

Innovation in Sustainable Fuels Webinar Series

Session 3 – Renewable Gaseous Fuels

Document prepared by Zemo Partnership

Wednesday 31st March 2021

**Gloria Esposito, Head of Sustainability
Zemo Partnership**

Gaynor Hartnell, CEO, RTFA



**Zemo
Partnership**
Accelerating Transport to Zero Emissions



Today's Agenda



10:30am	Welcome and housekeeping	Gloria Esposito, Head of Sustainability, Zemo Partnership Gaynor Hartnell, CEO, RTFA
	Session Chair	Gloria Esposito, Zemo Partnership
10:35 am	Low carbon hydrogen use in heavy duty vehicle applications	Dr Penny Atkins – Deputy Director, Advanced Engineering Centre, University of Brighton
10.50 am	Biomethane deployment and opportunities for infrastructure roll out	CNG Fuels Ltd, CEO, Philip Fjeld
11:05 am	BioSNG, biohydrogen and greenhouse gas removal	Andy Cornell, CEO, Advanced Biofuel Solutions Ltd
11:20 am	Renewable propane: routes to production and applications	Dr Keith Simons, Principal Scientist – Sustainable Fuels, SHV Energy
11:35 am	Panel Discussion	
12:00 pm	Session wrap up and next session	Gaynor Hartnell, RTFA

All attendees on mute, camera off, please enter your questions in the chat function

Hydrogen in the heavy duty transport sector

Innovation in Sustainable Fuels Webinar Series: Part 3 Renewable Gaseous Fuel
31 March 2021

Dr Penny Atkins
Deputy Director, Advanced Engineering Centre

There is an urgent need to decarbonise transport rapidly to mitigate climate change

- The UK needs to reach net zero GHG emissions by 2050
- The Tyndall Institute at Manchester University illustrates the urgency of near term carbon reduction

To limit warming to a 1.5-2°C rise ...

... this needs to be split **equitably** amongst all of the world's nations



Splitting the global carbon budget equitably and calculating the UK's fair share gives < 9 years at our current rate of carbon emissions

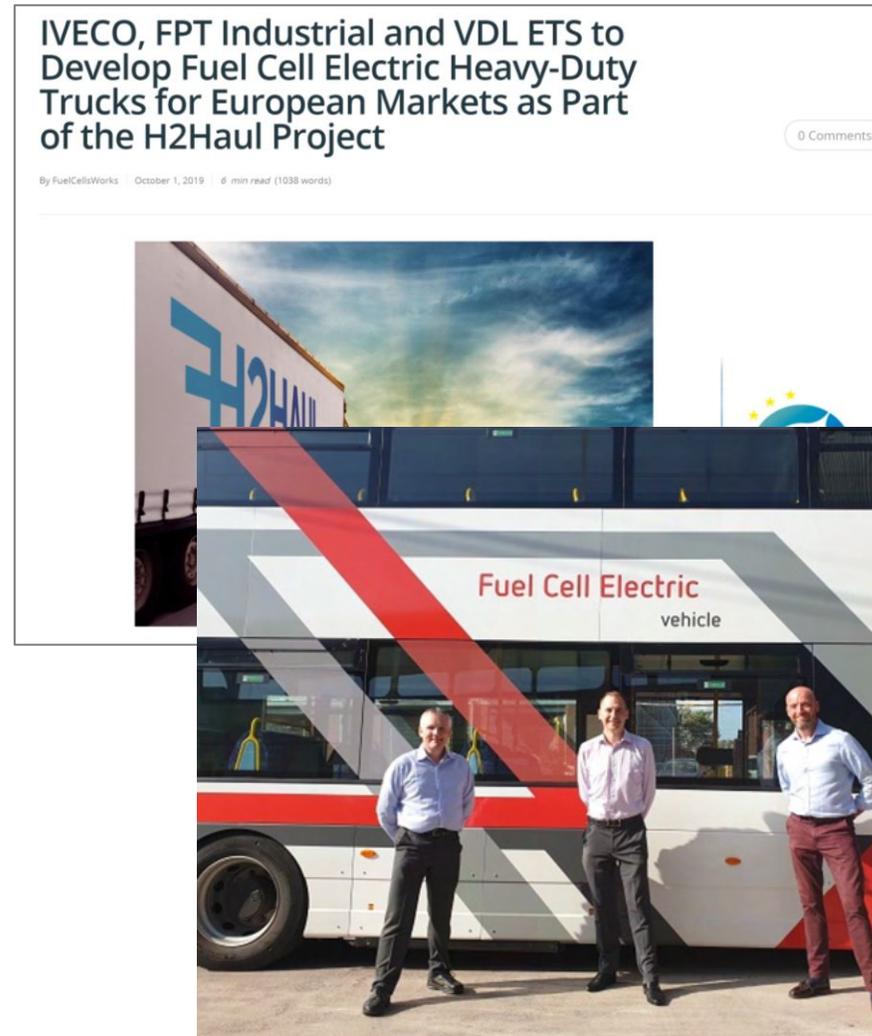
This means the UK needs to ramp up rapidly to a reduction rate of 13% per year

... how much should the UK get?



Low carbon hydrogen is seen as a key enabler for HD decarbonisation due to zero tailpipe emissions, fast refuelling and increased range of BEV

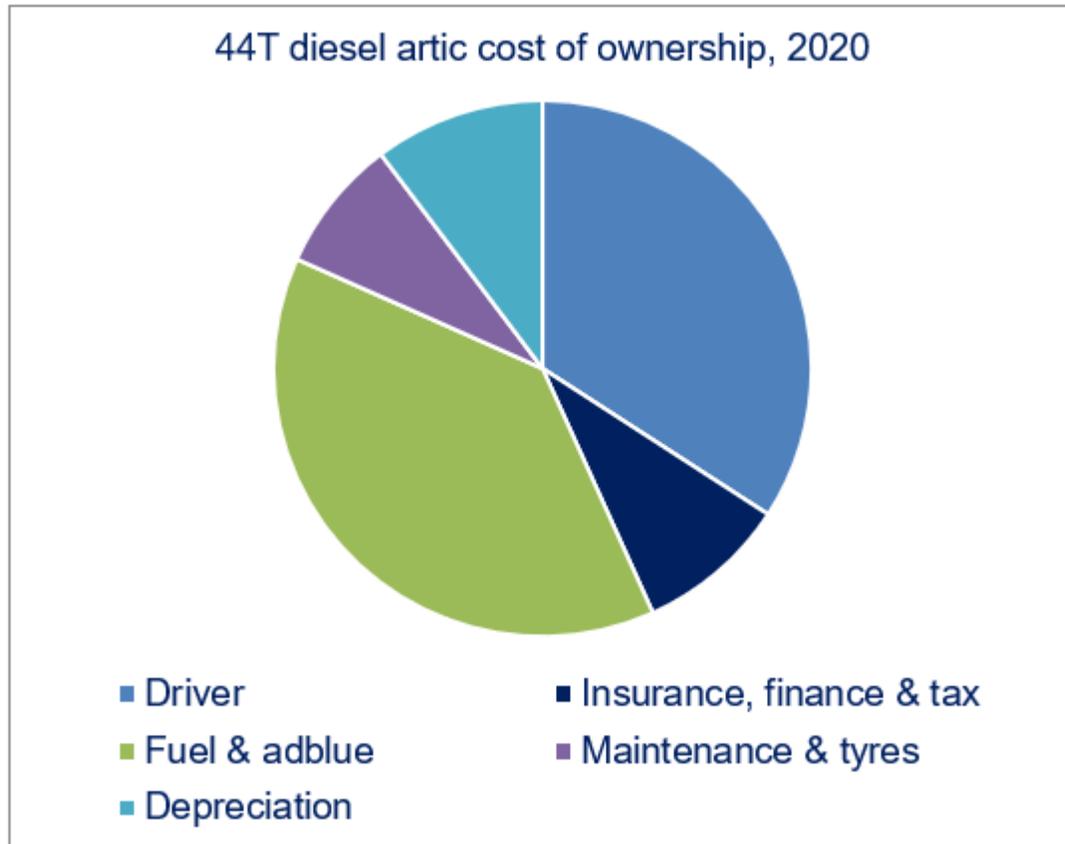
- PEM fuel cell demonstrators are on the road in a range of applications, for example:
 - Bus demonstrators on the road in Aberdeen, Birmingham and London, co-funded by the Fuel Cells and Hydrogen Joint Venture (FCH JU) under the Horizon 2020 programme through the JIVE project.
 - Refuse trucks in Eindhoven as part of the Life 'N Grab Hy! Project
 - H2Haul will trial 16 H2FC trucks in Belgium, France, Germany, and Switzerland
- Brighton and Hove buses plan to introduce 20 H2FC buses into commercial operation
 - Part funded by European Commission (£2.9M) and UK low emission bus scheme (£4.3M)



For the heavy duty transport sector, cost of ownership is key, alongside compliance with regulatory requirements

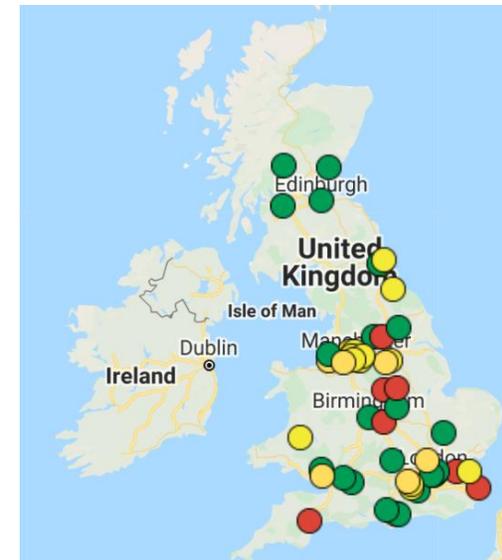
Operators requirements

- Cost of ownership is key (annual, per tonne mile)



Regulatory requirements

- In 2019, the European Commission implemented CO₂ emissions regulation for heavy duty vehicles, From 2025 – 15% reduction, From 2030 – 30% reduction, (compared to EU average 2019-20 emissions)
- Many low emissions zones are planned in the UK



- Clean Air Zone expected or being planned
- Area required by government to produce a CAZ plan
- CAZ not expected or opposed by local authority

In London ULEZ, HD vehicles must comply with Euro VI
Typical charge for non compliant HD vehicles £100 per day

Practical considerations are also very important as they impact freight efficiency, and in turn cost of ownership

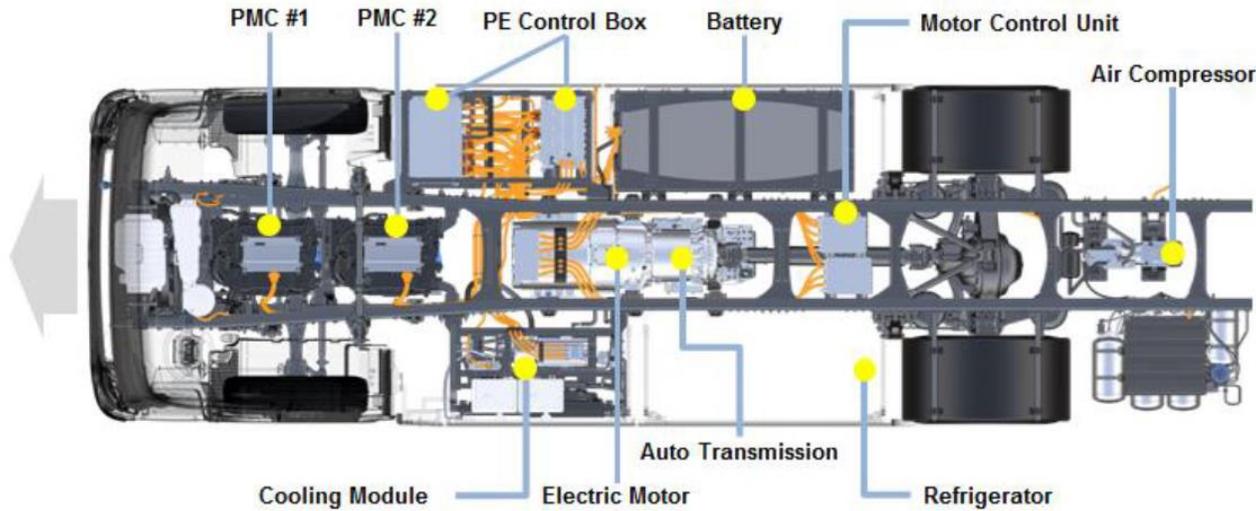


Figure 16. Schematic of major components of FC truck

This Hyundai Xcient fuel cell truck has 190 kW PEM fuel cell, 73,2 kWh battery, 32 kg hydrogen storage to give a range of 300km at 34 tons gross combination weight

Packaging powertrain and energy storage components on the truck can affect available payload mass and volume

