Zemo Partnership

Accelerating Transport to Zero Emissions

The Renewable Fuels Guide

Helping heavy duty vehicle fleet operators lower their greenhouse gas emissions

July 2023

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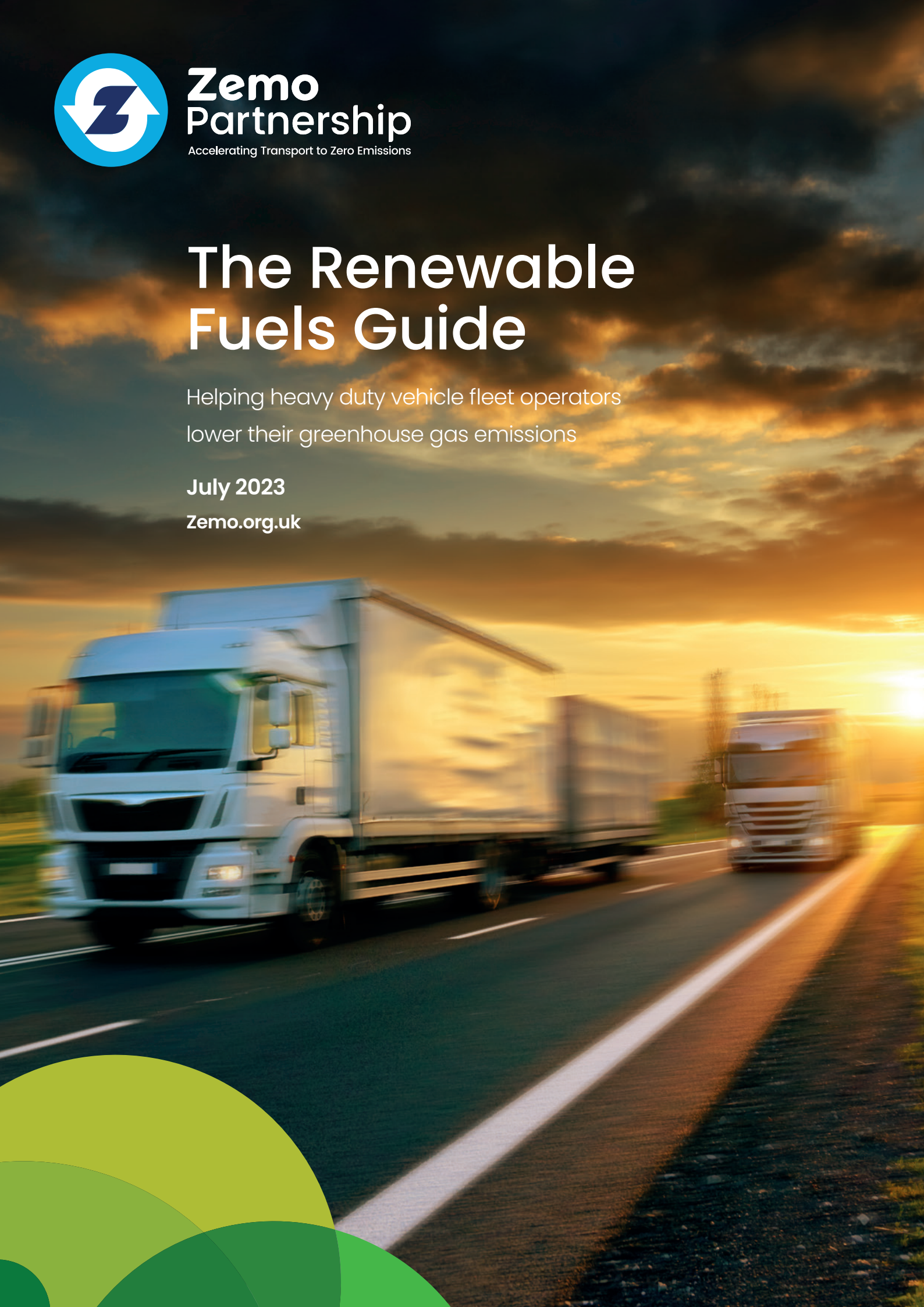

Renewable Fuels Guide Publication
The Renewable Fuels Guide has been produced by Zemo Partnership. Zemo Partnership is a public-private partnership working to accelerate a sustainable shift to low carbon fuels and zero emission vehicles. Around 240 organisations are engaged from diverse backgrounds including automotive and fuel supply chains, vehicle users, academics, environment groups and others. Zemo Partnership runs a Fuels Working Group comprised of sixty organisations from across the renewable fuels value chain. The organisation also manages the Renewable Fuels Assurance Scheme.

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Contents

1. Introduction

Climate change is the most pressing environmental challenge facing society today, increasingly recognised as a materially important topic for businesses of all sizes. The UK Government has set regulations for minimising GHG emissions, setting an ambitious target of achieving net zero emissions by 2050, with an interim economy-wide target of 78% GHG reduction by 2035. The Government's Net Zero Strategy sets out policies and proposals for decarbonising all sectors of the UK economy to meet the net zero target by 2050[1].

The 2020s are a critical decade for delivery of climate ambition. The window of opportunity for effective action to secure a sustainable future for all is rapidly closing. The world's remaining carbon budget will be exhausted within the decade if emission rates continue at their current levels. As warming increases, so does the risk of reaching irreversible tipping points in climate and ecological systems, highlighting the increasingly urgent need for action. The world's leading climate scientists[2] have made it clear, **"without immediate and deep emissions reductions across all sectors, limiting global warming to 1.5°C is beyond reach"**.

Road transport is responsible for 24% of UK GHG, with heavy goods vehicles (HGVs) contributing to 19% of these emissions[3]. Long-haul duty cycles account for the largest portion of HGV GHG emissions. To achieve net zero by 2050, road transport emissions will need to drop substantially, in the region of 80% by 2035. This requires dramatic cuts in fossil fuel use, combined with the increased adoption of sustainable low carbon fuels and zero tailpipe emission technologies. There will be no single solution for curtailing diesel HGV fleets' GHG emissions, moreover a variety of abatement pathways will be required to meet different HGV applications and operational requirements.

Greenhouse Gas Emission Measurement and Reporting

Disclosure of GHG emissions is becoming a mandatory requirement for businesses in the UK and internationally. The Companies Act 2006 requires UK quoted companies to measure and report their GHG emissions as part of their annual Directors' Report. The Streamlined Energy and Carbon Reporting regulations is another relevant policy for business. The recognised international standard used for GHG measurement is the Greenhouse Gas Protocol[4]. This covers Scope 1 emissions, those for which a company is directly responsible, for example their own vehicle fleet. Scope 2 indirect emissions from electricity use, and Scope 3 indirect emissions that are outside of a

1 Net Zero Strategy: Build Back Greener - GOV.UK
2 Intergovernmental Panel on Climate Change, AR6 Synthesis Report 2023
3 Greenhouse gas emissions by transport mode: United Kingdom, 1990-2021 (DfT 2022)
4 Greenhouse Gas Protocol 5 Science Based Targets

company's direct control, for example 'upstream' fuel supply chain emissions and 'downstream' distribution emissions. The GHG Protocol GHG emission 'scopes' are illustrated in Figure 1.

A growing number of organisations are measuring and disclosing GHG emissions as part of their Corporate Sustainability Reporting. Many UK and international businesses are joining the Science Based Target Initiative[5], setting ambitious GHG emission reduction targets to 2030 and 2050. Strong attention is being given to companies not only tackling their own carbon footprint but also addressing emissions arising from their supply chain. Decarbonising transport related emissions will feature heavily in nearly every company's climate change mitigation strategy. A switch to using low carbon fuels for transport operations offers an immediate opportunity for reducing Scope 1 and Scope 3 GHG emissions.

