0.0

tCO2e/t NH3 (Scope 1)

nium

Ammonia is critical, big and dirty.

- Half of global food
- Clean fuel & versatile hydrogen carrier
- 450 Mt of CO_2 each year

nium

Haber-Bosch is hard to electrify

- Massive pressure
- Capex heavy
- Spiraling opex
- Increasing imports
- It’s dirty

Smart, flexible, dynamic ammonia production

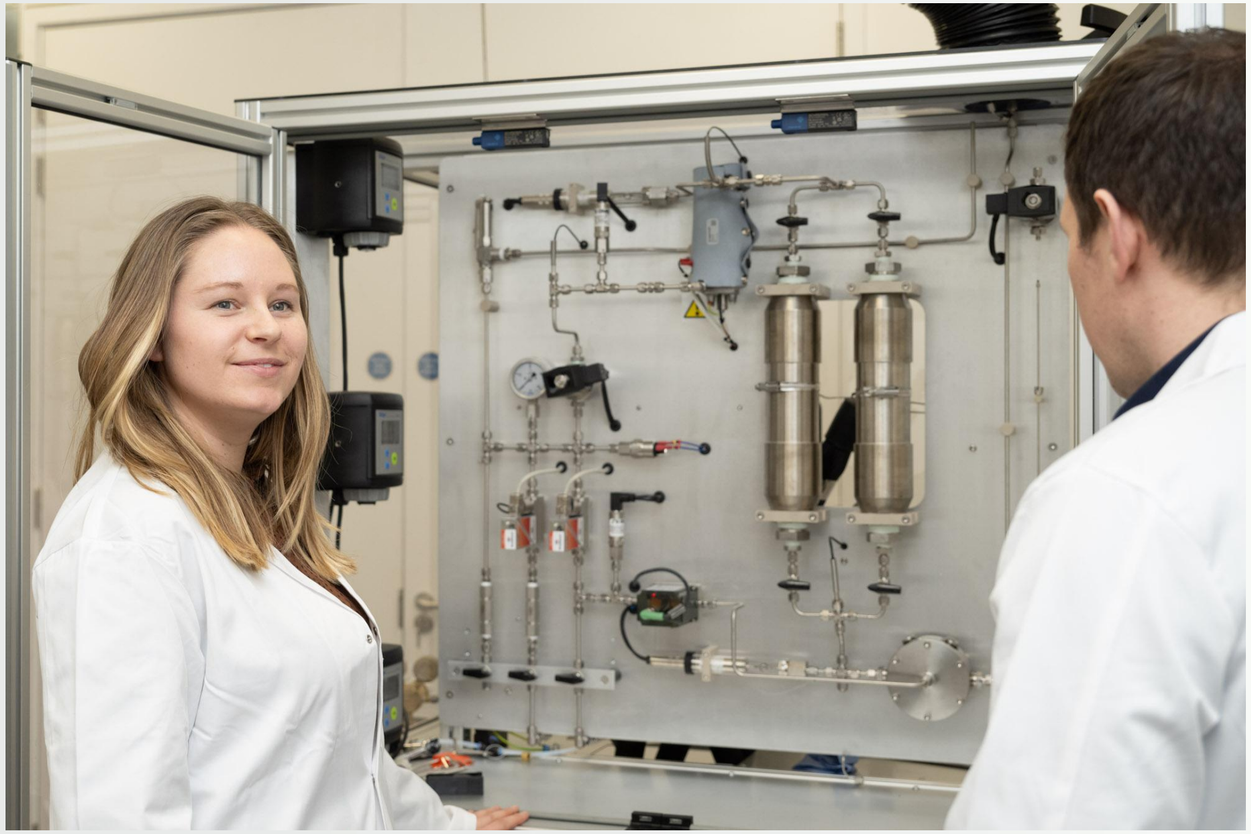
- **Low-pressure and temperature:** 200-400°C, 10-50 bar
- **Rapid ramp-up capability:** <60 mins from cold, <5 mins from hot
- **Flexible operation:** 5% minimum turndown
- **Light on engineering:** 85% reduction in footprint, up to 50% capex saving

MK1 reactor

- Gram scale for rapid catalyst R&D

MK2 reactor: Smallest ammonia plant in the world

- 1KG Catalyst - 5KG Hydrogen/day - 30KG Ammonia/day
- Full kinetic conditions



Project Koala

Project Koala - Creating an innovative local solution to a global and regional challenge

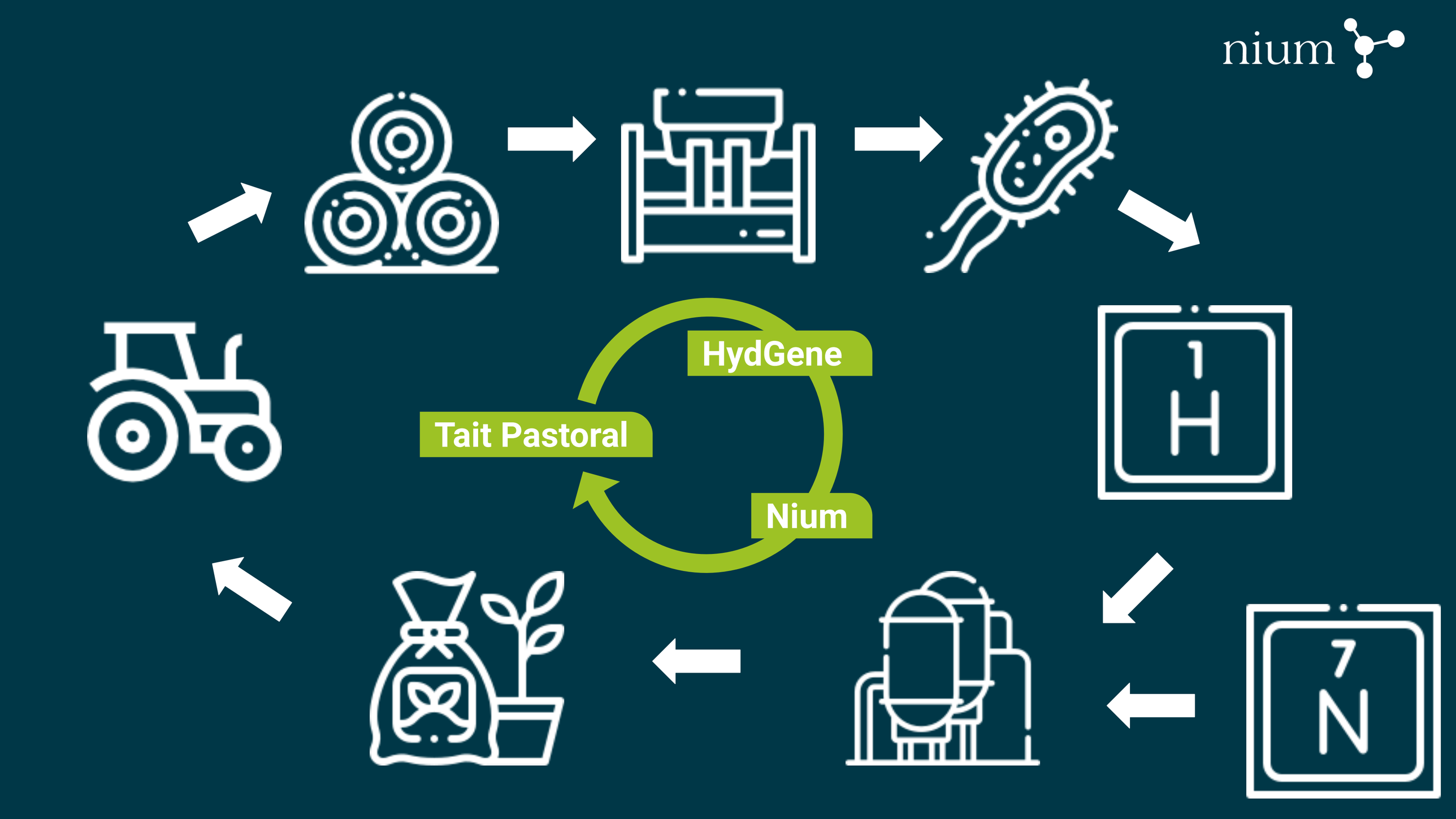
- Develop a circular, decentralised, on-farm process for production of low-carbon renewable hydrogen from waste straw and conversion into green ammonia fertiliser
- Nium, UK, and HydGene Renewables, Australia, will combine their proprietary and patent-pending catalytic technologies
- £1.2 million grant through the Australia-UK Renewable Hydrogen Innovation Partnerships Program

