RGU role in energy transition.

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2020

"Towards a Zero-Carbon Hydrogen-Based Energy Economy"

16 September 2020

Organised by the School of Engineering (Robert Gordon University) & HYLANTIC EU

09:15 "Welcome" – Dr. Dallia Ali, School of Engineering, Robert Gordon University (RGU)

09:20 - 09:40: Dr. Dallia Ali, School of Engineering RGU, "RGU Role in Energy Transition"

09:40 - 09:50: Dr. Alfredo Ortiz Sainz De Aja, Project Leader, Hylantic, University of Cantabria, "Introduction to the HYLANTIC EU Project"

09:50 - 10:10: Councillor Philip Bell, Aberdeen's Hydrogen Spokesperson and Champion for Aberdeen's Hydrogen Transport Economy, "Aberdeen Hydrogen and Fuel Cell Hub and why the City is Pioneering the Development of a Sustainable and Commercial Supply of Hydrogen?"

10:10 – 10.30: Ian Philips, Director of Acorn Hydrogen and CCS Projects, Pale Blue Dot Energy Limited – "Green versus Blue Hydrogen and Hydrogen Transportation and Storage"

10:30 - 10:50: Stuart McKay, Head of Hydrogen Policy, Scottish Government, "Developing the Hydrogen Policy in Scotland"

10:50 - 11:00: Break

11:00 - 11:20: Dr. Kashkarov Sergii, Ulster University, "HYLANTIC EU Project - Hydrogen Safety"

11:20 - 11:40: Dr. R. Gazey, Director, Pure Energy Centre, "HYLANTIC EU Project – Bulk Marine Production of Green Hydrogen"

11:40 - 12:00: Robert Clements, Sustainable Development Manager, Northern Island Housing Executive, "Energy Solutions for Housing Associations"

12:00 - 12:20: Mirela Atanasiu, Head of Unit of Operations and Communication in the Fuel Cells and Hydrogen Joint Undertaking, FCH JU, "FCH-JU update"

12:20 - 12:40: Derek Wilson, 1st Founder and CEO, Zero Carbon Consultants Ltd, "Decarbonizing the UK with Green Hydrogen Cities"

12:40 - 13:00: Jack Gomersall – Futurist, Pale Blue Dot Energy Limited, "How might a Hydrogen Market Emerge"

13:00 - 13:10: Dame Sue Bruce – Convener of Court, University of Strathclyde, Electoral Commissioner for Scotland, and Deputy Lieutenant of the City of Edinburgh, "Closing Remarks"

Final Thanks – Dr. Dallia Ali, RGU

End of Webinar

Speakers Biography:

Dr. Dallia Ali – Associate Professor in Electrical Power Engineering – Robert Gordon University

Dr. Dallia is a Chartered Engineer who has completed her PhD in Electrical Power Engineering in 1997. She is member of the UK Institution of Engineering & Technology (IET) and the US Institute of Electrical and Electronic Engineers (IEEE) as well as the IEEE Power and Energy Systems (PES) and the IEEE Smart Grid Community. She is a member of Aberdeen Renewable Energy Group (AREG) and the Robert Gordon University Energy Working Group and Renewable Energy Research Group. She is honour Chair of Research and Development for Monsson Middle East. She is Reviewer for IET Renewable Power Generation Journal, the American Journal of Electrical Power & Energy Systems, and the Elsevier.

Prior to her current post at Robert Gordon University, she was Visiting Associate Professor at the Executive Education Centre of Qatar Foundation and Visiting Associate Professor in the Electrical Engineering Program at Texas A&M University in Qatar and was a member of the Texas A&M University Smart Grid Centre.

Dame Susan Bruce DBE - M.Phil. ;LLB; Dip; D.Univ Hon (University of Strathclyde); D.Univ, Hon (Heriot-Watt University), FRSE; FRSA

Sue Bruce has a portfolio of non- executive director roles including SSE PLC; Convener of the Court of the University of Strathclyde; Chair of the Royal Scottish National Orchestra, Trustee for the Prince's Foundation. She is the Electoral Commissioner for Scotland and a Deputy Lieutenant of the City of Edinburgh. In recent activity Sue has been the Independent Chair of the Expert Panel on Environmental Charging and other Measures and a member of the Advisory group on Economic Recovery, both commissioned by the Scottish Government. Sue runs her own consultancy business.