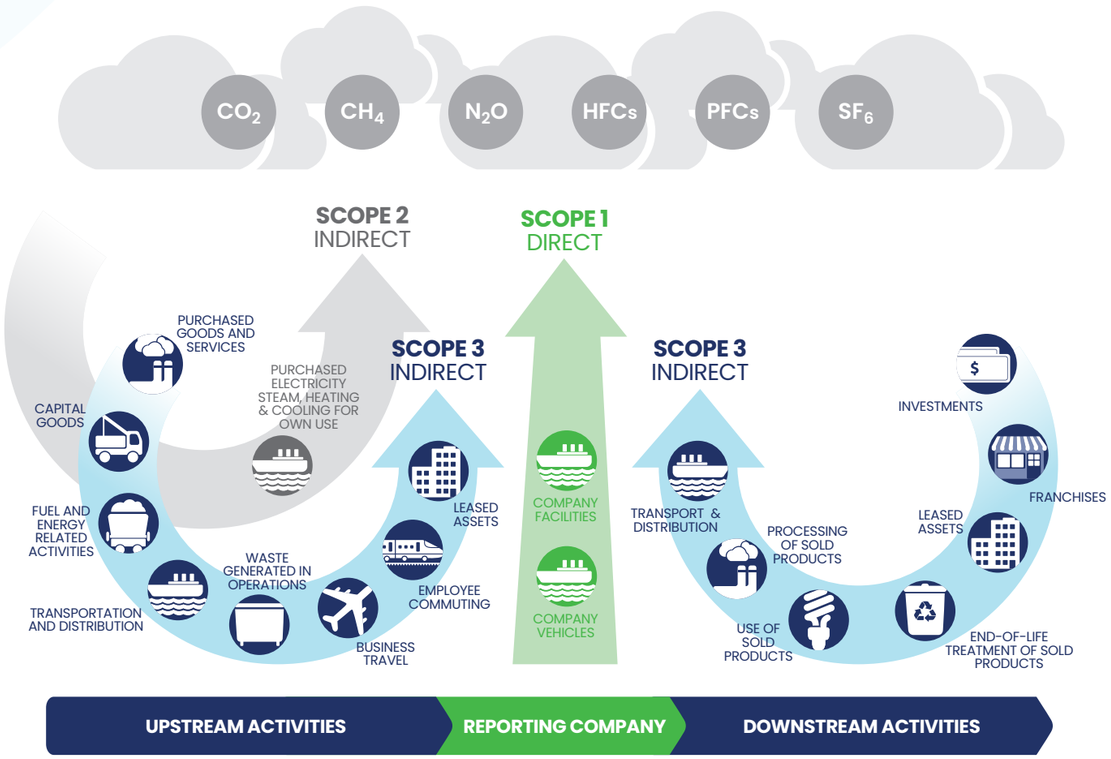

Figure 1: Corporate GHG emission measurement and reporting sources.

5 Science Based Targets

Increased desire for sustainable products and services is driving consumers to align their purchase behaviour with companies who are addressing climate change. Corporate social responsibility is more important than ever, while businesses' reputations have never been under greater scrutiny by their customers. Attention to contractors' supply chains is increasing, demonstrating the importance of fleet operators having robust evidence to back up GHG and sustainability claims related to low carbon fuel supply chains.

Both private and public sector organisations are integrating GHG emission reduction into their procurement policies, considering their own vehicle fleets and those of their contractors. Many organisations incorporate sustainability performance standards into their contractor tendering process. By operating an HGV on sustainable low carbon fuel, fleet operators will be a step ahead of other bidders.

UK Policy Landscape

Transition to a Zero Emission HGV Fleet

The Government's Net Zero Strategy highlights the strong role that zero tailpipe emission vehicles will play in decarbonising road transport. The end of sale dates for new, non-zero emission HGVs have been set by the Government: 2035 for HGVs less than or equal to 26 tonnes, and 2040 for HGVs over 26 tonnes. The Department for Transport (DfT) will be running a multi-year Zero Emission Road Freight Demonstration[6] programme, due to start in 2025. This will determine the operational, GHG emission, and economic performance of long-haul articulated 40-44 tonne battery electric and hydrogen fuel HGVs in real world fleets.

The mass market transition to zero tailpipe emission HGVs will, however, take more than fifteen years. Research carried by Zemo Partnership[6] has revealed that significant volumes of diesel will continue to be consumed by the UK HGV fleet from today to 2035 – approximately 6 billion litres per annum. Sustainable low carbon fuels offer a valuable complimentary pathway to decarbonising diesel HGVs during the shift to zero tailpipe emission technologies. In the medium to long term, renewable fuels can help lower the GHG emissions of residual diesel HGVs, thereby enabling fleet operators to completely decarbonise their operations. Long and regional duty cycles benefit the most given their high mileage and fuel use. Opportunities also exist for HGVs with heavy payloads, which will be difficult to electrify.

[6] Decarbonising HDVs using high blend biofuels | Fuels Projects | Zemo Partnership

Zemo Partnership has estimated that GHG emissions from UK HGVs could be reduced by an additional 46 million tonnes over the next seven years (2030), if an average of 30% renewable fuel were adopted across the existing HGV fleet – including high blend biodiesel, renewable diesel and biomethane. This would be equivalent to 4% of all road transport GHG emissions. This scenario assumes early adoption of zero tailpipe emission HGVs would also be underway, albeit at an initially slow rate.

The Role of Low Carbon Fuels

The Net Zero Strategy identifies that low carbon fuels will be an important pathway to decarbonise heavy duty vehicles, in particular long-haul trucks, during the transition to zero emission propulsion technologies. The Department for Transport will be publishing a Low Carbon Fuel Strategy this year, outlining a long-term vision for decarbonising a variety of transport modes using low carbon fuels up to 2050. This will cover low carbon fuels such as biofuels, renewable hydrogen and recycled carbon fuels. The strategy will shed light on the role low carbon fuels will play in reducing GHG emission from the heavy-duty vehicles including buses, coaches and trucks.

The Renewable Transport Fuel Obligation (RTFO) Order is an overarching policy mechanism, established by the DfT over ten years ago, to deliver reductions in greenhouse gas emissions from fuels used in road transport and non-road mobile machinery (NRMM)[7]. The RTFO requires large fossil fuel suppliers to blend a proportion of biofuels in petrol and diesel supplied to end users. Currently, 7% of total road fuel supplied in the UK comprises of renewable fuel. This will gradually increase over time and by 2032 a 14% renewable fuel content will be mandatory. The use of energy crops is being phased out due to renewable energy policies set at the European level. The DfT has introduced a crop cap to limit energy crops as raw materials and promote increased use of waste bio-feedstocks.

The RTFO incentivises a variety of supply of sustainable low carbon fuels and over the last decade this has focused on biofuels. These include biodiesel, bioethanol, biomethane and renewable diesel (e.g. hydrotreated vegetable oil). Biofuels are renewable fuels produced from biological raw materials or feedstocks, such as energy crops or organic waste. When biofuels undergo combustion in a vehicle, tailpipe CO_2 emissions are accepted as zero. This is because CO_2 has already been absorbed by plants during the growing process, essentially producing a closed loop in the carbon cycle. A vehicle will still release very small quantities of other greenhouse gases (methane and nitrous oxide), dependent on the vehicle type.

[7] Renewable Transport Fuel Obligation (RTFO): compliance, reporting and verification - GOV.UK

The production of biofuels can offer wider environmental and social benefits. For example, enabling sustainable waste management and the preservation of natural resources, plus helping to stimulate a circular economy through using waste as a resource. The manufacture of biofuels can generate co-products such as animal feed and digestate, a natural fertilizer. Biofuel production can additionally have the potential to create new opportunities for sustainable rural development.

Ensuring Sustainable Low Carbon Fuel Supply Chains

The RTFO has set mandatory GHG emissions and sustainability standards for renewable fuel supply chains to qualify for fiscal rewards. For example, biofuels must achieve more than 65% life cycle GHG emissions savings compared to fossil fuel[8]. Life cycle GHG accounting covers emissions associated with growing an energy crop or collecting biomass waste, transportation of feedstock, manufacturing a biofuel, transportation of the low carbon fuel market and combustion in a vehicle. CO_2 emissions avoided through carbon capture and re-use or long-term geological storage are also accountable.

The production of biofuels involving the cultivation of energy crops should not result in land use changes that cause deforestation, loss of biodiversity or removal of high value carbon vegetation. This ensures protection of sensitive ecosystems such as tropical forests, wetlands and peat land. Renewable fuel suppliers are required to demonstrate that their feedstocks originate from genuine biomass wastes and residues. The DfT has established a list of RTFO approved waste and residue bio-feedstocks that can be used to produce renewable fuels. These include a variety of plant and animal wastes, agriculture and forestry residues, and industrial waste such as end of life tyres (biomass fraction).

Renewable fuel suppliers can evidence compliance with the RTFO GHG emission and sustainability standards through voluntary sustainability scheme certification. One of the most widely adopted schemes is the International Sustainability and Carbon Certification (ISCC). ISCC supports the principles of environmentally and economically sustainable biofuel production, verifying the traceability of biomass feedstocks.

The most recent DfT statistics reveal UK renewable fuel supply achieves an average greenhouse gas savings of 81% compared to fossil fuels.

[8] RTFO fossil fuel compared is 94 gCO2e/MJ

Renewable Fuels Assurance Scheme

The Renewable Fuels Assurance Scheme (RFAS) is a voluntary initiative managed by Zemo Partnership. The RFAS verifies claims made by companies supplying renewable fuels regarding their product's life cycle GHG emission savings and feedstock sustainability. The RFAS works alongside the RTFO scheme, providing assurance of the chain of custody for sustainable low carbon fuels distributed to commercial fleet and NRMM operators. The RFAS approves companies supplying 100% renewable fuel, and blends of renewable and fossil fuel. The scheme is open to stakeholders across the renewable fuel supply chain including producers, traders and distributors. An example of a biofuel supply chain is presented in Figure 2.

