Decarbonisation of the Scottish Wholesale Industry

Creating a Green & Sustainable Local Food & Drink Supply Chain

Fleet Emissions Reduction Roadmap

SCOTTISH WHOLESALE ASSOCIATION

The voice of the Scottish Food, Drink and Allied Trades

Decarbonisation of the Scottish Wholesale Industry

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The Scottish Wholesale Association (SWA) is the official trade body for Scotland's food and drink wholesaling industry. SWA members are 'the wheels to Scotland's food and drink industry' supplying products to over 5,000 independent convenience stores, 30,000 catering, hospitality, tourism and leisure businesses and the majority of public sector establishments, across Scotland.

This Roadmap set outs some options available to SWA members to decarbonise their vehicle fleet emissions as well as an emission reduction timeline. This should be read in conjunction with the SWA's Fleet Emissions Baseline report which describes the estimated emissions generated by the membership's vehicle fleet.

That report, along with this Roadmap, is part of a series of reports which will be produced for the SWA's Decarbonisation Project. The Decarbonisation Project aims to help the Scottish Wholesale Industry transition to greener and more sustainable practices, in alignment with the Scottish Government's ambitious target of achieving net zero by 2045 as covered in their Climate Change (Emissions Reduction Targets) (Scotland) Act 2019.

Appendix A gives additional background to the Association, the size of the Wholesale Industry and wholesaler demographics.

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Fleet Emissions Reduction Roadmap

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Decarbonisation of the Scottish Wholesale Industry

Fleet Emissions Reduction Roadmap

1. Introduction

This report presents a Roadmap to achieving zero emissions from the Scottish Wholesale Industry vehicle fleet. The Scottish Government has introduced an ambitious target of reaching net zero carbon emissions by 2045[1], meaning that by then the volume of greenhouse gases emitted within Scotland and the amount extracted from the atmosphere in Scotland will be equal to zero. There are interim targets of a 75% reduction in emissions by 2030 and 90% reduction by 2040, compared with 1990 levels.[1,2]

The starting point for the Roadmap is the baseline data on the carbon impact of the Scottish Wholesale Industry's vehicle fleet and the number and types of vehicles in the fleet. This has been gathered through earlier work with SWA members and published in our Fleet Emissions Baseline report.

These figures have informed the development of an emissions reduction plan - the Roadmap to net zero vehicle emissions from the Scottish Wholesale Industry fleet by 2045. The Roadmap presents:

- A description of decarbonisation options available including methods of reducing fuel consumption and routes to the adoption of new technology.
- An exploration of the challenges of transition to low carbon technology.
- An assessment of the potential business and economic benefits accruing to fleet operators from decarbonisation measures.
- A timeline for reducing emissions across the Scottish Wholesale Industry fleet.

Some of these measures could be implemented immediately while others will take longer. This Roadmap aims to show the stages of the journey – the steps the industry can take to reduce fleet emissions and when they can be done.

2. Background

The Paris Agreement, otherwise known as the United Nations Framework Convention on Climate Change, aims to limit global warming to below two degrees centigrade through reducing global greenhouse gas emissions to net zero.

In June 2019 the United Kingdom, a signatory to the Paris agreement, became the first major economy in the world to pass laws to end the country's contribution to global warming. The legislation sets a target to bring all greenhouse gas emissions to net zero by 2050.

In December 2020, the Scottish Government published the Update to the Climate Change Plan 2018 – 2032: Securing a Green Recovery on a Path to Net Zero. This builds on the Scottish Government's target of ending Scotland's contribution to climate change by 2045 set out in the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019[95]. It further commits the Scottish Government to achieving this target in a just and fair way through a green recovery, a *"transition to net zero emissions in a way that is just, and that delivers a thriving, sustainable economy."*

As part of their programme to meet these challenging targets, the Scottish Government has pledged to invest significantly in greener technology. This includes £60 million to support decarbonisation of the industrial and manufacturing sector, the £2 billion Low Carbon Fund and a further £100 million for the Green Jobs Fund.

The 2021-22 Programme for Government sets out plans to help secure Scotland's just transition to net zero. The just transition to a low-carbon economy for people and businesses will be supported by a £180 million Emerging Energy Technologies Fund to support the development of hydrogen and carbon capture and storage. Scotland's five-year Hydrogen Action Plan will be published in late 2021, setting out specific actions to support Scottish supply chain activity and drive the development of a low-cost hydrogen capability.

GREENHOUSE GASES

GREENHOUSE GASES ARE SO CALLED BECAUSE OF THEIR EFFECT ON GLOBAL TEMPERATURES. CARBON DIOXIDE, OFTEN SIMPLY CALLED CARBON, IS THE GREENHOUSE GAS PRODUCED IN GREATEST VOLUME BY FOSSIL FUEL COMBUSTION.

The Decarbonisation of the Wholesale Industry Project

The Decarbonisation Project aims to help SWA members transition to greener and more sustainable practices.

The UK and Scottish Governments and partners have committed to implementing a variety of measures to achieve this target which will directly affect the fleet operations of the Scottish Wholesale Industry. These include:

- The phasing out and eventual ban of the sales of new petrol and diesel cars by 2030.
- The phasing out and eventual ban of the sales of new Heavy Goods Vehicles (HGV) by 2040. [3,4, 5]
- The introduction of Low Emission Zones in Scottish cities which will apply a penalty should vehicles which do not reach a minimum standard for emissions enter the zone.

In the updated Climate Change Plan, the Scottish Government pledge to *"lead the way by phasing out the need for new petrol and diesel light commercial vehicles by 2025"* and *"establish a Zero Emission Heavy Duty Vehicle programme with Scottish Enterprise to support innovation in the Scottish supply chain for HGVs."*

To support our members in preparing for these changes and to ensure that the sector can play our part in achieving net zero in an achievable and sustainable way, the Association have embarked on an ambitious Decarbonisation of the Wholesale Industry Project.

This project, dovetails with our local sourcing and supply chain partnership programme 'Delivering Growth Through Wholesale' which is an education and training programme helping local producers understand, access and distribute through Scottish wholesalers as an effective route to market. SWA are committed to supporting our members and Scottish suppliers to increase the amount and range of Scottish products stocked within our sector. This will assist in the creation of truly local, sustainable, circular food and drink supply chains.

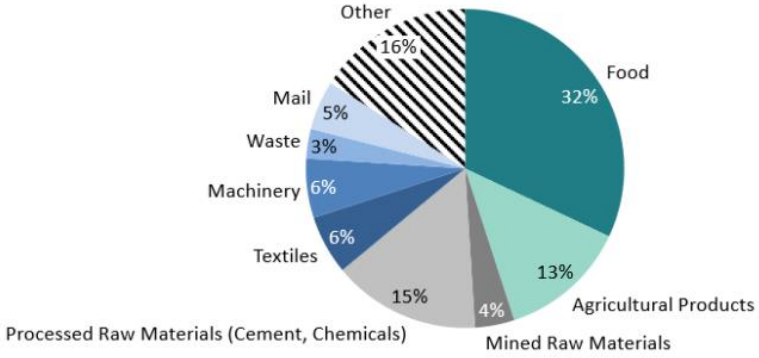
Our 'Decarbonisation: Fleet Emissions Baseline' report has established a baseline of our sectors fleet emissions. This document will review, and provide insight on, the various options available to support our sector in tackling their emissions and to implement them in a planned and manageable way.

The project will also identify the challenges and obstacles to realising our sector's aims as well as where market intervention may be required, from the Scottish and UK Governments to enable the sector to achieve net zero carbon emissions across the wholesale food supply chain by 2045.

The project has been designed in three phases:

- **Phase 1: Our Fleet**

  Establishing a baseline on the current food and drink wholesale fleet through analysis of the number and types of vehicles, their life cycles, distances travelled, fuel consumption and carbon emissions. Creation of a strategic plan – a roadmap - to support our members transition to low carbon technology and alternative fuels and to highlight the opportunities and challenges the sector faces in making the transition.



***Scottish goods moved by HGV by sector** (% of goods moved in million tone KM)* [94]

- **Phase 2: Our Buildings**

  Establishing a baseline on the carbon emissions from our buildings, including chilled and frozen storage facilities and exploring solutions to make them greener and more sustainable.

- **Phase 3: Our People**

  Exploring opportunities to reduce emissions arising from how our people travel to and from work and their activities during their working day.

Parallel to the three phases of the project SWA has produced a self-help calculator for members, *Measuring Your Emissions: Road Freight and Vehicle Emissions Toolkit*. This toolkit automatically calculates carbon emissions for member vehicles using their fuel and mileage data. This will help members to monitor their emissions and contribute data to the measurement of progress from the baseline set out in this report.

The methodology used in calculating the figures given within this document can be found in Appendix B.

Summary of Baseline

Total Number of Vehicles in SWA

2198

878	1320
Refrigerated	Non-Refrigerated

88% of the SWA's vehicle fleet comprises of fossil fuel vehicles

Numbers by Vehicle Type

Forklifts

251

Forklift 251

6% are diesel

4% are Gas

90% are electric

Cars

548

Medium 501

Large 32

Small 15

88% are diesel

5% are Petrol

5% are Electric

1% are Hybrids

Vans

344

Class III (1.75-3.5 tonnes) 169

Class I (up to 1.3 tonnes) 132

Class II (1.3-1.74 tonnes) 43

99% are diesel

1% are Hybrids

HGVs

1055

Rigid (> 17 tonnes) 599

Rigid (7.6-17 tonnes) 196

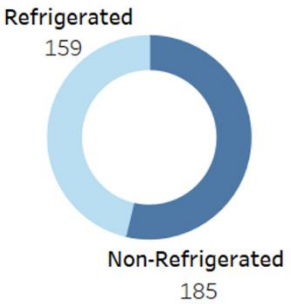
Rigid (3.5-7.5 tonnes) 162

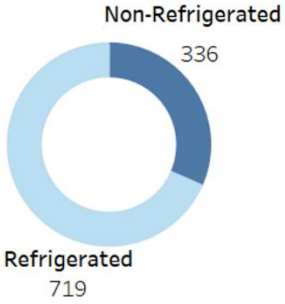
Articulated (>33 tonnes) 55

Articulated (26-33 tonnes) 43

99% are diesel

1% are Hybrids





Total Sector Vehicle Emissions

110,881

tonnes of CO_2 equiv

Scope 1 Emissions	Scope 3 Emissions	Fugitive Emissions
81,674 tonnes of CO_2 equiv	23,949 tonnes of CO_2 equiv	5258* tonnes of CO_2 equiv