In kind contribution from Stuart Tait of Tait Pastoral, NSW, Australia

Proprietary synthetic biology technologies

- Using synthetic biology to engineer microorganisms to produce hydrogen
- Compatible with range of biomass feedstocks - only those that are otherwise discarded or burned
- 100% renewable, carbon-negative
- Modular engineering: on-site and on-demand

HydGene® Renewables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HydGene
Tait Pastoral
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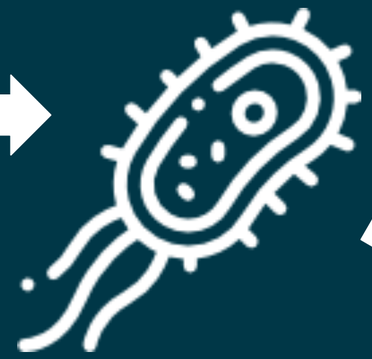
6.5 tonnes/yr of
straw residues



200 kg/yr
bio-hydrogen

1:50 PILOT SCALE MODEL

1 tonne/yr
green ammonia

The 3 D’s - Decarbonise, Decentralise, Democratise

Decarbonise

- Clean ammonia has the potential to eliminate up to 300 MtCO2eq from ammonia production for fertiliser now
- Using biomass as feedstock avoids biogenic release by converting biomass to bio-hydrogen instead of burning in-field

Decentralise

- Small, modular systems
- Can be deployed anywhere
- Lower energy usage and low emissions
- Adaptable to power output fluctuations inherent in renewable energy

Democratise

- Potential to restore independence for fertiliser production to farmers and reduce their reliance on vulnerable global supply chains
- Sufficient 'excess' straw (35 megatonnes) to produce 1 megatonnes of renewable hydrogen across Australia, worth approximately £1.6bn

“Farmers manage a large portion of the world's landmass, and have always been renowned for being innovative and implementing new practices.”

Stuart Tait

Nium Impact Reports 2024

Clean Ammonia:
The Decarbonised Future of Fertiliser

Clean Ammonia:
As Sustainable Shipping Fuel

Clean Ammonia:
The Versatile Vector

Using the Stockholm Resilience Centre's Planetary Boundaries framework, we mapped the environmental impacts of the technology.

Full text available via our LinkedIn:
www.linkedin.com/company/nium-clean-ammonia-on-demand

Syngas for Green Ammonia

Photo credit: Alex Wilkinson Media

Project aim - Determine feasibility of using gasifier syngas as feedstock for Nium's nanocatalyst

- Kinetic gasification model developed in Aspen Plus
  - Inputs for gasification operating parameters and feedstock composition based on Schmid et al (2018)
  - Steam-oxygen fluidized bed gasification method
  - Drying of wet biomass, decomposition, pyrolysis, partial oxidation and reduction

Outcomes

- End-to-end model developed for syngas to green ammonia
- Gasification model shows good agreement with experimental data - potential to accurately predict syngas production from biomass gasification
- Hydrogen purification incorporated - hydrogen purity from 44% to 97%
- Suggests it would be feasible to use biomass gasification for green ammonia

Next steps

- Techno economic feasibility of hydrogen purification
- Alternative technologies for hydrogen purification
- Dynamic modelling

Additional funding awarded from Supergen Impact Hub - extends HyDEX project to incorporate GreenCo Energy - *De-risking Negative Carbon Biomass-based Ammonia: Digitalisation for Innovative Catalysis*

Supergen Bioenergy

SUSTAINABLE BIOENERGY SYSTEMS FOR OUR LOW-CARBON FUTURE

Acknowledgements

Team Nium

Team HydGene

Stuart Tait and Tait Pastoral

Dr Amirpiran Amiri, Dr Isaac Okereke and team at EBRI, Aston University

Martin Stanley, GreenCo Energy

UKRI Innovate UK

Australian Government
Department of Climate Change, Energy, the Environment and Water

HyDEX

Supergen Bioenergy

Investors

Carbon13

Investors

DCC

Investors

AgFUNDER

nium

Clean Ammonia on Demand

Would you like to learn more about Nium?

Let's talk - please get in touch: **hello@wearenium.com**

We're Social

Join us on LinkedIn for the latest updates from Nium. We also write a newsletter featuring nano-sized posts on our journey, the power of clean, green ammonia and its potential to help deliver a Net-Zero future.

www.wearenium.com

UK HQ

Unit A, 126 Olympic Avenue
Milton Park, Abingdon
Oxfordshire OX14 4SA
United Kingdom

R&D Labs

Research Complex at Harwell (RCaH)
Rutherford Appleton Laboratory
Harwell Oxford, Didcot
Oxfordshire OX11 0FA
United Kingdom

Celebrating HyDEX

John Jostins & Anne Shepherd,

Microcabs &

Yousif Al-Sagheer, University of Birmingham

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Microcab

Introducing Microcab

- Microcab developing Fuel Cell vehicles for 15 years
- Circular Economy is a major theme in the design process
- PortaWatt uses ex-automotive Fuel Cells
- Re-purposed as portable clean power generators

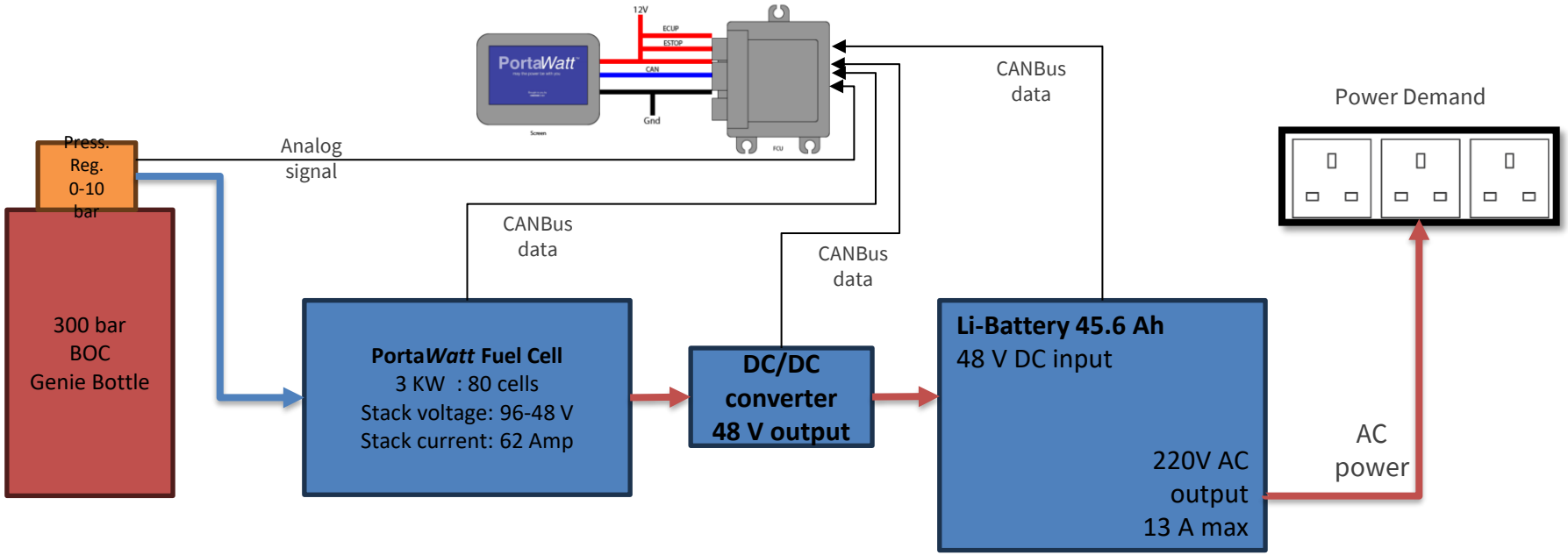
Specs of PortaWatt

- 3.2kW FC stack with BOP
- 2.0kWh Lithium storage
- DC/DC converter
- Intelligent control system
- GUI
- Portable Genie hydrogen cylinder