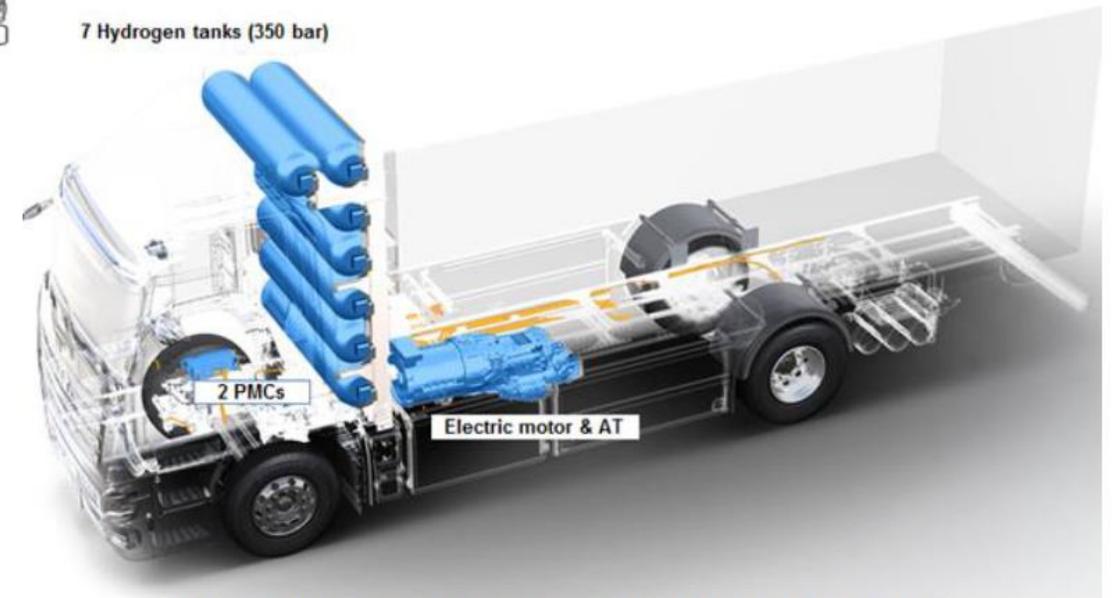


Figure 14. Configuration of HMC's FC truck

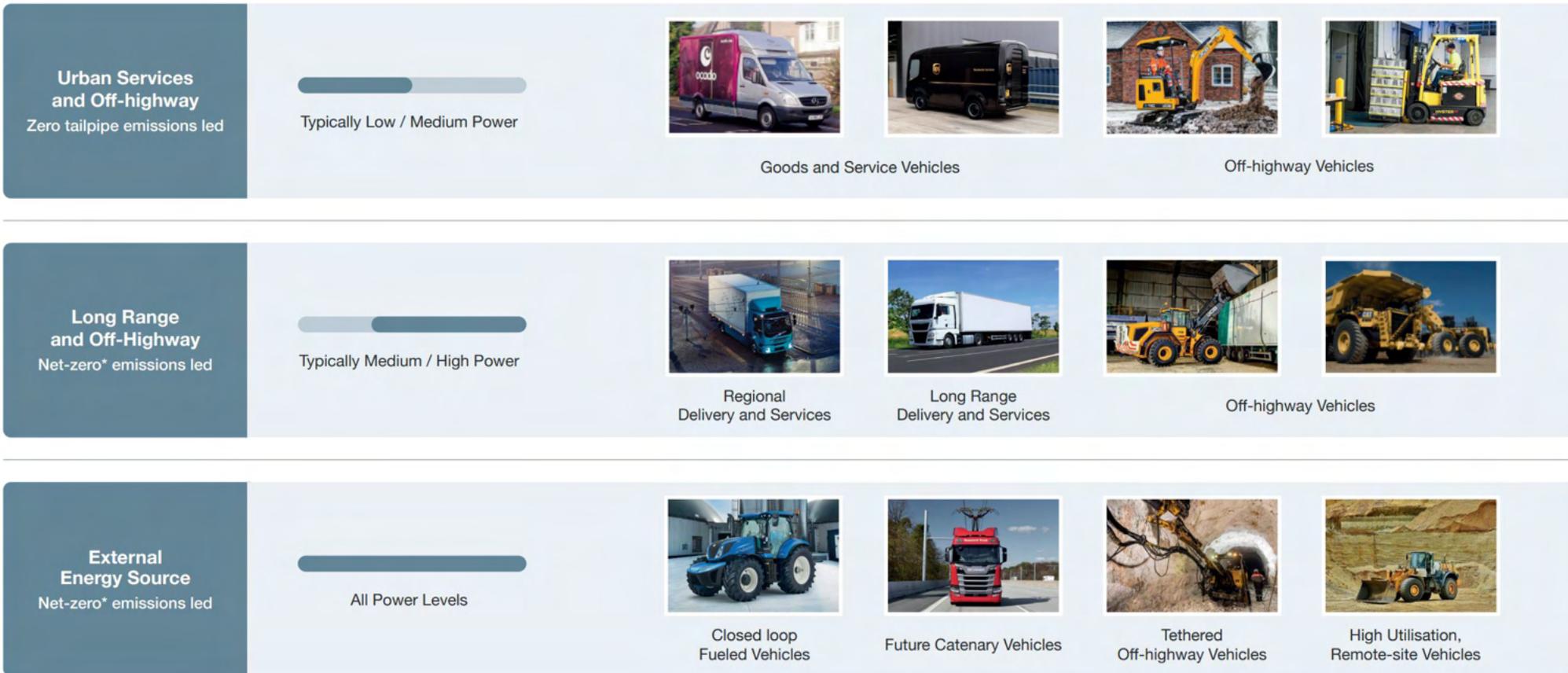
Operational requirements like range and payload depend on vehicle type and duty cycle



Roadmap 2020

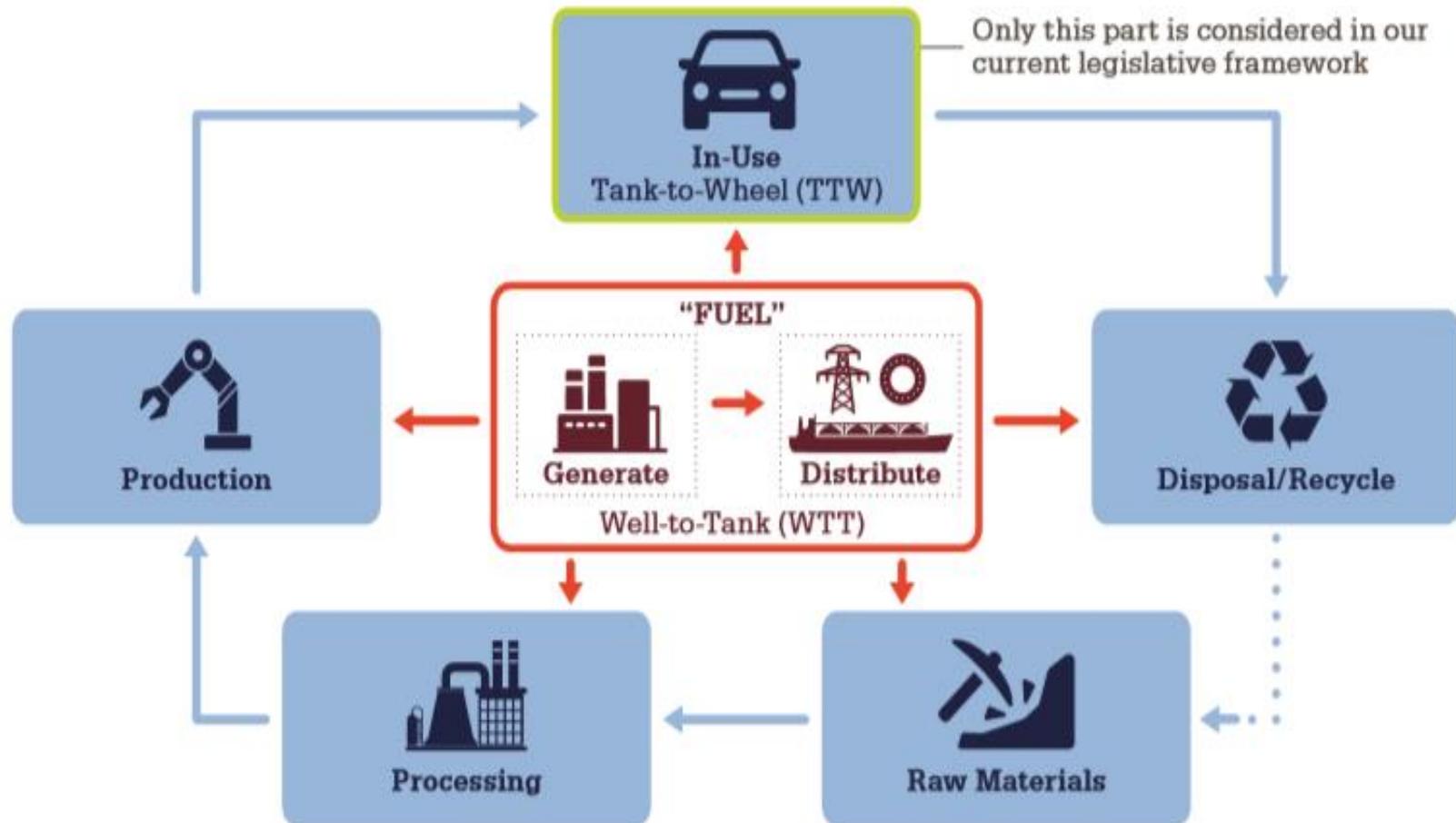
Heavy Goods >3.5t
and Off-highway Vehicle

Product Classification



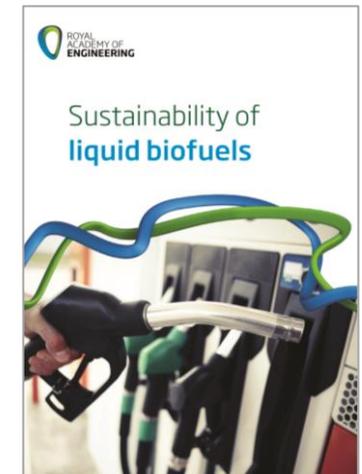
Life cycle analysis of emissions is important to ensure genuine GHG reductions are achieved

Lifecycle analysis considers cradle to grave emissions – emissions from production and use through to final disposal as waste

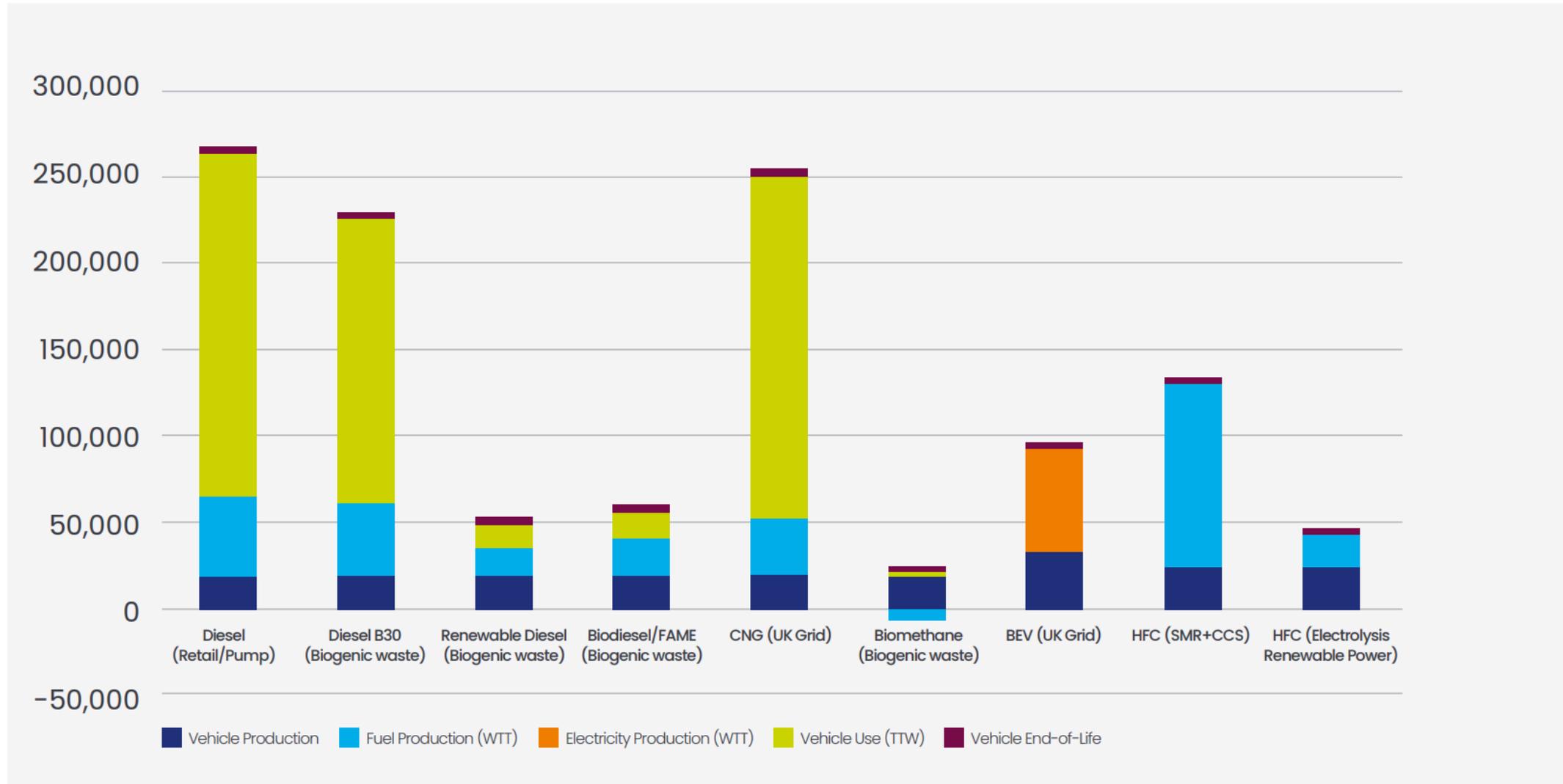


Broader sustainability issues are also important:

- Cost of production (economic impact)
- Competitiveness with fossil fuels
- Energy and water security
- Employment provision
- Rural development
- Human health impacts