*Does not include fugitve emissions from Class I and Class II refrigerated vans

Emissions by Vehicle Type

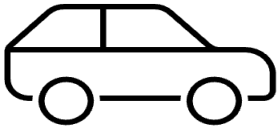
Forklifts

278

tonnes of CO_2 equiv

Forklift 278 tonnes

Cars



8269

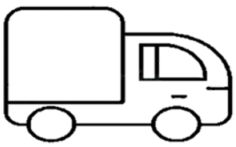
tonnes of CO_2 equiv

Medium **8049** tonnes

Large **111** tonnes

Small **109** tonnes

Vans



19,053

tonnes of CO_2 equiv

Class III (1.75-3.5 tonnes) **16,681** tonnes

* Class I (up to 1.3 tonnes) **1962** tonnes

* Class II (1.3-1.74 tonnes) **410** tonnes

*Does not include fugitve emissions from Class I and Class II refrigerated vans

HGVs

83,281

tonnes of CO_2 equiv

Rigid (> 17 tonnes) **33,143** tonnes

Rigid (7.6-17 tonnes) **28, 649** tonnes

Rigid (3.5-7.5 tonnes) **9491** tonnes

Articulated (>33 tonnes) **8583** tonnes

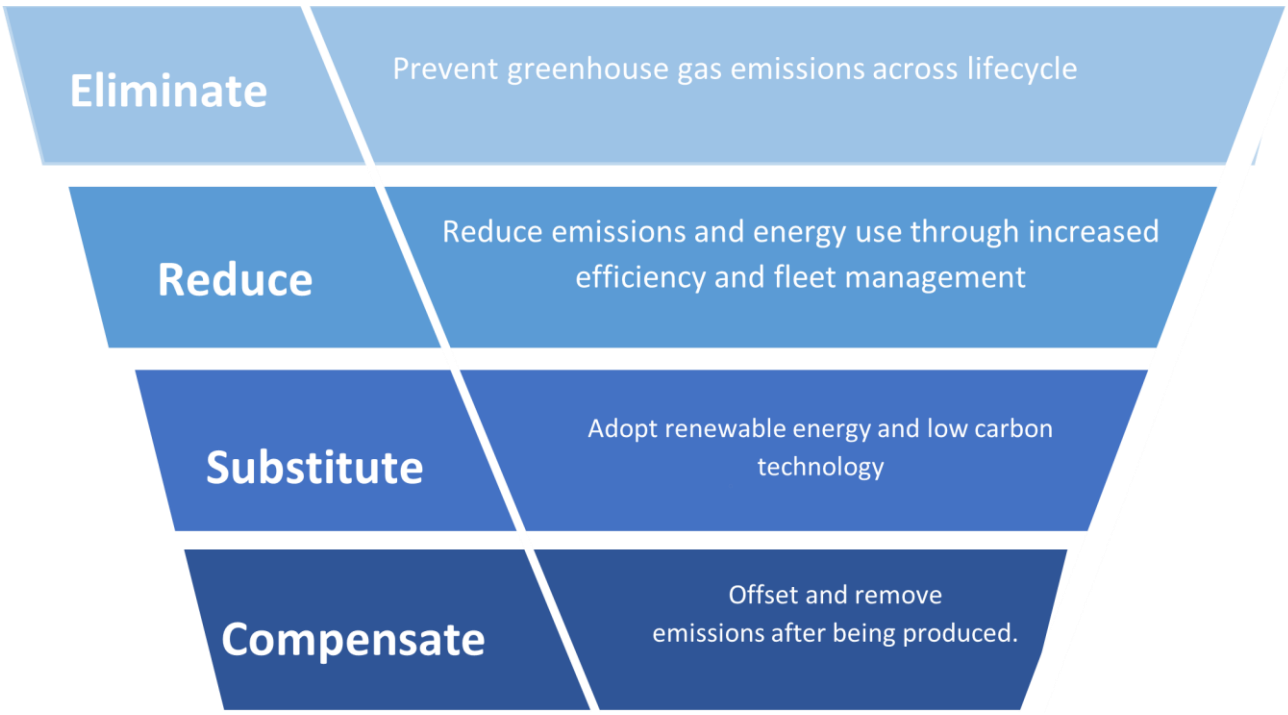
Articulated (26- 33 tonnes) **3415** tonnes

3. Elimination and Reduction Measures

This chapter describes measures which can be implemented in the short-term and which require minimal changes to the makeup and operations of the fleet. Some may also offer financial and operational benefits, as well as the reduction in emissions.

Emission Reduction Hierarchy

The emission reduction hierarchy is a greenhouse gas management tool used to classify approaches to decarbonisation.



Institute of Environmental Management and Assessment emission reduction hierarchy

The Institute of Environmental Management and Assessment system favours cost reduction methods, like fuel management, over heavy investment into low carbon technology.[6]

The approaches recommended in this Roadmap focus on the elimination, reduction, and substitution tiers in the above classification. Compensation, also known as carbon offsetting, does not require emissions to be reduced or eliminated, and is not addressed in this Roadmap.

Fuel Management

Systematic recording of fuel use and mileage enables fuel management targets to be set and calculations of the relative fuel efficiency of routes to be made. Setting an organisational baseline will enable the business to assess the impact of changes and to use these insights to develop further fuel-efficiency measures.

The following data should be collected every time a vehicle is refueled:[7]

- Refueling date.
- Vehicle registration number or other vehicle identifier.
- Litres of fuel used.
- Mileage since last refuel.

One method of collecting this data is to use a fuel card which would automatically capture these details. Mileage driven and routes taken should also be recorded in terms of total annual distance as well as distance driven by individual vehicles or drivers.[7, 8]

Appendix C provides links to further resources on this topic.

Reducing Driving Miles

Reducing driving miles can result in lower fuel consumption with a consequent emissions and economic saving. The Energy Saving Trust estimates that a reduction of 10% on an annual mileage of 12,000 miles could produce a £150 saving on fuel.

Driving miles may be reduced through a systematic analysis of routes to optimise journeys and scheduling. Moderately priced commercial vehicle telematics software products can efficiently perform a route analysis of this type.

Fuel Efficient Driving

Increasing fuel efficiency is an alternative to reducing driving miles and will have the same benefits. One of the most straight forward ways to reduce fuel consumption is through driving training.

Hard breaking and accelerating uses a greater amount of fuel than softer braking and accelerating. Training drivers to have improved anticipation time and to spot hazards earlier can reduce the frequency of hard breaking and consequently reduce fuel consumption.

Driving at a reduced speed can reduce fuel consumption. Increased speed can increase air resistance which uses more fuel. This explains why motorway driving is often the most fuel intensive for HGVs. One study found that an increase in speed from 50mph to 70mph in a Ford Transit Jumbo increased fuel consumption by approximately 20%.

Achieving reduced driving speed may require changes to routes, therefore additional mileage may have to be considered.[7, 8] This delivers a logistical challenge for fleet operators in balancing the most efficient and cost-effective solutions for their business. Driver training can also reduce accidents which can lead to a reduction in insurance premiums as well as improvements in driver and pedestrian safety.

Engine idling can be a cause of substantial levels of fuel consumption. It has been found that after 10 seconds it is more fuel efficient to switch the engine off. In practice a 30 second idling rule is more feasible to implement to prevent driver fatigue inherent in starting and stopping a vehicle continuously. Excessive engine idling may also be reduced by more effective route planning.

Although these measures may appear to have a limited impact, Eco Stars, a fleet management service, has found that just 1 hour of driver draining can improve mile per gallon consumption by up to 16% over 3 years. When this is scaled up across a fleet this could result in significant cost savings.[8]

Equipment Changes and Service

The measures discussed above demand minimal changes to the present fleet. Maximising fuel efficiency gains may help justify investment in new equipment.

Vehicle telematics instruments can record information on location, driving behaviour, distance travelled, and fuel used. The level of detail recorded can vary depending on the precise provider and instrument settings. At the time of writing, telematic solutions were

available from £10 a month. The use of vehicle telematics may provide more accurate data and be a more effective way of recording driver data than a manually recorded fuel card.

Changing to lower rolling resistance tyres can also offer both fuel efficiencies and cost savings. Tyres have an efficiency rating of A-G, with A being the most efficient. Using A rated tyres can result in a 9% fuel saving over the lifetime of the tyre compared with standard tyres.[8, 9] However, this is strongly dependent on mileage and may not always be the most efficient. Tyres should be properly serviced and properly inflated, a 20% drop in the recommended tyre pressure can result in a 2% increase in fuel consumption.[9]

Trials of alterations to trailers for HGV vehicles have also been shown to have produced significant reductions on journeys and emissions. This may be of particular benefit to larger national wholesalers which are more likely to include larger vehicles in their fleets. An eight-year long, Department for Transport backed, trial of 2,565 trailers found that expanding a semi-trailer length from 13.6 meters up to 15.65 meters saved up to 37 million miles and the equivalent of 48,000 tonnes of CO2 over a seven-year period. This is an approximate saving of 14,961 miles and 19 tonnes of CO2 per truck. Following on from the success of the trials the UK Government is presently conducting a study into the effects of increasing the maximum laden weight of 6 axle articulated lorries from 44 to 49 tonnes.[10,11]

Wholesalers may wish to consider a phased approach to the introduction of the above measures, implementing a manageable number of changes over a period. No change process is time and resource neutral but if wholesalers have good quality baseline data, the effect on emissions of any changes implemented should be measurable.

There are services providers that can conduct an overview of a wholesaler fleet and provide fleet management advice, in some cases without charge. This includes Energy Saving Trust as well as Eco Stars, an affiliate member of the SWA.[7,8]

The above measures, excluding the trials for HGV trailer extenders and increasing payload, can be implemented in the short to medium term, i.e. between 2021-2026.

If implemented across the entire Scottish Wholesale Industry fleet, these measures could produce a CO2e saving of approximately 10,563 tonnes per annum. This is based on a 10%

fuel use reduction - the average saving generated by these measures - from the current fleet baseline.

Further research amongst wholesalers is still required to ascertain what fuel reduction measures have already been implemented to establish the true value in the emission savings achievable through such measures.

