THE ASSOCIATION FOR RENEWABLE ENERGY & CLEAN TECHNOLOGY

UK Green Gas Day TASTER SESSION 2020

WEBINAR

12th November 2020 | 10:00-12:40

@REAssociation

REA BIOGAS

Decarbonising the economy

Webinar

UK Green Gas Day
TASTER SESSION 2020

WEBINAR

12th November 2020 | 10:00-12:35

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UKGGD 2021

GREEN GAS DAY 2021

22nd April 2021

National Motorcycle Museum

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Webinar Housekeeping

- All please join as *muted* & *without video*
- Please note where the *chat or questions box* should you have any questions for the speakers

The session will be recorded for accurate note taking.

Participants of the webinar will receive a copy of the slides and recording will be available upon request. Also available on the *Go to Webinar*'s 'Handouts' tab.

Thank you

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Our UK GGD2021 exhibitors

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How we represent green gas...

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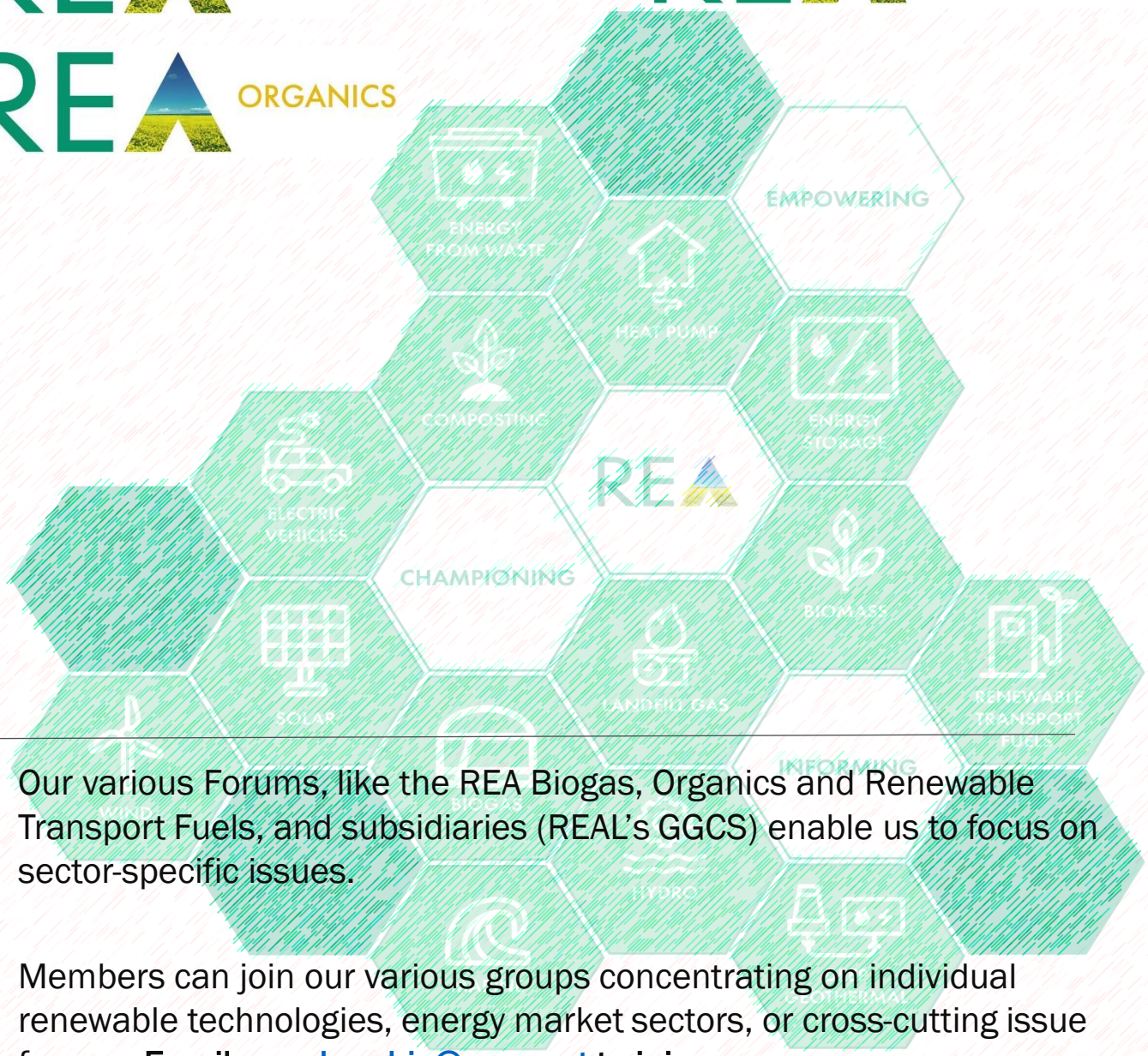

Our various Forums, like the REA Biogas, Organics and Renewable Transport Fuels, and subsidiaries (REAL's GGCS) enable us to focus on sector-specific issues.

Members can join our various groups concentrating on individual renewable technologies, energy market sectors, or cross-cutting issue forums. **Email** membership@r-e-a.net **to join.**

Our Subsidiary

REAL
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GreenGas
CERTIFICATION SCHEME

Speakers

William Mezzullo

Foresight Group and REA Biogas Chair

Jane Lumb

BEIS

Matt Hindle

ENA

Simon Farris

Severn Trent

David Hurren

Air Liquide Biogas Solutions Europe

Richard Riley

Element Energy

Jesse Scharf

Green Gas Certification Scheme

David Jones

Cadent Gas

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Please use the **Questions/Chat Box** if you have questions for any of the speakers

Agenda

- **10.00 - 10.15 Welcome and introduction**

  William Mezzullo - Foresight Group and REA Biogas Forum Chair

- **10.15 - 10.30 Policies to support biomethane & green gases**

  Jane Lumb - Head of Biomethane and Non Domestic RHI - BEIS

- **10.30 - 10.45 Delivering net zero: the role of the gas networks**

  Matt Hindle - Energy Networks Association

- **10:55 - 11:05 Q&A**
- **11.05 - 11:20 Severn Trent's Biomethane strategy**

  Simon Farris - Severn Trent

- **11.20 - 11:35 Trading Biomethane within the EU - the latest developments**

  Jesse Scharf - Green Gas Certification Scheme

- **11:35 - 11:50 Q&A**
- **11:50 - 12:10 The transition pathway from renewable methane to a Net Zero emission future**

  Richard Riley - Element Energy and David Jones - Cadent Gas

- **12:10- 12:25 The growing market for freight**

  David Hurren – Air Liquide

- **12:25- 12:40 Q&A & close**

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GB Government Biomethane Support proposals

Green Gas Day, November 2020

GB Government biomethane support

- Future of heat and the heat and buildings strategy
- Announcements since March
- RHI changes
- GGSS
- What about Hydrogen?
- Questions

Heat strategy

Department for
Business, Energy
& Industrial Strategy

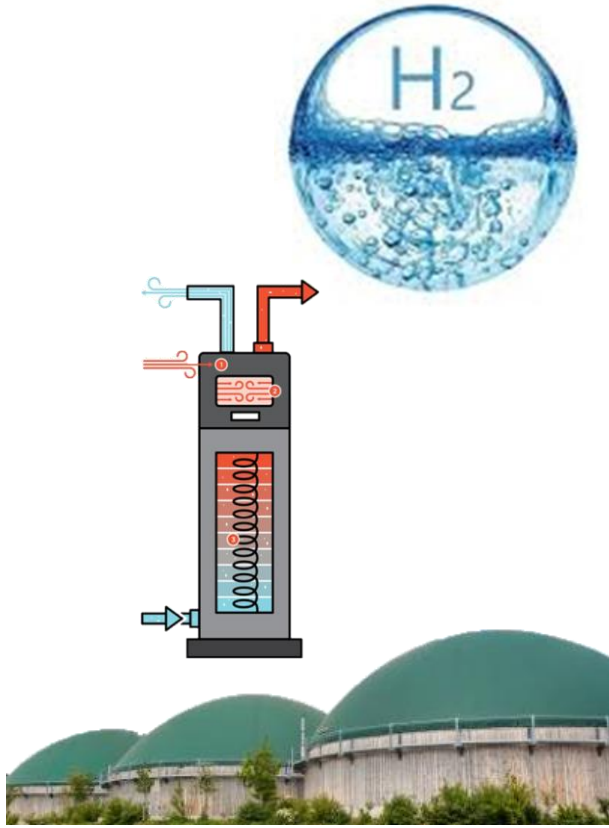
The long-term future of heat

- No clear consensus on the best approaches to decarbonising heat at scale
- Come a long way in developing our understanding of the options since we published *Clean Growth: Transforming Heating*, but evidence gaps remain:

  Hydrogen - testing the costs, practical delivery challenges and public perception and experience of hydrogen technologies;

  Electrification - improving understanding of potential future requirements for electricity generation and network reinforcement;

  Bioenergy – improving understanding of the potential for expanding feedstocks and the competition for limited bioenergy resources in the future



Heat and Buildings strategy

- Planning to publish a Heat and Buildings Strategy, which will set out the immediate actions we will take for reducing emissions from buildings.
- These actions include the deployment of energy efficiency measures and low carbon heating as part of an ambitious programme of work required to enable key strategic decisions on how we achieve the mass transition to low-carbon heat and set us on a path to decarbonising all homes and buildings.
- The Committee on Climate Change states that **biomethane injection** into the gas grid will be valuable across all decarbonisation pathways. Biomethane injection offers a low-regrets, cost-effective way of contributing to near-term, legally binding carbon budgets.