Sue Bruce started her career in community education specialising in social and economic regeneration and latterly served as Chief Executive of the City of Edinburgh Council having previously been Chief Executive at Aberdeen City Council and Chief Executive at East Dunbartonshire Council.

Mirela ATANASIU - Head of Unit of Operations and Communication in the Fuel Cells and Hydrogen Joint Undertaking, FCH JU (Public-Private Partnership between European Industry and Research Community, and European Commission)

Previously, for more than 12 years she was a Senior Project Manager and Research Programme Officer in the FCH JU and European Commission (Directorate R&I/Energy), following on a background experience as researcher in the Energy sector in Romania.

She holds an M.Sc. in Chemical Engineering/Materials Science and an M.Sc. in Economics/Cybernetics and Economic Analysis.

Councillor Philip Bell - Eur Ing, BSc. CEng. MIET, Aberdeen City Council

Cllr Bell is a chartered electrical engineer and a group 1 member of FEANI. He first came to Aberdeen in 1980 after graduating with a BSc in electronic and electrical engineering from Surrey University. Philip worked on control and safety systems within the oil industry in UK and international locations

for over 35 years and in May 2017 become an elected member of Aberdeen City Council. Philip sits on 8 ACC committees including the Steering Group for the Crown Estate, became a director of the Aberdeen renewables energy group (AREG) shortly after becoming an elected member, is Aberdeen's hydrogen spokesperson and also champion for Aberdeen's hydrogen transport economy. In June 2020 he became a director of the Aberdeen Science Centre.

Ian Phillips - Transition Energiser & Acorn Project Director

Ian Phillips has over 30 years' experience in the upstream oil and gas and climate change industries, including 18 years with oil operating companies (Shell, BP, Marathon and Ramco) and 6 years with a major service company (Halliburton).

In 2007 he became a founding Director of CO2DeepStore Limited, and in 2013 he and his CO2DeepStore colleagues launched Pale Blue Dot Energy - an energy transition business consultancy. Having spent 5 years as CEO of the Oil and Gas Innovation Centre Ian re-joined Pale Blue Dot Energy in March 2020 as Director of the Acorn Hydrogen and CCS Projects.

He obtained an M.Eng. in Petroleum Engineering from Heriot Watt University (1983), and an MBA through the Open University (1994). He is also a Fellow of the UK Energy Institute and is a Chartered Petroleum Engineer.

He has long been active with the SPE - having recently chaired the SPE Aberdeen Section for 4 years and been its Treasurer and Continuing Education Chair. He has also been North Sea Regional Director on the SPE International Board and a Director of SPE Europe Limited. He currently chairs the committee running the annual Offshore Achievements Awards.

Jack Gomersall – Pale Blue Dot

Jack graduated from the University of Strathclyde with Master's in Civil Engineering. He completed his dissertation in the design of a net-zero residential building before gaining experience of working in the energy transition through an Internship with PBDE. He then went on to offer freelance assistance across a wide variety of hydrogen projects before re-joining the Pale Blue Dot Energy team to support the development of low carbon hydrogen projects.

Robert Clements, Sustainable Development Manager, Northern Ireland Housing Executive

Robert Clements is the Sustainable Development Unit Manager for the Housing Executive, working within Regional Services. His unit is the custodian for the Home Energy Conservation Authority (HECA) statutory function and the Housing Executive's environmental management system.

Robert has worked in social housing for over 20 years, and has extensive experience in residential maintenance and refurbishment with his previous experience in the Private Grants Department and within the housing association sector. He has worked in residential energy efficiency for over 5 years and recently he wrote the '*Energy Efficiency Good Practice Guide for Refurbishment of Residential Sector'* and is a certified Passive House Consultant.

Robert graduated from Ulster University in 1993 with a BSc (Hons) in Building Engineering and Management and is a chartered member of the Charted Institute of Building.

Dr. Ross Gazey, Director, Pure Energy Centre

Ross's career in hydrogen technology spans more than 15 years in designing, developing, implementing, and operating hydrogen energy solutions for customers. He has been responsible for the technical delivery of the first renewably powered low and high-pressure hydrogen refuelling stations in

Scotland. Technical project management and delivery budget responsibility ranges up to projects in excess of £2m. In addition, he has also been the technical lead in innovative pan-European projects developing smart mobility, smart grid, electric mobility, hydrogen transport infrastructure and innovative hydrogen safety solutions. He maintains an active link between academia and industry in applying the latest innovations to meet customer needs and has been author and co-author in over 25 publications including the Elsevier Comprehensive Renewable Energy 2012 reference modules and most recently in the Elsevier Renewable and Sustainable Energy Review Journal.