The first step should always be the establishment of a fleet emission baseline, so that businesses may set an achievable reduction target for the business and ensure that the impact of any change is measurable. The first report in the SWA Decarbonisation of the Scottish Wholesale Industry project 'Fleet Emissions Baseline' provides more information on setting an emissions baseline.

Members can also use the SWA's Vehicle Emissions Toolkit to generate a calculation of their carbon emissions from fuel and mileage data.

Appendices C and D provide links to additional resources on methods to estimate emissions and manage fleet fuel consumption.

The above measures alone are unlikely to achieve the overall emission reduction targets required. They should therefore be considered alongside other measures including a shift to low carbon vehicles.

Summary of Elimination and Reduction Measures	
Pros	**Cons**
• Measures are available to implement immediately. • No significant changes to make up of fleet required. • Many companies/services either offer initial consultation or service for free e.g. Energy Saving Trust or Eco Stars. • Most measures can produce financial savings and operational efficiencies.	• Need to have accurate data of fuel usage, mileage and journeys before implementation. • Can be time consuming to implement. • Capacity to implement measures will vary significantly across fleets dependent on size and type. • These measures alone will not help reach net zero.

Assistance Required for Enablement
Fleet operators to start tracking fuel usage, mileage and overall carbon emissions. Fleet operators to consider investment in vehicle telematics.

Substitution Measures

This chapter describes alternatives to current internal combustion engine vehicles and fuels. Some of these are not immediately implementable, but it is imperative that they are explored and considered as early as possible to determine the factors influencing their uptake.

Hydrotreated Vegetable Oil Fuel

Hydrotreated Vegetable Oil (HVO) Fuel is considered to be a renewable or green diesel.[12] It is a type of biofuel that is produced from vegetable fats and oils, similar to biodiesel. However, unlike traditional biodiesel, HVO uses hydrogen instead of methanol as the catalyst during the creation process making it more clean burning than both biodiesel and regular diesel. This is because the hydrogen, unlike the methanol, removes oxygen from the fuel making it more stable than biodiesel.[12, 13, 14 ,15] As a result it can reduce overall Well-To-Wheel emissions by up to 91%, with most of the savings being made Well-To-Tank.[12, 13, 16] It can also reduce nitrogen oxide and particulate matter tailpipe emissions by 10%.[12]

WELL-TO-WHEEL EMISSIONS

INCLUDES EMISSIONS THAT RESULT FROM THE EXTRACTION AND REFINING OF FUEL, AS WELL AS THE DIRECT COMBUSTION OF THE FUEL WITHIN THE VEHICLE. IF THE VEHICLE IS ELECTRIC, THEN EMISSIONS GENERATED FROM THE ELECTRICITY USED CHARGING THE VEHICLES ARE INCLUDED.

However, the level of benefit and emissions reduction compared with traditional diesel is dependent on the driving environment.[16] HVO has a similar chemical composition to conventional diesel, unlike biodiesel, allowing it to be put directly into the current fleet without the need for it to go through a cleaning process. It can be mixed with conventional diesel

without an impact on the operational capacity nor does it impact the warranty with any major original equipment manufacturer.[12, 17]

However, there are some draw backs to HVO. Firstly, it is currently more expensive than conventional diesel. It is estimated that, in the present market, HVO is 15p/litre more expensive than fossil-fuel diesel. It is also currently subject to the same taxes and duties as regular diesel.[17] With most wholesalers operating on a (pre-Covid) 1.3% net profit margin this cost increase could significantly affect profits.

For example, the average volume of diesel purchased by an SWA member is 487,464 litres per annum, which costs approximately £638,578 for regular diesel, based on the UK Government average cost of diesel in 2019. This would increase to £711,698 with HVO, an additional cost of £73,119.

This represents an 11% increase in cost and would be a significant barrier to the adoption of HVO. However, it may be possible to reduce the cost if there were subsidies or if bulk ordering were achieved. However, it's still likely to be more expensive than traditional diesel which may discourage implementation.

At present, there is also limited market availability for HVO as there are only three UK suppliers and it can currently only be purchased for fuelling at depot.[12,17] This could mean potential supply chain problems and make it difficult to acquire in the future, while it also limits HVO use to those wholesalers who have the facility for onsite refuelling.

In addition, there are some issues with feedstock surrounding HVO and biofuels in general. This is because the major vegetable oils, used to produce HVO, are already in high demand so there is a limited supply. Palm oil is one of the main oils used to generate HVO and due to concern about the implications of palm oil use in deforestation it is likely to face restriction in use in the coming years, particularly in Europe. Furthermore, the hydrogen supply required for HVO production is currently very expensive and unstable.[14]

Finally, not all HVO fuel offers the same level of reduction in Well-To-Wheel (WTW) emissions. While some can achieve as much as a 90% WTW carbon reduction compared to fossil diesel,[14] HVO is still only a stepping stone to net zero with such fuels only reducing tailpipe emissions by between 5% and 10%.

If the right conditions were found and HVO was used in place of diesel across the Scottish Wholesale Industry fleet, then **HVO could produce up to 8,133 tonne CO2e[1] reduction in Scope 1 emissions and 21,509 tonne CO2e reduction in Scope 3 emissions.** If combined with fuel reduction measures, then savings could be as high as 37,241 tonnes, a 35% reduction excluding fugitive emissions or refrigerant gas from refrigerated vehicles. Fugitive emissions are not included in this calculation as it is unclear how they would be affected, and the available fugitive emissions baseline figure is only an approximate estimation.

Summary of Hydrotreated Vegetable Oil	
Pros	**Cons**
• HVO is available now and is regarded as a good stepping stone on the road to decarbonisation. • It can be used in current fleet with no additional technology changes needed. • Does not void warranties of many vehicles. • No staff training required or changes to operational procedures. • If there are HVO supply issues, operators can easily switch back to regular diesel with no damage to the vehicle. • Lowers emissions and reduces air pollution by up to 90%.	• It is a stepping stone fuel and is widely accepted as not the final alternative to diesel. • It is estimated to be 15p/ltr more expensive than traditional diesel. • Limited supply with only three UK suppliers and only available for onsite depot fueling. • Possible future supply issues could hinder uptake. • Some doubt over wider environmental impact outside of emissions. This is true of any biofuel. • Savings are not as strong for tailpipe as with Well-To-Tank but still less emissions than diesel.

[1] CO2e means the 'equivalent saving of Carbon Dioxide'. When written as MTeCO2 it means per metric tonne saving equivalent.

Assistance Required for Enablement
Scottish Government: Require subsidies/incentives to make HVO cheaper or comparable in price to diesel. HVO Developers/Suppliers: Greater access to HVO supply outside of depot refuelling.

Liquefied Natural Gas Fuel

Like HVO, Liquefied Natural Gas (LNG) is already available as an alternative to diesel but vehicles need adapted, or bought specifically, to run on LNG. Although still a fossil fuel LNG does produce significant emission savings and reduction in pollution. Overall, there is an estimated 20% Well-To-Wheel carbon emission saving compared with diesel.

The use of bio-LNG can increase the level of Well-To-Wheel reduction to 80%.[17, 18, 19, 20] Furthermore with bio-LNG it is estimated that there is a Tank-To-Wheel saving of at least 20%. An Innovate UK Low Emission Freight Trial indicates an almost complete reduction in Tank-To-Wheel emissions when used in long haul HGVs.[21]

If used across the entire Scottish Wholesale Industry HGV fleet this could create up to 62,539 tonne CO2e reduction per annum. This is a 59% reduction from the current emissions level. If combined with fuel reduction measures, then the reduction could be as high as 66,848 tonne CO2e per annum.

However, the level of reduction is strongly dependent on the driving environment, with urban driving seeing the least amount of emission reduction. As with HVO, these estimates do not include fugitive refrigerant gas emissions from refrigerated vehicles.

In addition to reducing overall carbon emissions, trucks using LNG can reduce nitrogen oxide and particulate matter emissions. The precise reductions in these emissions vary dependent on the type of truck being used as well as driving environment, with motorway and rural driving seeing the biggest savings compared with solely urban driving.[19,20]

LNG has a 30-35% lower price compared to diesel and has a fixed 50% lower fuel duty until 2032 compared to diesel.[19,20,22] However, this lower fuel price is unlikely to produce immediate short-term savings as LNG trucks have a higher initial upfront purchase cost of

£30,000-£40,000 compared with diesel trucks. If leased, then rates will vary but they are not significantly more expensive compared to diesel trucks.[13, 14, 16]

Over the long term, the lower price of LNG can result in savings after a few years depending on fuel price and distance travelled. If driven for 80,000 miles per annum, then savings occur after approximately 2 years, if 40,000 miles per annum then after 3-4 years.

The trucks are comparable to diesel and are currently the only feasible HGV alternative that does not sacrifice driving range or payload.[19] There is also a similar refueling time and driver experience with minimal training required.

However, there are significant barriers to using LNG related to the current infrastructure supporting it. There is only one private refueling LNG station located in Scotland, although there are more than 30 located in England.[23] While developers are currently looking at installing additional refuelling points across Scotland, it is too early to say whether this solution will become viable for fleet operators who rely on third party refuelling sites in Scotland. This could restrict this solution to those who could invest in their own onsite refuelling solution.[24]

In addition, the economic viability of LNG, under present market conditions, requires a fleet of approximately 20 vehicles. Below this, the cost of the infrastructure versus the volume of fuel sales would be too high for suppliers resulting in higher fuel costs for the operator.

If a refueling station could be shared by multiple businesses, this would make it more economically viable for both the end users and the supplier. In terms of acquiring on site refueling infrastructure there are companies, such as Gasrec, that will cover the initial cost of any fueling infrastructure needed to be put in place.[24]

Whilst LNG may be a good step towards reduced emissions, particularly as it is the only commercially viable, tried and tested alternative to diesel HGV's, it is again recognised as not being the final goal.

There is also a risk that by the time the necessary infrastructure is installed, other alternatives such as Hydrogen Fuel Cell (HFC) and Electric Vehicles would be closer to commercial market viability than at present. Currently, the commercial viability of these technologies is estimated to be approximately 10-15 years in the future for HGVs.

This may make LNG an attractive option, however, there is increasing emphasis and momentum at industry and government level to accelerate the development of these other technologies especially HFC HGVs.

This is in part due to the planned ban on sales of new diesel and petrol cars and vans and on diesel HGVs, and the UK and Scotland's ambitious emission reduction targets.