Announcements since March

NDRHI:

- Consulted on reforms and closure of NDRHI
- Consulted on, and issued government responses to, amendments to Tariff Guarantees, and covid-mitigations for both TGs and smaller projects

Green Gas Support Scheme:

- Consultation on Future Support for Low Carbon Heat, including the Green Gas Support Scheme
- Stakeholder notice on GGSS - ensuring value for money

RHI changes

Biomethane RHI TG and Covid-Mitigation changes

Regulations in July 2020:

- 3rd round of TGs with a flexible element
  - Submit application with stage 2 info (financial close) by March 2021
  - Commissioning deadline of March 2022 but “clock starts” on payments in March 2021
- Extension to deadline of existing TGs (2nd round) to at least mid-March 2021 to respond to Covid 19 project delays

Government response on 5th November:

- Sub-TG (smaller) installations able to apply for 1 year commissioning extension if criteria met relating to covid-delays

Biomethane RHI closure proposals

Consultation closed in July on reforms to non-domestic RHI, including:

- Closure of Non-Domestic RHI March 2021
- Increased flexibility for biomethane producers through
  - better interactions with other schemes (e.g. RTFO)
  - enabling change of “registered producer”
- Provisions on taking account of use of (or contamination by) fossil fuels in feedstocks

Government Response to be published soon

Future support for biomethane

Green Gas Levy and Green Gas Support Scheme

Department for Business, Energy & Industrial Strategy

GGL consultation, closed 2nd November

- Funding mechanism for the GGSS, a levy on licensed gas suppliers.
- The GGL will be collected from April 2022. Both schemes will be administered by Ofgem.
- BEIS will calculate an annual levy rate based on that year's projected GGSS deployment.
- Charged to gas suppliers at a flat-rate for each domestic and non-domestic meter point that they serve.

GGL – payments to GGSS participants

- Quarterly cycle, to allow sufficient time to collect funds from suppliers.
- Biomethane producers will make quarterly meter readings submissions at a fixed date during the quarter.
- Ofgem will confirm these against volume data on biomethane injection into the grid. Applicable payments will then be made based on biomethane injected over the previous quarter.
- First levy can’t be raised until April 2022, so developing policy to ensure participants joining GGSS before then receive backdated payments.

Green Gas Support Scheme (1)

- New support scheme for AD biomethane injection
- From Autumn 2021 for 4 years, then replaced by long-term alternative
- Learning lessons from RHI – through the evaluation report, and stakeholder feedback
  - ongoing tariff support
  - tweaks to improve experience for you
  - continuing to ensure VfM for the taxpayer

Green Gas Support Scheme (2)

- Tariffs and tiering
  - Proposed a range of tariff values at each tier, and range of tariff lengths
  - We need your input on what you need to build good plant
- How to ensure Value for Money throughout the scheme
  - Could we collect cost data from applicants to support annual tariff review?
  - How to amend degression to work better?

Green Gas Support Scheme (3)

- Tariff Guarantees
  - Retain and refine
- Waste feedstock - could we increase the % of waste feedstock required?
- Digestate - how can we improve air quality, and increase commercial market?
- Interaction with other schemes – as with RHI reforms, want to make this work better.

Green Gas Support Scheme – next steps

- Consultation closed in July 2020
- Expect Government Response early 2021
- Scheme launch autumn 2021

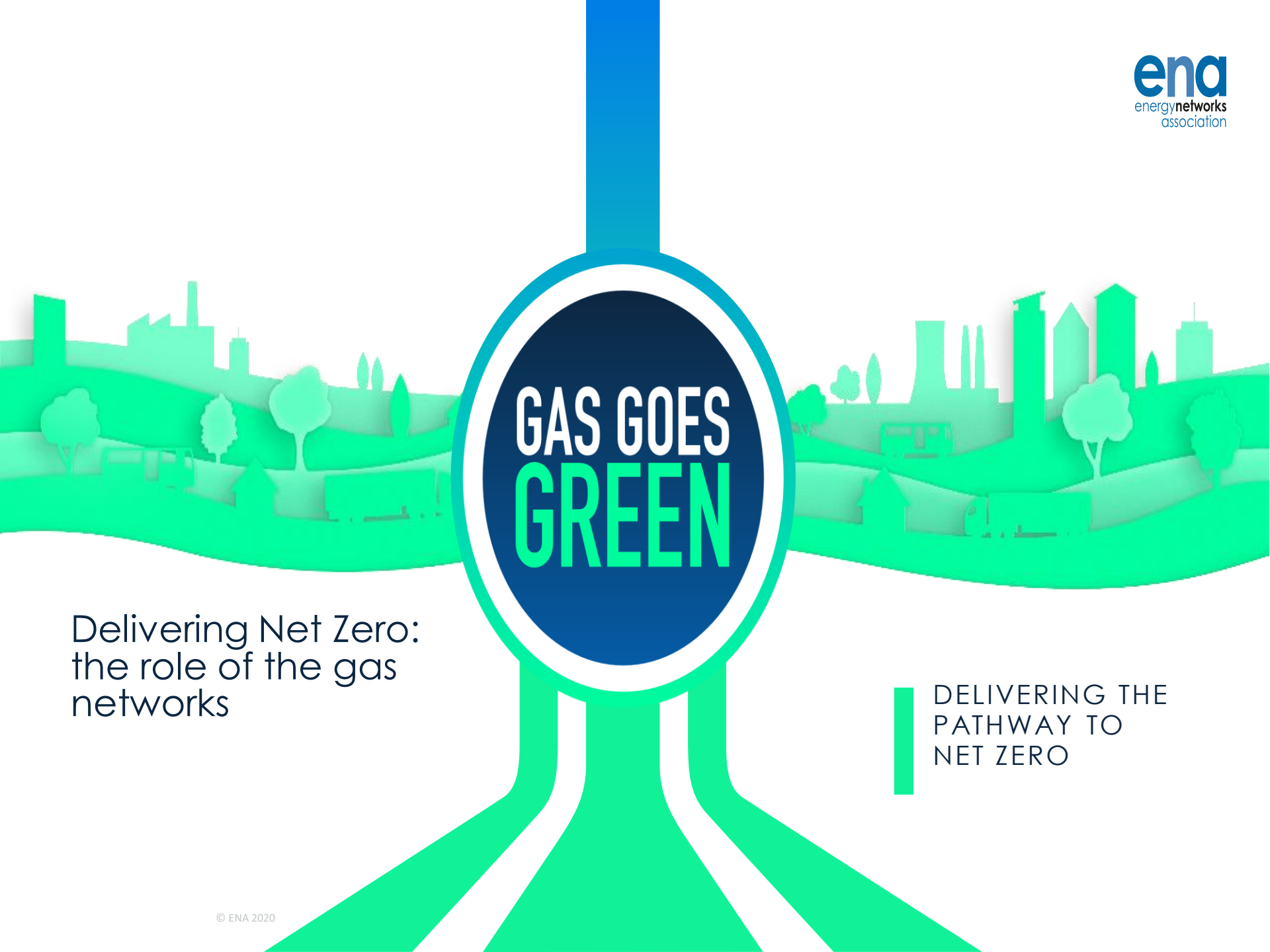
What about Hydrogen?

Hydrogen

- Hydrogen has the potential to play a major role in decarbonising the economy
- The Government is committed to developing hydrogen as a strategic decarbonised energy carrier. In line with this we are already investing up to £121m (between 2015 and 2021) in hydrogen innovation across the value chain.
- We are developing new policy, in partnership with industry, to help bring forward the technologies and supply chain we will need to grow the UK hydrogen economy. This includes business models to support the deployment of, and investment in, low carbon hydrogen production and a £100m Low Carbon Hydrogen Production Fund to stimulate capital investment.

Summary

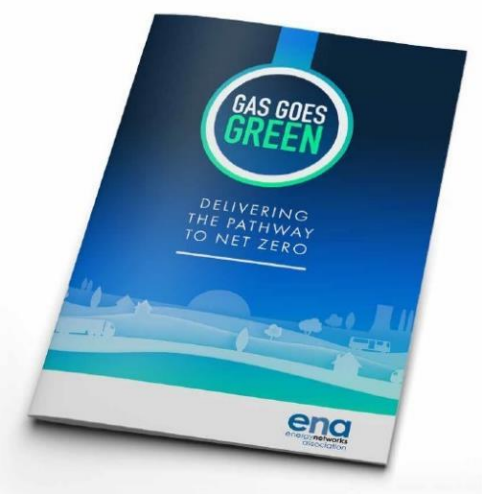
- Biomethane valuable role to play in all decarbonisation pathways
- RHI – continuing to support new biomethane development in transition to GGSS
- GGSS – learning lessons from RHI to deliver ongoing AD for biomethane injection from Autumn 2021
- Hydrogen – investing in innovation, business models and capital investment