Derek Wilson, 1st Founder and CEO at Zero Carbon Consultants

Derek's focus is to promote sustainable lifestyles and protect biodiversity to ensure future generations can do the same, whilst still enjoying the freedom and conveniences that modern societies are based on. He believes that transitioning from a fossil fuel based economy to a green hydrogen based economy is the most effective way to achieve these goals. Recently Derek has been developing the "Pandora" project, a blueprint to decarbonise energy production, agriculture and construction, creating the worlds first smart city, powered by its own green hydrogen energy plant and fed from its own organic vertical farming and hydroponics.

Dr. Kashkarov Sergii, Ulster University

Dr Sergii Kashkarov has been Research Associate in Safety Engineering at HySAFER centre of Ulster University since 2016. He obtained MSc in Computer Engineering at East Ukrainian National University (2010). He undertook a postgraduate course in mechanics of the formed solids on the development of polymer composite materials at the same University. In 2013 he joined HySAFER as PhD researcher working on fire resistance of onboard high-pressure storage for hydrogen powered vehicles and blast waves from explosions of high-pressure tanks. Since 2016 he has been a Research Associate. Sergii is co-inventor of the safety technology for composite vessels for hydrogen storage (European Application No 18706224.5, 2019). He has led two Proof of Concept projects funded by Invest Northern Ireland on the development of this technology. His expertise is CFD modelling of combustion, hydrogen storage thermal behaviour in a fire, analytical calculations of blast waves from high-pressure tank rupture and hazard distances, etc.


Hydrogen-Based Energy Transition

RGU First H2 Webinar: "Towards a Zero-Carbon Hydrogen-Based Energy Economy", 16 September 2020

Dr. Dallia Ali

Outline

- Webinar Aim and Objectives
- RGU Role in the UK Energy Transition
- The UK 2050 Net Zero Emissions Target
- Why Hydrogen is on the UK Net Zero Agenda?
- From Where the UK can get the Needed Hydrogen?
- How RGU can Contribute to the Uptake of the Hydrogen Economy?
- Case Study - H2 Potential in Decarbonizing the UK Transport (Railway)
- Conclusion

Aim

This Webinar aims exploring the potential of hydrogen in enabling the UK Energy Transition.

Objectives

To explore, through the Webinar Speakers, how the H2 technology can be employed across the different sectors to support the 2050 Zero Carbon Emissions Target while creating new jobs and developing new supply chains

RGU Role in the UK Energy Transition

RGU is Contributing to the UK Energy Transition through:

- **Skills Development:** we deliver up-to-date accredited Courses on Energy Transition Technologies to develop the needed skills
- **Industry Solution-focused Research:** we provide innovative focused solutions for enabling small and large-scale renewables implementation and integration
- **World-class Simulators**: which can model and benchmark solutions for achieving the decarbonization of the power generation, transport, and heat

Additionally, RGU has founded an Energy Working Group (EWG) in October 2019. The Group aims developing and implementing concepts/projects that reduce the energy consumption and associated carbon emissions within RGU

The UK 2050 Net Zero Emissions Target

In June 2019, parliament passed legislation requiring the government by 2050 to reduce the UK's net emissions of greenhouse gases by 100% relative to 1990 levels

Net Zero Emissions can be achieved by:

- **Reducing Emissions through the implementation of more Renewables**
  The Up-take in UK offshore wind can make this option viable; however storage is needed
- **Decarbonizing CO_2-Intensive Sectors this includes:**
  - Industrial feedstock for production processes and high heat requirements
  - Transportation
  - Residential and Commercial Power and Heat