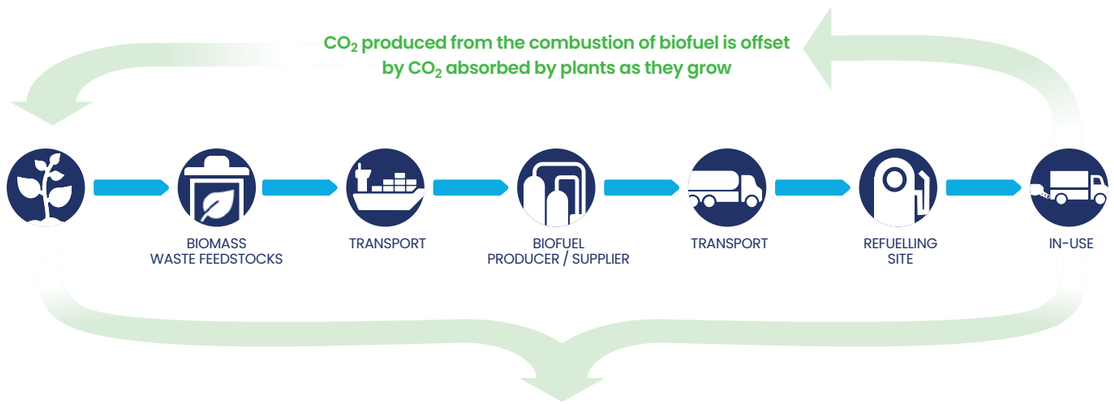

Figure 2: Biofuel supply chain example.

Renewable fuel suppliers are required to meet the RFAS performance standards outlined below. Once approved by Zemo, renewable fuel suppliers receive a 'Renewable Fuel Supplier Approval' document. This is renewed each year following a successful third-party audit to verify continuous compliance with the RFAS performance standards. All companies approved under the RFAS are identified on the RFAS website[9].

[9] RFAS | Zemo Partnership

Life cycle GHG emission thresholds[10]

- Biofuels to achieve >65% GHG savings compared to fossil fuel
- Renewable hydrogen to achieve >65% GHG savings compared to fossil fuel
- Renewable fuel and fossil fuel blends to achieve >15% GHG savings compared to fossil fuel

Sustainability criteria for biomass feedstocks

- Protection of land and biodiversity
- Use of biomass wastes and residues (aligning with RTFO feedstock lists)
- Renewable hydrogen to be produced from new renewable energy sources

Traceability of renewable fuels across their supply chain

- Chain of custody in place for RTFO approved low carbon fuel sold to the end customer

Renewable fuel suppliers are required to provide their customers with a Renewable Fuel Declaration for batches of renewable fuel, or blends of renewable fuel, sold. This document identifies the life cycle GHG emission savings and intensity, the types of biomass feedstocks used to produce the renewable fuel, as well as confirmation of voluntary sustainability scheme certification. Each Declaration has a unique ID and identifies the customer's RFAS approved fuel supplier. It is important to highlight that **only companies approved under the RFAS** are permitted to issue Renewable Fuel Declarations to their customers. Declarations issued by non RFAS approved fuel suppliers are invalid. Renewable Fuel Declarations will soon feature a QR code, linked to the RFAS website. This will enable recipients of the Declarations to use a smart phone to easily check if their renewable fuel supplier is approved under the RFAS.

The Scheme enables fleet operators to receive renewable fuel supply chain specific GHG emission data from their fuel supplier, thereby providing representative information for company carbon measurement and reporting. With increasing scrutiny of the product supply chains, the RFAS enables company procurement and fleet management teams to have confidence in the sustainability credentials of low carbon fuels.

[10] The RFAS aligns with the RTFO life cycle GHG accounting methodology, vehicle combustion GHG emissions treated as zero, fossil fuel comparator is 94 gCO2e/MJ.

As of Q1 2023, twenty companies were approved under the RFAS, supplying compressed and liquified biomethane, renewable diesel such as HVO, biodiesel blends and renewable hydrogen. All companies supplying biofuels use 'second generation' biomass waste materials.

A growing number of organisations are requiring their contractors to use low carbon fuels, specifying RFAS approved fuel suppliers in their tendering process.

Overview of the Renewable Fuels Guide

Zemo Partnership has produced this guide to assist HGV operators on their journey to net zero and understand the low carbon fuel options available today. The renewable fuels covered are biodiesel, renewable diesel, biomethane and bio-propane. Each section provides an overview of the UK renewable fuels market, current deployment in heavy duty vehicle fleets (HDVs), GHG emission performance and primary sustainable feedstocks, operational information including public and depot based refuelling infrastructure, as well as financial information. Accompanying this guide is a seperate appendix listing heavy duty manufacturers engine models that are approved to run on high biodiesel (e.g. B20, B30) and renewable diesel (e.g. HVO).

In this guide, two metrics are used for reporting the GHG emission performance of different renewable fuels: 1. GHG emissions intensity on an energy basis (gCO_2e/MJ), 2. Well-to-Wheel (WTW) GHG emissions savings compared to retail diesel (%). The WTW GHG emissions of each renewable fuel have been calculated by summing the Scope 3 upstream fuel supply GHG emissions intensity and the Scope 1 direct use GHG emissions intensity as follows:

- **GHG emission intensity (Scope 3 – upstream fuel emissions)**. This data has been sourced from renewable fuel suppliers approved under Zemo's RFAS, and where not available DfT's RTFO statistics, for the year 2022. The upstream fuel life cycle GHG emissions take into account the biomass feedstocks used to produce the biofuel. A range of GHG emission intensity values has been presented for each renewable fuel. (The GHG emission intensity value presented on Zemo's Renewable Fuel Declarations is an expansion of the BEIS company reporting conversion factor for renewable fuels, providing fuel supply chain specific GHG emissions data).

- **GHG emission intensity (Scope 1 – vehicle direct emissions)**. The calculation of the renewable fuel GHG emissions intensity under RFAS follows the RTFO methodology. While this does cover the fuel life cycle, the GHG emissions from the combustion of renewable fuels are accepted as zero under the RTFO methodology (CO_2 from combustion is offset by the CO_2 absorbed by the biomass feedstock during growth). This differs from the GHG Protocol methodology used in company carbon reporting, whereby the Scope 1 GHG emissions for biofuels are based on N_2O and CH_4 emissions (CO_2 emissions are set to zero). As such, the data for direct vehicle emissions has been sourced from the DEFRA company greenhouse gas reporting Scope 1 conversion factors 2022.

- **Well-to-Wheel GHG emissions savings (Scope 1 - vehicle direct and Scope 3 - upstream fuel emissions)**. The savings have been determined by comparing the WTW GHG emissions of each renewable fuel, with the WTW GHG emissions of retail diesel (assumes a maximum blend of 7% biodiesel). The WTW GHG emissions for retail diesel have been determined using data sourced from the DEFRA company greenhouse gas reporting conversion factors 2022: Scope 1 plus Scope 3 (WTT, Well-to-Tank). For blends of biofuel and fossil fuel, the proportion of the renewable fuel fraction has been accounted for.

2. Biodiesel

UK Supply Chains and Market Trends

Biodiesel, otherwise known as Fatty Acid Methyl Esters (FAME), is produced via the transesterification of vegetable oil or animal fats with methanol. By-products from the production of biodiesel can be upgraded and converted into value-added end products such as glycerine. Several companies produce biodiesel in the UK and supply a variety of high blend biodiesel products. The increasing electrification of the UK car and van fleet over the next decade, and accompanying in a decline in retail diesel consumption, will result in larger volumes of higher blends of biodiesel becoming available for HDV fleets.

Retail diesel has a biodiesel blend limit of 7% (B7). Higher blends of biodiesel commonly supplied to HDV fleets are B20 (20% biodiesel), B30 (30% biodiesel) and B100 (100% biodiesel). Biodiesel is required to meet precise European fuel specifications. B100 must comply with European Biodiesel Standard EN14214 and B20/30 with EN16709.

RFAS Approved High Blend Biodiesel Suppliers

Companies approved for supplying high blend biodiesel under Zemo's RFAS:

- **Argent Energy Ltd, Greenergy Fuels Ltd, ESL Fuels Ltd.**

Currently, all RFAS high blend biodiesel supplied to commercial fleet operators in the UK is produced from biomass waste sourced from UK and international markets. RFAS members' biodiesel supply chains are approved under internationally recognised voluntary sustainability certification schemes.

Deployment in Heavy Duty Vehicle Fleets

B20 and B30 have experienced the greatest market penetration in the UK. B20 has been deployed in several thousand buses over the last decade, with Metroline being a recognised pioneer. Demand for high blend biodiesel is increasing in HGV fleets with companies such as McGregor Logistics, Stewart Hymas, Greenergy Flexigrid and McDonald's choosing this as a route to decarbonising their HGV fleet. Zemo estimates that approximately 2000 buses and 1500 HGVs are running on high blend biodiesel.

GHG Emission Performance

The GHG emissions performance of the primary feedstocks used for producing high blend biodiesel supplied in the UK are presented in Table 1. GHG emission savings will be influenced by the proportion of renewable fuel in the final blend. For example, B100 can achieve an average WTW GHG emissions savings of 85% compared to retail diesel, whereas B30 can achieve around 25% GHG savings.