Delivering Net Zero: the role of the gas networks

DELIVERING THE PATHWAY TO NET ZERO

GGG: Delivering the pathway to net zero



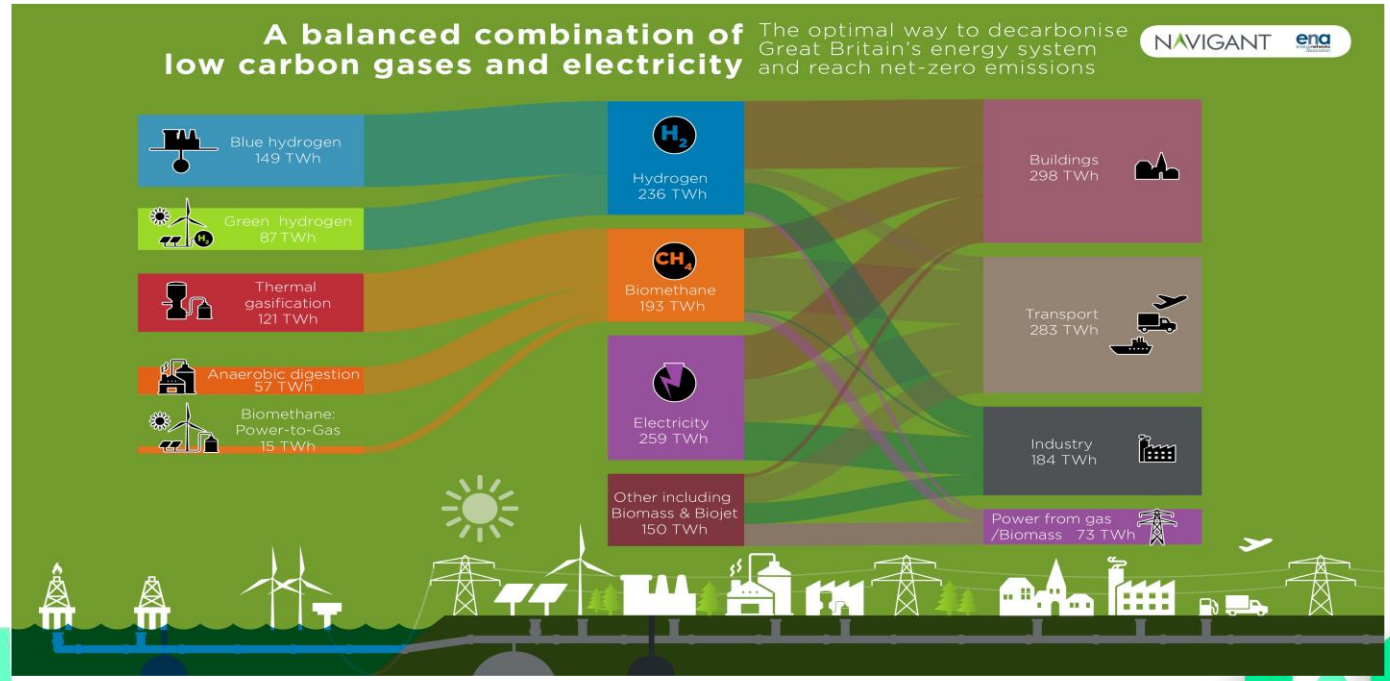
The Gas Goes Green programme will deliver the world's **first zero carbon gas grid**, helping meet the UK's net zero carbon emissions target.

It will make the changes needed to move Britain's gas network infrastructure from delivering methane-based natural gas to zero carbon hydrogen and biomethane.

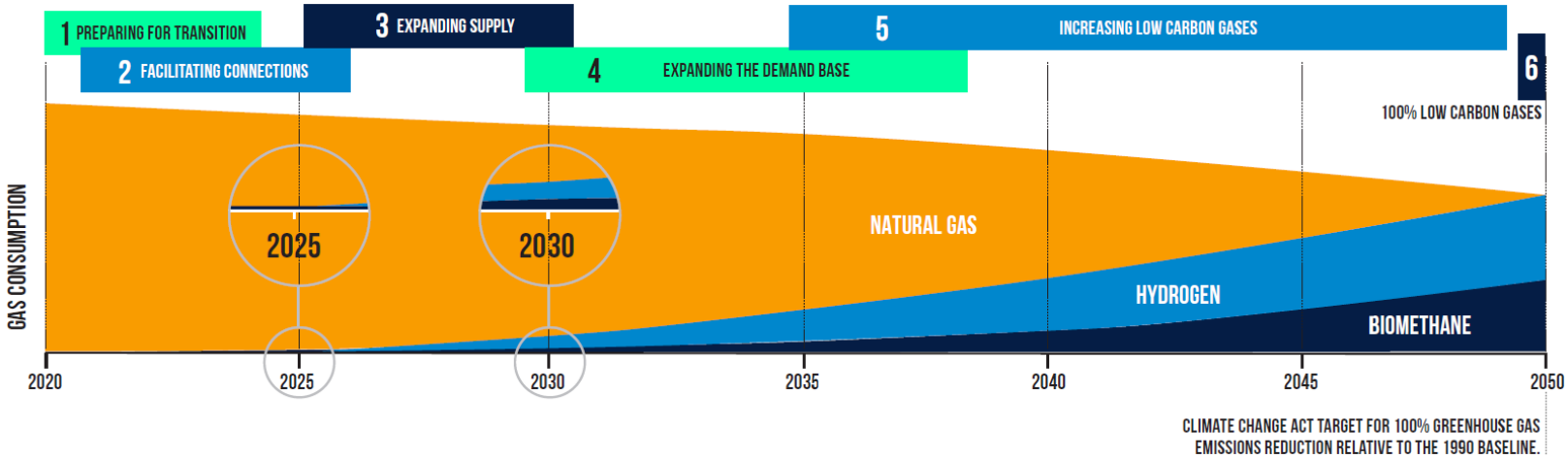
Zero carbon gas grid: Real world outcomes

- **Choice**: A zero carbon gas grid would generate a genuine choice of decarbonised energy solutions for households, businesses and communities – in the home, on the road and at work
- **Disruption**: Changes to domestic energy appliances are less disruptive than the alternative
- **Costs:** By 2050, a whole system approach could save billpayers £13bn vs 100% electrification
- **Investment:** By 2045, billpayers would be a net beneficiary of immediate investment in a hydrogen economy compared to the fossil fuelled status quo
- **Rebalancing the economy**: A world leading hydrogen economy could create 221,000 jobs by 2050

A truly whole system approach



Pathway to net zero

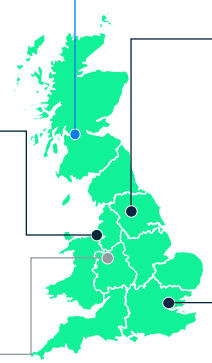


Leveraging world-leading innovation

Objectives	H100 project is looking to construct and demonstrate the UK's first network to carry 100% hydrogen
Status	Engineering design stage
Timeline	Construction targeted for Summer 2021

Objectives	Demonstrate hydrogen production from natural gas with CCUS, distribution, and use at scale
Status	Engineering design stage
Timeline	FID is required by the end of 2022 to enable deployment of the project on schedule (delivery in 2023-26)

Objectives	• First project in the UK to inject Hydrogen into a natural gas network • Demonstrate that 20% volume blend of hydrogen with natural gas in homes is safe with lower emissions that current natural gas • Demonstrate that blending hydrogen is not disruptive and costly for customers because they will not need to change current cooking and heating appliances
Status	Live pilot began in January 2020
Timeline	Project to end in October 2021



	H21 Leeds City Gate	H21 NIC	H21 North of England
Objectives	Demonstrate technical feasibility and economic viability of UK gas distribution networks conversion to 100% hydrogen	Demonstrate that a hydrogen network can be managed to the same safety standard of current natural gas networks	Produce a strategic report setting out the design requirements for infrastructure to convert the North of England to hydrogen between 2028 and 2035 – project delivery 2023-2028
Status	Completed in 2016	-	-
Timeline	-	Delivery in 2020	Delivery in 2023-28

Objectives	• Determine the viability of utilising existing infrastructure to enable the Isle of Grain region to supply decarbonised hydrogen to London and the South East. • Ascertain what additional infrastructure would be required if the Isle of Grain was to supply all of London's hydrogen, including the identification of critical environmental issues and ecosystem mapping of stakeholders. • Develop a roadmap for hydrogen development in the region
Status	Live – Funding from Network Innovation Allowance
Timeline	Study to conclude in March 2020

GGG 2020 Deliverables

1.1 Zero Carbon Commitment (May)

Report

Hydrogen: Cost to Customer (May

Report

1.2 Iron Mains emissions reduction (August)

Infographic

1.3 Updating the GGG pathway (November)

Report

2.1 Engagement for IGEM consultation on gas quality and changes to GS(M)R (July)

Event

2.2 Hydrogen Deblending use cases webinar (July)

Event

3.1 Transport Pathways report (Feb 2021)

Report

4.1 Connection standardisation (October)

4.2 Grid capacity options (October)

Customer Forum created

4.3 Fugitive emissions innovation review (December)

Recommendation

5.1 Hydrogen Transformation Plan (November)

Report

6.1 Pathways toolkit (November)

Infographic and animation

DELIVERING THE NET ZERO PATHWAY

Entry Customer Forum: supporting biomethane

- The **Entry Customer Forum** gives producers and networks the opportunity to discuss common issues and challenges
- It is developing a **Connections Standard Methodology** (CSM) which will set out how each gas network around the country undertakes the connection, commissioning, maintenance, and operation for gas to grid distributed gas projects
- The Forum will also maintain and review an Action Plan for all the entry improvement initiatives including changes to the CSM
- Met for the first time in October, we have already received several proposals, ranging from **seasonal grid capacity issues** to **propanation**. Priority items and steps for addressing them will be discussed at the next meeting.

Northern Gas Networks

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Questions?

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or

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SEVERN TRENT BIORESOURCES

Developing Our Renewable Energy Generation

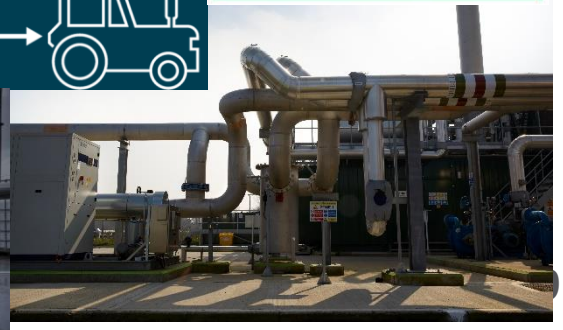
Simon Farris – Bioresources Strategy Manager

WONDERFUL ON TAP

SEVERN TRENT

SEVERN TRENT NOW OPERATES TWO ANAEROBIC DIGESTION BUSINESSES

- From 1st April this year, Ofwat decided to setup a new Price Control for our Regulated Anaerobic Digestion activities. This Price Control is known as Bioresources and is focussed on the digestion of sewage sludge.
- Our Food Waste, crop and non-regulated renewable energy business is delivered by ST Green Power
- ST Bioresources is responsible for the treatment of the sewage sludge from 8.3m customers across the Midlands. We operate 27 sites to service our 1008 sewage treatment works.
- This means we currently treat c. 234,000 Tonnes dry sludge every year – along with around 4 million tonnes of water!
- We have been developing AD as a business for many years now, and still believe it is the best core technology but we are working on future proofing some of our strategy moving forwards.