H2 is able to make both options Viable thus achieving Net Zero

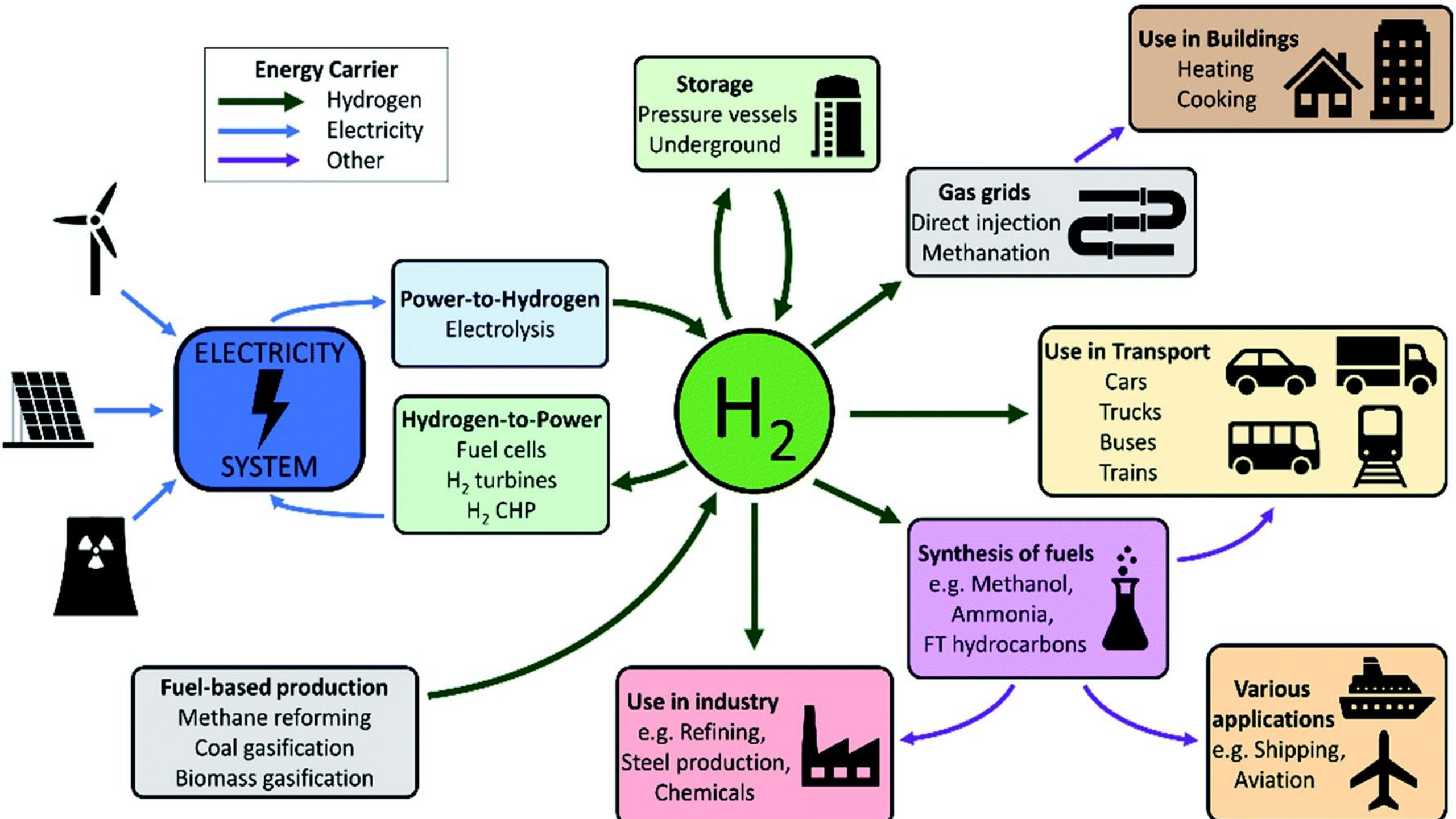
Why H2 is on the UK Net Zero Agenda?