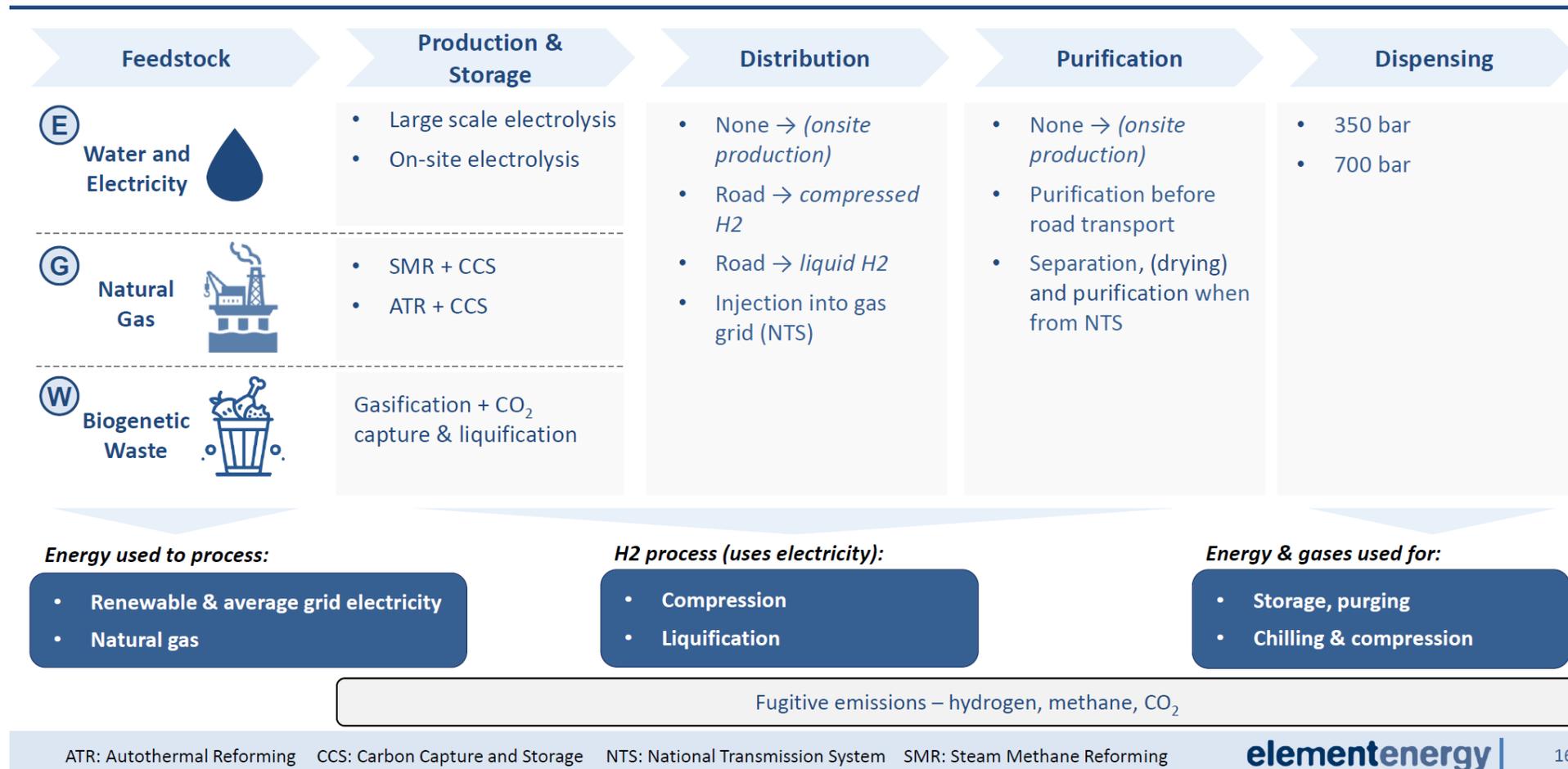


Hydrogen production pathways can have a significant impact on lifecycle emissions

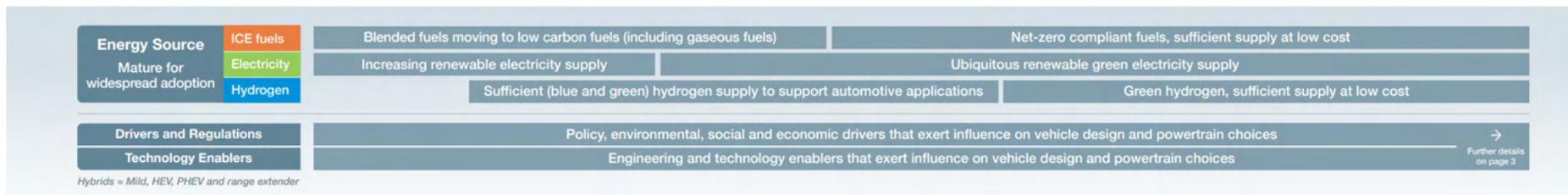
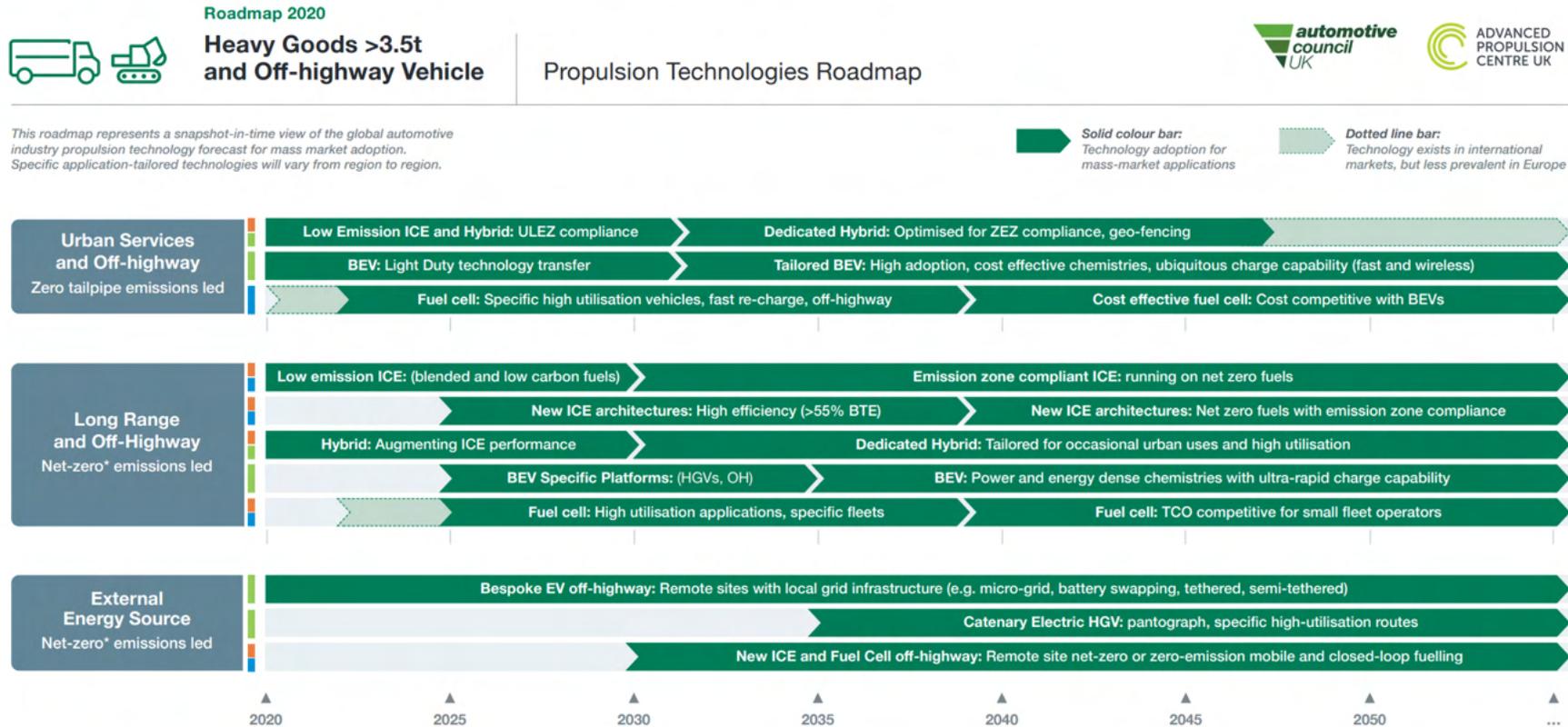


A sustainable supply chain is needed to enable hydrogen to play a role in decarbonisation of the UK heavy duty sector

Overview of the main steps making-up the WTT pathways



PEM fuel cells are seen as a key solution for heavy duty vehicle propulsion, but APC roadmaps show they may not reach mass market until 2040



Hydrogen fuelled engines could provide a near term alternative to PEM fuel cells, accelerating the uptake of hydrogen in the heavy duty sector



- Hydrogen engines could offer a faster route to market than fuel cells – industry view that H₂ ICE could be on the market by 2025
- Research shows that hydrogen engines could produce very low NO_x emissions with lean combustion with similar efficiency to PEM fuel cells
- Development in the UK could safeguard jobs in ICE R&D and production supply chain

Powertrain changes: diesel - hydrogen

Modified piston, compression ratio, valves, valve seat, piston rings

Package injectors for PFI or DI fuelling, ignition system

Modified control system



New Holland Bio-methane e

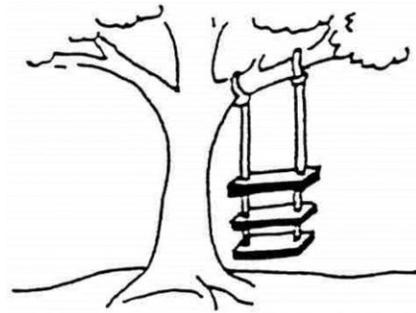
Turbocharger and aftertreatment

H₂ safety measures – eg crank case ventilation

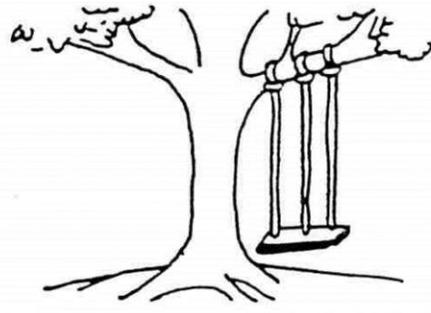
Powertrain system must meet market needs for power output and driveability

Must have zero impact NO_x emissions

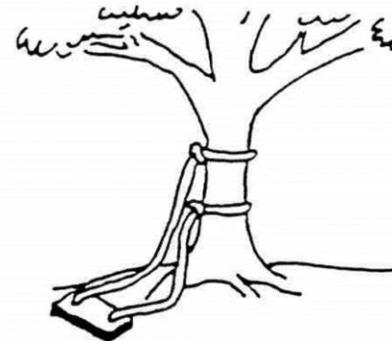
Hydrogen could provide practical zero emissions propulsion in the heavy duty sector – focus on fast, cost effective decarbonisation is needed



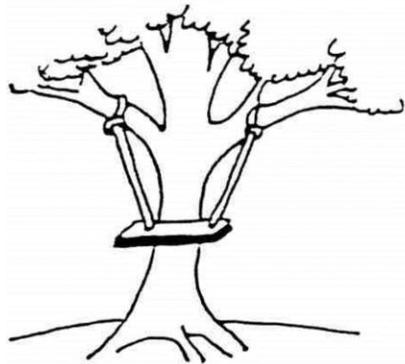
As the architect drew it.



As engineering designed it.



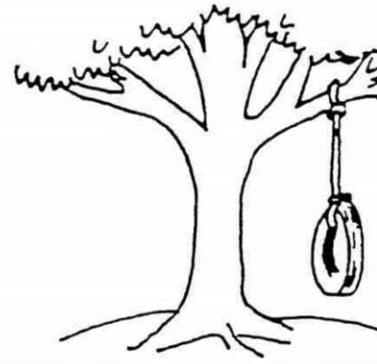
As OSHA regulated it.



As the sales force bid it.



As the field crew installed it.



What the customer wanted.