SEVERN TRENT

DEVELOPING OUR TRIPLE CARBON PLEDGE AND WHAT IT MEANS FOR OUR ENVIRONMENT

- In February 2020 we announced our Triple Carbon Pledge that by 2030 we would have:
  - 100% of the energy we consume sourced from Renewable generation
  - Net Zero Carbon emissions
  - 100% Electrical fleet (where technology allows)

- We have already met the first challenge through a large scale PPA, but we want to do more with our generation.

- Biomethane has a huge role to play in this – as a power generator, heat generator and a vehicle fuel.

- We have also signed up to science-based targets for carbon reduction.

- This means we need to not only generate renewable energy, but do it in an even cleaner, greener way

WHY DO WE WANT TO PRODUCE BIOMETHANE?

- Raw Biogas is an energy dense fuel and has multiple end applications – most of which are improved by the conversion to Biomethane.

Biomethane to Grid – we can upgrade and inject the fuel into the National Gas Grid where it can be used in higher efficiency energy generators.

Biomethane to Vehicle fuel – we operate a fleet of 90 tankers all day every day. Biomethane as CNG can play a role in decarbonising this activity and helping us towards our 2030 ambitions.

Base fuel for Hydrogen – much has been made of the future hydrogen economy and we want to be involved. Methods for producing hydrogen are limited, and the scale of what we need to achieve as a nation is huge. Methane reformation will need to play a part in developing hydrogen for future energy systems.

Waste to Biomethane has a key part to play in the UK's transition to low carbon technology through the next 10 years and we will play our part.

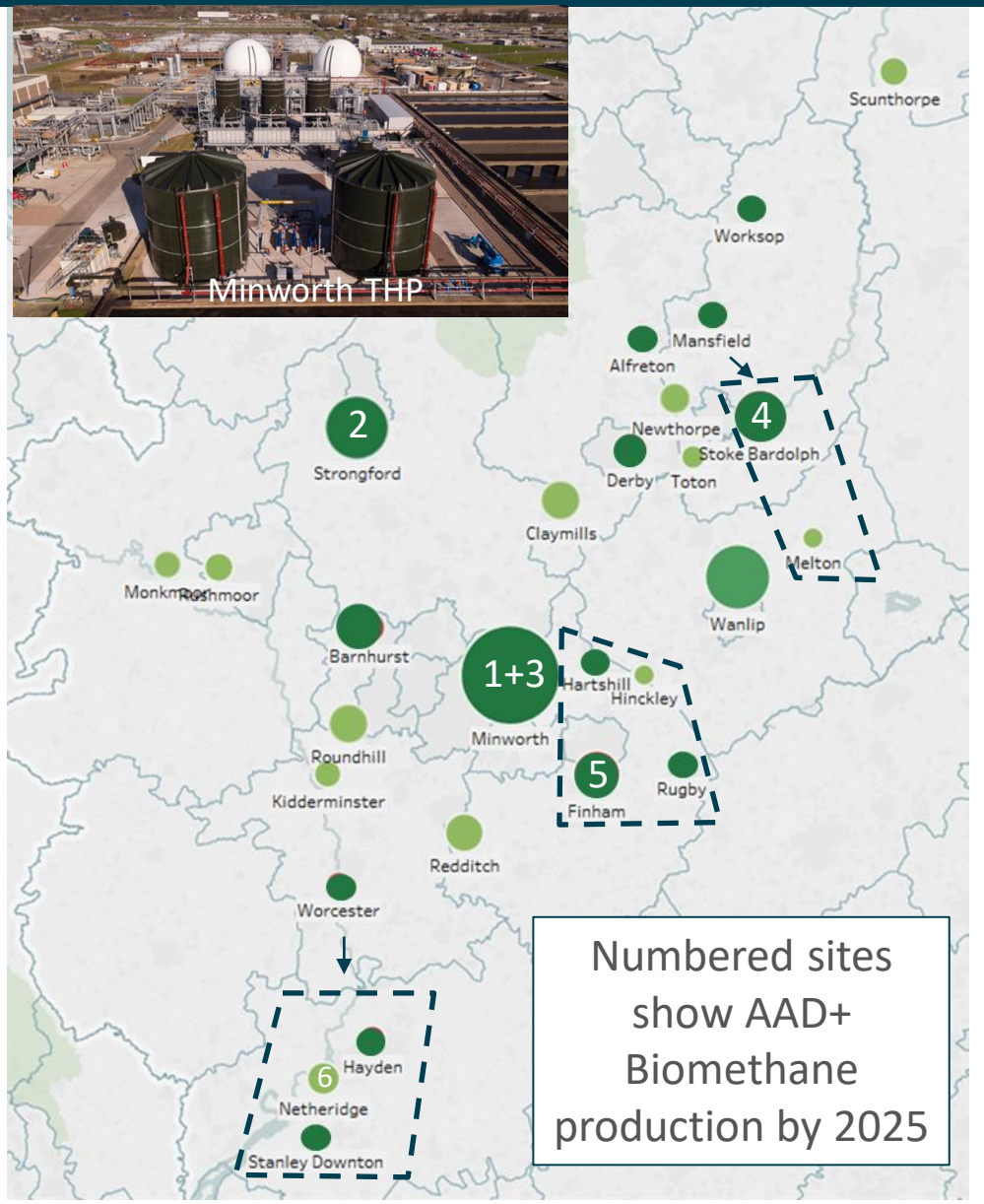
HOW ARE WE GOING TO DELIVER MORE BIOMETHANE?

- As part of our AMP7 (2020-25) plan we are developing 3 new Advanced AD sites,
- For our biosolids product AAD gives us the highest standard and reduces the risk of losing our route to land. It also increases our biogas yields and opportunity to use Biomethane.
- We are combining the AAD with new Biomethane plants to join the existing biomethane production in Birmingham and Stoke on Trent
- We have 2 of the sites in construction and expect to deliver early next year on first gas to grid, building volumes through the AMP by closing sites

- Depending on the outcome of the current Green Gas Support Scheme, we will also consider whether we can develop smaller sites where the heat balance is less favourable.

- By the end of the AMP we hope to have 6 area hubs – 5 of which will produce Biomethane.

- **We are looking at developing treatment hubs near our big cities that combine Advanced AD and Biomethane injection to best deliver on our carbon commitments**



RENEWABLE ENERGY GENERATION IS NO LONGER ENOUGH - INTEGRATING CARBON CAPTURE TECHNOLOGY

- Whilst the generation of renewable energy is essential to hitting our targets, we can do more.
- We are focussing on how we can remove some of the carbon from our generation process and deliver on our targets for carbon reduction
- We are exploring a few options, but we are about to commission a plant that uses the CO_2 from the Biomethane upgrader or a CHP exhaust to produce a pelletized fertilizer product

SUMMARY

- At Severn Trent we are looking to push our Environmental performance beyond just Renewable Energy Generation
  - We have made our carbon triple pledge and we are committing to Science based targets
- A big part of our ambition is built on growing our Biomethane production to produce opportunities for heating, vehicle fuel and potentially even hydrogen
- We are building more Advanced AD plants and Biomethane upgrading across our region to achieve our goals
  - To reduce our carbon footprint, we are seeking to remove the carbon dioxide from our upgrading process and use it to produce higher value products

We have already established the ability to inject Biomethane into the grid, we are now looking at how we can use it to deliver our wider carbon reduction ambitions and our renewable energy generation.

DO YOU HAVE ANY QUESTIONS?

Trading Biomethane within the EU – latest developments

Jesse Scharf
Green Gas Certification Scheme

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GGCS - Quick Intro

- Established in 2011
- One of two registries in the UK
- Issuing GoO for approx. 80% of UK biomethane production
- Operated on not-for-profit basis by a trade association subsidiary (Renewable Energy Assurance Limited/REAL)
- No competent authority/issuing body for gas GoO in UK
- Certificates, Certs, CoO, GoO, RGGOs –I'm going to call them GoO (even though we are not an appointed issuing body)

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Prices

- www.greengas.org.uk/certificates/market-information
- We don’t know the prices but there are two sources
  - Greenfact
  - Cornwall Insights

Why is trading with the EU important?

- Biomethane **imported** from Germany, Sweden, Austria, etc for RTFC claims
  - unsubsidised at point of production
  - must be mass balanced and sustainability criteria met
  - see RTFO stats here
- Biomethane **exported** to all over EU
  - subsidised at point of production (RHI)
  - allocated to EU consumer via GoO from a GGCS account
  - or GoO transferred to DENA Biogasregister in Germany

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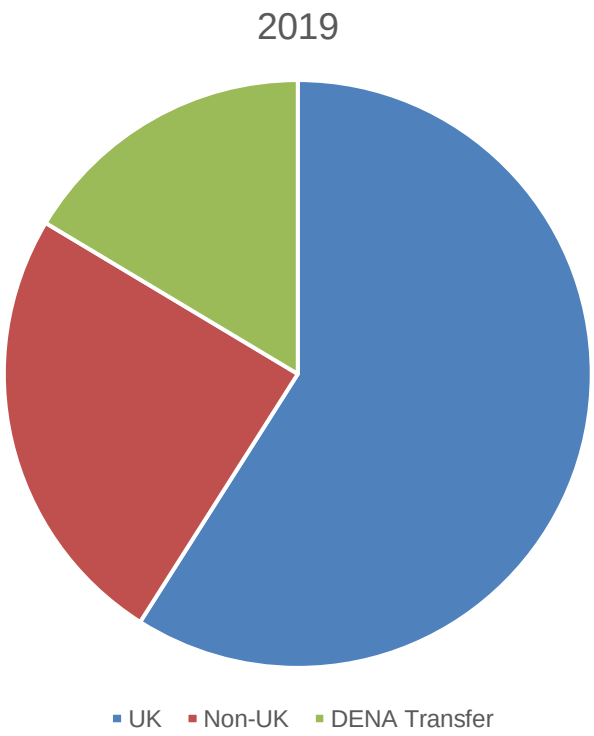
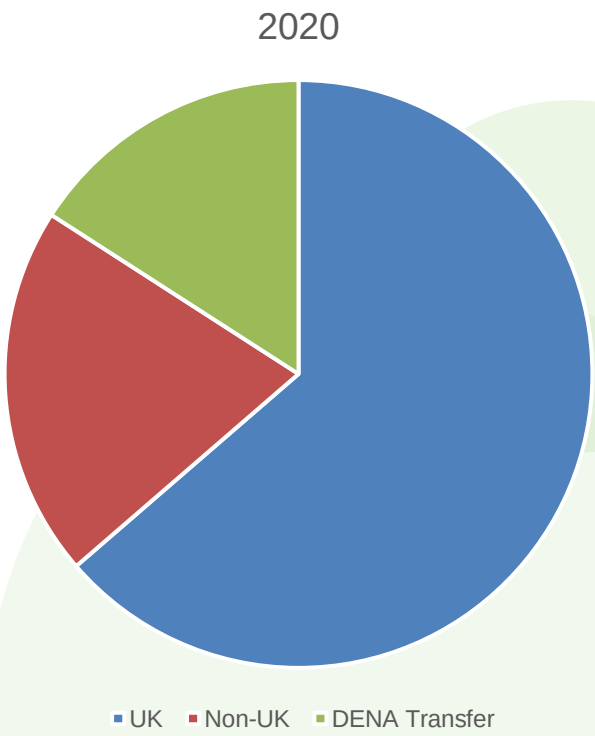
GoO Retirement by Consumer Location