WTW GHG Emission Intensity Range	15 to 21 gCO_2e/MJ	
WTW GHG Emission Savings (v. retail diesel)	76 to 83%	
WTW GHG Emission Savings for Biodiesel and Diesel Blends (v. retail diesel)	B20: 12 to 13%	B30: 20 to 22%
Primary Sustainable Feedstocks	Brown grease, used cooking oil, soap stock acid oil, sewage system fog, palm oil mill effluent, food waste	

Table 1: GHG emission performance of biodiesel and associated biomass feedstocks

Vehicle Compatibility and Availability

Several HDV OEMs warranty new Euro VI for blends of B20, B30 and B100 predicated on the biofuel complying with the relevant biodiesel fuel quality standard. Appendix 1 provides a summary of heavy duty vehicle manufacturers' warranty position for different biodiesel blends. It is possible for fleet operators to independently purchase a warranty to cover their HGV engine and parts for running on higher blends of biodiesel. One company that offers this solution is Warranty Solutions Group.[11]

HGV manufacturers can fit certain parts whilst building the vehicles to enable them to run on high blend biofuel or retrofit them. Fleet operators should therefore enquire with manufacturers which biodiesel blends new vehicle products are warrantied for.

Refuelling Infrastructure

High blend biodiesel is commonly delivered to fleet depots with standard diesel storage and refuelling equipment for B20 and B30. It is advisable to clean a tank before switching to high blends to remove the inevitable sludge formed from storing fossil diesel. High blend biodiesel is not available at retail fuel forecourts.

B100 biodiesel storage requires additional equipment and management compared to standard diesel. All diesel has a temperature point at which it begins to gel in colder weather. Pure waste-based biodiesel (B100) starts to be affected if cooled down to between zero and 10 degrees Celsius depending on the base raw material and must be kept above that temperature (Cold Filter Plugging Point, CFPP). Suppliers of B100 can provide information and infrastructure such as heated tanks, heated lines and dispensing pumps. Biodiesel is more hygroscopic than diesel and the presence of water in diesel should be avoided as it can contribute to microbial growth in the fuel storage tank. Although rare, if left unchecked high microbial growth can lead to fuel filter blockages. Anti-microbial products can easily be added to stop microbial growth in both storage and fuel tanks.

[11] Warranty Solutions Group

Financial Information

Vehicle Costs: Some manufacturers require a biodiesel upgrade package to be installed for B20 and B30, typically costing a few hundred pounds at vehicle production stage. In the case of retrofitting an existing HGV to run on B20 or B30, costs can reach up to £2000 per vehicle. For B100 use, vehicle conversions include a simple system for warming the fuel. Factory or retrofitted conversions typically cost from £6,500 to £8,000 per vehicle.

Fuel Costs: Depending on the supply chain, use of high blend biodiesel can offer fuel cost parity with fossil fuel.

Maintenance Costs: While many fleet operators of B20 and B30 have found limited changes in maintenance regimes, some vehicle manufacturers require additional maintenance. Biodiesel is an effective surfactant and more frequent filter inspections may be useful after switching fuel types, if small particles of dirt are removed from fuel pipes. The fuel quality standard for biodiesel requires anti-oxidation treatment to be used to provide protection against oxidation issues occurring. However, some engine manufacturers recommend more frequent oil changes as a further precaution. Additional maintenance costs for B30 ranges between £1000-£2000 per annum.

Infrastructure Costs: Biodiesel blends up to B30 can be stored in and dispensed from existing infrastructure for diesel vehicles at no extra cost. B100 however needs to be kept at an appropriate temperature to ensure it remains liquid in the colder months. Fuel suppliers test for the Cold Filter Plugging Point (CFPP) and can advise on the optimal minimum temperature for the fuel. This will result in some heating costs.

Case Study: McGregor Logistics

McGregor Logistics Ltd is a haulage, warehousing and distribution firm based in South Yorkshire, with depots in Tilbury and Cardiff. It sought the most cost effective and environmentally beneficial way of fuelling its fleet of vans, rigid and articulated trucks.

McGregor sources B30 from Argent Energy for use in its bunkered fuelling system, delivering significant savings against conventional diesel. The transition to B30 was smooth, and after using it for over a year it has not presented any operational or engine issues. Apart from deciding to have their tank cleaned to remove the residual sludge that had accumulated over time, there was nothing else required to support the introduction of the fuel. The biofuel is currently deployed in over 80 trucks and vans.

Argent Energy's biodiesel is all made from waste to avoid using crops that would normally go to the food or feed chain. Their feedstocks include animal waste fats, fats, oil and grease recovered from grease traps and water treatment facilities, used cooking oil and food waste oil. The technology includes intensive pre-treatment to clean up the waste oil and full distillation of all products to ensure maximum purity of the biodiesel.

Using UK government data, McGregor calculates that using this fuel has reduced their emissions by 1,197 tonnes of CO_2 in the last 12 months. In addition to the competitive purchase price, McGregor sees a commercial advantage in operating biodiesel. The business reports that many existing and potential customers are now interested in what steps McGregor is taking to reduce its carbon footprint (and therefore their carbon footprint) as part of the contract process. There is a substantial capital cost involved in setting up on-site refuelling, but McGregor is confident that the savings they make on fuel will cover this within two years. The company plans to expand the use of B30 in its vehicle fleet.

Case Study: Metroline

Metroline is a bus company operating across Greater London, with additional routes in Hertfordshire. Metroline's fleet consists of approximately 1600 vehicles, with their entire London-wide fleet running on B20 across Euro III, IV, V and VI buses.

B20 was introduced into Metroline's bus fleet in 2014 further to the company's participation in a TfL run scheme for operators to trial B20. Adoption quickly followed, and they trialled the fuel for an approximate period of 9 months before deploying B20 across the wider fleet. With Volvo hybrids' ability to run on higher blends of biofuel, B20 acted as a crucial link to fleet purchases at the time and facilitated the beginning of Metroline's longer term fleet decarbonisation strategy.

As part of the transition to B20, Metroline gathered fleet information on engine and fuel equipment life to run extended trials. Part of this process included reaching out to manufacturers and engine producers. Not all responses were positive, but despite the risks, Metroline was able to transition its entire fleet to B20 over a period of around 10 weeks.

Metroline experienced no additional maintenance cost requirements compared to their standard diesel buses.

During the shift to B20, new sock filters were fitted to fuel tanks in depots (prior to fuelling stations), and all fuel filters were changed on vehicles. After this, bunkering facilities required regular maintenance cycles, including tank-to-pump filter changes and routine inspections at depots. Prior to B20 adoption, Metroline had already established consistent fuel tank cleaning regimes, and as of January 2023, their tanks are drained and cleaned on a three-year cycle.

For operators thinking of adopting B20, Metroline recommends preparation and planning for initial filter changes on both fuel tanks and vehicles, and establishing a good relationship with a fuel supplier. The company advises establishing a supply package that incorporates weather forecasting for temperature-driven fuel consistency fluctuations. Metroline has established a process for B10 to be used once temperatures drop below 8 degrees Celsius. In instances where B10 has been utilised during colder periods, Metroline has offset usage by running vehicles on B30 at periods across the year.

3. Renewable Diesel

UK Supply Chain and Market Trends

Renewable diesel today refers to paraffinic diesel produced from biogenic feedstocks. It is classed as a ‘drop-in’ fuel, which means that it can be used in HDVs without modification to the engine or fuel storage. Renewable diesel is required to meet the paraffinic fuel quality standard EN15940. Renewable diesel and retail diesel can be blended at very high blends although there are some practical issues in complying with EN590 above a 30% blend.

The hydrotreatment of oils and fats, using hydrogen, is currently the most popular production pathway for renewable diesel supplied to the UK. Renewable diesel is also referred to as hydrotreated vegetable oil (HVO). Originally, HVO was produced by the hydrotreatment of virgin vegetable oils, however in the last few years a variety of waste oils and fats-based raw materials have become the main feedstocks. Improvements in feedstock processing is allowing new types of biogenic waste to be exploited.

The UK does not have any domestic HVO production, subsequently HVO is imported from Europe, Asia and more recently the US. Over the last twelve months the UK has experienced a sharp increase in HVO imports, mainly due to expanding capacity of HVO plants internationally. HVO is typically sold as 100% renewable diesel, however a few companies are selling blends of renewable diesel and fossil fuel. These include Esso offering 25% renewable diesel blended with mineral diesel, and Green Biofuels offering 45% HVO blended with fossil paraffinic diesel (GTL).

One UK company, ESL Fuels, is importing renewable diesel as well as producing it via an innovative process called fractionalisation. This is being supplied through various UK distributors.

Over the next two years new renewable diesel supply chains will enter the UK, using advanced production pathways and feedstocks. This includes the pyrolysis of agriculture and forestry wastes and residues. The process produces a bio-oil which is upgraded to renewable diesel, also referred to as ‘biomass-to-liquid’ fuel. A by-product from the pyrolysis process is a charcoal-like material called bio-char. Bio-char is becoming recognised as greenhouse gas removal technology, offering CO_2 capture and long-term storage.