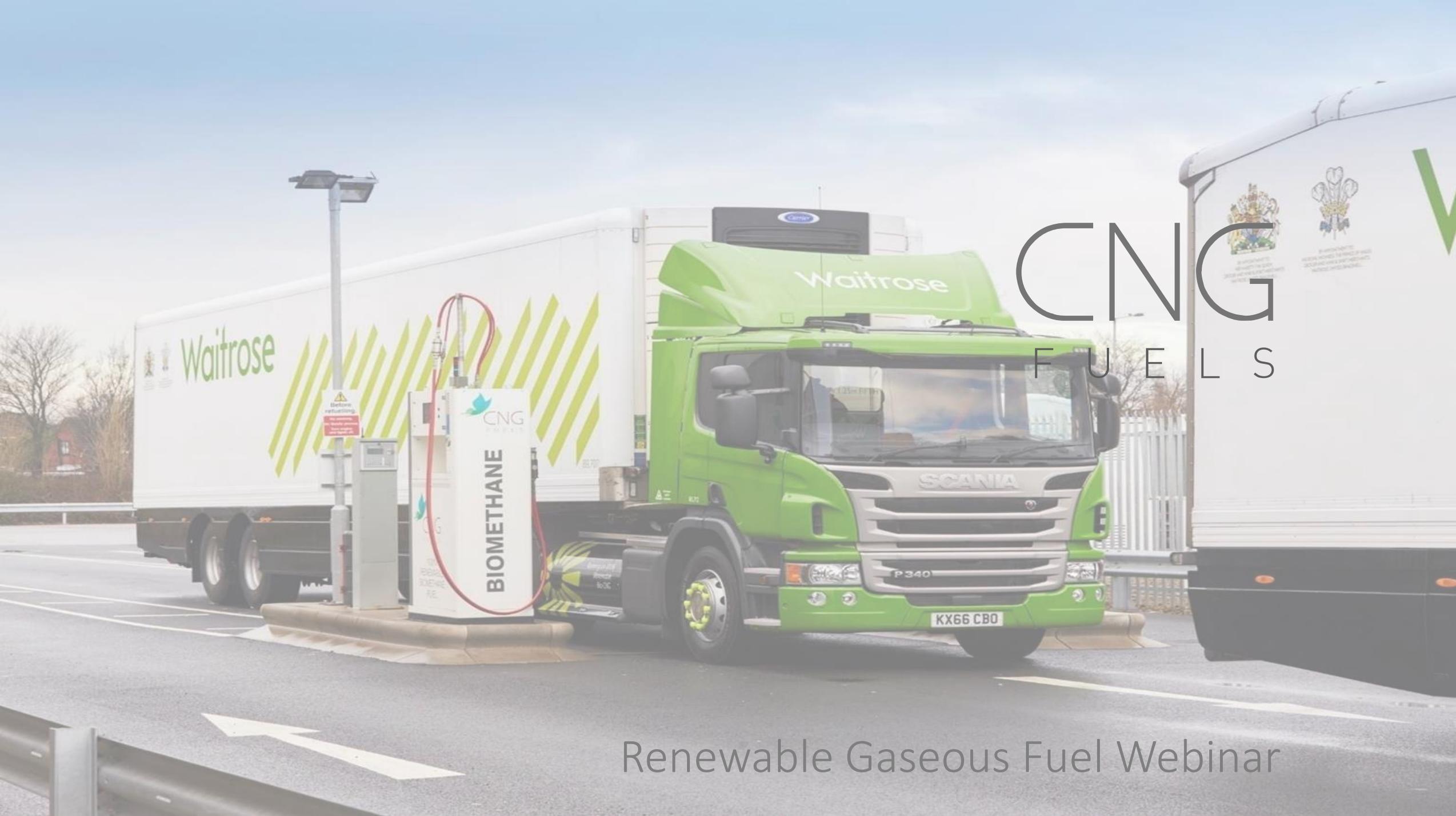
Get involved in the discussion

Join the Transport Energy Network

The Transport Energy Network (TEN) is a collaborative network designed to develop a consensus view of pathways to net-zero emissions for challenging applications with high journey energy requirements like heavy-duty trucks and off-highway machines.

[FIND OUT MORE](#)

[Spokes - APCUK](#)



CNG FUELS

Renewable Gaseous Fuel Webinar

CNG Fuels at a Glance



CNG Fuels is the UK's largest developer, owner and operator of public-access bio-CNG (100% biomethane) stations



- CNG Fuels is the UK's largest and fastest growing operator of public-access biomethane refuelling (Bio-CNG) infrastructure
- Since 2016, 100% of fuel volume dispensed at CNG Fuels' Bio-CNG stations has been RTFO-approved biomethane sourced from sustainable and renewable waste feedstocks

25+ UK Bio-CNG stations in various stages of development

1,000% growth in biomethane since Q3 2016



UK's Road Haulage Emissions Problem



HGVs account for 1.3% of vehicles on the road yet produce 17% of transport emissions and are therefore a key sector for decarbonisation. The only currently proven, mass-adoptable solution is biomethane powered HGVs.

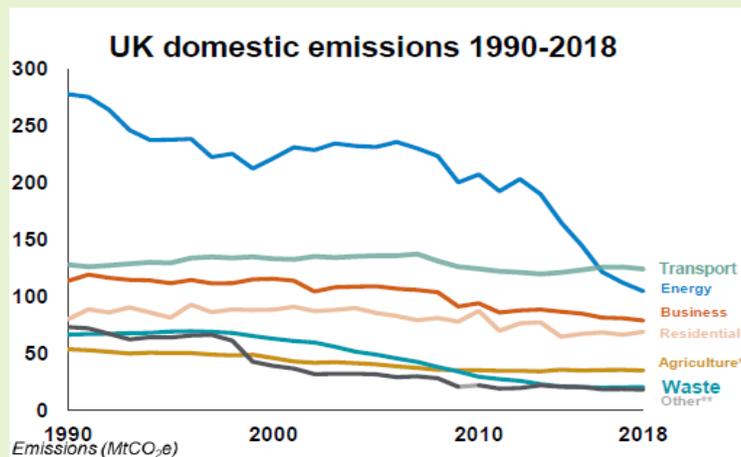
The emissions problem is huge...

- The UK currently emits 500Mt of carbon dioxide each year, but has committed to a legally binding target of net-zero emissions by 2050
- **HGVs** account for just **1.3% of vehicles** on the road, yet produce **17% of road transport emissions** and 4.5% of total UK greenhouse gas ("GHG") emissions
- There are c.**130,000 HGVs over 31 tonnes** with numbers increasing to meet consumer demands
- HGVs are the hardest road vehicles to decarbonise due to their long driving range, high payload and low production volume

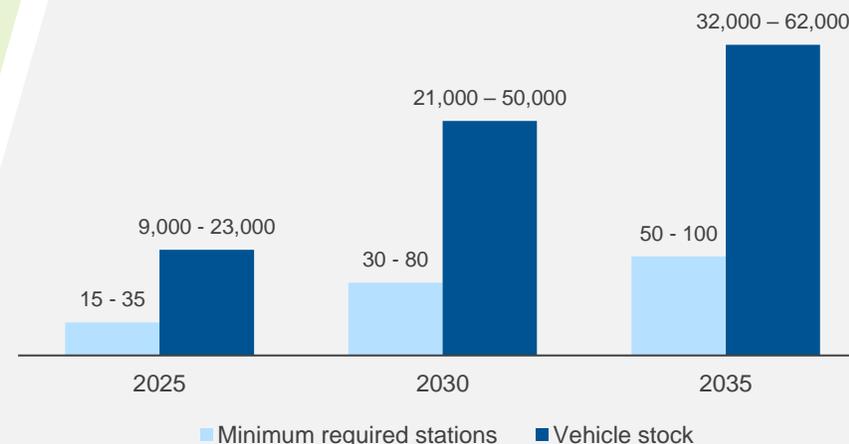
...but with a clear solution

- Beyond diesel trucks there are three options:
 1. Electric vehicles: commercially available and well-suited for light, short range transport sectors but there are few or no options for long-haul freight
 2. Hydrogen: expected to provide a solution for HGVs in the long-term but the technology readiness is low and the timeframe is uncertain
 3. **Biomethane (CNG or LNG):** currently the only proven, commercially available option for long-haul vehicles for the next 10-15 years
- Strong fundamentals are driving demand for Bio-CNG HGVs from fleet operators as a means to address emissions targets

Transport is the UK's largest GHG emitter (2018)



Projected uptake of CNG and LNG HGVs in the UK fleet



The RTFO Scheme



The Renewable Transport Fuel Obligation (RTFO) is the UK's main policy for decarbonising road transport

- ✓ The Renewable Transport Fuel Obligation (RTFO) is a market-based policy that was launched in April 2008 and has been successful in reducing GHG emissions from transport
- ✓ Only unsupported (unsubsidised/no feed-in-tariff) biomethane can be used. Due to single vs double counting, for crop vs waste feedstocks, the RTFO effectively excludes non-waste biomethane from road transport
- ✓ Biomethane is the fastest growing biofuel and can either be:

Supplied, liquefied or compressed by trailer



Mass-balanced via pipeline grid to Bio-CNG station



Emissions Benefits Over Diesel



Bio-CNG offers lower total cost of ownership and 100%+ emissions reductions over diesel

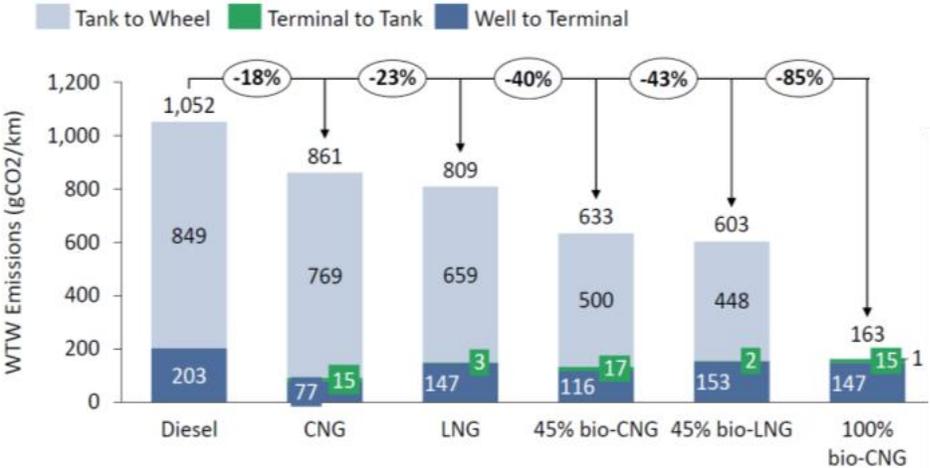
Biomethane offers deep GHG cuts compared to diesel

- ✓ Currently biomethane from a waste feedstock typically offers GHG savings of 85%
- ✓ From Jan 2022 onwards, biomethane produced from manure is will become a GHG negative fuel

Well-to-wheel emissions benefits, gCO₂/km



2018 Well to Wheel emissions, gCO₂/km



Biomethane from manure goes negative

Some Stats



Replacing one diesel, long-haul, HGV with one that runs on biomethane, typically reduces GHG emissions by **120 - 150 tonnes/annum**

This is the equivalent to taking **50 - 70** conventional passenger vehicles off the road

In 2019, **80% of all gas** supplied to road transport was biomethane from a waste feedstock. We estimate the percentage is **above 90 - 95% for 2020**

From Q1 2019 to Q1 2020, the quarterly volume of RTFO approved biomethane in road transport **increased by 358%**

As a result of the industry momentum outlined above, biomethane could result in GHG savings from the UK heavy haulage industry of more than **2 million tonnes** of GHG emissions per year **by 2025**

Typical Public Access Bio-CNG Station



One station can refuel 500+ HGVs per day, 24/7/365 days per year

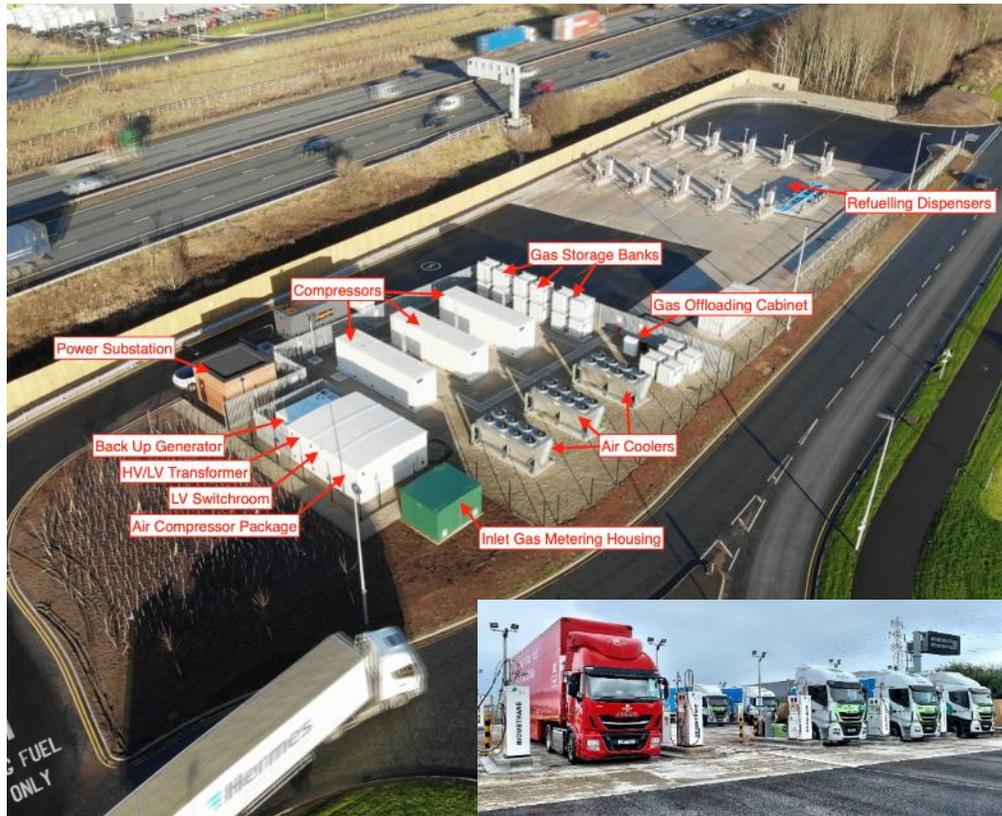
- RTFO biomethane is heavily focused on long-haul HGVs
- Back-to-base logistics dominates, making it possible to refuel many vehicles at relatively few stations
- Our Warrington station, which is the largest dedicated CNG truck refuelling station in Europe, was recently opened
- Similar stations in development across the UK



Operation and Maintenance of Sites



CNG Fuels' in-house team of engineers provide sufficient coverage of sites and will expand as new sites become operational, supported by CNG Fuels' bespoke 24 hour monitoring system and additional security monitoring.