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Strong demand from non-UK consumers

- Only a few countries have significant domestic GoO markets
  - France, Netherland and Denmark
- All others either have no/insignificant biomethane production or all production is tied up with transport/other subsidies so no freely tradable GoO is created
- Large pool of customers looking for GoO to be able to lower emissions reported from gas use as well as suppliers wanting to offer green tariffs to households
  - Italy, Germany, Spain, Switzerland, Belgium, Austria

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Can I sell biomethane to an EU consumer?

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Why a shrug?

- If it seems a bit messy then that's because it is…
- GHGP/CDP, national governments, European directives are always developing…**including UK status vs EU**
- It always comes down to the consumer and the value they put on the GoO
- Recommend starting discussions with consumers by getting details down…
  - Name of reporting scheme? name of reporting guidelines e.g. GHGP/national guidelines?
  - Name of regulatory benefits expected e.g. EU ETS?
  - They understand what a GoO is?
  - Do they need a mass balance?

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Who sets the rules?

- DfT- sets the RTFO rules with reference to RED/RED II – mass balancing and sustainability criteria
- Environment Agency/Scottish Environment Protection Agency – administer the EU ETS (and will administer the UK ETS?) as do their equivalents around the EU
- GGCS - sets rules on ability to allocate GoO to non UK consumers – must be connected to the UK/EU gas network e.g. can't be in Iceland!
- Consumer – what is their general perspective/gut feeling i.e. is this a good product? Do they want the plant to get ISCC Certified?
- Greenhouse Gas Protocol (GHGP) and reporting schemes e.g. CDP/GRI – some consumers will report using set methodology
- Registries in Germany, Netherlands, etc – what to they and their governments require?

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What about Brexit?

- Full guidance note from March 2020 is still valid – can be accessed here.
- From June 2021 GoO for gas are a “EU activity” as they are in the scope of RED II
- The UK is already a “third country” and when the transition period ends (Dec 31st) we will be treated as one.
- In order for GGCS to be fully integrated into EU GoO system post June 2021
  - We must be appointed as a competent body by UK gov to issue RGGOs
  - We must conform to the EN 16325 standard
  - UK must sign a mutual recognition agreement with EU on GoO

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More about Brexit

- BEIS said in February 2020 that they had no intention of implementing RED II. We have had a follow up meeting in August and there was no indication that their thinking had progressed.
- Most likely outcome is:
  - UK gov does not appoint anyone to issue RGGOs
  - No mutual recognition agreement is signed
  - GGCS will seek to conform to EN 16325 regardless
- For non-UK consumers - they should still be willing to buy UK GoO, but it won't help market confidence
- For transfer to other registries – seems likely that they will be restricted – maybe not on June 1st 2021, but over time.

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What about the rest of the EU

- GoO standardised according to EN 16325
- More and more countries injecting biomethane and issuing GoO
- Two hubs for transferring GoO between registries – ERGaR and AIB
- Mass balancing for RTFCs (and equivalents) gets easier?
  - ERGaR RED MB scheme
  - EU Biofuel Database.

GreenGas CERTIFICATION SCHEME

REAL RENEWABLE ENERGY ASSURANCE LIMITED

REA THE ASSOCIATION FOR RENEWABLE ENERGY & CLEAN TECHNOLOGY

- Thanks for listening in
- Contact me at jscharf@greengas.org.uk
- LinkedIn - Jesse Scharf

GreenGas CERTIFICATION SCHEME

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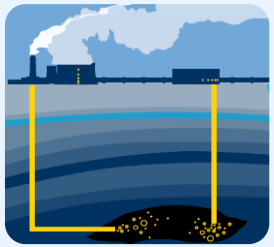




Green Gas Day

The Future Role of Gas in Transport

12th November 2020

Element Energy Ltd

Celine Cluzel
Richard Riley
Oliver Robinson
Alessandro Zanre

With Net Zero, the transport landscape has changed with greater roles for biomethane and hydrogen

Total UK hydrogen demand in 2050 could be 200 – 600 TWh

	Potential demand in 2050[1]
Industry: Hydrogen is the most technically and economically feasible low-carbon feedstock and source of high-temperature heat for many industrial processes	50 – 200 TWh
Heavy transport: Hydrogen is expected to be the primary low-carbon fuel for large vehicles such as HGVs, buses, trains and tankers	50 – 100 TWh
Buildings: Hydrogen is one of the leading options for decarbonising heat in buildings, alongside heat pumps and district heating networks	50 – 200 TWh
Power: Hydrogen is increasingly seen as the most viable low-carbon alternative to natural gas for peak dispatchable power generation	50 – 100 TWh
Flexibility: Hydrogen can provide energy system flexibility in the form of storage (including inter-seasonal) and sector coupling	TBC
Total potential demand in 2050	**200 – 600 TWh (c. 25 – 50% of the UK's total energy demand in 2050)[2]**

Source: Navigant, Element Energy, CCC, Aurora, Imperial College, National Grid

1. Ranges are directional
2. Based on National Grid's FES 2020 scenarios

Project Introduction

Project Introduction

- This summary is part of a much larger project Element Energy is conducting on behalf of the GB and Ireland GDNs and National Grid
- The project is NIA (Ofgem) funded
- The project is not currently complete, and this presentation represents interim findings
- The project aims to build a detailed narrative of the transition of the GB economy to net-zero by 2050
- This will highlight the key technical and legislative barriers to meeting net-zero under different scenarios
- A key outcome of the project is understanding the role of different fuels, green gas (biomethane, bio-SNG and hydrogen) and electricity in this transition
- A key focus of the work is on the role of transport as an early catalyst for low carbon fuel production and distribution

Steering group

Cadent

Gas Networks Ireland

nationalgrid

Northern Gas Networks

SGN
Your gas. Our network.

WALES&WEST UTILITIES

GDN: Gas Distribution Network. NIA: Network Innovation Allowance

Transport Pathways Methodology

Task 1 : Transport transition scenarios

Aim
- Understand the role of low emission fuels (biomethane, hydrogen, electricity) across different road transport modes

Outputs
- National and regional sales and stock of vehicles by fuel type from 2020 to 2050

Task 2 : Gas production and distribution pathways

Aim
- Understand the different pathways for the production and distribution of green gas (hydrogen and biomethane)

Outputs
- Fuel production and distribution pathways
- Data on CO_2 footprint and cost of the fuels

Task 3 : Net Zero modelling

Aim
- Determination of decarbonisation pathways for heat, industry and power and integration with transport pathways

Outputs
- Energy demand breakdown by sector and fuel and related CO_2 emissions

Task 4 : Infrastructure modelling

Aim
- Understand the distribution and dispensing infrastructure requirements to support green gas use in HGVs

Outputs
- Spatial and temporal mapping of infrastructure rollout across GB

Task 5 : Recommendations and reporting

Aim
- Feed into DfT Transport Decarbonisation Plan
- Develop high impact narrative for wider publication

Outputs
- Final report in Word

The project considered four scenarios to understand the varying roles of biomethane, bio-SNG, electricity and hydrogen in decarbonisation

- This work considered four scenarios, as set out below, to understand the impact on the narrative of different levels of biomethane/bio-SNG and hydrogen demand across the economy
- Although the study is economy wide there is a specific focus on the decarbonisation of HGVs, this is because
  - Decarbonisation technology in transport is at a more commercially advanced level than in industry and heating making transport a catalyst for the scale up of these technologies
  - Developing biomethane/bio-SNG and hydrogen infrastructure requires scale volume to de-risk investment. HGVs through their regular large demand for fuel are effective as anchor loads for projects

High Electricity – High Biomethane

Low electricity prices supported by smart RES and demand integration and low-cost storage drives uptake of electricity as the dominant clean fuel

High Hydrogen – High Biomethane

Rapidly increasing H_2 production scale brings down costs. H_2 similarity in use to fossil fuels means it is popular with end users