Therefore, there is a strong possibility that HFC development could accelerate and be implemented much more quickly than currently anticipated.

This could not only set back adopters of LNG but also hinder the development of any external LNG infrastructure which could be seen as diverting resources away from a better environmental technology.

Alternative fuels are available now to use and could help to significantly reduce vehicle emissions from the Scottish Wholesale Industry fleet, but their use alone is not going to achieve zero emissions. However, they are a good stepping stone and can provide a starting point for many businesses as they begin their environmental journey. Widespread uptake will require greater economic and infrastructure support as well as greater political clarity and certainty of approach.

For additional resources about alternative fuel see Appendix E.

Summary of Alternative Fuels	
Pros	**Cons**
• LNG is available now and is regarded as a good stepping stone on the road to decarbonisation. • Currently the only available HGV alternative for diesel. • LNG Trucks operate the same as diesel counterparts and require minimal driver training. • Lowers emissions and reduces air pollution significantly in some cases. • Whole life cost is cheaper than diesel due to lower fuel price.	• It is a stepping stone fuel and is widely accepted as not the final alternative to diesel. • High upfront capital costs of the vehicle. • Cost effectiveness is dependent on mileage and size of fleet. • Lack of infrastructure currently supporting deployment of LNG is a major barrier. Only currently an option for businesses that refuel on site and are not dependent on external refueling stations. • Strong likelihood of the acceleration of the development of other technologies within the next 5 years. This could leave users of LNG behind and hinder LNG infrastructure being put in place.
Assistance Required for Enablement	
Developers: Plan for external infrastructure to be put in place. Scottish Government: Financial assistance to help with the initial high cost of LNG Trucks and delivery of refuelling infrastructure	

Electric Vehicles

Electric Vehicles (EVs) have improved tremendously in the last few years and are now a realistic option for those that operate company cars and small vans. While there are concerns about the mileage range and charging time of these vehicles, there are a number of options currently on the market and further improvements are expected to be made in the near future .[28, 29,]

Although EVs do not entirely eliminate emissions there is a 50% to 70% Well-To-Tank reduction depending on the vehicle and driving environment, and zero tailpipe emissions are produced. Therefore, **if all cars and forklifts in the Scottish Wholesale Industry fleet were converted to EVs this could save up to 8451 tonnes CO2e per annum.**

The remaining emissions from EV are created through the production of electricity, required to charge the batteries, and will only be reduced further as the electricity grid decarbonises.[30] In the UK the electricity grid has a goal to be net zero by 2035.[31] Furthermore, the absence of tailpipe emissions will improve air quality, particularly within urban environments.

The whole life cost of Electric Vehicles is cheaper despite the initially high upfront cost. While EVs can cost anywhere from £2,000 to upwards of £10,000 more, compared with a diesel alternative,[30] there are financial support options available which can reduce the initial capital costs of those vehicles. These include the following:

- Up to a total of £120,000 interest free loan for the purchase of new and used electric cars, vans and HGV's.[32]
    - Up to £28,000 interest free loan for pure electric and range extended cars (must choose from list of eligible makes and models).
    - Up to £35,000 for new electric van purchases (must choose from list of eligible makes and models).[32]
    - Up to £120,000 for an HGV and which must show significant carbon savings (assessed on a case-by-case basis).
- Up to 100% grant funding for business electric charge point installation. [32]
- Up to 75% off charging point infrastructure costs. This is capped at £350.[32, 33]

- Businesses can claim up to 100% of the cost of zero emissions goods vehicle in tax year they were purchased. For example, if an Electric Vehicle costs £20,000 and the business pays 19% corporation tax, the cost will be reduced by £3,800.
- There is no fuel or vehicle duty on Electric Vehicles.
- Grants that will pay for 35% of purchase price for selected cars and vans and up to 20% for HGVs. This represents up to £2,500 for Cars, £3,000 for small vans, £6,000 for large vans and £16,000 for HGV's. Such grants are offered directly to the garage and will automatically be included in the vehicle's price.[34]

Through the assistance of the grants given on EVs, combined with the tax and fuel savings, the whole life cost of EVs works out cheaper than their diesel counterparts.[32,34]

Currently, even though the whole life cost of EVs can be cheaper, for many wholesalers the initial upfront capital required to replace the car or Light Goods Vehicle (LGV) fleet is still very high and too great for many businesses to undertake in the short term.

For example, the Nissan E-NV200 Acenta has a cost of £25,305 whilst its diesel alternative, the Nissan NV250 Panel Van Accent, has a cost £17,990. Even when the electric vehicle £3,000 grant is applied to the Nissan E-NV200 Acenta it is still £4,310 more expensive than the diesel alternative.[35, 36] This does not include the cost of charging point installation. In an industry which operates on pre-Covid average net margins of 1.3%, additional capital costs of this order may be unaffordable even if there is a saving on the vehicle in the long run.

A study by Transport and Environment, a non-profit organisation that campaigns for greener transport, found that if the right policies are introduced such as stricter carbon targets for equipment manufacturers alongside support for infrastructure, then the average Electric Vehicle could be cost comparable to diesel by 2026-2027. This is in part because Transport & Environment expect the cost of batteries, which make up to a quarter of the cost of EVs, to fall by 58% by 2030. However, this would only be possible if the right economic and policy support is implemented.[38,39] Others believe that cost parity may be achieved by 2024 and that, by the mid-2020s, cost will no longer be a barrier to EVs.[40,41]

The SWA survey of members found that 73% had concerns about the available Electric Vehicle charging infrastructure. Other surveys by the RAC, SMMT and Deloitte all highlight that a lack of reliable charging infrastructure for EVs is one of the main barriers for EVs adoption.[42, 43, 44]

If charging infrastructure is to meet the estimated demand of EVs by 2030, then 700 charging points would need to be installed a day. The current rate is 42 a day.[45] Businesses need certainty that they can recharge their vehicles conveniently and on demand.

An additional concern is that the local grid may not be capable of supporting the number of charging points that would be required for EVs at wholesaler's depots. The national grid has acknowledged that there could be issues associated with the growth in numbers EVs putting greater demand on the grid.[46] **This is something that the Scottish Government must consider when encouraging transport decarbonisation.**

In addition to the number of chargers required, charging connectors have typically been very slow often taking between 6-12 hours to fully charge a vehicle.[47] This speed of charging is not practical for any business that requires refuelling over the course of the day.

Wholesalers are also likely to require a charger for each EV. This not only has onsite practical issues in terms of space but also requires a huge upfront cost, averaging £800 per point, assuming no grant funding is secured.

Depending on charge cycles, businesses who operate on a 24-hour basis may need two trucks for every one they previously had to ensure there is no lost delivery time. This again increases the upfront capital cost associated with vehicle purchase and acts as a disincentive.

However, improvements in technology are reducing charging time with rapid chargers entering the market that can recharge an EV to 80% capacity in as little as 20 minutes.[47] This would overcome some of the barriers outlined above, namely charging time and the need for additional vehicles. There is no clear study or concrete guidance on how a multiple of these chargers would impact the local grid supply or the power that would be able to be supplied to each. This must be resolved to give business owners the reassurance that the chargers will work at the stated capacity before they make a significant financial investment.

In the last few years, the average range possible for an electric car on a single charge has reached 235 miles. It is expected that this will continue to improve in the future, making electric cars a viable option now.[43]

Furthermore, almost all LGV electric trials to date have focused on vehicle use within urban areas, but many SWA members operate in more rural and remote locations. Electric LGVs will need to be trialed in more diverse locations if widespread adoption in the Wholesale Industry is to be encouraged.

It is estimated that EVs achieve 25% fewer miles in range when driven at faster speeds, which is often the case when not operating in cities or urban areas. This can reduce to 50% fewer miles if the driving is particularly aggressive. Furthermore, it is estimated that range may be reduced by as much as 30% if the full payload is utilised. [30]

Although many within the industry believe that these issues will become less prevalent in the coming years, some resolution is required if there is to be business confidence and earlier adoption. Businesses may need financial aid to compensate for risk or business alterations made due to limitations of payload or range.

For example, if the range is less than the current diesel vehicle then this would lead to changes to the way delivery routes were planned and potentially mean a lower volume of goods would be deliverable, as the truck would be required to return to the depot to be charged. This may change as public charging points increase but, in the short-term, businesses may require a larger number of vehicles to ensure that a similar volume of deliveries can be made. This would not only increase the potential cost to wholesalers but also potentially increase emissions as well.

There is limited availability of refrigerated EVs. Our research could identify only one model of refrigerated electric LGV on the market. Refrigerated vehicles make up 40% of the Scottish Wholesale Industry fleet. There is therefore a significant need for a refrigerated low carbon alternative that is proven to work.[48]

With at least 23% of the refrigerated vehicle operators using red diesel to power their refrigeration condensers, a switch to electric powered refrigeration could produce significant carbon savings. A change to the UK fuel duty in 2022-23 will remove the duty

rebate on red diesel.[50] This will mean an increase in fuel cost for fleets using red diesel-powered refrigerated units. Therefore, a switch to electric powered refrigerated units could produce financial, as well as emission, savings.

Currently there are no EVs on the market that can replace or compete with traditional Internal Combustion Engine (ICE) HGV. This is primarily because the extra batteries required for electric HGVs are too expensive and too heavy. One wholesaler in our survey stated that they could buy five 18 tonne ICE HGVs for the same price as one electric HGV and its charger.

A more optimistic study by the Stockholm Environment Institute concludes that Electric HGVs could be more economically viable if a fast-charging network is available. This study based its findings on a charging time of 40 minutes after 4.5 hours of operation. However, this would require a charging network with a type of charger that currently either does not exist or is prohibitively expensive. Unless there is universal coverage in the charging network, trucks may be restricted in the routes which they could take, which is unlikely to be practical or suitable for all businesses.[49]

It is likely that EVs will become the norm for company cars and small vans by 2030. The future for electric HGVs is less certain and currently does not seem feasible. However, more support is needed particularly around an adequate charging infrastructure to ensure that electric cars and vans are practical for wholesalers servicing urban areas.

For more resources about Electric Vehicles see Appendix F.