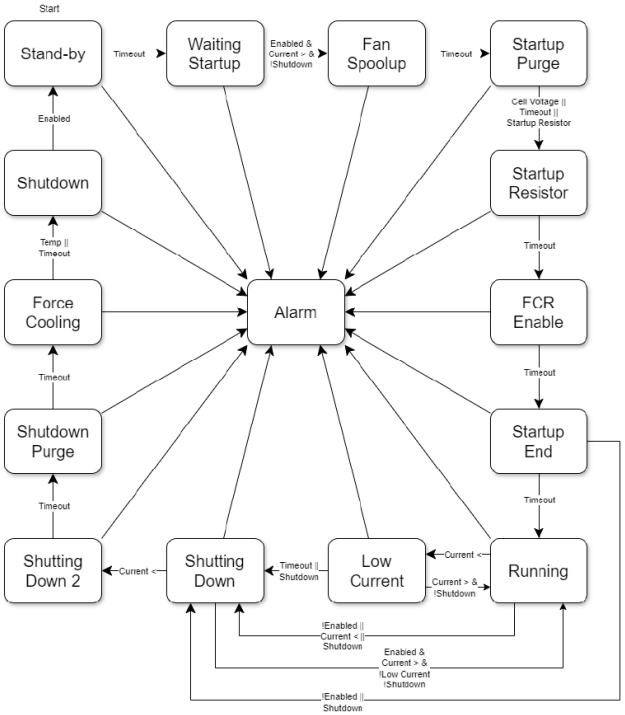
HyDEX Innovation Fund Round 4:

- Support collaboration between SMEs and University
- £10k Led by University.
- Start date: 1 May 2024
- End date: 30 Sep 204
- SoW: Develop FC control system
  - Simulink embedded ECU controller
  - Develop HMI display
  - Optimise Porta*Watt* fuel cell performance:
    - H2 purging / fuel utilisation
    - Cooling system losses
    - Start-up and shutdown procedures
  - Simplify integration with battery

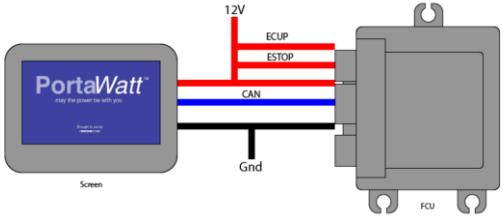
Porta*Watt* Specs



Porta*Watt* FC generator



State chart of Porta*Watt* controller

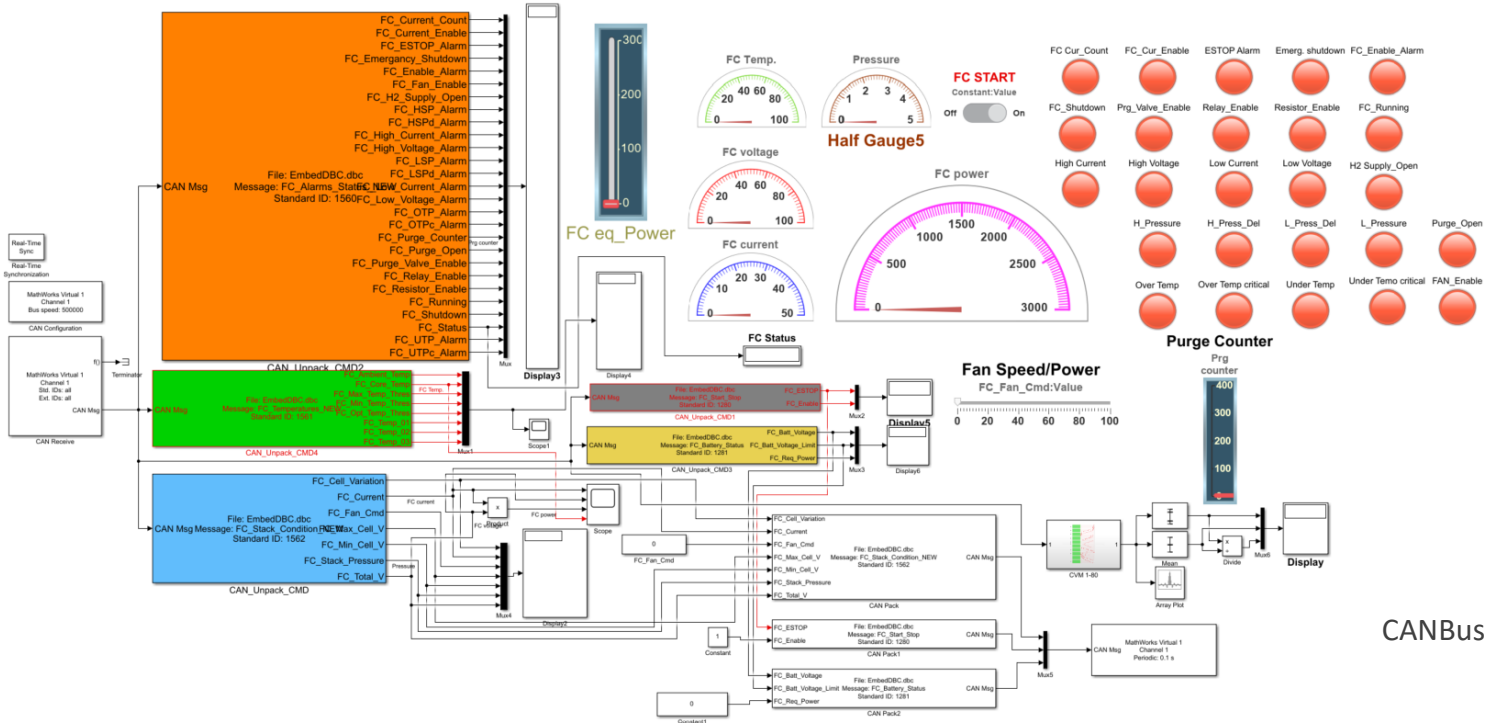


Porta*Watt* FC generator

Development of FC generator:

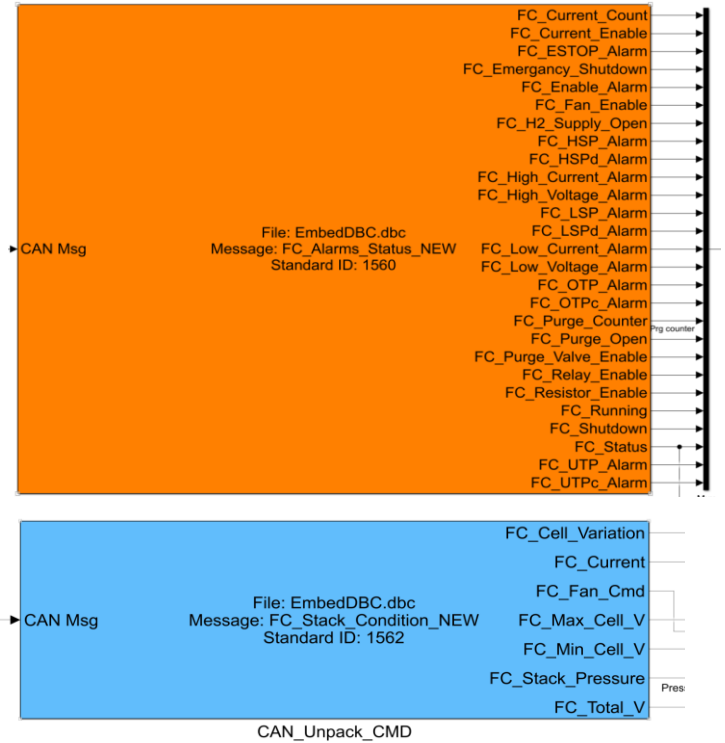
- Aluminium casing design
- GUI
- Gas inlet assembly
- Genie hydrogen storage
- Complete system running
- Powering light
- Powering fan heater