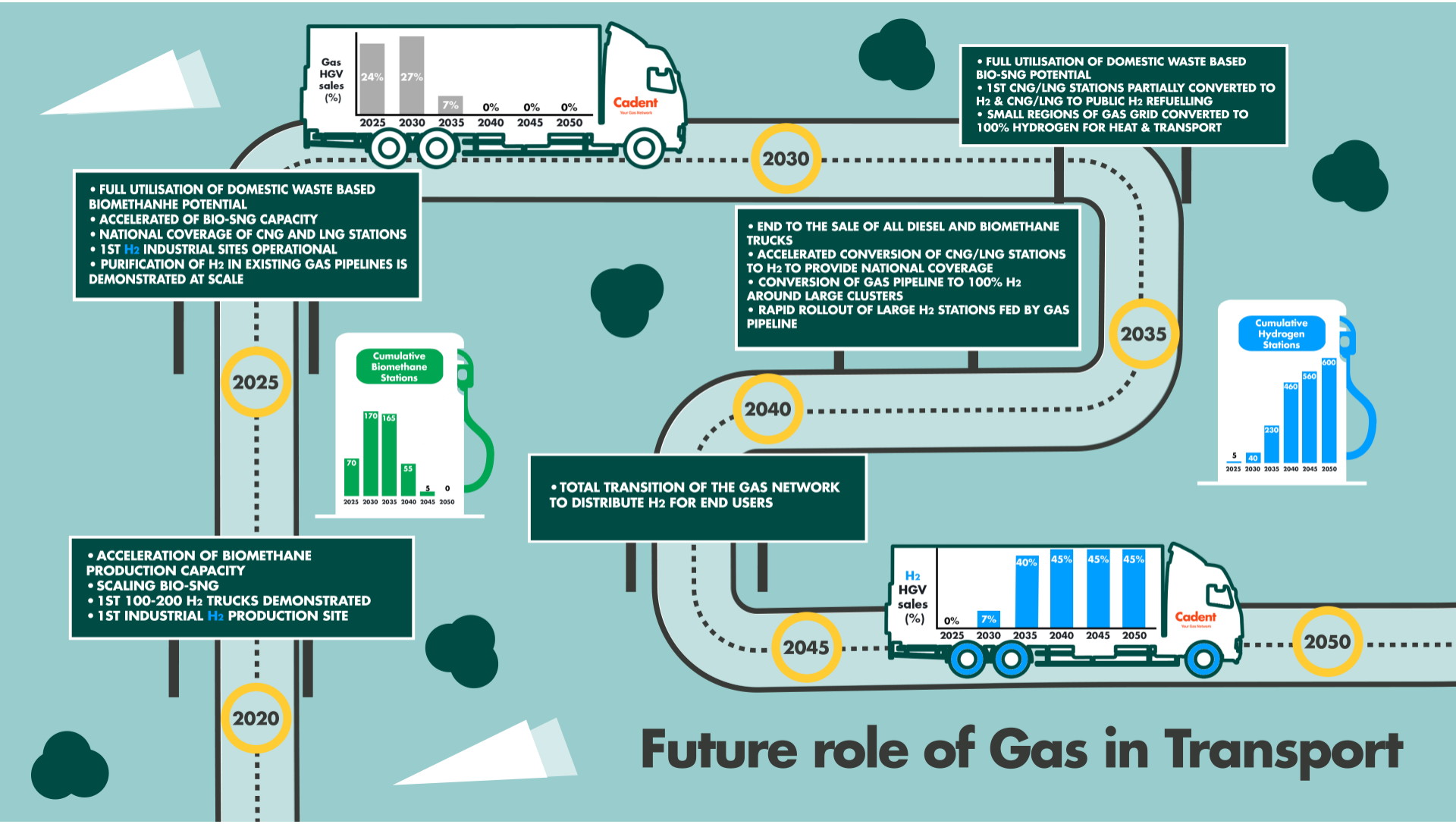
High Electricity – Low Biomethane

As above but limitations on feedstock and production capacity build up limit biomethane and bio-SNG supply

High Hydrogen – Low Biomethane

As above but limitations on feedstock and production capacity build up limit biomethane and bio-SNG supply

Overview of the narrative



Narrative Key Findings: biomethane and bio-SNG

Timeline

There is enough time between 2020 and the large-scale adoption of ZE HGVs for biomethane HGVs to play a role given existing investment

The focus of biomethane HGVs in the longest-range vehicles prevents competition with ZE HGVs and extends the role and impact of biomethane

The long-range biomethane HGVs, which don't completely leave the stock until the 2040s, ensure a good business model for investment in infrastructure

Impact

Biomethane and bio-SNG are available to decarbonise HGVs when no other decarbonisation options exist

Biomethane/bio-SNG will lay the groundwork for ZE refuelling in terms of operators refuelling behaviour and the development of a network of refuelling sites

The gradual conversion of each CNG/LNG site to ZE fuels will provide national ZE refuelling while helping to overcome the limited demand at each site

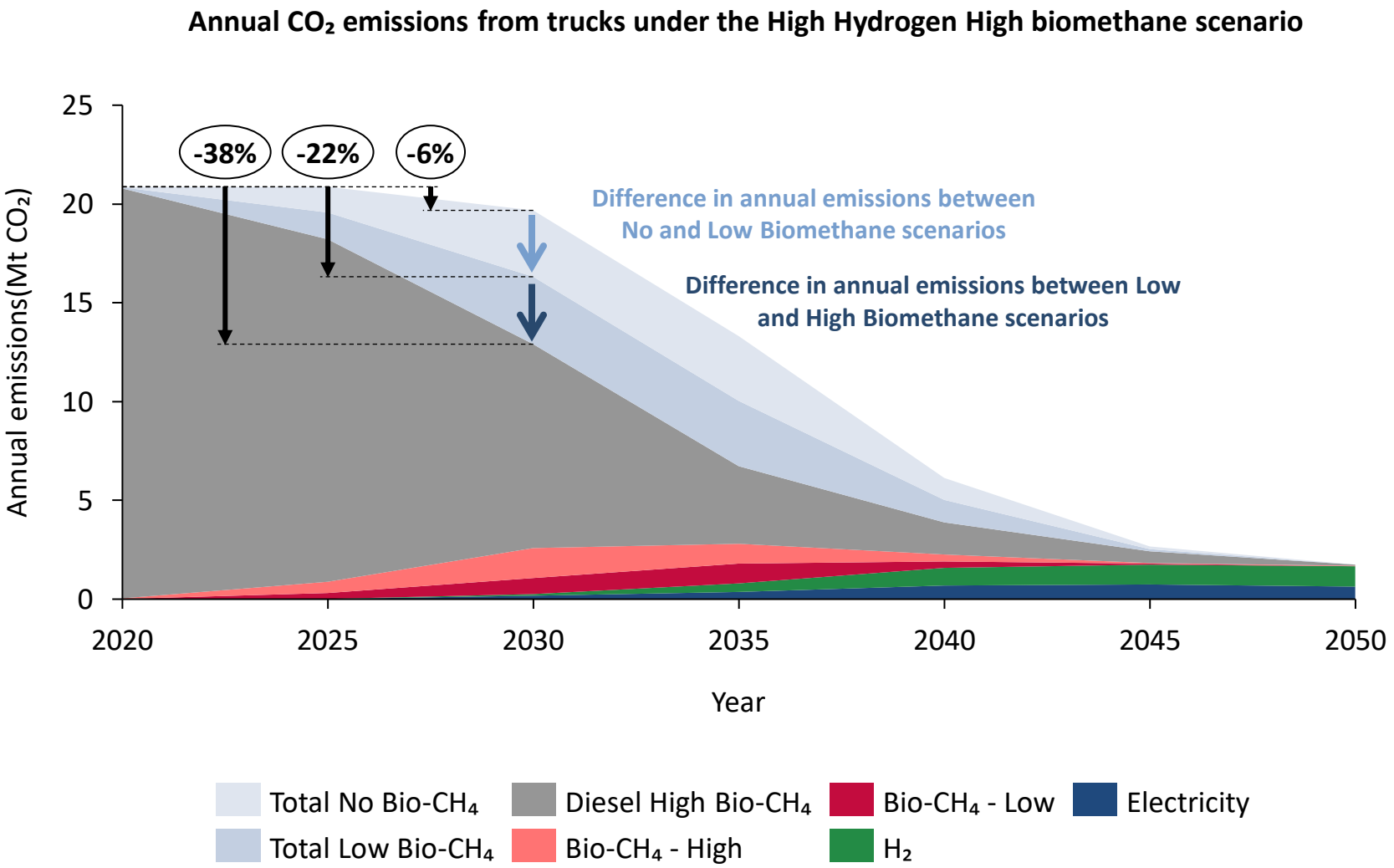
Challenges

The utilisation of feedstocks is currently very low. Realising the full potential of these fuels by 2035, when transport demand peaks, will be very challenging

The time window for biomethane and bio-SNG in transport is short. Realising the potential requires strong investment in the very short term

.

The inclusion of biomethane as a decarbonisation fuel for trucks enables the sector to achieve significant additional emission reductions by 2030



Green H_2 = through electrolysis of renewables. Blue H_2 = through reformation of natural gas with CCS

Narrative Key Findings: Hydrogen

Timeline

HGVs could be an important early H_2 user helping to boost production/distribution scale, while also acting as an anchor load for cars, vans & buses

H_2 HGVs start with a commercial demonstration, transition to back to depot medium haul applications and then enter the long-haul market with public refuelling

H_2 HGVs directly displace biomethane HGVs in the long-haul stock between 2035–2045. At the same time, the public refuelling infrastructure shifts

Impact

Increasing H_2 demand in transport builds scale brings down costs making H_2 and H_2 derived fuels more accessible to decarbonise other sectors

H_2 HGVs can operate on longer routes in the 2030s when BEV are still technology constrained, helping to accelerate decarbonisation

Large HGV HRS need piped H_2 and can act as a purification and distribution center for other H_2 transport demand decreasing overall costs

Challenges

The largest 10% of HGV HRS will be between 5-20t/day and will dispense 32% of HGV H_2. These stations can only be fed by pipeline

Pipeline H_2 contains contaminants meaning the H_2 must be purified before it can be used in a vehicle. The purification process needs further development