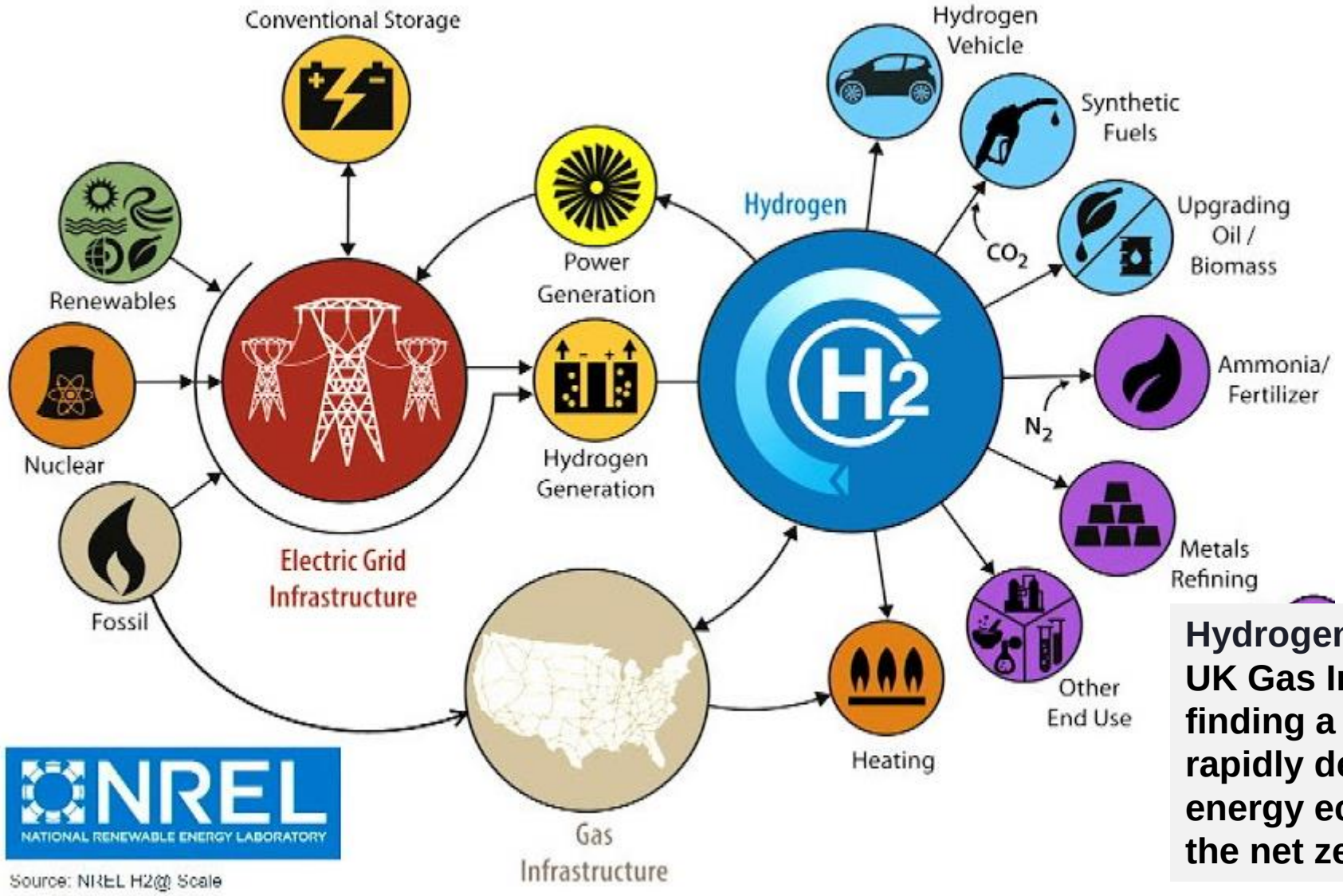
Hydrogen is a **carbon-free energy carrier** that can be produced from fossil energy resources (with CCS) and renewable energy resources

Hydrogen allows cost-efficient bulk energy transport over long distances, thus can **decouple the energy production and usage in location and time**

Hydrogen can Decarbonise;

- **Electricity Network:** in 2 ways, H2 as a form of energy storage enables balancing the largescale integration of renewable generation into the network, and H2 as a clean source of power generation can complement the intermittent renewables generation
- **Gas Grid:** by injecting clean H2 in the UK national gas network
- **Industry:** by using clean H2 in industrial high temperature heating, and as a feedstock for processes like the production of ammonia (hence fertilizers) & methanol (for the manufacture of many polymers)
- **Transport:** by using clean H2 as fuel for the road, railway, water and air transport
- **Buildings:** by transforming clean H2 at the point of use into power and heat for buildings


Energy Carrier
Hydrogen
Electricity
Other
ELECTRICITY
SYSTEM
Power-to-Hydrogen
Electrolysis
Hydrogen-to-Power
Fuel cells
H_2 turbines
H_2 CHP
Storage
Pressure vessels
Underground
H_2
Gas grids
Direct injection
Methanation
Use in Buildings
Heating
Cooking
Use in Transport
Cars
Trucks
Buses
Trains
Synthesis of fuels
e.g. Methanol,
Ammonia,
FT hydrocarbons
Fuel-based production
Methane reforming
Coal gasification
Biomass gasification
Use in industry
e.g. Refining,
Steel production,
Chemicals
Various
applications
e.g. Shipping,
Aviation