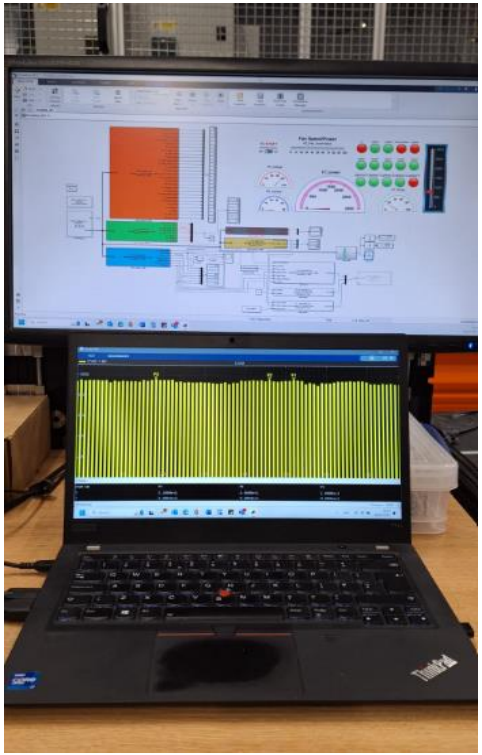
Porta*Watt* FC generator



CANBus diagnostic tool

Porta*Watt* FC generator

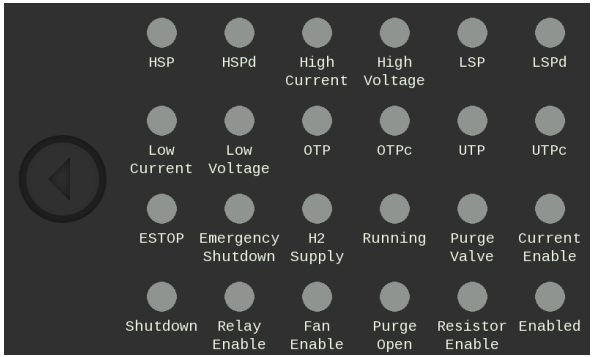




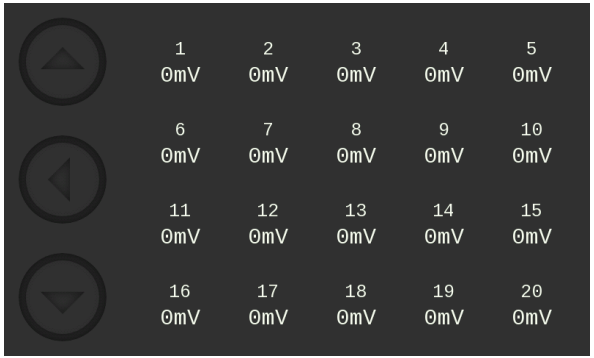
CANBus data

Porta*Watt* HMI developement

Main display of Porta*Watt* control

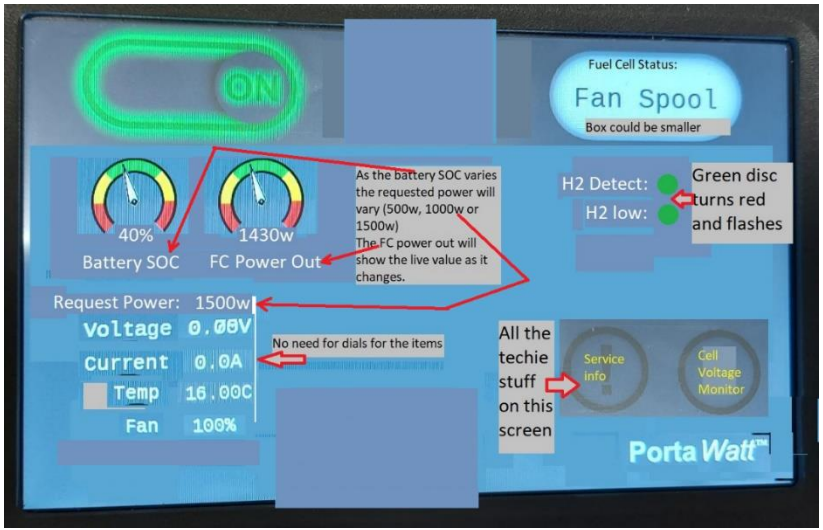


Alarm status page

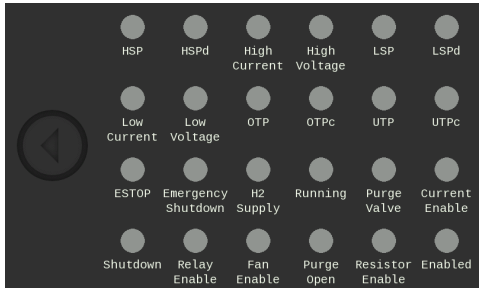


CVM display page

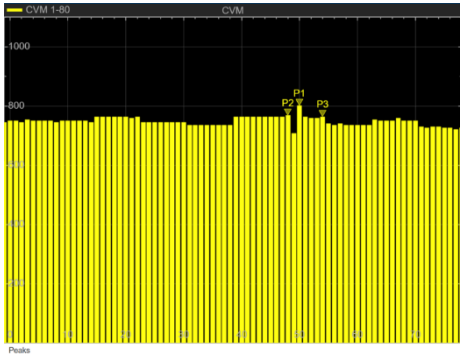
Porta*Watt* HMI developement



Display of Porta*Watt* controller



Alarm status page



CVM display in the service page

Porta*Watt* Project Outcomes

- Development of new Microcab product.
- PortaWatt Trademark registered with Patent Office.
- portawatt.co.uk web address secured.
- Potentials for new jobs (Microcab) with further investment.
- Establish further collaboration between Microcab and UoB.
- Network of supply chain and subcontractors.
- Develop skills in industrial/vehicle ECU programming.
- Potentials of applying advanced control strategies of FC/Bat hybrid systems (UoB research).
- Develop new training activities in FC systems (UoB education).

Fuel Cell and Hydrogen Research Centre / UoB

- A group of 14 staff and 40 PhD and MRes students working in:
- Hydrogen and Synthetic Fuel Production
- Fuel production from biomass and waste
- Low Temperature Fuel Cells & Electrolysis
- High Temperature Fuel Cells & Electrolysis
- Socio-techno-economic studies
- Educational initiatives
- Fuel Cell Systems and integration.
  - Mobility applications.
  - Stationary applications.

Enquiries?

John Jostins
Microcab Ltd.
johnj@microcab.co.uk

Dr. Yousif Al-Sagheer
University of Birmingham
y.i.w.al-sagheer@bham.ac.uk

Networking Break

Please visit the exhibition space upstairs

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HyDEX Skills

Sarah Gomes

Skills Officer, HyDEX

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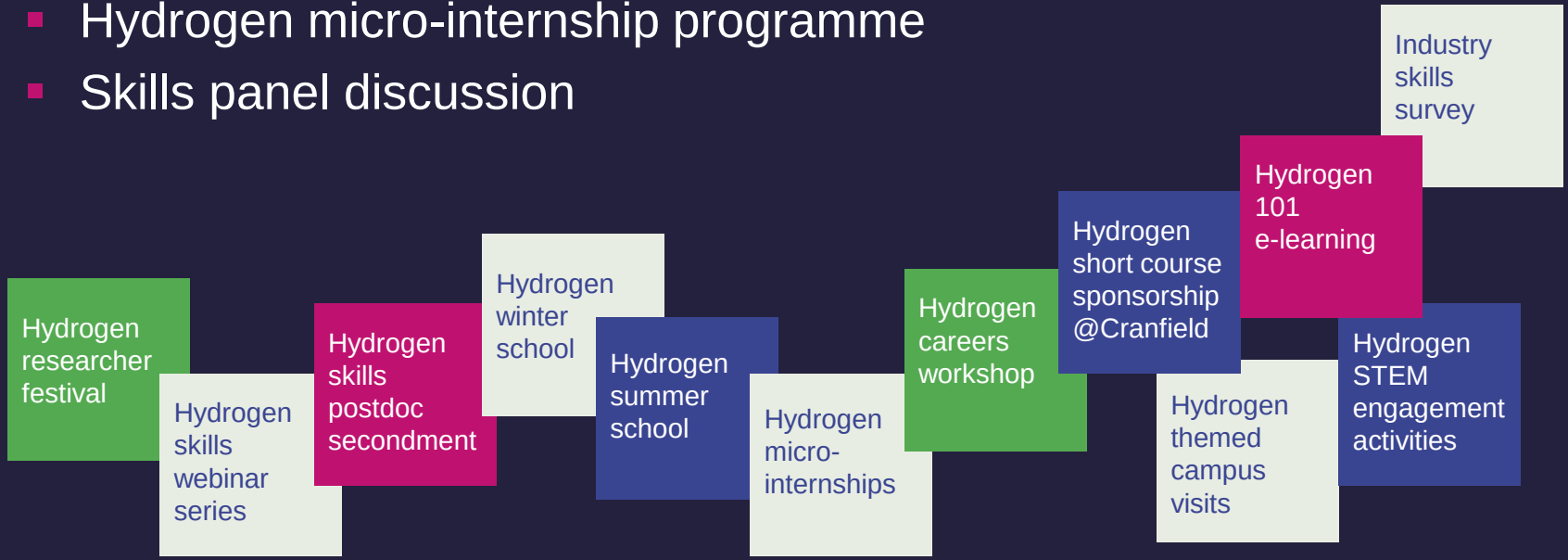
Celebrating HyDEX