Summary of Electric Vehicles	
Pros	**Cons**
• Eliminates tailpipe emissions completely and emissions will reduce further as the energy supply decarbonises. • Whole of life cost cheaper than diesel. • It is not a stepping stone technology and is considered the end point. • Range for certain models is low comparable to ICE alternatives. • Will be suitable for Low Emission Zones. • Adoption will help prepare businesses for new diesel/petrol car and van ban. • Good current alternative for company cars and some Light Goods Vehicles.	• High initial upfront cost. • Supporting infrastructure for charging is currently not adequate. • Grid capacity concerns. • Charging ability is currently not suitable for the way some wholesalers operate (but it is likely to change in the next 3 years).(Why/How 3 years ?? Not covered in narrative) • Operational concerns for certain models particularly for Light Goods Vehicles. • Limited research/trials for commercial environments outside urban areas. • No current EV HGV solution and alternatives to EV HGV look more likely.
Assistance Required for Enablement	
Scottish Government/Local Authorities/Developers: Expedite plans for additional external charging infrastructure to be put in place. Government/National Grid: Examine and upgrade grid capacity, particularly in hotspots. Scottish Government: Support for trials of commercial EV outside cities/urban areas.	

Hydrogen Vehicles

Hydrogen is expected to play a significant role in the transition to a sustainable energy future with many in the industry believing it to be the future solution for powering HGVs. This view is supported by both the Scottish and UK Government as laid out in their respective hydrogen action plans.[51,52,53,54]

This is because Hydrogen fuelled vehicles are as efficient and can offer similar range and refuelling time as traditional diesel trucks.[55,56,57] However, the technology to enable this transition is not yet commercially viable so this chapter shall describe the current options and the likely course of this technology.

The two primary areas that need to be considered in relation to the deployment of hydrogen vehicle technologies are the production of hydrogen and the development of the physical vehicle.

There are several different types of hydrogen and methods in their production and these include:

- **Black/Brown Hydrogen:** produced through Black/Brown coal gasification
- **Grey Hydrogen:** generated from natural gas, or methane.
- **Blue Hydrogen:** same as grey hydrogen but where the carbon emissions are captured and stored underground.
- **Green Hydrogen:** produced by water electrolysis using renewable electricity.

Brown and Grey Hydrogen are available now and are primarily used in agriculture. However due to their production methods, and emissions thereof, they are not considered to be part of Government plans to net zero. Blue and Green Hydrogen are considered as part of the UK Government's Hydrogen strategy[53]. This SWA Roadmap focuses on Green Hydrogen - which uses renewable fuel to create hydrogen.[58]

Green Hydrogen has the potential to be completely emission free but is currently too expensive to be distributed widely. It is produced primarily in an electrolyser which uses an electric current to split water into hydrogen and oxygen in a process known as electrolysis. When the electrolysis is powered by renewable power it produces Green Hydrogen.[58,59,60]

Currently, the cost of the electrolyser and the limited number of operational electrolysers make Green Hydrogen two to three times more expensive compared with other types of hydrogen and more costly than traditional fossil fuels.[60, 61] The current average estimated production cost of Green Hydrogen ranges between £7 and £8 per kg. However, the end user cost can be doubled if the hydrogen needs to then be transported from the production site to the end-users or a point closer to them.[62,63]

It is estimated that the end user cost needs to be approximately £5 to £6 per kg to make Green Hydrogen competitive with diesel.[63, 64] While Octopus Energy, [98] is currently offering batches of green hydrogen at around this price mark, this is based on a minimum delivery of 200kg. This means targeting operators, or shared access, of around 20 hydrogen vehicles in order to make it viable to supply.

It is envisaged that hydrogen price parity with diesel will be achieved within the next 10 years, with the cost of Green Hydrogen predicted to fall by 70% to 80% by 2030, as electrolysers become cheaper to buy and operate and large-scale commercial production becomes more common place.[60, 65,98]

Today, early adopters could install an on-site electrolyser to produce their own hydrogen. The potential fuel cost savings could off-set the cost of the electrolyser itself and the wind turbine, or solar panels, required to power it. This may limit operators to only being able to refuel at their own depot. Some providers envisage the hydrogen fuel production taking place in depot in the future.[60,63, 66, 67]

To encourage the early adoption of hydrogen and its production, particularly within private sector businesses, Government assistance in this area could help offset the high cost of an electrolyser installation and/or subsidise the price of hydrogen.

Support mechanisms could include grants or subsidies, such as the Renewable Transport Fuel Certificates, for hydrogen producers which form part of the Renewable Transport Fuels Obligation order.[60,62,67,68]

Some believe a £1 to £2 per kg subsidy would accelerate hydrogen production by increasing affordability for end users, thereby increasing demand and making it more viable for producers to enter the UK market.[60,62,67,68]

As outlined above, affordable hydrogen fuel and its availability are not the only challenges. The development, production and affordability of hydrogen vehicles is equally as important, if not more so.

Hydrogen Fuel Cell (HFC) – Zero Emission

A hydrogen fuel cell (HFC) works like a battery, but one which does not run down or need recharging. It generates electricity through an electrochemical reaction between Hydrogen and Oxygen, not combustion. [97]

While Hydrogen Fuel Cell (HFC) trucks are currently being trialled on the European market they are limited in number, bespoke to specific sectors and are around four times the cost of conventional trucks. Unlike passenger vehicles, where there is still debate over HFC benefits compared to their electric counterparts, there is greater consensus on hydrogen as the preferred option for commercial vehicles [69] particularly for HGVs.

Within the last few years, some major manufacturers such as Hyundai, Scania and Iveco have begun to produce hydrogen trucks for projects in Europe.[69] Hyundai currently have the most clear-cut roadmap with a plan to deploy 25,000 hydrogen trucks across Europe by 2030. At the time of writing, they have deployed seven hydrogen vehicles in Switzerland and intend to have fifty on the road by the end of 2021.

This development is part of a partnership with Swiss companies, including supermarket chain Migros, to bring zero emission commercial vehicles to the road. This partnership has circumvented the high purchase cost of hydrogen vehicles by offering a pay per km lease scheme.[69, 70, 71, 72]

Daimler and Volvo have signed an agreement to jointly produce commercialised HFC trucks, with plans to have customer trials by 2023. Toyota and Isuzu have made similar agreements with hydrogen producers.[69] Hyzon, a new truck manufacturer focusing on HFC, are offering HGVs of up to 50 tonnes with a range of up to 380 miles per fill and have opened a production site in the Netherlands.[73,74] They have partnered with a New Zealand energy company to build a hydrogen refuelling network which aims to deliver 1,500 HFC trucks by 2026.[74]

Clearly there is recognition by manufacturers that hydrogen vehicles, especially trucks, are going to play a role in the future. However, it is unclear how soon they will be available for widespread deployment…particularly in the UK which, unlike most of Europe drives on the left. The current price point of hydrogen vehicles makes them uneconomic to purchase. Leasing arrangements may ameliorate the capital costs but are still likely to be more expensive than leasing diesel alternatives.

It is likely that HFC trucks will reduce in price as the technology develops but it is predicted that significant reductions are unlikely to be achieved until after 2030.[75,76,77] Some manufacturers, such as Daimler and Volvo, believe that cost parity will not be achieved until 2035 unless further government support is provided.[79,80] However, it is expected that customer trials of HFC trucks shall be increasingly implemented from 2023/24.[77, 78,80] The SWA are taking a lead in these trials through our role in the Scottish Hydrogen Fuel Cell Freight Trial (SHyFT) feasibility project, in partnerships with Arcola Energy Ltd. [93]

Hydrogen Dual-Fuel Cell – Low Emission

Hydrogen Dual-Fuel hybrid retrofits are available today for fleet wide conversions and while they are not zero emission, offer a CO2 reduction of up to 40%, typically using around 5-10kg of hydrogen in every day operating duty cycles. Should the hydrogen supply be interrupted, a dual-fuel vehicle can also solely run off diesel if required. This can give businesses the security of knowing that they are helping cut their emissions but that the vehicle is still operational even if hydrogen becomes temporarily unavailable.

The Hydrogen dual fuel retrofit solution is only suitable for Euro 6 diesel vehicles and typically cost between £35-£50k per unit. For every 1kg of hydrogen used, 3.3litres of diesel can be saved.

While still expensive for wholesalers, such conversions are already offered through SWA affiliate member ULEMCo. The retrofit solution offers a quick start to the transition to hydrogen as a fuel and is a way to create the required hydrogen demand in single locations to achieve diesel parity pricing for hydrogen.

Hybrid vehicles have an emission saving of up to 40% if green hydrogen is used. Therefore, **if 10% of HGVs in the Scottish Wholesale Industry fleet were replaced with hybrids the industry would produce a 2,736 tonnes CO2e per annum saving.**

Hydrogen Internal Combustion Engine (H2ICE) - Zero Emission

Hydrogen Internal Combustion Engines (H2ICE) are, zero carbon emitting, engines that have been designed/adapted to run on hydrogen and operate in the same way as current diesel internal combustion engines. Unlike HFC vehicles, which needs all it's systems adapted to electric, H2ICE vehicles use all the same systems as is currently used[96]. This makes the overall cost of H2ICE more comparable with current vehicles.

Research to date suggests that H2ICE would have near zero NOx emissions[96] and therefore fulfil the requirements for both carbon and air quality emissions for future transport solutions. Current data also indicates that H2ICE could have lower costs and lifecycle emissions than HFC. Fuel consumption data for both technologies indicates that they have similar efficiencies, although HFC is more efficient at lower loads and H2ICE has better efficiency at higher loads. This means that H2ICE could potentially be more favourable for higher power output applications like HGV's, while HFC could be preferable for lower load applications like buses.

There remains the challenge of getting both H2ICE and HFC to the UK market, with both technologies still in the 'research and development' (R&D) stages. However, H2ICE would appear to offer a lower commercial risk. Due to its incremental change compared to existing technology and its mature supply chain. Therefore, in the short to medium term H2ICE could accelerate decarbonisation in the HGV sector, and potentially provide a long-term solution for some applications, depending on the comparative technology performance against HFC.

Additionally, roll out of H2ICE within the UK could accelerate the development of hydrogen infrastructure, build greater hydrogen R&D capability and repurpose the pre-existing ICE supply chain, safeguarding highly skilled jobs across the UK.

Hydrogen Summary

The pace of hydrogen vehicle uptake could be accelerated if government incentives such as those introduced for electric vehicles were implemented. A double pronged incentive support package would be particularly effective if both the vehicles and fuel were being supported at the start of the roll-out of hydrogen vehicles, helping avoid the 'chicken and egg' situation where the fuel is produced but without vehicles to fill and vice-versa.