Producers of HVO are starting to upgrade their hydrotreatment plants to produce Sustainable Aviation Fuel (SAF). This will enable the co-production of sustainable aviation fuel and renewable paraffinic diesel. The SAF market is however in its infancy.

RFAS Approved Suppliers

Renewable diesel suppliers approved under the RFAS are:

- **Green Biofuels Ltd, Certas Energy Ltd, ESL Fuels Ltd, Philipps 66 Limited, Jet Retail UK Limited, Valero Energy Ltd, Crown Oil Ltd, Speedy Fuels & Lubricants Ltd, Nationwide Fuels Ltd, Beesley Fuels Ltd, WFL UK Ltd (Watson Fuels), Prema Energy Ltd.**

Currently, all renewable diesel supplied under the RFAS is produced from waste biomass feedstocks originating from international markets. RFAS members are supplying renewable diesel produced from feedstock supply chains approved under internally recognised, voluntary sustainability certification schemes.

Renewable Diesel Deployment

The adoption of renewable diesel in HGV fleets has risen substantially over the last two years. Organisations deploying renewable diesel as part of their fleet decarbonisation strategy include Hovis, Ceva Logistics, DHL, Howard Tenens, London Borough of Hackney, Scarborough Borough Council, Travis Perkins, DPD, British Gypsum, PepsiCo and XPO Logistics. Crown Oil has adopted renewable diesel across 100 vehicles, being one of the first fuel distributors to decarbonise their delivery fleet. Zemo estimates 4000 HGVs are running on renewable diesel. Renewable diesel is proving to be a popular decarbonisation route for companies operating NRMM at construction and demolition sites.

GHG Emissions Performance

The GHG emissions performance of the primary sustainable feedstocks for producing renewable diesel supplied in the UK is presented in Table 2. In situations where renewable diesel is blended with fossil paraffinic fuel (GTL) or mineral diesel, the GHG emission savings will be lower.

WTW GHG Emission Intensity Range	8 to 17 gCO_2e/MJ
WTW GHG Emission Savings (v. retail diesel)	81 to 91%
Primary Sustainable Feedstocks	Used cooking oil, tallow oil, palm oil mill effluent

Table 2: GHG emission performance of renewable diesel and associated biomass feedstocks

Vehicle Compatibility

Most major truck manufacturers approve renewable paraffinic diesel for use in their Euro VI HGVs, predicated on the fact the fuel meets the European Standard Fuel Quality Standard EN15940. Fleet operators are advised to obtain evidence from their fuel supplier that renewable diesel meets the paraffinic fuel quality standard. In the case of older HGVs, (pre-Euro V) fleets, operators are advised to check with their HGV manufacturer regarding engine approval for renewable paraffinic diesel. A summary of heavy duty vehicle manufacturers' warranty positions for different biodiesel blends is provided in Appendix 1 accompanying this guide.

Public Refuelling Sites

Public forecourts selling renewable diesel have increased over the last year, albeit national coverage is quite sparse. Certas Energy offers renewable diesel at one of its HGV refuelling sites at Thurrock. The company plans to expand the number of sites supplying renewable diesel in its national HGV network over the next twelve months. Esso is running a pilot programme selling retail diesel with a blend of 25% of renewable diesel at twenty refuelling sites in London and Essex. Jet Retail is selling renewable diesel at two retail forecourts in North East Lincolnshire and South Yorkshire. Further information regarding renewable diesel refuelling site can be found in Section 6.

Financial Information

Vehicle Costs: No impact on vehicle cost.

Fuel Costs: Cost of fuel per litre is higher than diesel, ranging between 15% and 30%.

Maintenance Costs: Maintenance costs are identical to that of diesel vehicles.

Infrastructure Costs: Bunkering of renewable diesel may require additional storage tanks.

Case Study: Certas Energy

Certas Energy distributes fuels and lubricants across the UK to a wide range of businesses and industries. The company distributes approximately 20% of the UK's diesel and gas oil. Certas Energy operates a fleet of 900 HGVs, with typical duty cycles ranging between back-to-back depot operation for rigids, and both terminal and depot operation for artic tankers.

HVO is playing an important role in their current decarbonisation strategy. Certas Energy has been using HVO since November 2021, and as of January 2023, 225 of their HGVs run on HVO. To ensure vehicle compatibility and engine warranty for different Euro Standard HGVs, Certas Energy worked closely with various engine manufacturers to ensure HVO was compatible with their HGV fleet. The handling and operability of HVO were trialled prior to deployment. In the initial stages of HVO procurement, Certas Energy relied on fuel suppliers to provide a credible supply with reliance on generic sustainability standards. The RFAS is seen as a passport to the market, providing independent assurance of HVO supply chain sustainability. The company has now embedded specific sustainability requirements in their fuel procurement protocol.

Fleet decarbonisation plans are currently in development, with Certas Energy establishing 2030 GHG reduction targets. Externally, Certas Energy is facilitating Scope 3 emissions reduction across its customer base through use of HVO in the delivery fleet. Certas Energy is intending to increase its HVO usage over the coming years. Accommodating increased HVO supply results in a direct trade-off of main fuel grades (kerosene, gas oil, and diesel) due to storage capacity limits. HVO sales and storage capacity need to develop synergistically to mitigate challenges for Certas Energy's supply and logistics.

Certas Energy's parent company (DCC PLC) has fed into the business case for adopting HVO, alongside the desire to futureproof the company. Customer demand (in part stimulated by corporate sustainability objectives), and evaluations of transition fuels have further encouraged the use of HVO.

Case Study: Travis Perkins

Travis Perkins PLC is a UK based building materials distributor that operates a range of businesses, including Travis Perkins Builders Merchants and Toolstation. With plans to reduce 80% of its Scope 1 and 2 GHG emissions by 2035, (from a 2020 baseline), the business conducted a strategic fleet review to identify the best low carbon fuel to implement across its delivery fleet of 805 LGV and 1635 HGV fleet.

HVO has played a role in Travis Perkins Group's fleet since October 2021. Prior to deployment, initial HVO trials were conducted at four locations, and then progressed to include 35 locations and 219 delivery vehicles. As of January 2023, 164 HGVs and 55 light commercial vehicles (LCVs) within the Group's fleet operate using 100% HVO sourced from Green Biofuels Ltd.

HVO was identified to be highly suited to the range of Travis Perkins PLC's duty cycles (typically single shift day multidrop, and regional and local delivery) and vehicle types. In addition, HVO required no modification to vehicle design or operation. The Group engaged with various vehicle engine manufacturers to ensure their vehicles were warrantied to run on HVO prior to deployment.

Bunkering facilities required adaptations to facilitate the move to HVO, namely the installation of bespoke smart tanks at each site. Site suitability was established using a bespoke assessment criteria. Management plans were developed for fuel delivery, local traffic levels and the installation of physical infrastructure. This included the identification of space for the HVO fuel tank, development of line markings, and erection of barriers and power infrastructure. Various challenges were addressed in the plans including deployment costs, security, minimising opportunities for theft, the management and adaptation of site traffic flow and preparation of physical space for storage tanks.

Zemo's RFAS proved highly valuable in giving Travis Perkins plc the confidence of the company's HVO supply chain. The RFAS also enhanced the Group's existing evidence base for demonstrating the WTW GHG emissions saving of HVO compared to diesel. This subsequently supported the development of a business case for adopting this low carbon fuel as a route to fleet decarbonisation.

HVO is a steppingstone in the Group's decarbonisation roadmap as the fleet technology develops and matures. As a leading partner to construction, Travis Perkins plc is committed to leading on the decarbonisation agenda. The Group is working with the industry to share experiences and learnings from the use of HVO, thereby supporting other businesses to reduce fleet emissions and adopt a collaborative approach to achieving the UK's common goal of achieving net zero.

4. Biomethane

UK Supply Chain and Market Trends

The dominant production route for biomethane used in road transport is anaerobic digestion (AD) using organic waste feedstocks. This includes biogenic waste arising from arable and livestock agricultural practices, sewage treatment and municipal waste. Biomethane is upgraded to a quality suitable for use in gas vehicles then typically compressed and injected into the National Gas Grid for distribution. Biomethane is produced in the UK and imported from European AD plants.

The RTFO allows biomethane producers to inject compressed biomethane into the European and UK gas grids, and an equivalent mass of biomethane can be extracted from the grid at a refuelling station. This is known as mass balancing. The RTFO permits mass balancing of compressed biomethane and liquid natural gas, enabling liquid biomethane to be supplied to fleet operators. Biomethane is commonly dispensed as compressed biomethane gas (CBG) or liquid biomethane (LBM).

Biomethane is being produced, at small scale, on livestock farms through the capture of methane released from animal slurry. Renewable fuel producer, Bennamann is pioneering this biomethane supply chain in the South-West of England.