Highlight HyDEX skills

- Hydrogen micro-internship programme
- Skills panel discussion



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Highlight HyDEX skills

Hydrogen micro-internship programme

Guest speakers:

- Clinton Liu, CEO, Modular Clinton Global
- Numan Ahmed, Intern at Modular Clinton Global
- Chloe Tindale, Hydrogen Strategic Marketing Manager, Air Products PLC
- Shakana Onyinah, Intern at Xodus

MCG

AIR PRODUCTS

XODUS

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Highlight HyDEX skills

- Numan Ahmed,
  Intern at Modular Clinton Global

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Software Engineering Internship

Numan Ahmed

Background

2nd year **Computer Science** BSc Loughborough University

Software engineering and Web development

Outreach ambassador for Loughborough University Promoting **Green Hydrogen**

Summer internship at MCG

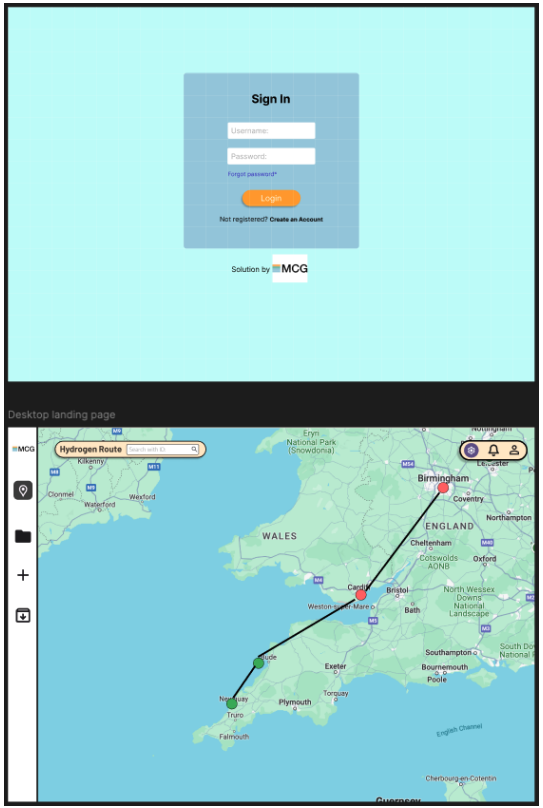
Project

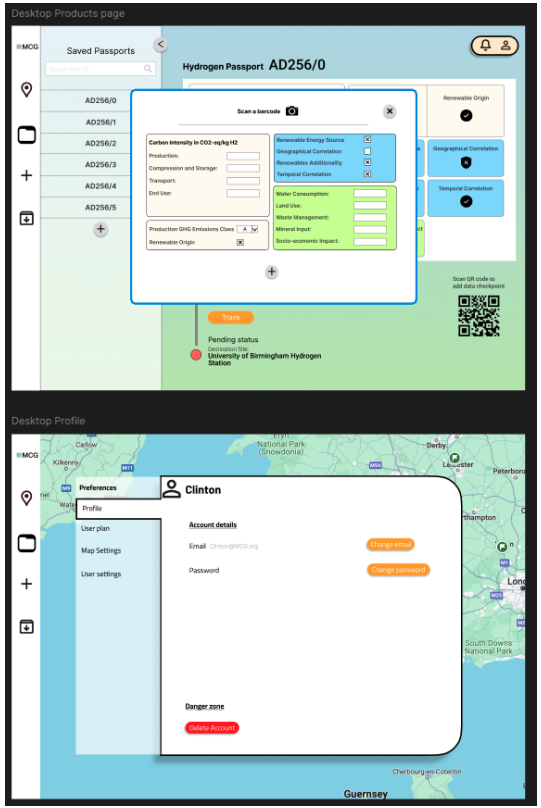
Objective: Create a demo/proof of concept to map out the hydrogen supply chain and keep track of sustainability standards

Outline:

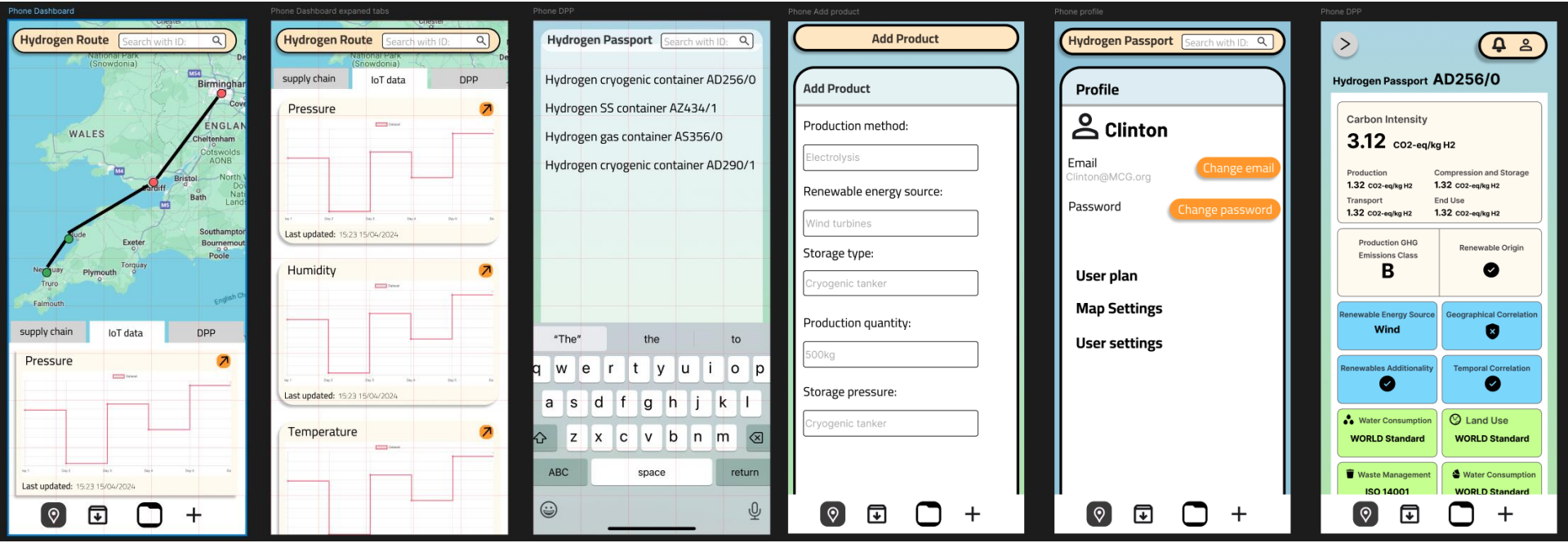
- Design
- Implementation
- Presentation

Desktop design





Mobile Design



Result

https://modularclintonglobal.com

Reflection

Learning outcomes and overcoming challenges

Technical skis: non-relational databases, Software development life cycles, programming etiquette, debugging techniques