Hydrogen can support the UK Gas Industry in finding a role within the rapidly decarbonizing energy economy to meet the net zero target

https://www.google.com/url?sa=i&url=https%3A%2F%2Fm.youtube.com%2Fwatch%3Fv%3DPxkvnf2v0fg&psig=AOvVaw0D-Lmib6cOOXHtw1eVWALC&ust=1600266870240000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCKj2p52x6-sCFQAAAAAdAAAAABAO

From Where the UK can get the Needed H2?

UK has:

- Significant offshore wind resources to produce Green H2 from Renewables by electrolysis
- Industrial Carbon Capture, Utilization and Storage (CCUS) for producing Blue H2 from methane reforming

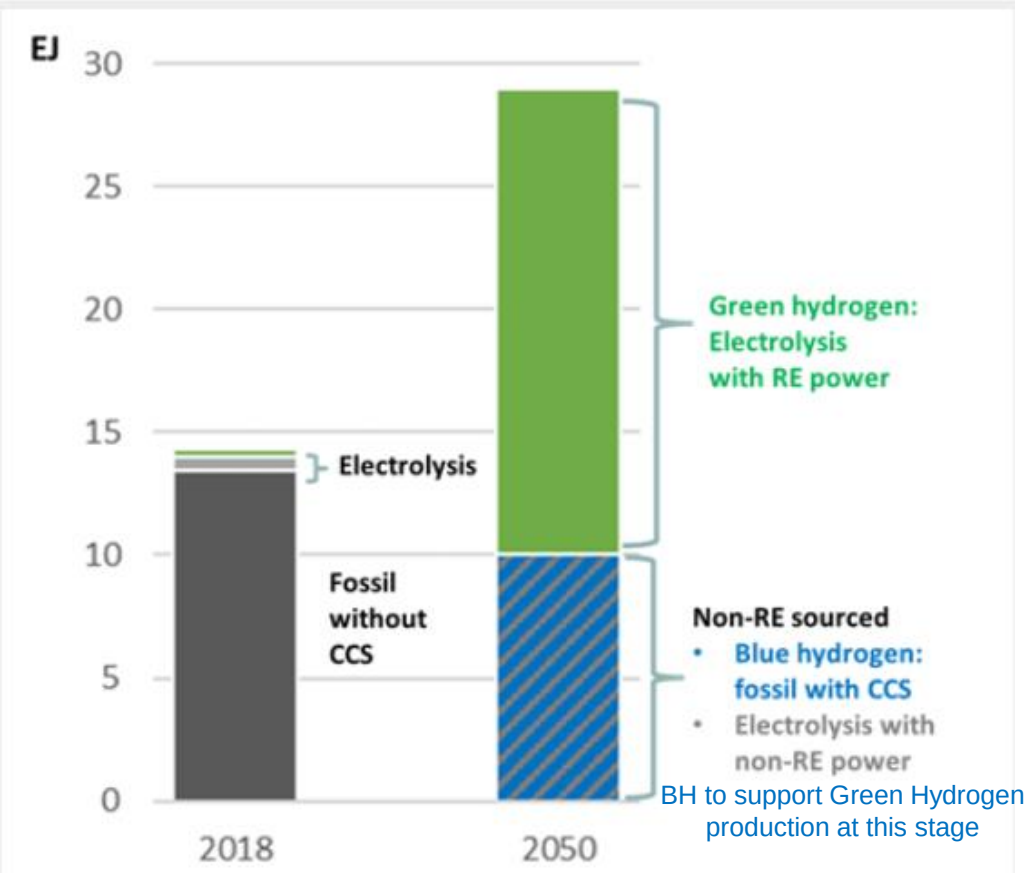


Figure – Role of clean hydrogen in IRENA Remap scenario. Source: IRENA

How RGU can Contribute to the Uptake of the H2 Economy?