Site maintenance

- Sites are maintained by in-house team engineers

Site monitoring, security and back up

- CNG Fuels has designed and commissioned a bespoke remote monitoring (SCADA) system,
- CNG Fuels has implemented back up generators and mobile refuelling capacity to support any material unforeseen events

Transport operations

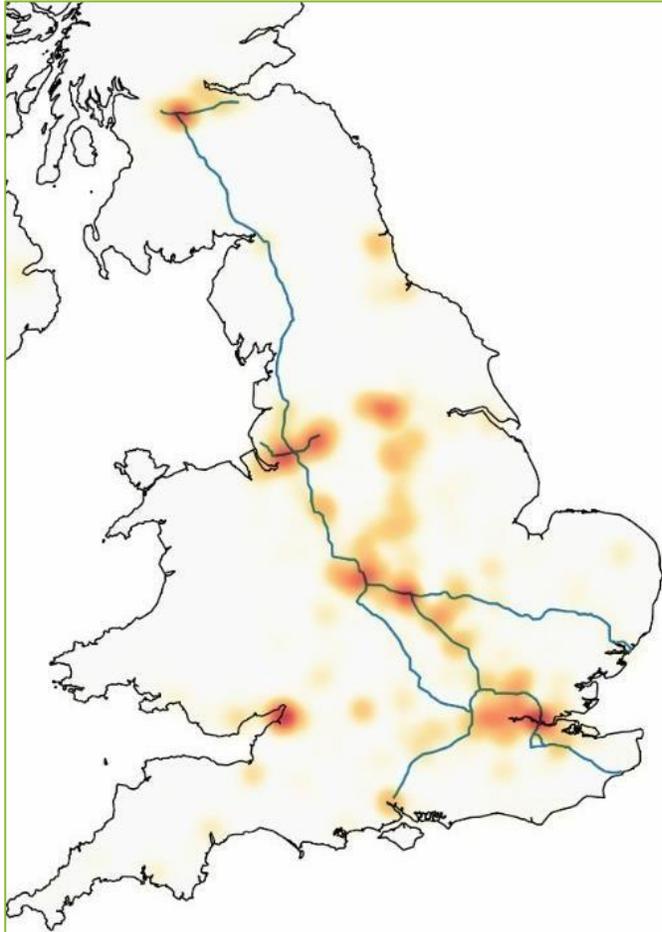
- CNG Fuels has an in-house team of transport and ADR specialists
- The company has a Transport Operators License and will bring all transport operations in-house to attain end-to-end supply chain control of biomethane from CNG Fuels' stations to the end customer

Bio-CNG Station Rollout



CNG Fuels' near term Bio-CNG station rollout plans is focused on areas with the greatest HGV penetration

Heatmap of UK HGV Fleets



CNG Fuels Bio-CNG Station Rollout



Summary



In order to meet carbon budgets we need transport **decarbonisation solutions now**

The UK HGV sector is a very hard sector to decarbonise, where electrification (BEV or H₂) is **still decades away from true mass adoption**

Biomethane as a transport fuel has reached a tipping point, where **mass adoption is now occurring** and the (long-haul) HGV sector is decarbonising more rapidly than other transport sectors

GHG savings from biomethane are typically 85-90% compared to diesel. However, biomethane from manure will become a **negative GHG transport fuel from 2022 onwards**

Given the rapid current deployment of gas trucks, and uptake of biomethane as a transport fuel, we estimate that as much as **2 million tonnes/yr of GHG emissions** can be saved by biomethane-fuelled HGVs in **2025**

Thank You



The logo for ABSIL features the lowercase letters 'absil' in a bold, green, sans-serif font. The letter 'o' is replaced by a stylized green leaf with a white vein, positioned inside a white teardrop shape that forms the upper part of the letter.

advanced biofuel solutions ltd

Innovation in Sustainable Fuels

March 2021

World-leading technology...

ABSL has the world's leading technology - **RadGas** - that transforms waste or biomass residues into

- ✓ BioHydrogen
- ✓ BioMethane
- ✓ Sustainable liquid fuels including aviation fuel

We lead the world in **efficiency**

- ✓ 85% of the energy of the waste input is retained in the gas output, creating a low cost route to satisfying green obligations

We lead the world in **commercial development**

- ✓ No other business or technology has a plant that makes chemical grade synthesis gas reliably and predictably...
- ✓ ...in a 24/7 x 365 commercial setting
- ✓ with major industry rollout imminent



...with Carbon Capture



- ✓ RadGas with carbon capture creates carbon negative fuels
- ✓ RadGas process has no emissions to air
- ✓ RadGas has received significant UK Govt financial support from DfT; they sit on the board
- ✓ RadGas was developed in formal collaboration with Cadent and Wales & West



Our Swindon Plant...

RadGas was initially proven with **thousands of hours of operation** at pilot scale. ABSL then built and commissioned the **first commercial demonstration plant** in Swindon.

- ✓ Converts 1,000kg per hour of waste wood or refuse derived fuel into 200kg of biomethane and 800kg of carbon dioxide
- ✓ Natural gas is injected into the grid and sold to CNG and LNG filling stations for green HGV and bus fuel
- ✓ Carbon dioxide is liquefied and sold to industry
- ✓ Plant operates 7,500 hours per year with one month annual shutdown
- ✓ Team of 20 will run plant including 15 operators, 3 maintenance engineers, administrator and plant manager
- ✓ Plant proves that technology operates reliably and efficiently
- ✓ In wet commissioning at present



Protos Park, Cheshire



ABSL is developing its first large scale plant in **Protos Energy Park, Cheshire**

Option over site with **planning permission**.

Focus is on **biomethane production for transport** with gradual transition to biohydrogen production

Tender for main contractor currently underway.

Plant converts 100,000 tonnes per annum or waste into 315GWh of low carbon natural gas or hydrogen.

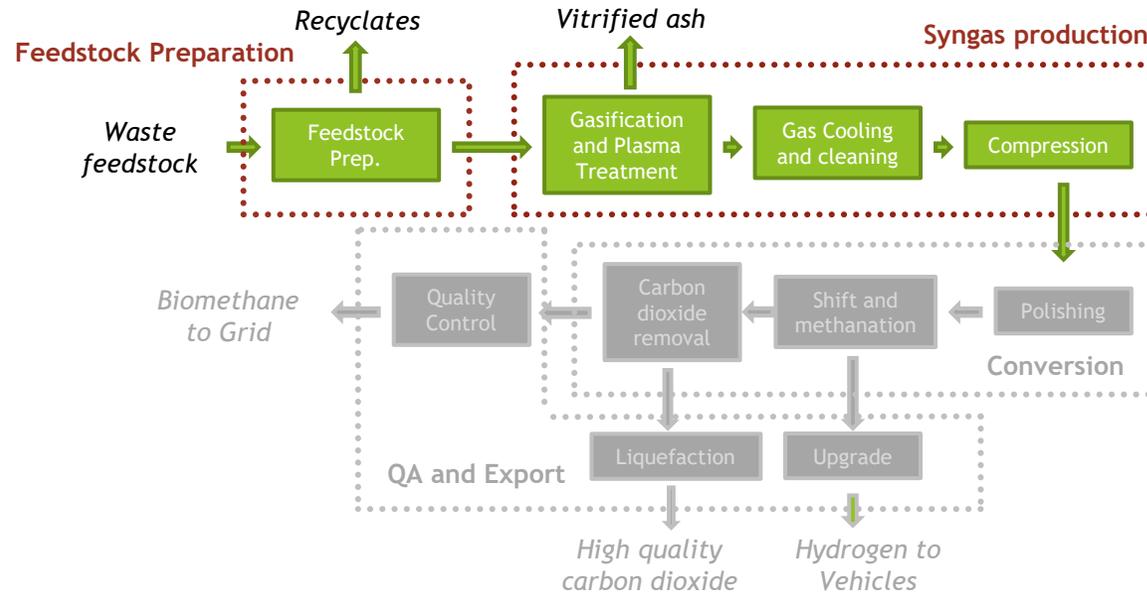
Plant will produce around 65 million development RTFCs per annum.

Waste contracts, carbon dioxide off-take in hand

Commence **FEED** in **Q3 2021** with target **financial close** in **Q3 2022**. Plant operational in **2025**.

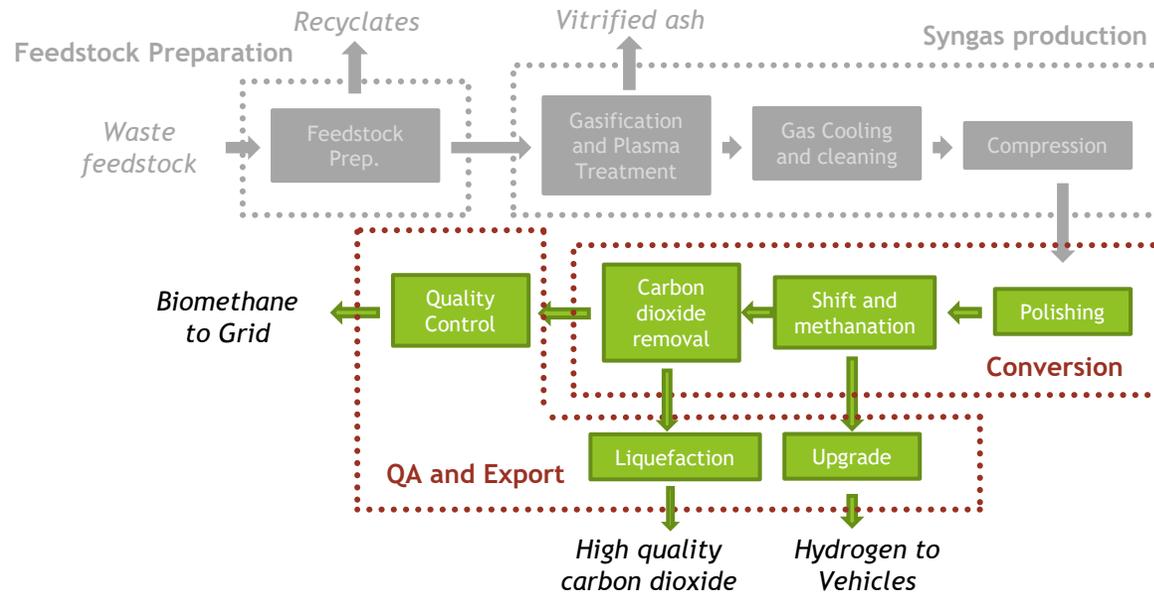


RadGas - The Process (1/2)



- ✓ Process accepts refuse derived fuel, solid recovered fuel, waste wood, tyre crumb, corn stover, straw, sugarcane bagasse or nearly any dry waste or biomass feedstock
- ✓ Metals, dense plastics and any other recyclates are mechanically separated and the waste is dried and shredded
- ✓ The waste is converted into a crude synthesis gas (syngas) using a conventional oxy-steam fluidized bed gasifier
- ✓ The crude syngas is cleaned in a direct current plasma furnace to produce a tar and ash free syngas that is suitable for catalytic conversion
- ✓ Ash in the waste is vitrified into a highly stable inert material that can be used as an aggregate

RadGas - The Process (2/2)



- ✓ The syngas is converted into biomethane which is metered into the grid. Biohydrogen is produced as an intermediate product that can be purified and used in fuel cell electric vehicles. Similar reactors can be used to produce liquid fuels.
- ✓ Carbon dioxide is liquified and sold for use in the food and drinks industry or transferred to long term sequestration.
- ✓ Conversion efficiencies of up to 75%, more than double the efficiency of conventional waste to energy plants producing electricity.
- ✓ No emissions to air. No particulate, dioxins, NOx or sulphur emissions.
- ✓ Plant designed to fit within standard industrial estate. No large stacks and all buildings less than 20m in height.

Technology Drivers



FEEDSTOCK

RadGas is focussed on refuse derived fuel produced from household and commercial waste. This is the UK's largest source sustainable feedstock.

Also handle lignocellulosic feedstock such as straw, short rotation coppice, etc.

Complementary to Anaerobic Digestion because it is focussed on dry, mixed, woody feedstocks.

Increases potential biomethane production by factor of five - 100TWh of fuel production from sustainable UK feedstocks.

BIOHYDROGEN

RadGas production of biohydrogen is more efficient and cost effective than biomethane production.

Plants can switch between biohydrogen and biomethane production at turn of dial.

RadGas biomethane plants create biohydrogen production infrastructure for the future.

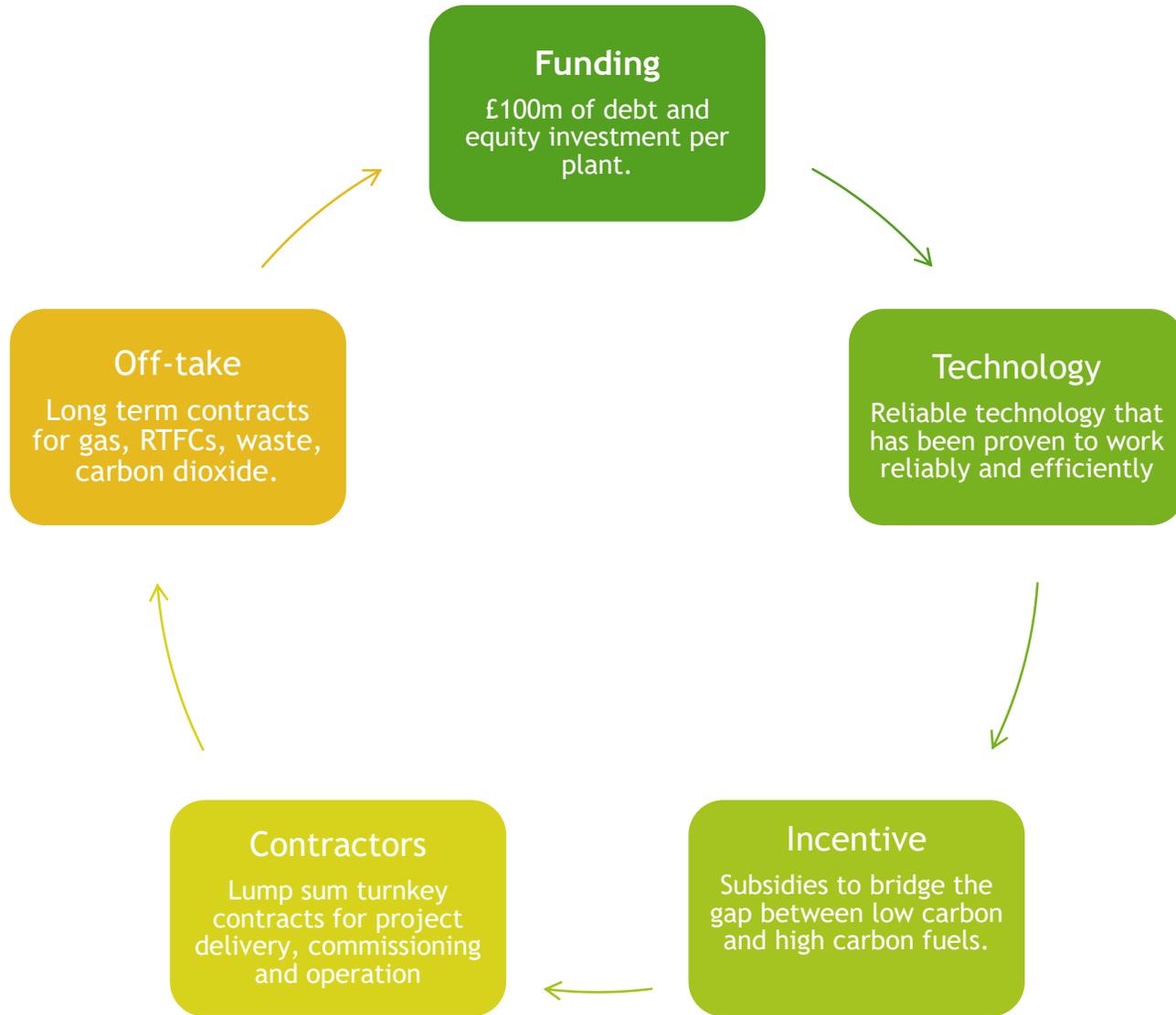
GREENHOUSE GAS REDUCTIONS

The process produces a high purity carbon dioxide stream for sequestration or reuse.