Soft skills: team work, communication, time management

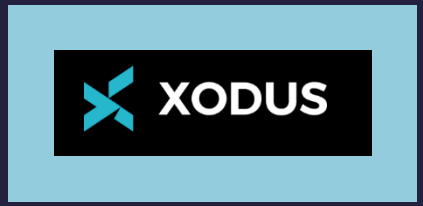
Be playfully curious

Learn to play to your strengths

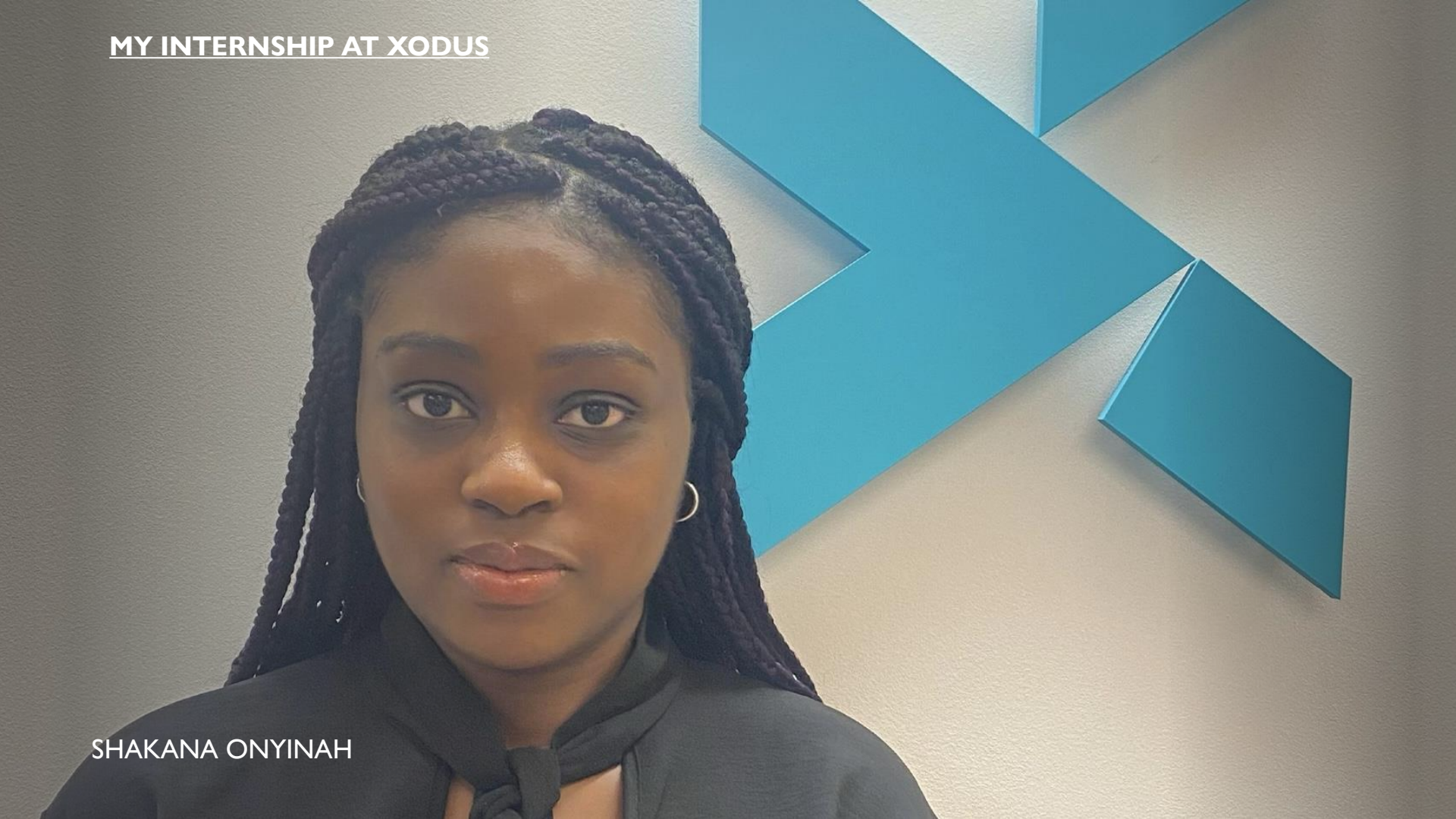
Conclusion: meaningful challenges

Highlight HyDEX skills

- Shakana Onyinah, Intern at Xodus



MY INTERNSHIP AT XODUS



SHAKANA ONYINAH

Overview

Global Electrolysers and their overall importance on green hydrogen production across different regions

Researched about the 4 main electrolysers as well as emerging technologies

Analysed the electrolyser market in 4 countries with notably high manufacturing capacities and had the top electrolyser manufacturers/companies within them

What were my responsibilities?

1

Creating a database of various electrolyser companies or manufacturers

2

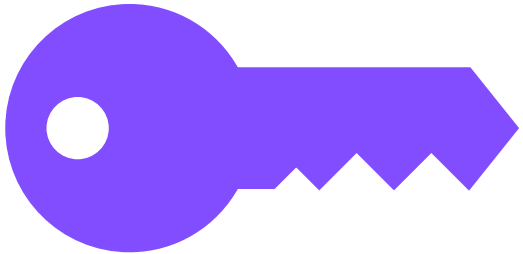
Writing a report to illustrate all my findings and research

3

Presenting to a group of industry professionals on Microsoft Teams

Learning Outcomes

- Confidence is key
- Technical skills improved significantly
- Learning from my mistakes and peers
- ASKING FOR HELP ISN'T EMBARRASSING



Challenges

Researching was difficult at times

Time management

Presenting

Asking for help

Impact and Reflections

- The value of global electrolysers
- I am very interested in exploring more clean energy and looking into other hydrogen sources
- I met great people who influenced my future aspirations

THANK YOU FOR LISTENING

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Highlight HyDEX skills

Skills panel discussion: Building the hydrogen workforce of the future: Skills, training and industry growth

Panel members:

- Richard Penn, Founder/Director, Penn Engineered Solutions
- Professor Sonya Calman, Loughborough University
- Dr Hanlin Li, Human Factors Consultant, CRA | Assystem UK
- Lisa Bingley, Operations Director, MIRA Technology Institute
- Richard Harper, Contract Manager (Gas), Energy & Utility Skills

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Coming up next

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Time	Afternoon session
1.15pm	Lunch, plus showreel and videos
2.15pm	Keynote: The future of hydrogen in the Midlands. Sally Brewis, Head of Regional Development, Cadent
2.35pm	Panel discussion: The future of hydrogen in the Midlands • Panel chair: Sarah Windrum, Cluster Development Lead, Horiba-Mira • Professor Martin Freer, Academic Chair, HyDEX • Kelly Manders, Regional Development Manager, Cadent • Matt Barney, Chief Hydrogen Business Officer, GeoPura
15.10pm	Closing remarks. Beyond the HyDEX legacy

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Keynote

The future of Hydrogen in the Midlands

Sally Brewis, Head of Regional Development, Cadent

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The Midlands is a hydrogen innovation

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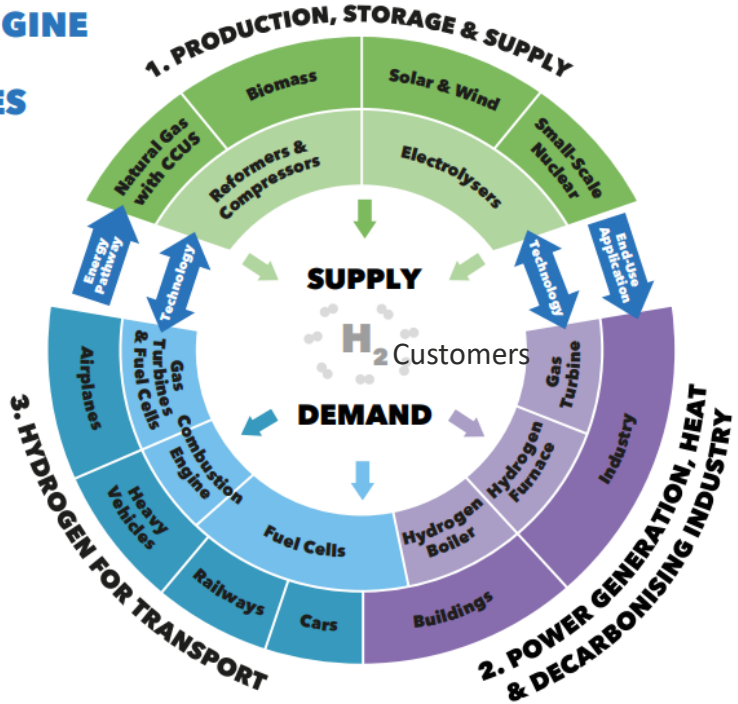
MIDLANDS ENGINE HYDROGEN TECHNOLOGIES