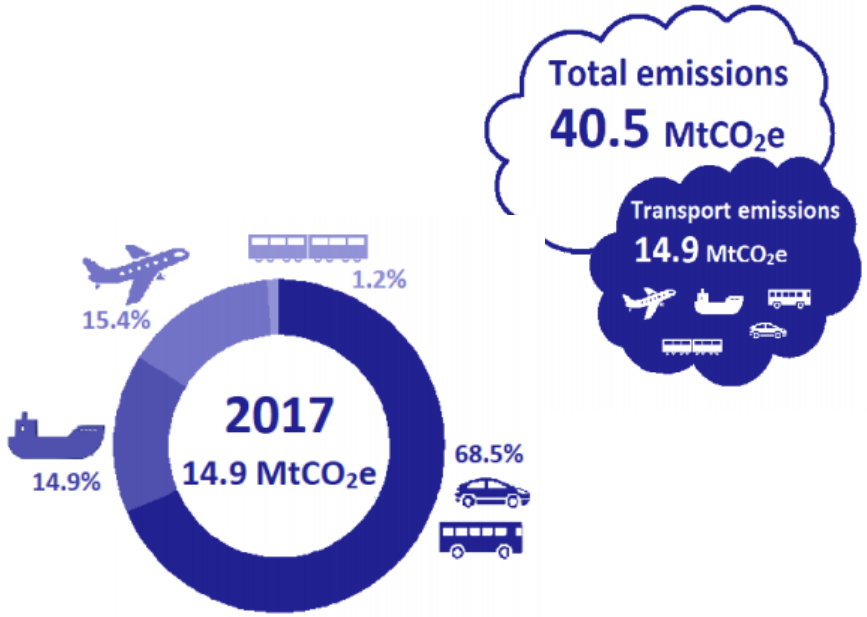
- Through research, analysis and modelling for enabling the H2 Deployment
- Through business models and feasibility studies that support employing H2 in multiple sectors
- RGU is willing to contribute in enabling 100% Renewable Electricity through modelling the electricity network balancing with largescale renewable integration using H2 production and storage
- RGU is willing to lead studies in implementing H2 for a Green Transport Initiative **(RGU has jointly started with PURE Energy Centre a sensitivity analysis to explore the potential of H2 trains)**

Case Study: H2 to Decarbonize Transport

In 2019, transport accounted for (34%) around a third of all UK CO2 emissions

Aberdeen City Council Hydrogen Fleet

Scotland 2017 Total CO2 Emissions and the Transport Contribution



https://www.transport.gov.scot/media/45659/sct09199659921.pdf

Case Study: H2 Potential in Decarbonizing the UK Railway

- Scottish government has planned to decarbonise the rail services by 2035
- The Decarbonization Plan includes:
  - **Accelerated Line Electrification** (already around £1bn has been invested in the electrification of 441 track-km since 2010)
  - **Rollout of Alternative Sources such as hydrogen and battery-powered trains**

The plan will increase the use of electric trains, which already account for around 76% of all passenger journeys.

ScotRail

https://www.railjournal.com/policy/scotland-unveils-rail-carbon-reduction-plans/

Why H2 Trains?

- Electricity used for electric trains is not essentially from green sources
- High CAPEX of Railway Electrification
- Negative visual impact of Railway Electrification
- REH2 trains remove the diesel-powered trains & non-green electric power trains emissions
- REH2 trains, already demonstrated in Europe, show competence with diesel powered trains while eliminating emissions
- Deploying REH2 trains can support the electrical network when integrating large-scale renewables
- Deploying REH2 trains can create jobs and develop new local supply chains

The Potential of H2 Trains:

1. H2 trains allow hybrid configurations of batteries and fuel cells thus increasing performance and range

2. Fuelling a H2 train is faster than charging a battery-based train

3. H2 trains have high-performance and are as versatile as diesel-powered trains with a similar range

Hydrogen tank and Ballard fuel cell system on CRRC-Sifang light rail
https://blog.ballard.com/fuel-cell-trains

Our sensitivity analysis on H2 trains aims identifying the cost of H2 at which the H2 trains become cost competitive compared to diesel and catenary electrification when considering the costs associated with their emissions

Conclusion

Hydrogen is a major contributor to the UK Net Zero Future and will play a pivotal role in achieving an affordable, clean and prosperous economy.

For Hydrogen to play such a key role, the following is needed:

- Long Term Strategy
- Favourable Government Policies
- Reduced Market Uncertainty
- Development of Local Skilled Workforce and Service Infrastructure
- Further Research, Analysis and Modelling that allows the effective deployment of hydrogen in different sectors

Thank You