H2ICE and HFC appear to be the medium and long-term zero carbon alternative to diesel for HGVs. Although not currently commercially viable due to cost, this could quickly change if the right financial and policy support is put in place. Furthermore, there are opportunities for involvement in commercial tests of this technology. The SWA is actively working with the Scottish Government, its agencies and the developers to bring Hydrogen vehicle technology into the private sector and help decarbonise 'the wheels to Scotland's food and drink industry'.

For more resources about Hydrogen and Hydrogen Fuel Cells see Appendix G.

Summary for Hydrogen Vehicles	
Pros	**Cons**
• Completely eliminates tailpipe emissions. • Renewable hydrogen eliminates Well-To-Tank emissions. • Range and performance comparable to Internal Combustion Engine alternatives. • Refueling very similar to diesel alternatives. • Will be suitable for Low Emission Zones. • Adoptions/adaptation will help prepare businesses for new diesel/petrol car and van ban. • Only current realistic alternative to diesel HGV.	• High initial cost for vehicles. • High cost for hydrogen. • Production and supply of Green Hydrogen is currently limited and inconsistent. • Other forms of hydrogen can produce no carbon savings compared to diesel. • Supporting infrastructure currently not available.
Assistance Required for Enablement	
Developers & Government: Plan supporting infrastructure. Scottish Government: Subsidies for renewable hydrogen to make it cost comparable to diesel. Developers & Government: Support for trials of H2ICE and HFC vehicles. Scottish Government: Financial subsidy/support similar to that given to electric vehicles.	

Refrigerants

Emissions from refrigerant gas leaks, such as at joints, valves and fittings, within refrigerated vehicles contribute an estimated 5% of the total Scottish Wholesale Industry fleet emissions.

This figure should be treated as an approximation due to the limitations of the available data. Fugitive emissions from refrigerated Class I and Class II vans could not be estimated, whilst Class III refrigerated vans fugitive emissions were scaled from only 15% of the membership. This means that the true fugitive emissions figure is likely to be higher.

It is important that fugitive emissions (leaks of hydrofluorocarbons or 'F-gases') are not overlooked as refrigerant gases have significant Global Warming Potential (GWP).

The most common refrigerant used within the Scottish Wholesale Industry fleet is R-404A, an F-Gas, which has a GWP value of 3,922. This GWP is one of the highest values amongst refrigerants and even limited release can produce a significant emission.[84]

GLOBAL WARMING POTENTIAL

GLOBAL WARMING POTENTIAL (GWP) IS A MEASURE OF THE ENERGY THAT 1 TONNE OF A GAS WILL ABSORB OVER A SET PERIOD. CARBON DIOXIDE HAS A GWP OF 1. GASES WHICH ABSORB MORE ENERGY THAN CARBON HAVE A GWP GREATER THAN 1. GASES WHICH ABSORB LESS ENERGY THAN CARBON HAVE GWP OF LESS THAN 1.

Due to R404-A's high GWP, as of 2020, it is illegal to use virgin R404-A to refill refrigerated units. However, reclaimed R404-A can be used until 2030.[85] This ban has also been applied to other F-Gas refrigerants. Therefore, refrigerants need to be examined and replaced not only to reach true net zero but also due to this ban.

Current alternatives to R404-A include R448-A and R449-A which have a GWP value of 1,387 and 1,397 respectively. **Wholesale industry fugitive emission savings of 3,418 tonnes (65%) C02e per annum could be achieved if it converted to those alternative gases.**

Another alternative is R744 which is actually CO_2. This is known as a natural refrigerant due to the natural occurrence of CO_2 on earth and has a comparatively very low GWP of 1.

If R744 were used as a refrigerant, it could reduce the impact of current fugitive emissions by over 99%. R744 not only reduces fugitive emissions significantly but is also relatively cheap to purchase due to its wide availability.

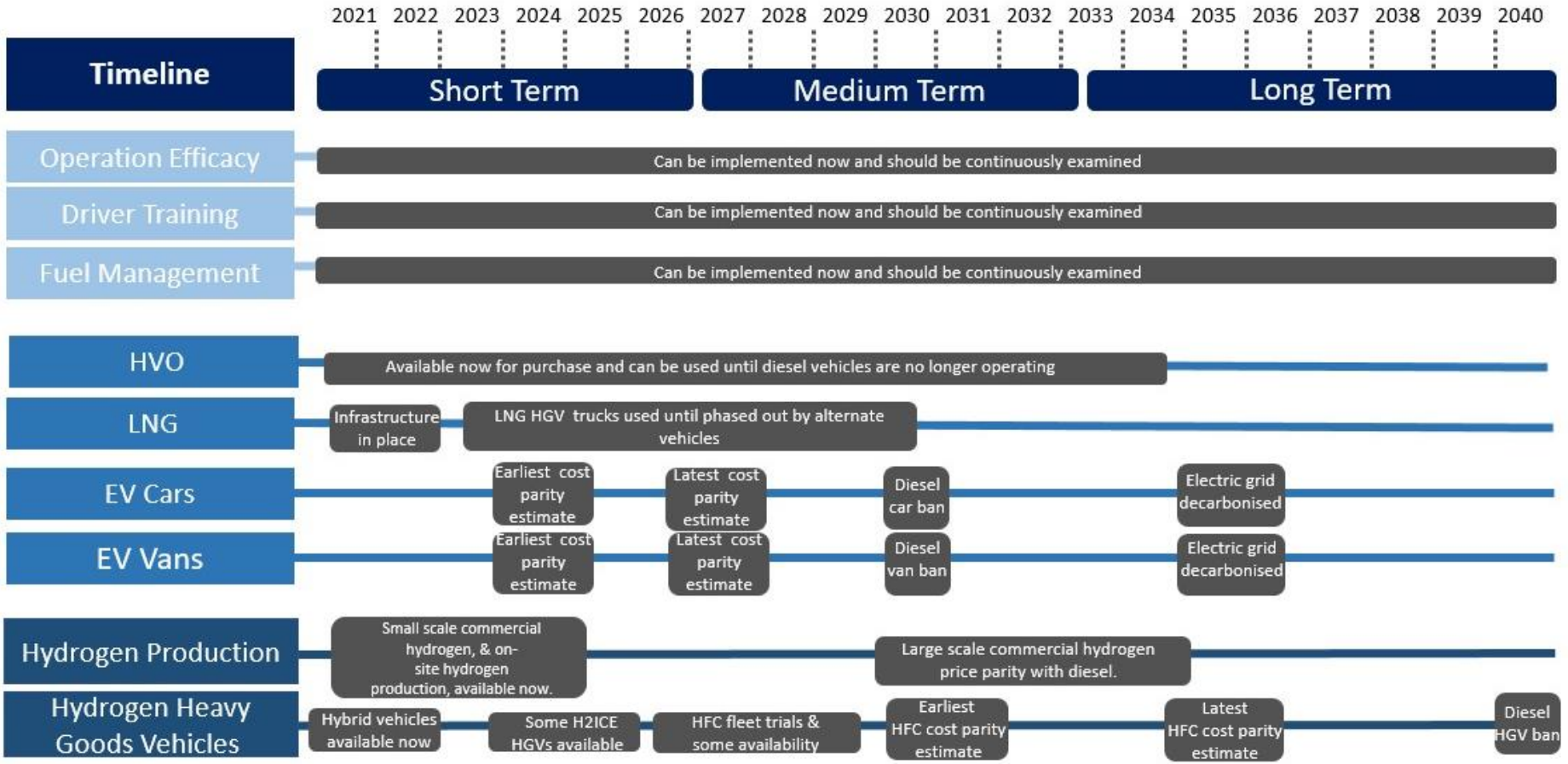
There are some challenges to using R744 as it needs to be used at a very high pressure to maximise efficiency.[86,87]

Although all the alternative refrigerants described above still produce fugitive emissions and may present operational challenges, they could significantly reduce fugitive emissions in the short to medium term.

There is less certainty in the long term around the nature of the refrigerant or cooling systems which could produce zero fugitive emissions. There are some zero emission trials taking place, such as those by Dearman Hubbard using liquid nitrogen as a coolant in refrigerated vehicles. **Liquid Nitrogen is already used as a refrigerant in some larger vehicles, but more research and trials would be needed before being implemented across the Scottish Wholesale Industry fleet to ensure that it would be appropriate for all wholesalers and their vehicles**.[88,89]

Operational Roadmap to Net Zero

Low Carbon Alternatives and Key Dates for Development



4. Roadmap Destination

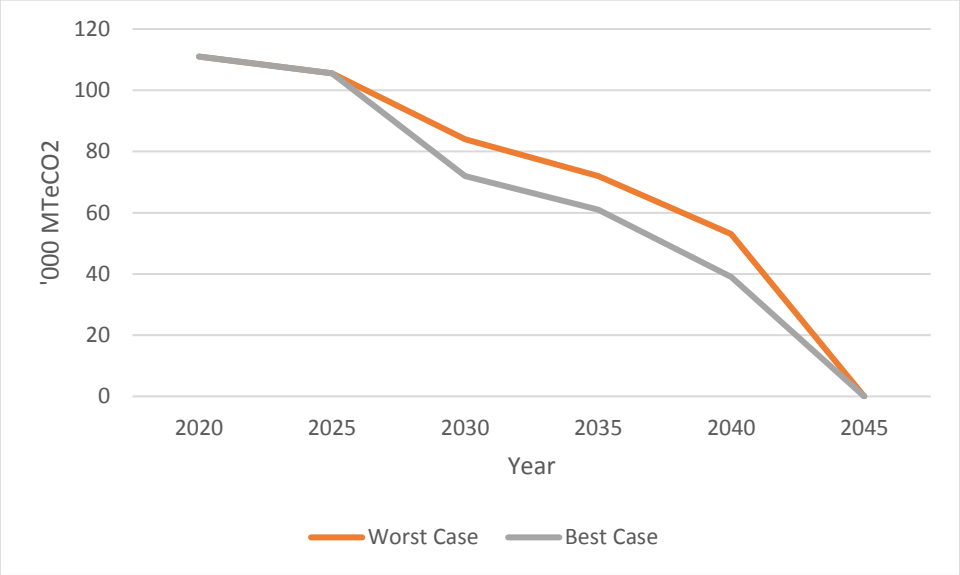
This report has explored and analysed a variety of measures that are available either today, or expected in the near future, that will help wholesalers reduce their fleet emissions.