LUXFER GAS CYLINDERS

HyMarnham Power

AqSorp

Intelligent Energy

SIEMENS energy

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The Midlands is a hydrogen innovation centre

- **HyDeploy** demonstrated the injection of up to 20% of hydrogen into the Keele University's existing natural gas network(100 homes, 30 university buildings). Customers noticed no difference.
- **Tyseley Energy Park:** Generating 1 tonne of hydrogen daily, refuelling hydrogen powered buses, ammonia cracker etc
- **Aston University** has the largest UK R&D Gasification Pilot plant in the UK and has developed a biochar demonstrator – turning waste into hydrogen

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...with JCB and Toyota located on the A50/500 'hydrogen corridor'

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MIDLANDS INNOVATION

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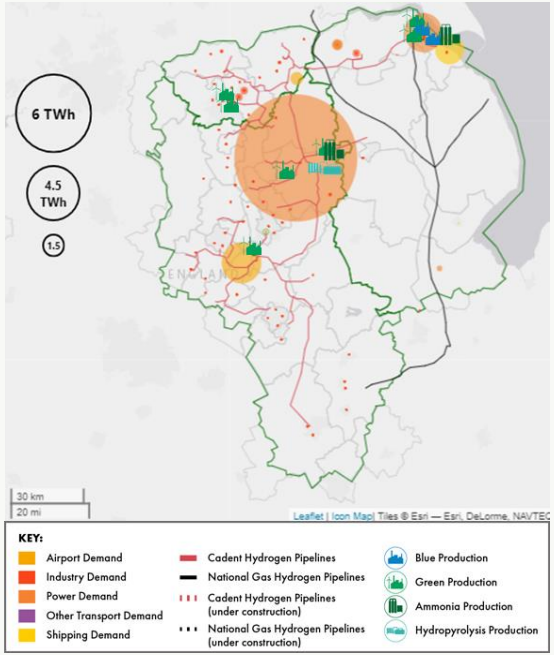
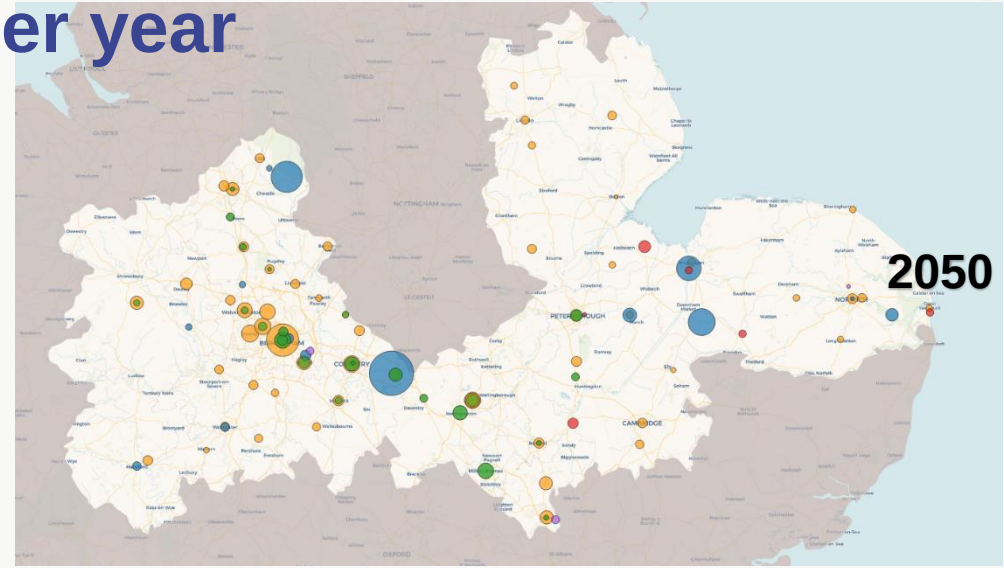
Demand for hydrogen in the Midlands could be c.100TWh per year





East Midlands Demand *c. 57TWh*
West Midlands Demand *c. 40TWh (excluding residential, including higher aviation demand)*

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Production in the Midlands could reach 70TWh per year; Midlands will be a net importer of hydrogen

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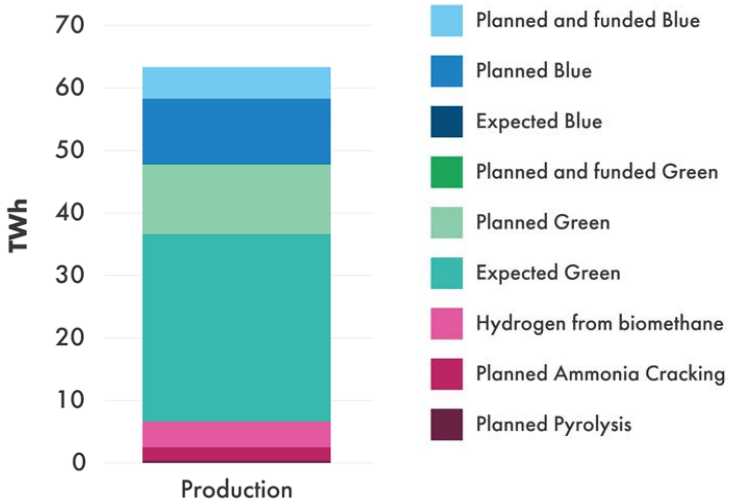
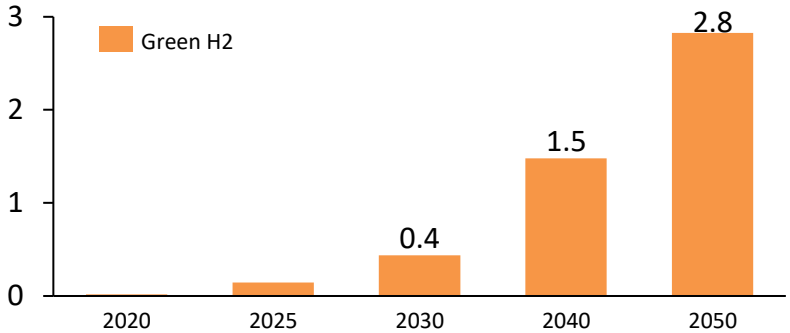
Hydrogen production in East Midlands: 65TWh by 2050