Over the next twelve months an advanced biomethane supply chain will become available in the UK. This entails the gasification of solid biogenic material such as wood waste or the biogenic fraction of refuse-derived waste, to produce a bio-syngas (bio-SNG). Bio-SNG is then upgraded to biomethane and injected into the UK gas grid. Advanced Biofuel Solutions Limited (ABSL) are working in partnership with Air Liquide to bring this supply chain to market very soon.

RFAS Approved Suppliers

Compressed and liquified biomethane suppliers approved under the RFAS are:

- **CNG Fuels Ltd, Air Liquide Advanced Technologies Ltd, Gas Bus Alliance and Gasrec Ltd.**

Currently all biomethane supplied in the UK is produced from biomass waste feedstocks, with raw material originating from the UK and Europe. RFAS members are supplying biomethane produced from feedstock supply chains approved under internationally recognised, voluntary, sustainability certification schemes.

Biomethane Deployment

Biomethane has experienced very strong adoption rates in the freight sector, with artic HGV fleets experiencing the greatest take-up over the past few years. Companies which have committed to operating biomethane HGVs include John Lewis Partnership, XPO Logistics, Aldi, Asda, Ocado, Tesco, Sainsbury's, Howard Tenens, DHL, UPS, Hermes, Amazon, Arla Foods, London Borough of Islington, Veolia, B&Q, Reed Boardall, Samworth Brothers, Wincanton, Gregory Group, and Lawsons building merchants. Zemo estimates approximately 2000 gas HGVs operate on biomethane in the UK.

GHG Emissions Performance

The GHG emissions performance of the primary sustainable feedstocks for producing renewable compressed and liquified biomethane in the UK presented in Table 3.

WTW GHG Emission Intensity Range	CBG: -22 to 17 gCO_2e/MJ	LBM: -22 to 27 gCO_2e/MJ
WTW GHG Emission Savings (v. retail diesel)	CBG: 81 to 125%	LBM: 69 to 125%
Primary Sustainable Feedstocks	Food waste, sewage sludge, nut shells, brown grease, organic municipal waste, wet manure	

Table 3: GHG emissions performance of biomethane and associated biomass feedstocks

Biomethane produced from wet manure (livestock slurry) can achieve a negative GHG emission intensity. When manure is stored in the open environment methane and nitrous oxide, two potent greenhouse gases, are released into the atmosphere. Methane is 25 times (by mass) more powerful as a greenhouse gas than carbon dioxide, whilst nitrous oxide is 298 times. Capturing these greenhouse gases and converting them into biomethane subsequently results in very high greenhouse gas emission savings. The GHG emissions savings of biomethane will vary depending on the proportion of wet manure in the biomass feedstock. For example, compressed biomethane produced entirely from wet manure is estimated to achieve GHG savings of 120% to 170%, depending on the supply chain.

Further GHG savings can be achieved for biomethane, in circumstances where the CO_2 emissions produced during the manufacture of biomethane are captured and used to replace fossil derived CO_2 used in industry. For example, CO_2 used in the beverage industry or in greenhouses. AD plant operators are exploring this abatement route in Europe, as well as companies producing bio-SNG.

The carbon intensity of biomethane varies depending where refuelling stations are connected to the National Gas Grid, with the lowest intensity for stations connected to the high pressure grid.

Vehicle Compatibility and Availability

Gas heavy duty vehicles can run interchangeably on natural gas and biomethane with no impact on fuel consumption or warranty considerations. The engines are either dedicated spark ignition (LNG or CNG) or High Pressure Direct Injection dual fuel (Volvo – LNG only). The latest compressed and liquified biomethane HGVs have a range of more than 300 miles.

Both CBG and LBM vehicles are available as rigid and artic HGVs up to 44t gross vehicle weight (GVW). Examples include the Scania P Series, G Series, S Series, Iveco Stralis NP, Iveco Eurocargo, two, three and four axle rigids plus 4x2 artics with 280, 340 and 410hp engines, Mercedes Benz Econic, and Volvo FH and Volvo FM, both with 420, 460, and 500hp engines. CNH Industrial recently introduced the first biomethane tractor to the UK market.

Financial Information

Vehicle Cost: Gas HGVs can cost around 25% more than a conventional diesel equivalent when purchased outright. A few companies offer gas vehicles on a lease contract.

Fuel Cost: Biomethane is cheaper than diesel on a pence per mile basis, partly driven by the reduction in fuel duty. Treasury has committed to maintaining the fuel duty differential between methane and diesel through to 2032. The fuel duty rate is 50% lower than conventional diesel.

Fleets operating on high annual mileages, such as long-haul logistics, experienced the greatest cost and carbon savings using biomethane. The payback period for gas vehicles has historically been around 2 to 3 years. The Low Emission Freight and Logistics Trial[12] results published in 2020, provide evidence of the positive GHG emission performance and whole life costs of UK CBG and LBM truck fleets.

Maintenance Cost: Gas vehicles are 20%-25% more expensive than diesel vehicles to maintain.

Infrastructure Costs: Costs vary depending on whether fleets use public access or depot refuelling. The capital costs of installing a depot refuelling station can be recovered through lower fuel operating costs. Alternatively, some companies will provide infrastructure and recover costs through the fuel price directly (wet lease).

[12] LEFT Dissemination | Commercial Vehicle Projects | Zemo Partnership

Refuelling Infrastructure

Biomethane refuelling stations can be categorised into three types, depending on the product(s) they provide.

- CBG stations can be grid connected or have gas delivered by a gas cylinder tanker, 200/250 bar pressure.
- LBM stations consist of a cryogenic tank and a fuel dispenser. They deliver liquid fuel at 2 to 8 bar pressure.
- LCBG stations supply both CBG and LBM. LBM is vaporised and compressed into storage tanks to add CBG functionality to the station. A sophisticated LCBG station may also utilise any 'boil off' from the LBM tank to compress into CBG.

Fleet operators can install refuelling infrastructure at their depot or choose to refuel at a public access refuelling station. Refuelling with biomethane is straightforward and usually takes no longer than filling up a diesel vehicle.

Depot-Based Stations

Depot-based refuelling stations are ideal for fleets which operate a return to base duty cycle. Smaller fleets can be refuelled using trailer-based or skid-mounted stations. Larger fleets, or fleets which need to refuel vehicles quickly, may need a gas grid connection. The depot will need to have sufficient space to install the equipment and enough electrical power supply, as well as access to a gas main. Timing for ordering new gas vehicles and installation of a refuelling station is important and needs to be appropriately planned.

Depot refuelling station costs vary significantly and as such we are unable to provide specific figures in this guide. Factors which influence costs include:

- **Capacity:** The amount of gas the station will be required to provide, which in return is driven by the number of vehicles to be refuelled, daily mileage, and forecast future demand.
- **Gas Grid Connection:** If the station is to be connected to the grid, the distance to the mains supply and the pressure of the local gas grid will impact the cost.
- **Electricity Grid:** Power availability and distance to the three phase mains.
- **Refuelling:** Number of refuelling nozzles required for the fleet size.
- **Footprint:** How large the station is and how much space is available at the depot.
- **Maintenance:** How maintenance costs will be managed.

Typical payback periods for depot-based stations are between two and six years, depending on the factors listed above. Gas refuelling stations can have a direct National Grid connection or have gas delivered by tanker (a so-called 'Mother and Daughter' arrangement).

Rather than purchasing a gas refuelling station outright, a fleet operator can adopt a wet leasing contract with a gas infrastructure supplier. This model entails a company supplying biomethane and CNG or LNG refuelling infrastructure, overseeing the station installation, operation and maintenance. The station will be provided and installed at no cost to the end user but with a marginally higher price per unit of biomethane to reflect the cost and risk undertaken by the supplier. Full repair and maintenance are offered over different contract periods, service contracts are typically ten years. Wet leasing has the added advantage of reducing the capital outlay required by truck operators to introduce gas vehicles and the assurance that the infrastructure required is operated by experts in the gas supply industry.

Grid Connected

Gas from grid connected stations is compressed on-site for dispensing into vehicles. It is therefore important to understand the specification of the local gas main; it must have enough pressure and capacity to supply the required demand.

- Connecting to a relatively high pressure part of the gas network reduces the amount of compression needed and therefore lowers running costs and reduces the GHG emissions of the biomethane. However, installation costs rise with increasing distance from the gas main network to the compressor unit.
- A lower pressure connection will require additional compression and potentially supply fewer vehicles or require additional gas cylinder storage. However, it may be suitable if vehicles are stationary for several hours, allowing gas to be compressed into tanks gradually.

A fast-fill grid connected station maintains sufficient site storage to allow vehicles to be filled in minutes. Where vehicle use is less intensive, slow-fill stations can be utilised. Here gas is compressed directly into vehicle tanks over several hours, saving the cost of site pressurised gas storage however, this is currently only implemented in Spain and Sweden.