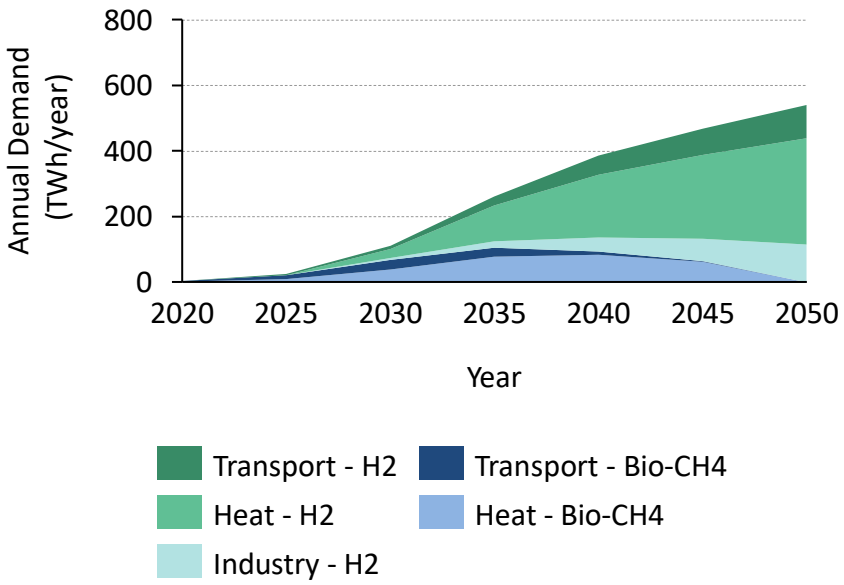
To succeed H_2 requires scale which relies on success across sectors. This means H_2 requires diverse stakeholders to work towards a common goal

HGV: Heavy Goods Vehicle. BEV: Battery Electric Vehicle. HRS: Hydrogen Refuelling station

There is a significant role for H_2 in UK decarbonisation and several key sectors, such as heating and HGVs will rely on piped supply

Significant H_2 Demand Expected

- Hydrogen demand in HGVs alone could reach as high as 22TWh by 2050
- Early demand is expected to be driven by transport and industry
- In the long-term, heat is the main demand for H_2 with 350 of the 550TWh projected



H_2 HGV Refuelling Needs Pipe Fed Stations

- Siting HGV H_2 refuelling within depots, as is done today for diesel, is expected to be challenging for fleets given space and safety constraints
- This suggests a higher proportion of HGVs will be fed from public stations siting near clusters of depots or along the strategic road network
- Feeding these large stations with on-site production or trailered delivery is impractical given land requirements and siting constraint
- Larger HGV stations, that dispense most of the H_2 are therefore likely to rely on piped connections

The realisation of this narrative relies on a number of key enablers

Key Enablers

- Support for and rollout of biomethane and bio-SNG production capacity must ramp up very quickly from today to realise the full feedstock potential before direct demand for these fuels' peaks in the 2030s
- Hydrogen must be seen as key decarbonisation option in transport, heat and industry in order to achieve effective scale in production and distribution to bring down costs. Each sector is important as each brings different factors to the success of hydrogen rollout
- Large HRS will require piped connections, this means the purification of hydrogen from pipelines must be shown to be viable and cost effective
- Green gases can be produced and distributed in through a wide range of pathways. The emissions from these pathways over time must be well understood to ensure effective decarbonisation

Outcomes and Next Steps

What's Next

- The findings from this project have already fed into the DfT Transport Decarbonisation Plan through our interim report and direct conversions
- The project will run until the end of this year with the final report published in early 2021
- The hope is that the narrative can be agreed by all major stakeholders and can act as a starting framework to align efforts
- The final chapter of the report will highlight future areas of work needed to help realise the narrative. Wider stakeholder engagement in these areas should be pursued

Growing Market for Freight

Biomethane for transport: Trucks are rolling now!

THIS DOCUMENT IS •BUSINESS CONFIDENTIAL INFORMATION

Green Gas Day 12/11/2020

GLOBAL MARKETS & TECHNOLOGIES

David Hurren CEO Biogas Solutions Europe

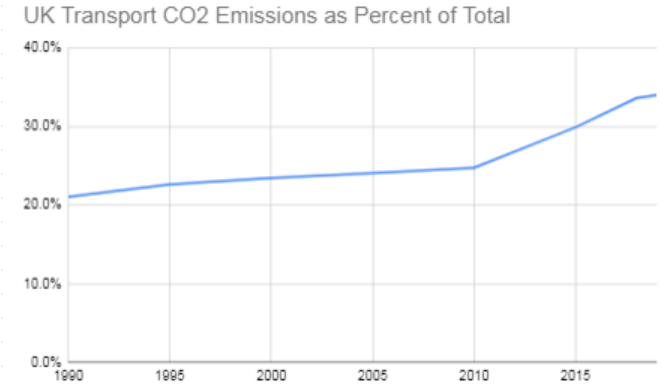
Contents

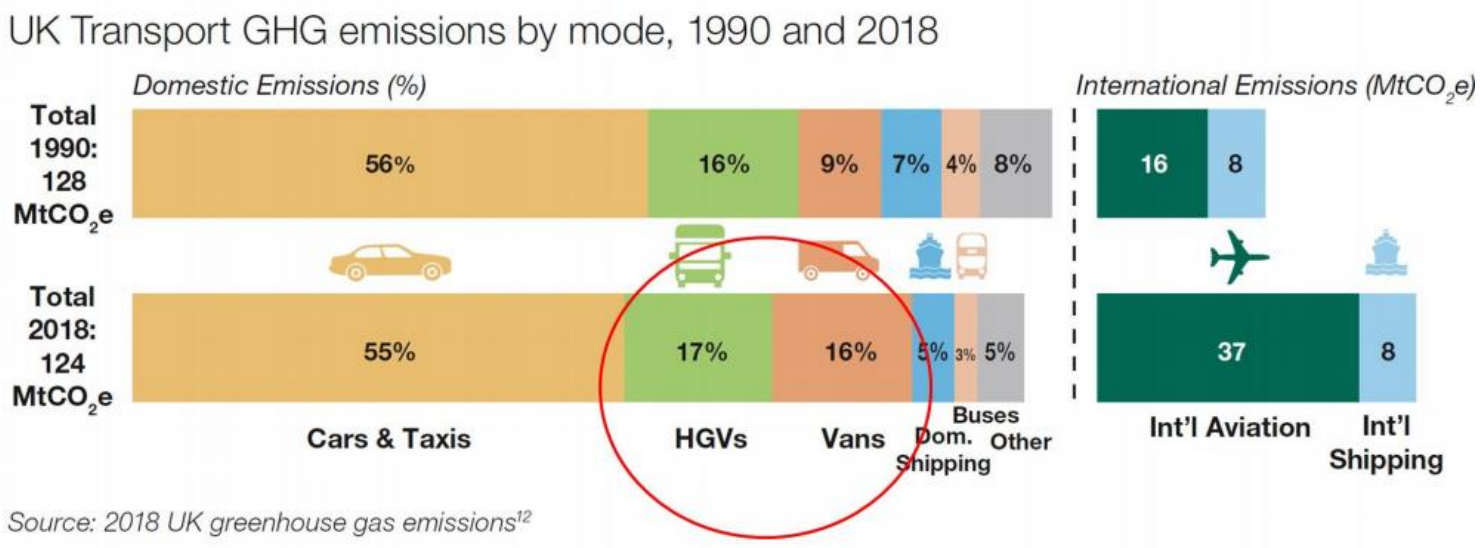
1. Why do we need a solution?
2. Biogas Solutions Europe UK - Biomethane Production & Supply
3. Low Emission Freight Trial – " Dedicated to Gas" Outputs
4. Gas Vehicle Network Campaign Launch
5. Positive signs for UK- it's here – it's now – it's happening

Why we need a solution

Between 1990 & 2019 (Provisional) Transport has become UK's biggest emitting sector for CO_2 & GHG & in 2019 amounts to 34% of UK CO_2 Emissions.

In 2018 17% of that related to HGV's with no major reduction & no clear plans on short term impacts.





Source: 2018 UK greenhouse gas emissions[12]

Biogas Solutions Europe UK

Upstream Production to Downstream Delivery

Energy transition key figures

More than 80 bio-NGV filling stations in Europe

More than 15 multi-energy stations (CNG, LNG, liquid nitrogen) already opened in France