Hydrogen production in West Mids: 3TWh by 2050



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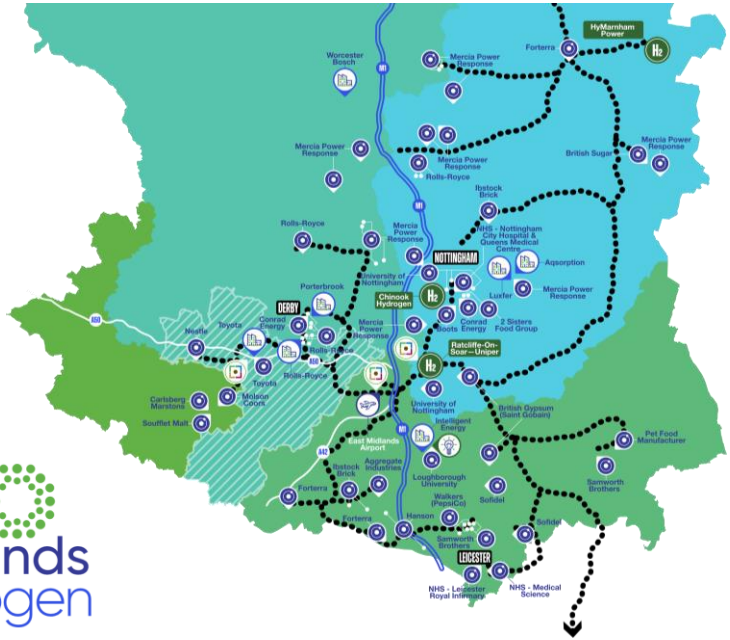
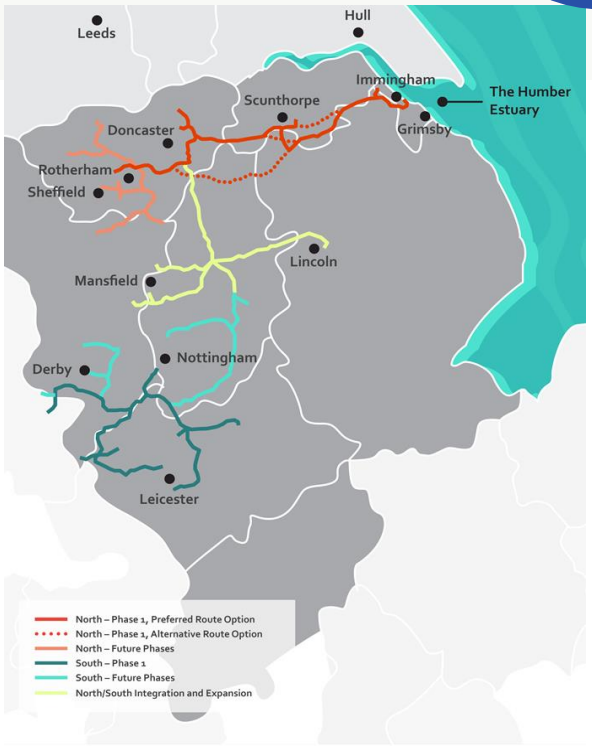
Planned pipeline infrastructure could connect supply and demand



East Midlands Hydrogen

East Coast Hydrogen



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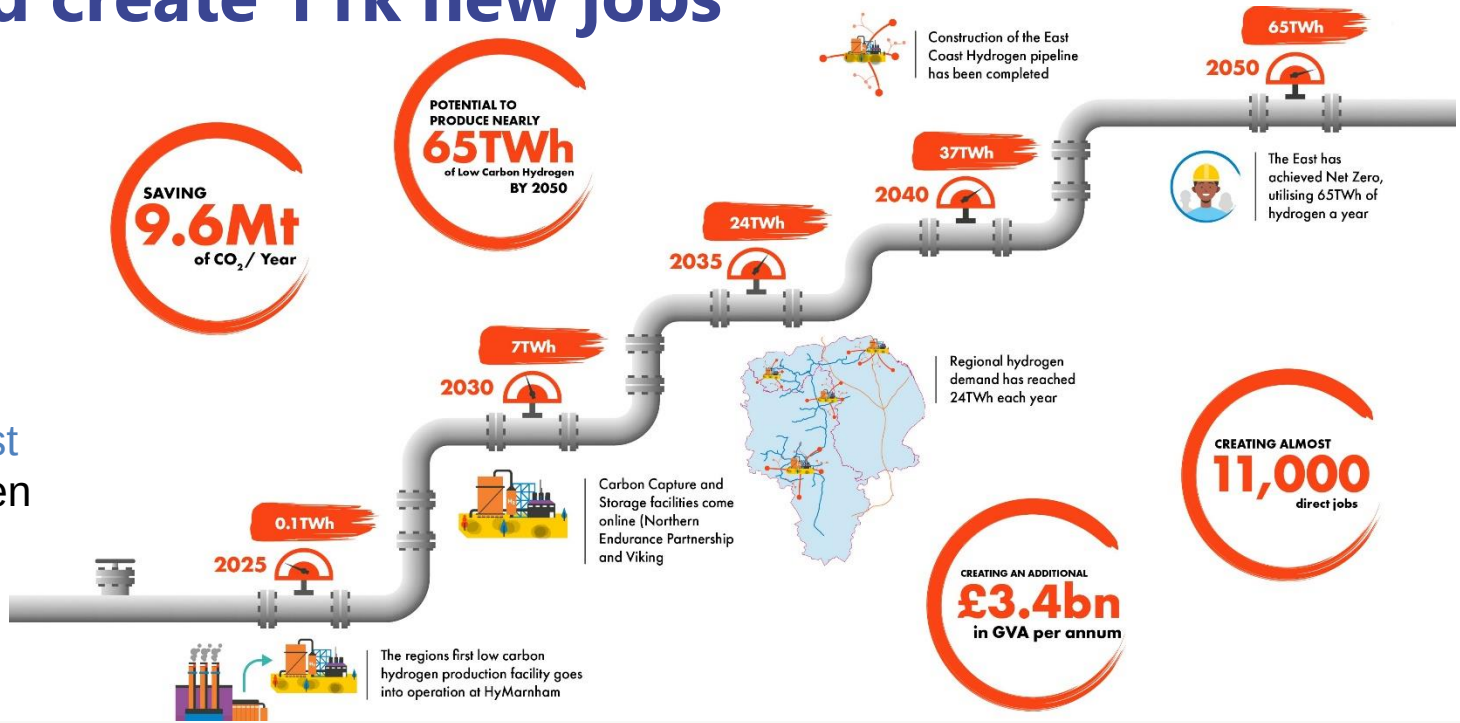
The East Midlands' hydrogen economy could create 11k new jobs

The East Hydrogen Vision



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The hydrogen economy in East of England and West Midlands, could create 9k new jobs

Job creation

There is the potential for up to **25,000 jobs to be supported and a further 9,000 created** in the UK hydrogen economy within the Hydrogen Valley.

Investment in the Midlands

This programme can attract up to **£28 billion of private capital investment** in transforming the region to a net-zero central belt in England.

Rapid decarbonisation

By accelerating the transition, the Hydrogen Valley can deliver **25% of the emission reductions** needed to reach net-zero in the region – 12.9m tonnes per year.

Increased energy security

The Hydrogen Valley **will drastically reduce the region's reliance on fossil** fuels with up to 48TWh of clean hydrogen produced for the region.

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What do we need to do to accelerate the hydrogen economy in the Midlands?

- **DESNZ to support infrastructure development by:**
  - Together with NESO, ensure that strategic plans account for distributed industrial and power generation customers
- Ensure that future rounds of the Hydrogen Transport Business Model support DEVEX for pipelines that are not connected to large-scale storage
- Accelerate the development of the market frameworks - move beyond bi-lateral offtaker/producer agreements
- Support developing hydrogen storage technologies eg EMSTor

The future of hydrogen in the Midlands: Panel discussion

Chair

Sarah Windrum

Cluster Development Lead, Horiba-Mira

The panel

Professor Martin Freer

Academic Chair, HyDEX

Dr Kelly Manders

Regional Development Manager (East and London), Cadent

Matthew Barney

Chief Hydrogen Business Officer, GeoPura

Beyond the HyDEX programme

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What next?

- Aston University
  Gasification and pyrolysis
  ebri@aston.ac.uk
- University of Birmingham
  Rail and fuel cells
  hfc@contacts.bham.ac.uk
- Cranfield University
  Production and aviation
  h2@cranfield.ac.uk
- Keele University
  Energy systems integration and management
  sustainability@keele.ac.uk
- Loughborough University
  Battolyser and sea water electrolysis
  https://www.lboro.ac.uk/research/hydrogen/contact/
- University of Nottingham
  Large engines and dual fueling
  zerocarboncluster@nottingham.ac.uk
- University of Warwick
  Materials and sensors
  sustainability@warwick.ac.uk
- Energy Research Accelerator (ERA)
  Linking businesses with researchers
  enquiries@era.ac.uk

Celebrating HyDEX

A big thank you

- Steering Group members who helped give the project strategic direction
- Management Group for their operational guidance
- Project members (funded and in-kind) who delivered activities to help us meet our KPIs
- Industry partners for their support and enthusiasm, and for the generous use of their premises
- The Energy Research Accelerator for working alongside HyDEX on collaborative projects
- Our funder – Research England
- And all of you who came to our event today!

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Thank you

Find out more at: hydex.ac.uk

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