Public Refuelling Sites

For CBG stations, 10 are public, 13 are restricted (prior arrangements are required for access), and 2 are private (depot owner access only). For LBM stations, 3 are public, 8 are restricted, and 4 are private.

As of January 2023, CNG Fuels operate 10 sites, with an additional 3 sites currently under construction, and 3 further sites with plans established. In total, 16 sites are expected to be operational within the UK by quarter two of 2024. The majority are located in England. Scotland currently has one operational site, and another site in-build. For Wales, construction has just started on their first CNG Fuels station. On average, each CNG station can refuel at least 500 trucks per day.

By 2026, CNG Fuels are projecting to have 30 to 40 operational refuelling sites established across the UK. All existing CNG Fuels stations, and the majority of their planned stations, are located on the high pressure grid.

Gasrec operates thirteen CNG and LNG refuelling stations offering biomethane. Following investment from BP, the company is planning to expand its network, with a target of 63 stations across the UK by 2027.

Case Study: John Lewis Partnership

Sustainability is at the core of John Lewis Partnership's (JLP) operation. It has implemented ambitious measures to reduce its carbon emissions, with a target of a zero carbon fleet by 2045.

The commercial vehicle fleet consists of 2,000 vans, 400 light trucks, and 600 heavy duty trucks. JLP is reducing road transport carbon emissions by driving fewer miles, improving fuel efficiency and switching to alternative fuels.

In 2010 JLP and Imperial College London reviewed 30 alternative fuels and technologies. Using criteria covering sustainability, availability and the long-term business case, JLP concluded that biomethane was the best option for its heavy fleet. The process of introducing biomethane began with a trial of one demonstration vehicle. The fuel was gradually rolled out across their fleet of predominantly Scania, and some Iveco, gas tracks. To date, JLP are running approximately 400 trucks powered by biomethane. JLP has committed to changing their whole fleet of heavy duty trucks to dedicated gas HGVs, fuelled by biomethane, by 2028.

Pre-2021, gas trucks cost around 25% more than their diesel equivalents to purchase. This was offset by fuel savings, as JLP was paying around 30-40% less for biomethane than diesel on a pence per mile basis. This means investments were expected to be recovered in no more than two years. Over the lifetime of a vehicle the total cost was about 24% lower than an equivalent diesel truck, though payback depends on factors such as fuel price and miles driven.

Volatility in the gas market since 2021, in part due to the post-COVID-19 recovery period, and also the war in Ukraine, has brought about price challenges for JLP. Over this period, gas pricing has fluctuated and become more expensive than diesel at times. Irrespective of this, JLP still made a small gain on energy costings compared to diesel alternatives. Despite this exceptional period of uncertainty, JLP look to continue their strategy, and expect the attractive business case to return in 2023.

JLP's biomethane vehicles are refuelled at the CNG Fuels station at Northampton, Avonmouth, and Leyland. The biomethane supplied is produced from a variety of feedstocks including food waste and manure.

Case Study: Cornwall Council

Cornwall Council's fleet service provider, Cormac, is sourcing biomethane for its HDV fleet from the county's dairy farmers in an innovative local production model based on Bennamann Ltd's processing technology. Cormac's decision to transition from diesel to biomethane has been driven by environmental considerations, in particular reducing their carbon footprint. Furthermore, the Council's Climate Emergency Declaration and 'zero carbon Cornwall by 2030' aspiration has influenced the company's decision to switch to using renewable vehicle fuel.

Bennamann's technology captures biogas that would otherwise escape into the atmosphere as methane and CO_2 from manure slurry lagoons. This results in significant reductions in greenhouse gas emissions. The biogas is then upgraded to CBG and LBM. The process additionally captures CO_2 for merchant sale (for example in the food and drink sector) and produces digestate as a fertilizer replacement. The biomethane production helps improve the sustainability of farmland management and demonstrates a local circular economy using agricultural waste to produce a range of bio-products. Three tenant farms owned by Cornwall Council are now producing gas, with further farms coming on stream in 2023.

Bennamann's innovations include patented equipment to process, liquify and store biomethane on the farm and proprietary engineering for lagoon and tank covers and biogas off-take. Distribution models include using biomethane as a low carbon fuel for agricultural tractors, for example for use with the New Holland range of methane powered tractors; hyper-local off-farm supply; aggregation for local fleet use, such as in the case of Cormac.

Initially CBG is being provided to Cormac for use in road and grounds maintenance equipment consisting of mainly vehicles between 3.5t and 6.5t. LBM will be used in gas trucks in a second phase of the project. One highly novel aspect of this biomethane application is that Cornwall Council are both an end-user, through Cormac, and the source of waste feedstock for fuel production. There are thirty-nine tenant dairy farms with slurry lagoons on the Council Farm Estate which are currently being studied for conversion to facilitate the biomethane production technology offered by Bennamann.

This year a dedicated refuelling station will open on a Cormac site near Redruth in Cornwall. Two other refuelling sites are planned to give county wide coverage. The Bennamann model will be rolled out to other areas of the UK during 2023, including with Waitrose (parent company is John Lewis Partnership) at their Leckford Estate farm in Hampshire.

Case Study: Gregory Group

Gregory Group handle, store, and distribute products nationwide. Their customer base ranges in size, from small, local businesses to multi-national companies. Gregory Group's fleet comprises of over 1200 HGVs that operate across various duty cycles. Some trucks operate for 23 hours throughout the working day.

Biomethane and HVO play a pivotal role in Gregory Group's fleet decarbonisation strategy. Thirty-seven gas HGVs run on bio-LNG, and 60 diesel HGVs run on HVO. Gregory Group began using biomethane at the beginning of 2021. HVO use followed just over a year later in 2022. HVO and biomethane are supplied from RFAS approved companies - Green Biofuels and Gasrec. The requirement for purchasing renewable fuel with independent supply chain verification is a key discussion point when liaising with customers. As a result of approval under the RFAS, confidence is instilled in their fuel procurement process.

Prior to deploying both fuels business-wide, Gregory Group ran a small-scale trial in concurrence with the development of infrastructure and technology across their sites. Infrastructure was seen as the biggest challenge, with one biomethane tank being installed at their Cullompton site. Additional refuelling occurs across multiple external sites, which has been established through reciprocal business-to-business arrangements. HVO provided Gregory Group with an easier switch, as two diesel tanks have been repurposed to accommodate HVO without requiring modifications. In terms of fleet infrastructure, discussions with Scania and DAF confirmed permitted HVO usage in Euro VI vehicles only.

Gregory Group has made commitments under the Science Based Target Initiative to establish GHG emission targets in alignment with those set by the Paris Agreement. Gregory Group is committed to reducing its fleet GHG emissions and is utilising biomethane and HVO as important transitional fuels, whilst awaiting availability of zero emission HGVs in the longer term.

Increasing demands for green logistics have seen a shift in customers actively leading the decarbonisation market, especially for renewable fuels and energy. Therefore, despite costing more than the diesel alternative, Gregory Group has found its customer base to be willing to share the whole life cost for HVO use. Gregory Group is aiming to be well equipped to aid customers in their decarbonisation journey, especially through offering solutions for customers to reduce their Scope 3 emissions, as demand for green logistics in the distribution market continues to grow.

For operators thinking of decarbonising their fleet, Gregory Group recommends getting ahead of the curve as transitional fuels take on a larger role in the freight logistics sector. The Group suggests evolving with the market, as customers pursue green solutions in accordance with their respective decarbonisation strategies. Looking forward, Gregory Group intends to increase usage of HVO and biomethane in its fleet in order to offer a 'decarbonisation opportunity' for future work tenders.

5. Bio-propane

UK Supply Chain and Market Trends

Bio-propane, also known as bio-LPG, is mainly produced as a co-product of the hydrotreatment of oil based energy crops and biogenic waste feedstocks. Bio-propane is chemically identical to conventional fossil fuel Liquid Petroleum Gas (LPG). It is a 'drop-in' fuel, which means it can be substituted for conventional LPG with no impact on operational requirements.

UK suppliers of bio-propane including Calor Gas, Flogas and Avanti, are importing this renewable fuel from Europe. Bio-propane is a relatively new product and only small volumes are currently supplied in the UK. At present, no bio-propane suppliers are approved under Zemo's RFAS, however Calor Gas and Flogas are registered under the government's RTFO scheme.

In the next few years renewable dimethyl ether (rDME) will become available in the UK. rDME is a low carbon liquid gas that can be blended by up to 20% with LPG and bio-propane with no changes to existing infrastructure. It is produced through the gasification and chemical conversion of various sustainable feedstocks including forest residues, municipal waste and sewage sludge. Dimente is developing an industrial scale rDME production facility in Teesworks, using non-recyclable waste as feedstock.

Deployment in HDV Fleets

At the time of writing bio-propane has limited deployment in the UK HDV sector. Its primary use is in heating and to power non-road mobile machinery, notably forklift trucks. A HGV dual fuel retrofit technology, capable of running on bio-propane and diesel, has been developed by UK-based company **add**vantage. Although only a small number of HGV fleet operators have fitted the technology, existing orders will see numbers significantly rise over the course of this year.