Generates negative emissions as biogenic carbon dioxide in the feedstock is stored.

GGR significantly higher for biohydrogen production.

Acceleration



Acceleration

Funders and contractors willing to put more time into assessing project risk and mitigation.

Off-takers willing to enter into long term commitments for low carbon technology.

Incentive structures that remove risk of committing to low carbon solutions.

Willingness by industry and Government to adopt technologies that haven't been proven.

Areas for Collaboration

- ✓ **Off-take** - ABSL is interested in conversation with off-takers of biohydrogen or biomethane for transport, RTFCs, waste, carbon dioxide.
- ✓ **Hydrogen development** - RadGas produce low carbon biohydrogen with negative emissions and ABSL is keen to develop the hydrogen transport opportunities.
- ✓ **Plant development** - ASBL is seeking sites with access to waste, good grid connections and a high likelihood of planning consent to develop commercial plants.

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Thank You



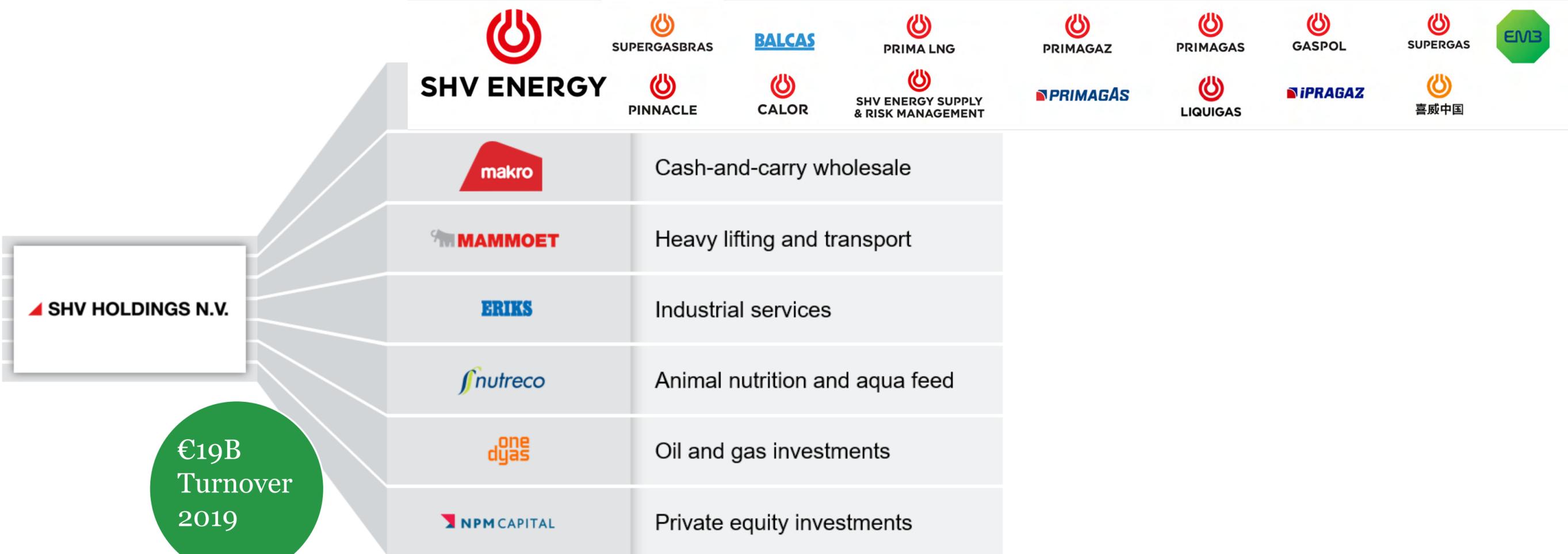
Renewable Propane: BioLPG

Dr. Keith Simons
Principal Scientist SHV Energy
31 March 2021



We are a family business, international in **reach** and local in **focus**.

Our purpose is defined as **‘The Courage to Care for Generations to Come’**



60,000 Employees

€19B Turnover 2019

Est. 1896

60 Countries

TIMELINE

1935
Calor Gas established.

1967
Calor awarded Royal Warrant by Her Majesty The Queen.

2018
Received UK's first BioLPG².

2040
Calor 100% renewable energy supply pledge³.

★ Trustpilot Ranking! ★★★★★

1ST
UK's leading LPG Supplier⁶.

OVER 196,000
UK customers.

ENGINEERING

100
Gas Safe[®] registered engineers and subcontractors.

24/7
National emergency coverage.

CALOR & SHV

28
Countries in which our parent company SHV operates.

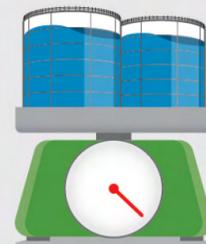
30 million
Customers are served by SHV Energy over 4 continents.

16,000
Colleagues working at our global family.



2
of Europe's largest LPG gas storage terminals.

100,000
Tonnes of strategic storage in the UK.



OVER 1,000
Dedicated in-house specialist LPG delivery vehicles.

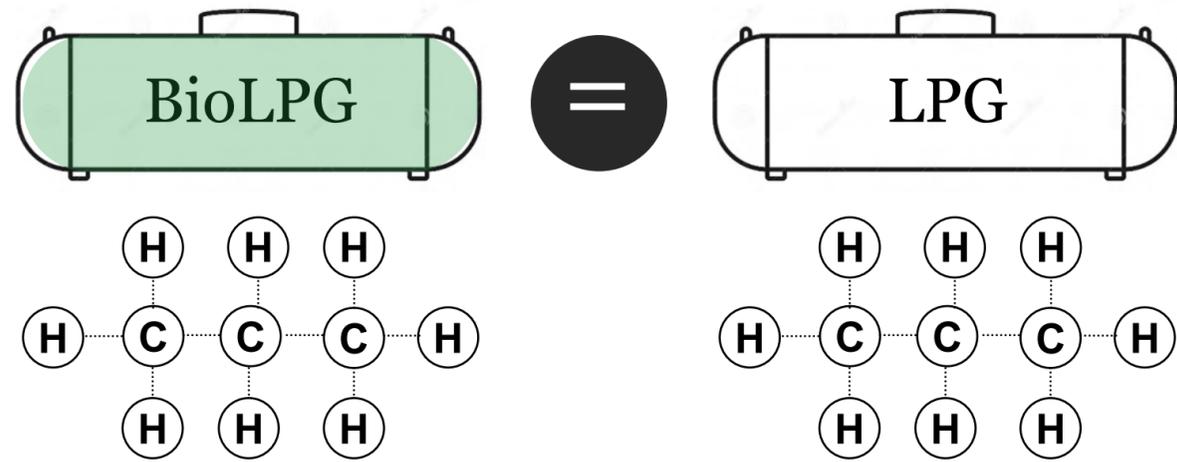
BIO LPG

58,000
Tonnes of BioLPG received to date by Calor⁴.

85,697
Tonnes of CO₂ saved since the introduction of BioLPG⁵.

SECURITY OF SUPPLY

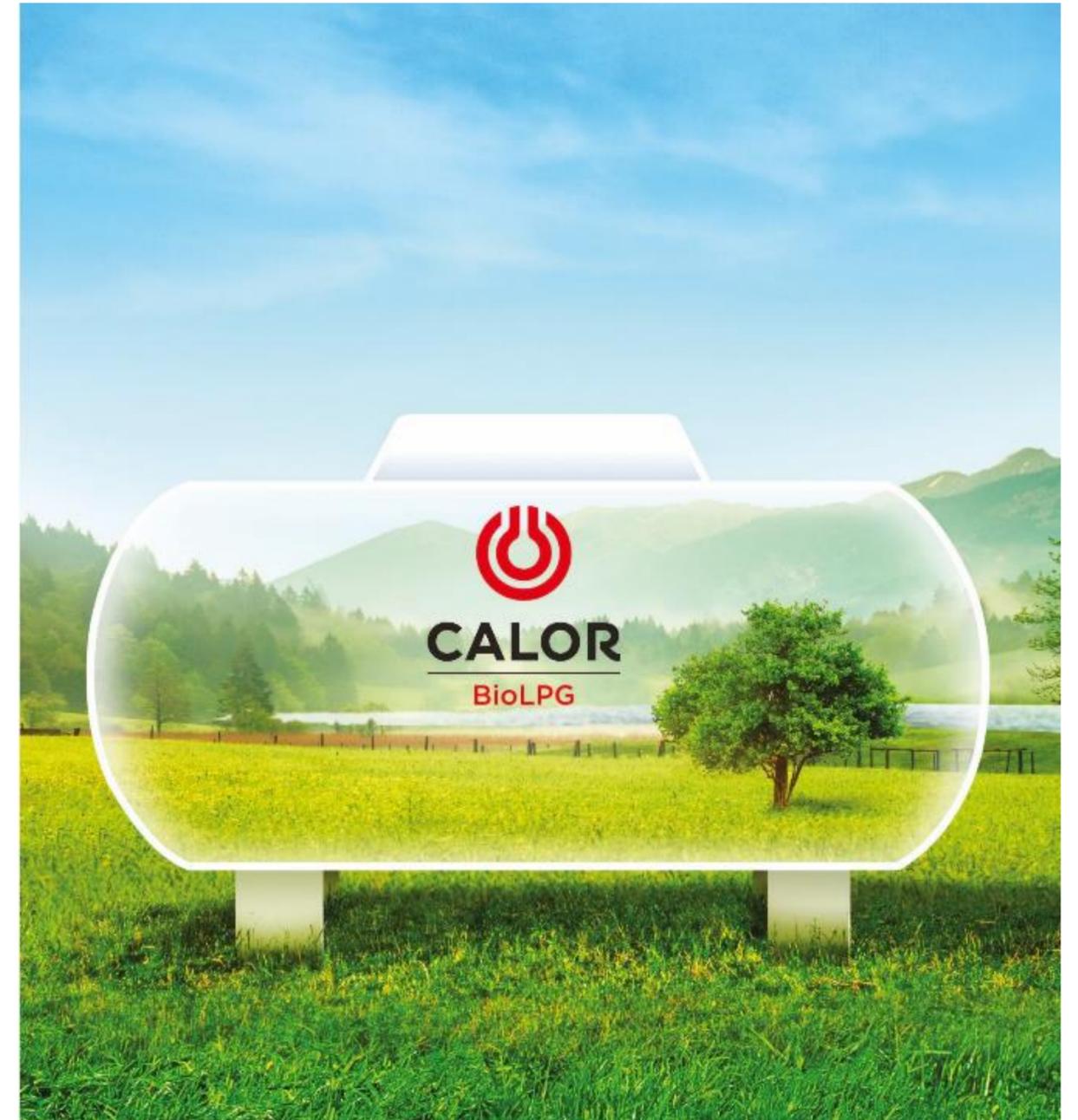
What is bioLPG?