More than 120 hydrogen stations designed and installed in the world

18 biomethane production units worldwide

More than 100 years of experience in gas separation

Low Emission Freight Trial

Some Highlights

Low Emission Freight Trial - Dedicated to Gas
Innovate UK

Project lead

Air Liquide

Vehicle operators

Howard Tenens

ASDA

KUEHNE+NAGEL

Technical experts

cenex

EMISSIONS ANALYTICS

microlise

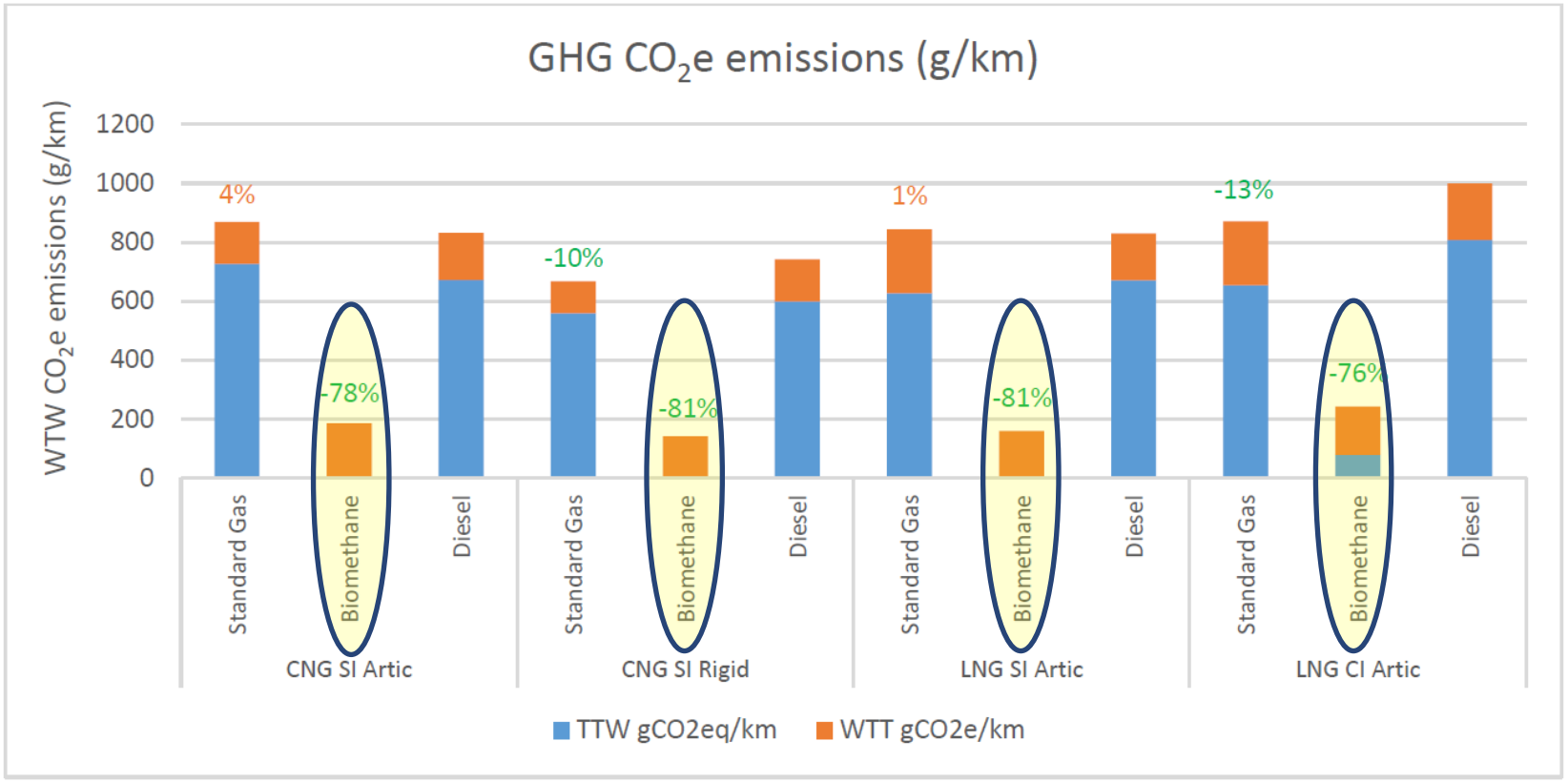
Vehicle equipment manufacturers

IVECO

SCANIA

VOLVO

Low Emission Freight Trial – Average across 3 duty cycles



Low Emission Freight Trial

1. Some key findings from in-service trials – e.g. operational impacts, infrastructure, driver perceptions, etc.

- **Positive operational performance and driver feedback** across the trials
- **Long haul** and **regional** operations most suited to dedicated gas technology
- Additional capital investment and maintenance costs in gas vehicles compared to diesel = **pay back from 2 years** at 160,000 km/year
- **More gas station infrastructure is needed**

2. Other trial findings, if appropriate – e.g. results of your own fuel/emissions testing

A key finding of this trial is that **methane slip was not an issue for the gas trial trucks**.

Business Case Modelling Shows
> 160 000km/a Ownership period > 5 years
Strong Economic & Environmental case for these trucks operating on Biomethane

Low Emission Freight Trial

•ASDA ordered 60 LNG trucks off the back of LEFT trial results, and are moving towards a significant roll-out of gas HGVs

•Kuehne+Nagel immediately deployed more LNG trucks following positive outcome of the LEFT trial

•Howard Tenens committed to broader CNG truck roll-out following positive experience of LEFT trial

•Air Liquide to have major its gas fuelling station infrastructure in the UK by Q1 2021

•Air Liquide has been supplying 100% biomethane to all UK stations since Jan 2019, and biomethane usage across overall UK gas fuelling station network reached 80% in 2019

GVN Campaign

11th November Campaign Launch

A **1%** annual CO_2 saving can be achieved by switching 540,000 diesel cars to electric OR,
14,000 HGVs from diesel to biomethane

With the fixed fuel differential (biomethane versus diesel) already in place until 2032 and a **national network** of 45-50 open access biogas refuelling stations operational by the end of **2025**, annual **CO_2e savings of around 5 million tons is achievable by 2030.**

Recommendation & Conclusion

- **The DfT's upcoming *Transport Decarbonisation Plan* should recommend a role for gas HGVs as a key method for decarbonising heavy goods transport.**
  It is the only way to decarbonise HGVs today without having to wait for a technological breakthrough in 20 years.

There is no other sector of the UK economy where large CO_2 emissions cuts can be so quickly and cost effectively implemented as the HGV and in particular the long-distance truck sector.

Here Now & Ready to Roll

Air Liquide Experience

Biomethane & HGV's Happening NOW

- **Continued roll out of Biomethane Production Facilities** - our **10th** Production unit in UK will start in Spring 2021

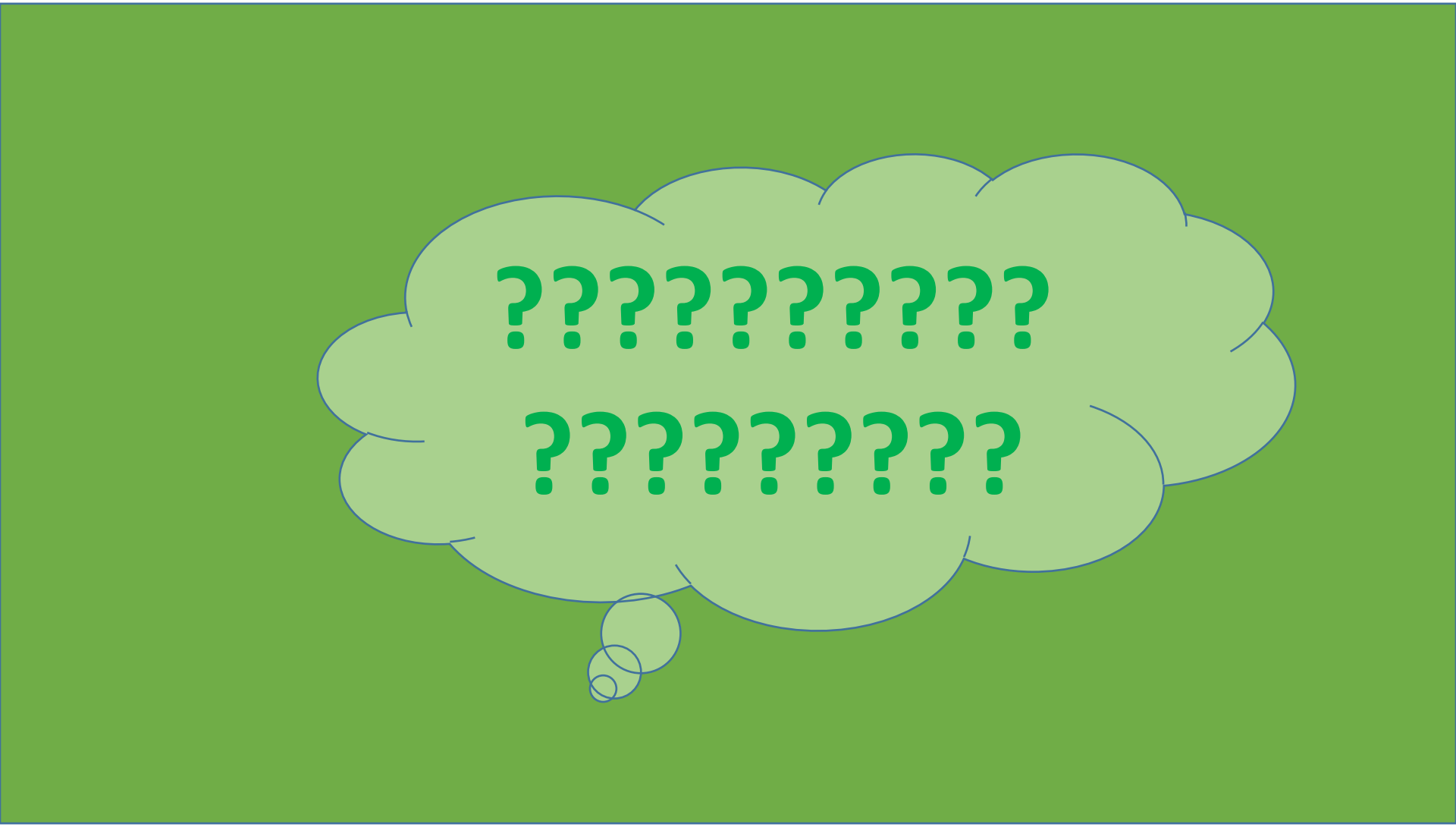
- **Strong interest & acceptance & experience now of operating Gas Trucks in the UK**

- **Market Shift to Renewable Fuels** - virtually all vehicles are running on Biomethane not Fossil Gas

  100 percent of our fuel is Bio to trucks and buses in the UK

  Rapid Deployment of Infrastructure - **7** more stations to become operational before **Q1 2021**, Network of 20 stations for Trucks & buses

QUESTIONS



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AD cost data review

NNFCC have been contracted by BEIS to conduct an evidence gathering exercise on costs associated with anaerobic digestion (AD) plants. The aim of this research is to establish the current costs of deploying and running an anaerobic digester to produce biomethane for injection into the grid, in Great Britain.

A survey is now live, for operators, developers or funders of AD facilities, with or without biomethane injection to grid, to provide up to date cost information. The survey is relevant to both operational facilities and those in the development phase.

NNFCC are initially reaching out via the survey to obtain high-level cost data, then plan to conduct more in-depth telephone interviews to improve the granularity of data, for completeness and validation purposes.

The survey is available here and should take no more than 30 minutes to complete.

Survey link: https://www.surveymonkey.co.uk/r/D9Y7MPS

The Bioeconomy Consultants
NNFCC

Thank you

See you on 22nd April 2022!

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UKGGD 2021

GREEN GAS DAY 2021

22nd April 2021

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