By applying the potential CO2e savings calculated by implementing some, or all, of the current, or future, solutions analysed within this document we have set out a Roadmap which outlines a series of incremental short- medium- and long-term reduction targets. This approach allows us to consider the variation within the Scottish Wholesale Industry fleet, its scale and where individual wholesalers are in their own particular journeys to net zero.

The SWA Roadmap to net zero by 2045 is ambitious and is very much reliant on new technological advances being delivered on time to enable the change required to reach this goal.

The Scottish Wholesale Industry fleet Roadmap aims to reduce vehicle emissions by:

- 5% by 2025
- 28% to 38% by 2030
- 38% & 48% by 2035
- 55% to 68% by 2040
- Net Zero achieved by 2045 (or earlier).



Wholesale Industry fleet carbon emissions reduction

While the Scottish Government have committed to reduce carbon emissions by 75% by 2030 without quick and significant investment the Scottish Wholesale Industry will substantially miss this target.

With 75% of the Wholesale Industry fleet carbon emissions coming from HGV's, and no alternatives currently offering commercial parity with Diesel until 2030, it's only with investment in hydrogen HGV's, private sector commercial trials and the refuelling infrastructure that the Wholesale Industry will achieve its net-zero goal by 2045.

Short Term: 2021-2025

As examined in Section 3 'Elimination and Reduction Measures', there are several options presently available that can help wholesalers to reduce their vehicle emissions in the short term.

Gradual implementation of such measures including driver training, telematic and route planning, changing to lower road resistance tyres and some uptake of alternative fuels (ie. HVO), over the next four years, could reduce industry emissions by at least 5%.

If combined with the additional efficiency improvement options identified by Element Energy in their 'Decarbonising Scottish Transport Sector Final Report'[94] a further 3% to 5% of emissions could be saved. **Further analysis by SWA would be required to identify and quantify the real benefits of options such as retrofitting with aerodynamic efficiency within the Wholesale sector.**

Action	Potential Emission Savings
Driver Training	3 – 10%
Telematic & Route Optimisation	5 – 10%
Retrofit with Fuel & Energy Efficient Tyres[94]	3 – 5%
Utilise Maximum Capacity & Laden Weight[94]	Up to 20%
Retrofit HGVs with Aerodynamic Efficiency Features[94]	3 – 5%

HGV efficiency improvement options and emission savings

Medium Term: 2021-2030

As well as continuing to invest in the short-term measures, it's envisaged that the sector's car fleet will be advanced in its transition to electric vehicles by 2030 ahead of the diesel car and van sales ban in this same year.

It is also expected that the businesses currently using diesel or gas forklifts will have transitioned to electric, where feasible, within this same timeframe.

However, it should be noted that replacing all company cars by 2030 with EVs is currently still a challenge, as highlighted in Section 3. While it's acknowledged that the current range of EV is constantly improving, and the cost of such vehicles are expected to become comparable with their diesel equivalents by 2030, challenges still remain.

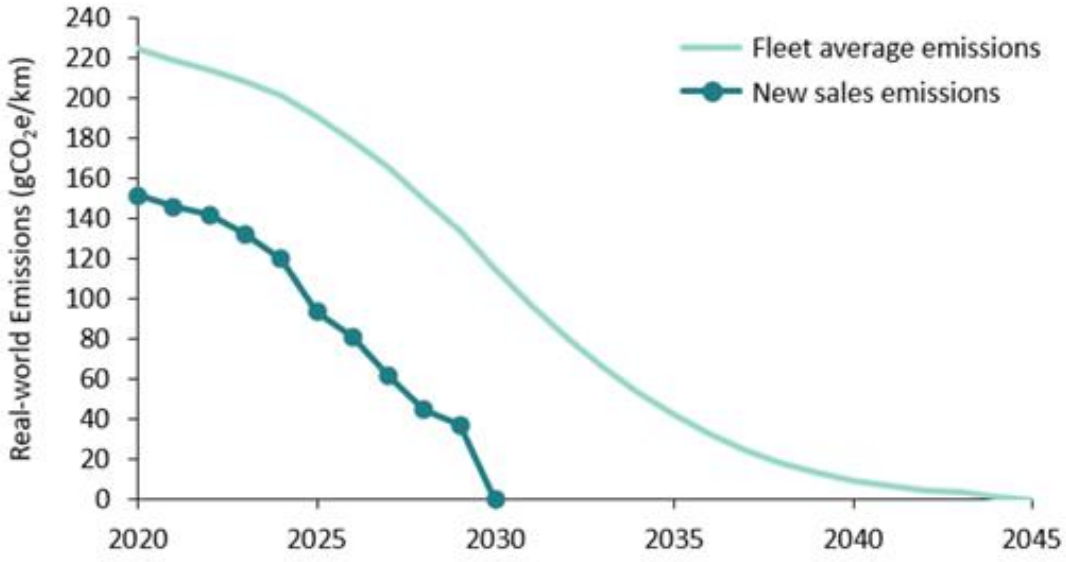
These challenges, which are acknowledged in the recent '*Decarbonising the Scottish Transport Sector*' report by Element Energy[94], are particularly in relation to the number of chargers that would be needed for all EV users and the National Grid's capacity to cope with the electricity demand required.

Charging infrastructure is of particular concern to the Wholesale Industry given wholesalers service the whole of Scotland on a daily basis, from areas of high population to the most isolated parts of the country including the Highlands & Islands.

Refrigerated vehicles currently make up 40% of the Scottish Wholesale Industry fleet and there are limited options available on the market for refrigerated EV vans. Element Energy have identified that the zero-emissions van sector is significantly behind the car market but that technology and learnings can quickly move over to this sector.

While all new van sales are expected to be zero-emission by 2030, Scotland's average van fleet emissions are expected to be 50% lower than 2020 levels[94]. Applied to the Wholesale Industry, this would represent a saving of 8,000 tonnes CO2e by 2030.

There are businesses, including SWA supplier member Heineken, which are trialling refrigerated EV vans.[90,91,92] However if the 2030 timeline is to be achieved more external support and trials will be needed to give businesses the confidence to adopt refrigerated EVs, particularly given member concerns about their performance.



New van sales and total van market roadmap to net zero [94]

By 2030, SWA envisage that all Wholesale Industry diesel-powered refrigerated condensing units could be replaced by electric powered versions. All coolants used in refrigerated vehicles should be replaced with either R448-A or R449-A which will reduce fugitive emissions by up to 65%.

Within the medium term, alternative fuels should begin to be examined and implemented by wholesalers within their HGVs as well as for any other remaining fossil fuel vehicles. However, as alternative fuels are seen as a stepping stone to net zero, businesses must be cautious of making significant investment, if different infrastructure is required (ie.in the case of LNG). This will have to be balanced in comparison to hydrogen vehicles that are expected to be the final net-zero solution.

Therefore, it is recommended that during this period SWA members get involved in trialling HFC and H2ICE for HGVs and examine the possibility of retrofitting, or adopting, hydrogen hybrid vehicles. This will not only reduce emissions but will also enable the development of a suitable supporting infrastructure.

Our minimum target is for all cars, half of the van fleet and nearly all forklifts in the Scottish Wholesale Industry fleet to be replaced with EVs by 2030.

While our minimum target does not include any Hydrogen Fuel Cell, a more ambitious target is for all cars, vans and forklifts to be electric, for 20% of HGVs to use an alternative fuel like HVO and for 5% of HGVs to be hydrogen hybrids. Additionally, R744 should be used as a coolant in all vehicles in this scenario.

If these improvements were implemented by 2030 the Scottish Wholesale Industry fleet should be able to cut emissions between 31,029 and 42,110 tonnes of CO2e, representing a 28% to 38% reduction versus 2021 levels.

Long Term: Beyond 2030

Between 2030-2045 the push for decarbonisation will become more important if the UK and Scottish Government's are to meet their net-zero targets. Within the Wholesale Industry, this period should see all remaining non-electric vans replaced by electric alternatives, or another type of zero emission vehicle if this became available.

By 2035, when the electricity grid is expected to be fully decarbonised, EVs will become truly net-zero. However, the focus after 2030 for the decarbonisation of the Wholesale Industry vehicle fleets really needs to focus on HGVs, with this section of fleet still emitting upwards of 72% of its 2021 levels.

Currently the only feasible alternative to diesel HGVs are those powered by hydrogen but commercial viability for these vehicles only begins in 2030, with wider adoption of HFC not anticipated until 2035 onwards.

Successful, early adoption would be more likely if the right government support is delivered. This support should include financial support to businesses for the purchase of HFC and H2ICE trucks, subsidies for purchasing Green Hydrogen, at least until the market price becomes comparable to diesel, as well as support to create the necessary refuelling infrastructure for hydrogen vehicles.

The Scottish Government's Hydrogen Policy Statement of December 2020 set out the ambition for Scotland to become a leading hydrogen nation, supporting energy