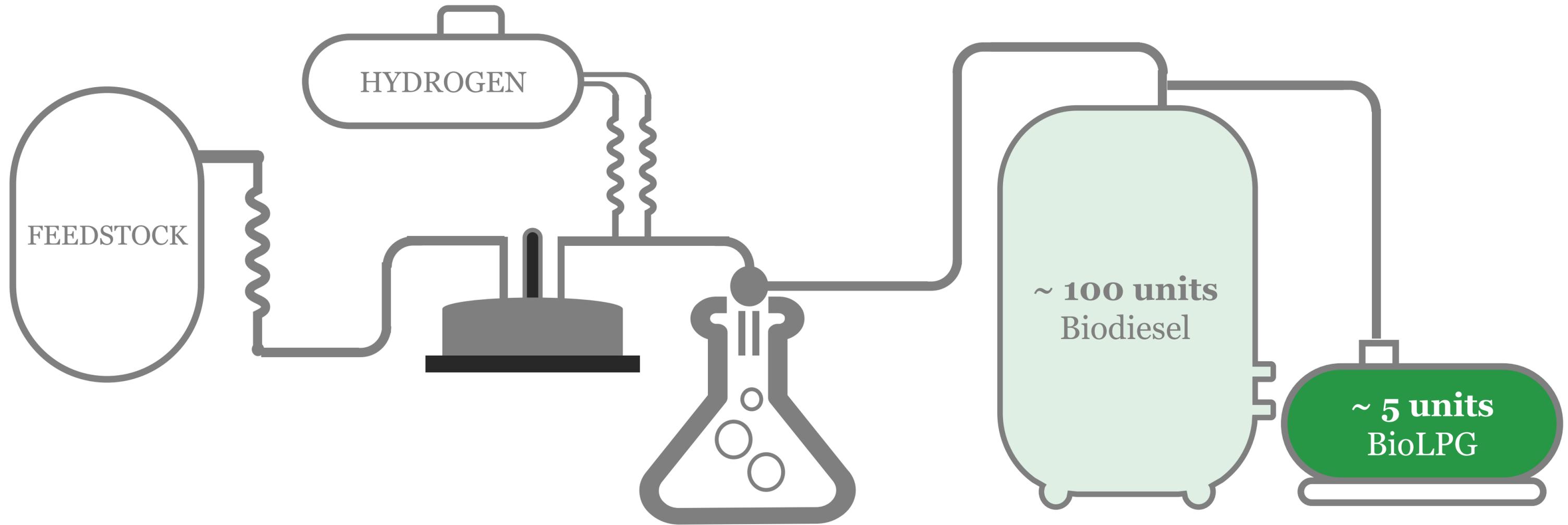
BioLPG is identical in use and performance to fossil LPG: **it is a DROP-IN SOLUTION**

The difference is the

- 1 **FEEDSTOCK** (made from 100% renewable sources) and the
- 2 **PRODUCTION PROCESS** leading to reduced greenhouse gas emissions by up to 80%



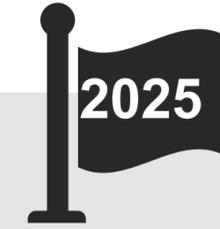
BioLPG as a by-product from HVO* advanced biodiesel production



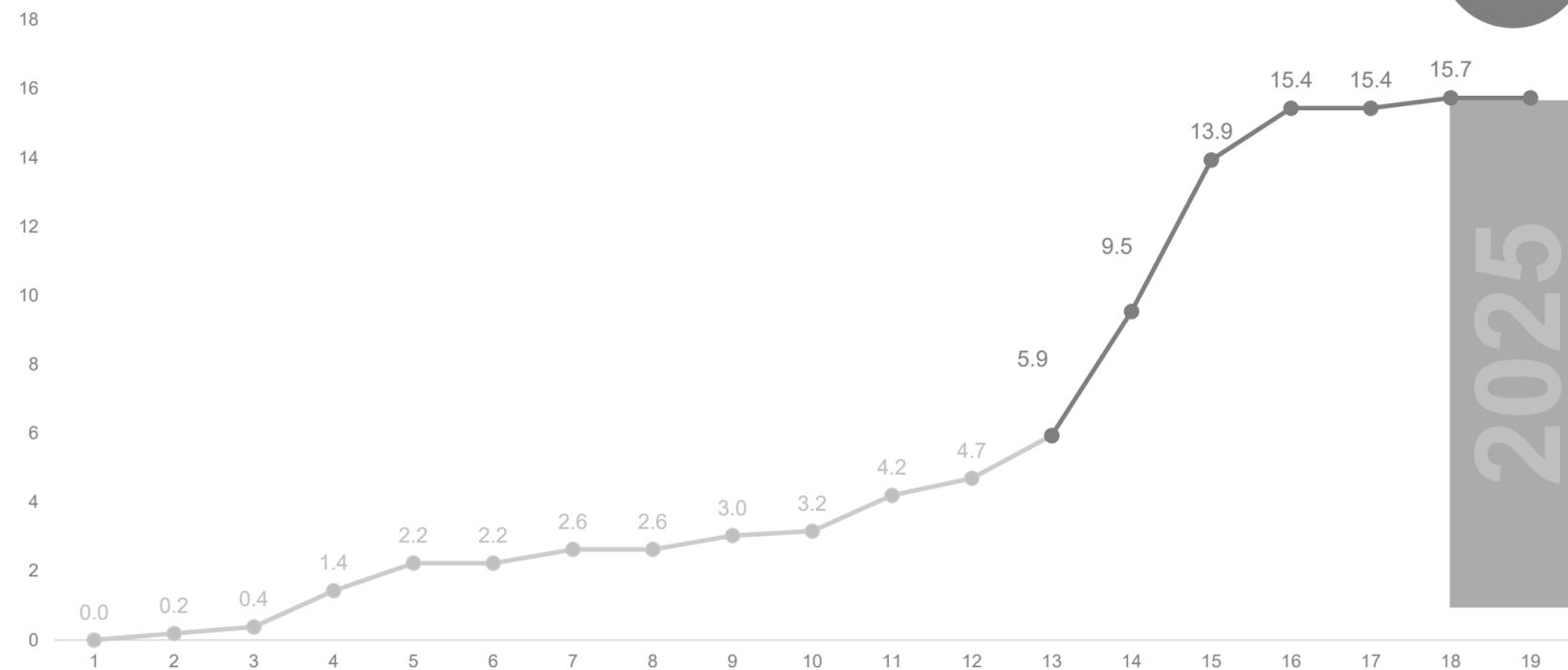
*HVO = Hydrotreated vegetable oil
HVO biodiesel is also known as Renewable Diesel

... but HVO*-diesel worldwide capacity is expected to substantially grow in the coming years

at least 12 million tons and up to 20 million tons



Pure HVO-renewable diesel projected worldwide capacity (million tons)