GHG Emission Performance

The GHG emissions performance of the primary sustainable feedstocks for producing bio-propane in the UK are presented in Table 4. Crop-based feedstocks typically give rise to lower GHG savings than waste-based equivalents. Data has been sourced from the RTFO statistics 2022.

WTW GHG Emission Intensity Range	29 to 38 gCO_2e/MJ
WTW GHG Emission Savings (v. retail diesel)	57 to 67%
Primary Sustainable Feedstocks	Palm oil, food waste

Table 4: Bio-propane GHG emission performance and associated biomass feedstocks

Vehicle Compatibility, Warranty Coverage, and Availability

Bio-LPG vehicles are only available in the UK as retrofit conversions. **add**vantage can retrofit their dual fuel technology to Euro IV, V and VI diesel HGVs. The **add**vantage system has now covered over 10 million miles with no consequential failures.

There are specific EU and UK regulations that protect consumers from blanket refusal of warranty coverage for use of aftermarket components. Under the EU Motor Vehicle Block Exemption Regulation 461/2010 (now retained in UK legislation), manufacturers have a legal obligation to honour the vehicle's warranty when it is serviced outside of the dealer network when non-manufacturer parts are fitted and when retrofit devices are installed. Fitting of retrofit systems and devices onto a vehicle is an insufficient reason for the warranty to be declared invalid. The only circumstance where a manufacturer can deny warranty coverage after fitting a retrofit conversion is where the system can be proven to have caused a consequential failure (**add**vantage provides comprehensive warranty coverage).

Refuelling Infrastructure

Over 1000 refuelling stations exist across the UK, albeit numbers have reduced a little in recent years. None of these yet offer bio-propane although the market leader Calor supplies blended bio-propane to all of their forecourt supplies. Depot-based bunkering installations and refuelling of bio-propane can be supplied on request where the **add**vantage technology has been adopted.

Financial Information

Vehicle Costs: In the case of **add**vantage, the company offers a rental only model which includes fitting and is charged at £150 per month, which means there is no capital investment required. The retrofit offers the greatest economic saving to long-haul HGV operators, with break-even costs achieved around 17,000 miles per annum. This is supported by bio-propane's lower operating costs.

Fuel Costs: Bio-propane is on average 60% cheaper than diesel and benefits from a preferential rate of fuel duty.

Maintenance Costs: For the **add**vantage retrofit technology, the only scheduled maintenance required is an annual gas filter change, which is undertaken as part of **add**vantage's contractual obligations.

Infrastructure Costs: HGV fleets typically have depot-based bunkered fuel with the infrastructure provided and maintained as part of the renewable fuel supply contract.

Case Study: G&B Finch

With a fleet of more than 30 heavy duty vehicles, G&B Finch wanted both to reduce fuel costs and to bring greenhouse gas emissions in line with their sustainability plan. After reviewing the available options, G&B Finch trialled **add**vantage, a unique dual-fuel retrofit technology that substitutes up to 25% bio-LPG for diesel.

After installation, which took around four hours per vehicle to complete, **add**vantage and G&B Finch worked together to measure emissions and fuel costs both with and without the **add**vantage system in operation. After proving that the system reduced fuel costs and CO_2 emissions in practice, G&B Finch elected to roll out the installation of **add**vantage across their entire fleet.

The system has been in use since July 2020 and delivers fuel cost savings of around 10% and cuts CO_2 emissions by approximately 20%. The vehicles fitted with the **add**vantage system have now covered more than 3.6 million miles and the company has not experienced adverse wear or operational issues on any of their vehicles.

Deliveries of bio-LPG are made by Calor Gas and this has run smoothly. Initially, some drivers were forgetting to fill up with LPG. While the vehicles could still operate successfully, no fuel or emission savings could be made until the vehicles were topped up with LPG. This problem has been solved by the development and installation of a dashboard monitoring system. This not only reports fuel levels (both in the cab and remotely at head office), it also reports fuel savings and emissions reductions in real time.

According to G&B Finch, installing the **add**vantage system has been a great success. The company confirmed that fuel savings from the **add**vantage system are very impressive, have lived up to expectations and have allowed them to reduce their cost base significantly. The emission reductions have enabled the company and their customers to report reductions in their carbon footprint. The telemetry dashboard **add**vantage has developed relatively recently has been seen as a game changer, from both an operational and a reporting perspective. It enables G&B Finch to have complete operational visibility and operate their fleet in the most efficient way possible.

6. Further Information

Renewable Fuel Guide Sponsors

Scania are a major manufacturer of commercial vehicles, specifically heavy trucks and buses. We have a long experience of operating on all of today's major biofuels – bioethanol, biodiesel and biogas.

Scania works in partnership with governments, organisations, universities and other stakeholders to combine our vision and competence in commerce and transport. We take into account the specific transport assignment, flows of goods and people, customer needs, and the local infrastructure.

By supporting this guide we aim to play a definitive role in the growth of renewable fuel use. Along with improved efficiency, sustainably produced renewable fuels are a key part of Scania's approach to Driving the Shift and achieving fossil free transport.

Visit: **https://www.scania.com/uk/en/home.html**

Certas Energy is committed to supporting local economies sustainably and ethically and recognises the significant part that the energy industry can contribute to limiting the impacts of climate change. As the largest distributor of fuel and lubricants in the UK, we are harnessing our industry-leading energy expertise to drive meaningful change and we're proud of the evolving liquid fuel business we have today.

Our diverse customer base includes rural residential customers, small, medium, and large businesses, agricultural businesses, and family farms. With over 2500 employees, 90 depots and 26 bunker sites we are energy partner of choice for businesses that are serious about reducing their carbon footprint and environmental impacts.

Visit: **https://certasenergy.co.uk/**

Gasrec is a major fuel provider for gas-powered commercial vehicles on UK roads. It supplies, builds and operates Bio-LNG and Bio-CNG refuelling stations. Gasrec's renewable fuels are enabling fleets to reach Net Zero targets by achieving GHG savings of between 80-190% and are independently verified by the Department for Transport's Renewable Transport Fuels Obligation (RTFO) scheme.

Currently Gasrec is operating 15 stations across the UK and is developing an open-access refuelling network across the UK.

Visit: **https://www.gasrec.co.uk/**

Since 1957, Watson Fuels have been proudly delivering fuels and lubricants to homes, farms, and businesses, growing from our roots in rural Wiltshire, to one of the largest fuel distributors in the UK.

Today, as a division of World Kinect Corporation, we combine our UK fuel network and specialist fuel expertise with the backing and scale of a Fortune 100 company and a wide range of energy and sustainability solutions.

Together with our colleagues at World Kinect , we're committed to helping our customers plan and progress their respective energy transitions. In addition to our growing nationwide renewable fuels footprint, our global experts have a proven track record supporting thousands of customers on every step of the decarbonisation journey.

Visit: **https://watsonfuels.co.uk/**

Over several years, **add**vantage Global has successfully developed retrofit technology to cut fuel costs and emissions for heavy duty trucks. Led by an experienced management team, **add**vantage Global now supplies and fits the **add**vantage dual-fuel system in the UK, across Europe and the Middle East.

The **add**vantage technology delivers proven fuel-cost savings of up to 10% and cuts CO_2 emissions by 20%. Trucks fitted with the **add**vantage system have clocked up over ten million miles in real-world use with no detrimental impact on engines.

Visit: **https://www.addvantageglobal.com/uk/**

UK Renewable Fuel Refuelling Sites

- https://www.jetlocal.co.uk/fuel
- https://www.esso.co.uk/en-gb/find-station/
- https://gasvehiclehub.org/about/

Useful Resources

- **Renewable Fuels Assurance Scheme**
  https://www.zemo.org.uk/RFAS

- **UK Government GHG conversion factors for company carbon reporting, 2021**
  https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

- **UK Government RTFO statistics, Q1 and Q1, 2022**
  https://www.gov.uk/government/collections/renewable-fuel-statistics

- **The Freight Portal is hosted by Zemo and EST, providing resources to on HGV fleet decarbonisation and wider fleet support schemes.**
  https://thefreightportal.org

Glossary of Abbreviations

CBG	Compressed Biomethane
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
FAME	Fatty Acid Methyl Ester
GHG	Greenhouse Gas
GTL	Gas to Liquid
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicle
HVO	Hydrotreated Vegetable Oil
ISCC	International Sustainability and Carbon Certification
LBM	Liquid Biomethane
LCBG	Liquefied to Compressed Biogas
LPG	Liquefied Petroleum Gas
N_2O	Nitrous Oxide
OEM	Original Equipment Manufacturer
RTFO	Renewable Transport Fuel Obligation
RFAS	Renewable Fuels Assurance Scheme
SAF	Sustainable Aviation Fuel
TTW	Tank-to-Wheel
UCO	Used Cooking Oil
WTT	Well-to-Tank
WTW	Well-to-Wheel

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Accelerating Transport to Zero Emissions

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