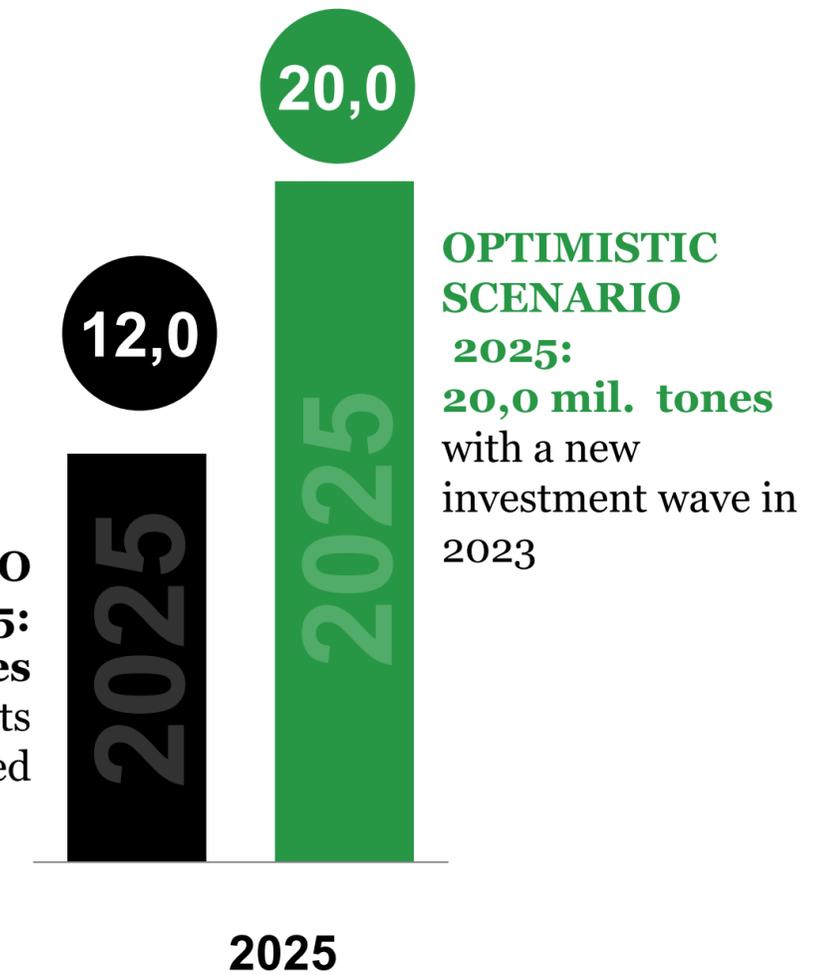
15,7

CONSERVATIVE SCENARIO

2025:
15,7 mil. tones
with only publicly announced future projects

PESSIMISTIC SCENARIO

2025:
12,0 mil. tones
with some cancelled projects and others delayed



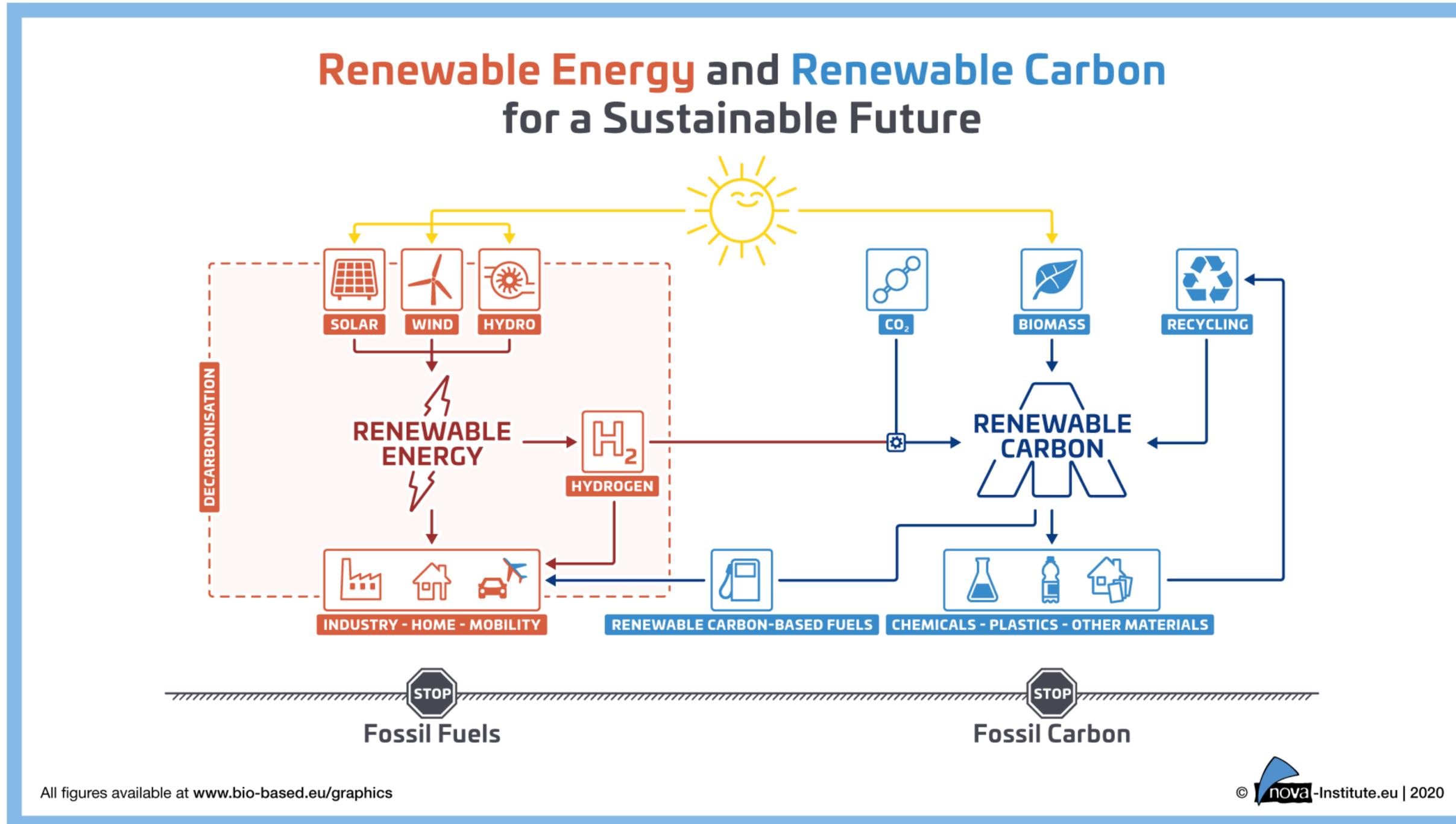
2025

*HVO = hydrotreated vegetable oil



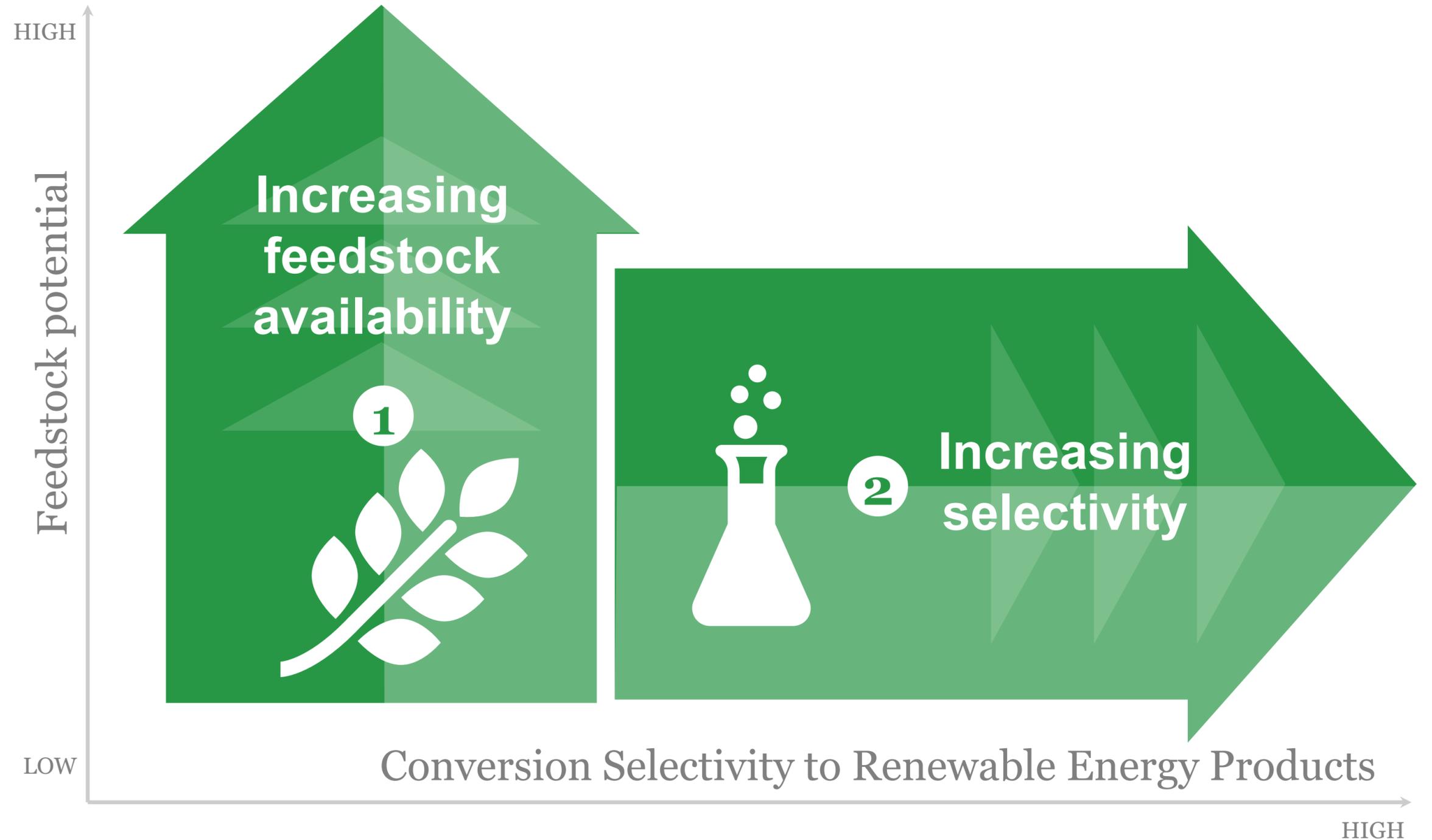
Source: Greenea Analysis

We are a founding member of the Renewable Carbon Initiative

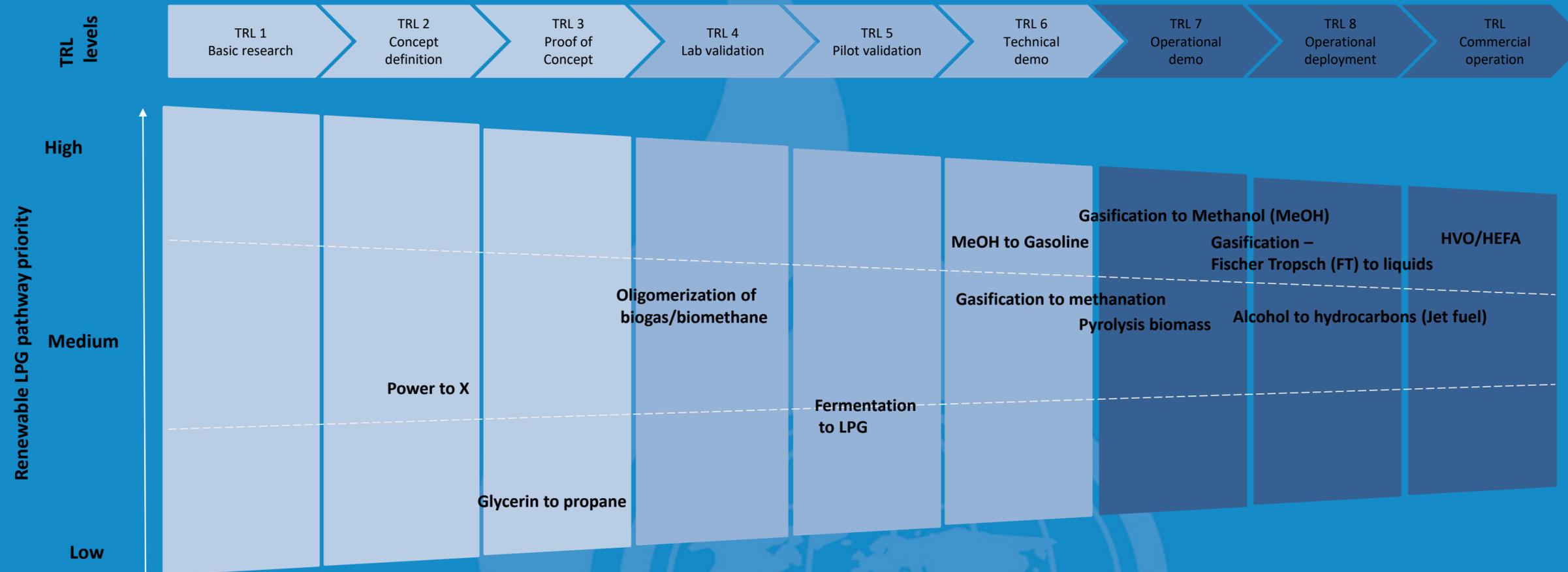




Our R&D Focus



Renewable LPG pathways – TRL and Priority



These pathways are prioritized using a scoring matrix that includes a variety of parameters such as Technology Readiness Levels (TRLs), Feedstock availability, Political Popularity, Process yield, etc. The ranking is based on long term potential of these pathways towards de-fossilization of LPG industry – short term company specific preferences might be different.

The sustainable future of LPG

Calor BioLPG is a sustainable fuel produced from renewable resources. By using BioLPG, businesses can reduce their emissions and carbon footprint without compromising on efficiency.

The Benefits

- The carbon emissions from BioLPG are up to 80% lower than standard LPG and can help businesses across the UK reach their sustainability targets.¹
- Every organisation that uses BioLPG is awarded 'Green Gas Credits' as part of the Green Gas Certification Scheme.²
- Businesses don't need to invest to make their operations compatible as BioLPG works seamlessly with existing LPG infrastructure. Conforms with BS4250:2014 and related standards



GreenGas
CERTIFICATION SCHEME

Date Created: 04/08/2016 12:14:41
Date Printed: 04/08/2016 14:35:52

Certificate issued to: **John Doe Ltd**

Renewable Gas Guarantees of Origin: **G0001BA01886314E0313 to G0001BA01906314E0313**

Injected between: Jun 15 - Jan 16
Technology/Feedstock: Bio LPG from Hydrogenated Vegetable Oil
Injection Location: England
Annual Amount: 20000 Litres
Period purchased: Mar 15 - Apr 16
CO₂ grams per MJ: ????
CO₂ savings: ????
Certificate Pin Number: 3a7f29
Green Gas Producer: **Neste**
02150 Espoo, Finland
Green Gas Supplier: **Calor Gas Ltd**
Athena Drive, Tachbrook Park Industrial Estate,
Warwick, Warwickshire CV34 6RL

About this Certificate
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BS EN 589:2018
Automotive fuels. LPG. Requirements and test methods

BS 4250:2014
Specification for commercial butane and commercial propane

bsi. ...making excellence a habit.

bsi. ...making excellence a habit.

¹ Atlantic Consulting 2017.

² Information about the Green Gas Certification Scheme can be found on the Green Gas Certification site.

³ The largest supplier by volume based on the UK market share statistics as produced by the government department BEIS.

BioLPG for FLTs



LPG powered forklifts will maintain power 24/7, with minimal refuelling time.

- You can reduce emissions by up to 32% by switching to our Green 60/40 tariff with BioLPG.
- You can also reduce your particulate matter by up to 98% relative to diesel.
- Suitable for indoors and outdoors.



Clean up your fleet and reduce those all-important carbon emissions by up to 32%*, helping you to meet the required 20% saving by 2020 under the UK's Carbon Reduction Commitment



We apply 'Green Gas credits' to all of our green customers, as a part of the Green Gas Certification scheme, so you can let the carbon cuts do the talking



Quick, hassle-free refuelling and minimal downtime for your forklift trucks. So you can maintain 24/7 power around the clock



Our green gas will help your forklift fleet power forward at a lower price, whilst demonstrating first-rate performance and minimal maintenance for both indoor and outdoor operation

BioLPG for HGVs

- Dual fuel vehicles have a standard diesel engine that has been adapted to burn a mixture of diesel and LPG in the combustion chambers.
- By replacing some of the diesel fuel with LPG, the vehicle will have reduced fuel costs and emissions as LPG is both cheaper and lower in carbon than diesel.
- By substituting LPG for just 25% of normal diesel consumption, you could reduce CO₂ emissions by 6%.
- Even more with BioLPG



Innovation



First live demonstration of BioLPG as a fuel for Freight Transport

With Government plans to end diesel-only trains in the UK by 2040, the race is on to find cleaner ways to transport goods and people by rail. To this end, G-volution, in partnership with Calor and Colas, has successfully carried out the first live demonstration project using BioLPG and diesel to power a freight train.

As the only supplier currently bringing BioLPG into the UK, Calor worked with G-volution to provide trackside refuelling facilities for the project. Although the freight locomotive, which was operated by Colas, was fitted with new fuel tanks, its engine only needed a minor conversion to take both BioLPG and diesel.



Innovation

Calor to power Orbex space rocket with renewable BioLPG

Calor, the UK's leading supplier of Liquefied Petroleum Gas (LPG) and BioLPG, has agreed with Orbex (Orbital Express Launch Limited), a UK-based spaceflight company, to exclusively supply BioLPG as the primary fuel partner for its Prime rocket.

Prime is the first commercial rocket engine designed to work with BioLPG (biopropane), a clean-burning, renewable fuel source that cuts carbon emissions by 90% compared to fossil hydrocarbon fuels. As part of the agreement, Calor will supply BioLPG to Orbex and provide technical support at the UK Vertical Launch Spaceport, located in Sutherland in the Scottish Highlands.

(54) Title: ROCKET PROPELLANT TANK ARRANGEMENT, ROCKET PROPULSION UNIT, AND ROCKET

(57) Abstract: A rocket propellant tank arrangement (40) for storing fuel and oxidizer for launching a rocket includes an oxygen tank (42) for storing liquid oxygen and a fuel tank (52) for storing liquid fuel, wherein the fuel tank is at least partially arranged within the oxygen tank.

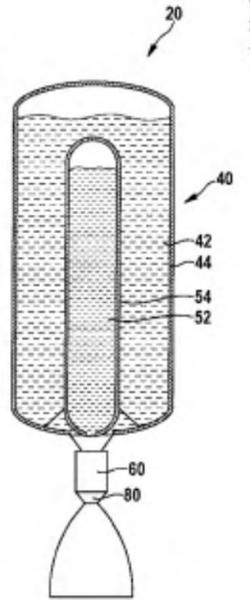


Fig. 2

WO 2018/130616 A1

BioLPG



Renewable, sustainable and energy efficient



BioLPG (biopropane) is chemically identical to LPG so can be used with all existing LPG equipment.



Totally renewable as produced from a blend of waste, residues and sustainably sourced materials.



Absolutely no compromise on performance, as BioLPG is as energy efficient as LPG.



BioLPG helps us to achieve a greener tomorrow.

Thank you

Thank you for listening, feel free to ask any questions.

If you'd like to discuss a specific project, please do not hesitate to contact us using the details below:



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Principal Scientist SHV
keith.simons@shvenergy.com
+31 6 83 294 003

Thank you



**Zemo
Partnership**
Accelerating Transport to Zero Emissions

Any questions? Please get in touch

Gloria Esposito

Head of Sustainability

E: Gloria.esposito@zemo.org.uk

T: 020 7304 6038

Next Webinar

Session 4: Sustainable Aviation Fuels

1st April 10:30am – 12pm

Interested in joining the Partnership?

E: Carolyn.webb@zemo.org.uk

T: 0207 304 6880

Zemo Partnership, 3 Birdcage Walk, London SW1H 9JJ

T: +44 (0)20 7304 6880 | E: hello@zemo.org.uk | [@Zemo_Org](https://twitter.com/Zemo_Org) | www.zemo.org.uk

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Interested in joining Zemo



Our work covers six areas related to accelerating the transition to a zero transport future.



Buses & Coaches

Action programmes to speed the introduction of zero emission buses in the UK by working with passenger transport companies and local authorities



Cars

Working with manufacturers, fleet operators, environment and consumer groups to accelerate the adoption of zero emission cars.



Fuels

We explore measures to increase the adoption of sustainable low carbon fuels such as biofuels and renewable hydrogen.



Commercial Vehicles

For manufacturers, freight transport operators, technology suppliers, technical expert and others interested in accelerating the transition to cleaner, greener road freight.



Energy Infrastructure

Formed to make suggestions to Government and industry to ensure that the GB energy system is ready for and able to facilitate and exploit the mass take up of electric vehicles.



Collaborative Initiatives

Joint working group projects where content crosses over, overseen by the members' council.

- Established end of August 2020, with 12 founder members
- Membership now exceeds 30 (and includes all UK bioethanol and biodiesel producers, all companies dispensing biomethane to transport, along with prospective SAF and development fuel producers)
- Formed to champion the contribution that renewable and low carbon fuels can make towards the decarbonisation of UK transport
- www.rtfa.org.uk
- Contact: Gaynor Hartnell, CEO
gaynor@rtfa.org.uk