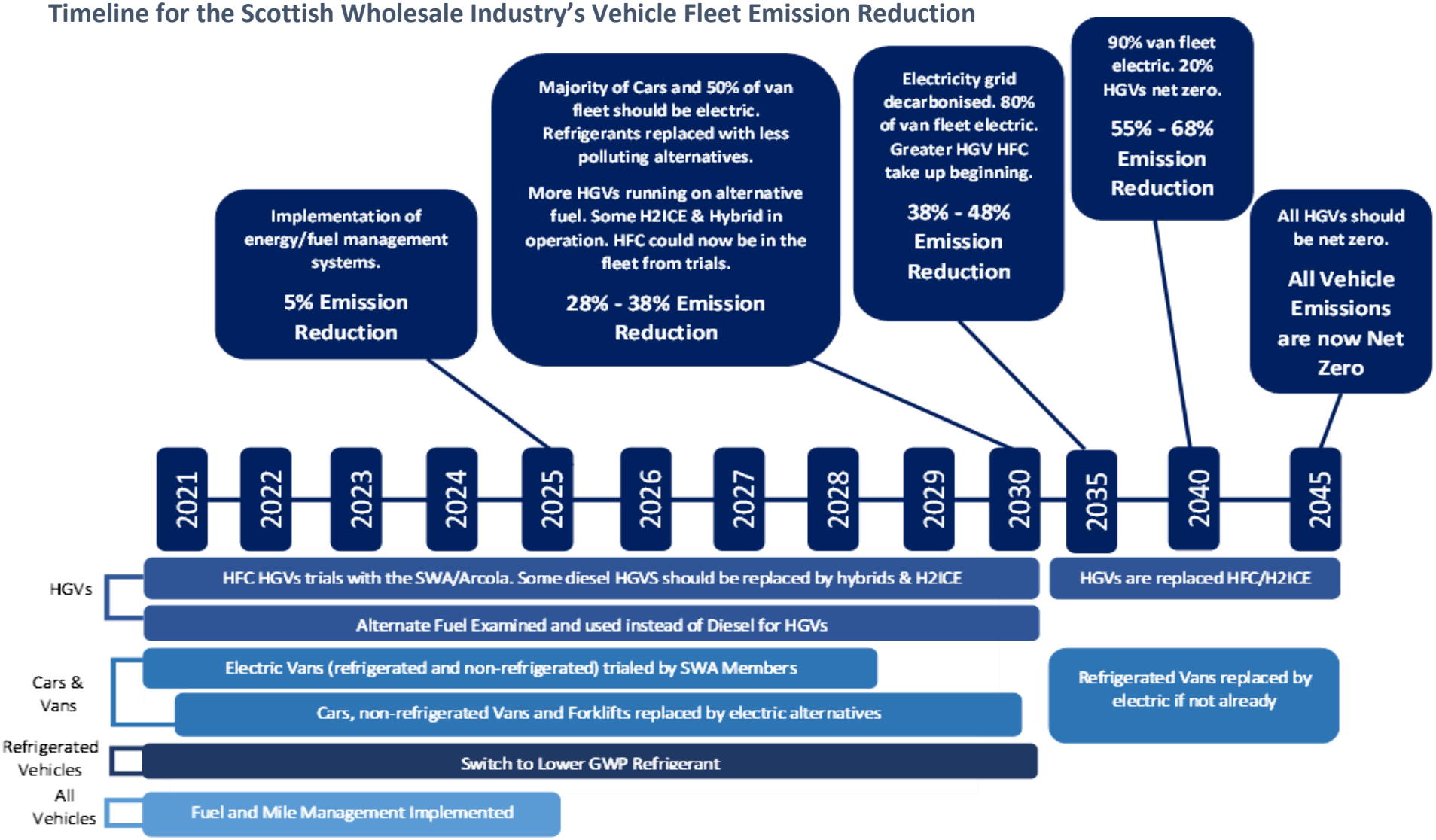
decarbonisation and Just Transition with production of reliable, competitive, sustainable hydrogen.

Scotland's five-year Hydrogen Action Plan will be published in late 2021, setting out specific actions to support Scottish supply chain activity and drive the development of a low-cost hydrogen capability. This will enable Scotland to meet an initial ambition of generating 5GW of renewable and low carbon hydrogen by 2030. This will be backed by £100 million investment to capitalise on success and innovation so far, support supply chain activity, and kick start the accelerated growth of the hydrogen economy in Scotland.

While this announcement is welcome, such support must ensure that it is targeted in the right areas to ensure maximum commercial uptake, especially within the private sector. With food and drink being the largest commodity group (32%) transported by HGVs; the Scottish Wholesale Industry representing at least 3% of all of HGVs registered in Scotland; and HGVs contributing 75% of all of the Wholesale Industry's fleet emissions, it's essential that financial support must be awarded to such an important and willing industry partner.

Roadmap to Net Zero

Timeline for the Scottish Wholesale Industry's Vehicle Fleet Emission Reduction



5. Managing the Obstacles on the Route to Zero Emissions

The Scottish Wholesale Association has a strategic aim of leading the decarbonisation of the food and drink industry and showcasing the opportunities available to other sectors. This report sets out the opportunities for the Wholesale Industry vehicle fleet to contribute to the achievement of Scotland's carbon reduction targets, along with industry specific targets and a timeline for achieving them. The report also sets out the barriers and challenges for the industry in meeting the ambitious targets we have set ourselves.

Without some Government financial support and a close working relationship between government and the SWA, it is unlikely that the Wholesale Industry will be able to deliver fully on our potential contribution to Scotland being net zero by 2045.

SWA, and our members, are keen to work with the Scottish and UK Government as well as the developers and engineers of net zero technology. We are asking for help and assistance, from both the Scottish and UK Government, to overcome some of the challenges our sector faces in the transition to net-zero.

1) **SWA seek support from Scottish Government to enable us to fully complete our 'Decarbonisation of the Wholesale Industry' project.**

The SWA Decarbonisation of the Wholesale Industry project has been designed in three phases. This report, and phase one, covers transport. Given that at national level, transport is the greatest contributor to carbon emissions, the SWA has chosen to prioritise this greatest challenge first. This work has been wholly resourced and funded by SWA.

As a not-for profit, membership association, if we are to fully deliver on phase 2 – our buildings - and phase 3 - our people - of our 'Decarbonisation of the Wholesale Industry' project, some external resource is required to support this work.

Such resource could be used to undertake the additional Phase 1 research, identified within this report, as well as progressing initial conversations SWA are having with potential technical partners who might assist us to overcome some of the challenges identified in this

report. This might focus particularly around solutions for refrigerated vans and vehicles and enable trials and investment in this area.

2) **Financial support for wholesalers to participate in, or implement, a Wholesale Industry wide driver efficiency training programme.**

One of the first, and simplest, actions available to Scottish Wholesale Industry fleet operators is through driver training to increase efficiencies and reduce emissions. On an industry scale however, this will have a significant cost, particularly for the SME wholesalers that make up 90% of Scotland's industry. These wholesale businesses have been particularly impacted by Covid. With many still operating at below pre-covid sales levels and now lumbered with debt and loan repayments that hinder investment in any other areas of their business.

Investment in a national skills training scheme for wholesale drivers will not only reduce emissions but aid in staff retention and encourage more drivers into the sector, a particularly current challenge for HGV operators.

Government support for the cost of a national training programme would enable a swifter, more consistent roll-out of training and have the near immediate impact of reducing miles per gallon diesel consumption by up to 16% across the entire fleet.

3) **Financial support for implementation of a Scottish Wholesale Association Fleet Audit Service.**

Included within Phase 1 of the Decarbonisation of the Wholesale Industry project, the SWA has created a *Measuring Your Emissions: Road Freight and Vehicle Emissions Toolkit*. This allows individual wholesalers to calculate their own current fleet CO2 emissions and that establishes a baseline for change.

While this report is designed to assist wholesalers and give them recommendations and options in the decarbonisation of their fleets, this could be improved significantly, and change implemented faster, if a professionally detailed audit of individual wholesaler's fleets were undertaken.

Using the SWA Emissions Toolkit as the wholesaler's baseline and supplemented by a costed set of professional recommendations on how they may reduce their emissions, change could be affected quicker and net-zero ambitions achieved sooner. Such establishment of a SWA Fleet Audit Service follows the same audit models and principles as currently used by the Zero Waste Scotland Energy Efficient Business Support Service and this could easily be managed by SWA with appropriate resourcing.

4) **Support for research into the establishment of shared green infrastructure clusters.**

The majority of SWA wholesalers are smaller scale SME businesses and that do not operate sufficient vehicles, or have sufficient depot space, to make investment in charging and/or refuelling technology infrastructure a logistically feasible or economically viable option.

The potential exists for clusters of wholesalers to work in partnership to establish shared facilities. This would have the benefits of making the investment more manageable for each member of the cluster and maximising the use of the shared facilities. Investment is required to undertake a national feasibility study to identify optimum locations, perform an economic appraisal of the costs and benefits and to explore and clarify the strategic operational systems required to make the initiative work in practice. This has the potential to offer valuable learning for other sectors and identify where multiple business operators could share such infrastructure. Therefore, such a feasibility study also acts as a pathfinder for those other sectors.

5) **Grant and financing support to enable the transition to green fleets.**

The average (pre-Covid) net profit margin across the wholesale sector is 1.3%. The capital investment required in green vehicles is currently significantly greater than that for traditional internal combustion engine (ICE) vehicles. This has the effect that businesses are unable to justify, or make, the significant extra capital investments required to purchase new technologies, including replacement vehicles, required to reduce their carbon emissions. It also means that the costs of commercial loan finance are equally unserviceable

for many Wholesalers especially when they are already burdened with Covid CIBL and Bounce Back Loans.

If there is to be significant uptake of green technologies across the Wholesale Industry in the short to medium term, affordable sources of finance funding will be required.

This should take the form of grants and loans at favourable terms – potentially offered through the Scottish National Investment Bank (SNIB). This could also be linked to business commitments to green jobs, fair work and local supply chains. If appropriate grant support were to be available in the short term this would significantly accelerate the uptake of low carbon vehicles across the Wholesale Industry, with the consequential cumulative impact on carbon emissions. SWA are keen to work with the Scottish Government to design mechanisms and identify resources to create the required grant and loan funding for the sector.

6) **We ask Scottish Government to recognise SWA, and our members, as their lead in decarbonising the vehicles and fleets of Scotland's food and drink sector. Supporting us in the research and trial of solutions to identified challenges.**

In their report to Transport Scotland, Element Energy[94] identified that *"…it is clear that actions taken [by UK and Scottish Government] to date are not sufficient to meet the net-zero and intermediate targets…"*

Given the critical role the wholesale sector plays in sustaining the food and drink supply chain as well as the sector's reliance on refrigerated HGVs, Scotland's wholesale fleet represents an important target for potential support.

There are currently no viable refrigerated EVs on the market or alternatives for HGV diesel replacement. Without this technology, the Wholesale Industry and wider food and drink sector, will never achieve zero emissions for their fleets. There is an urgent need for market intervention to create the conditions for industry to develop suitable vehicles and bring them to market. The SWA, having already started the fleet decarbonisation journey and being involved in the Scottish Hydrogen Fuel Cell Freight Trial (SHyFT),[93] can play a leading part in supporting tests and trials of such vehicles. However, the Scottish Government must

acknowledge the key role SWA and Scottish wholesalers play in the journey to net zero. SWA call upon the Scottish Government to identify SWA and the wholesale sector as key partners in helping develop, trial and invest in the necessary steps to assist the food and drink distribution transition to net zero by 2045.

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Appendix A: About the Scottish Wholesale Association

The Scottish Wholesale Association (SWA) is the official trade body for Scotland's food and drink wholesaling sector. Our members are 'the wheels to Scotland's food and drink industry' supplying products to over 5,000 independent convenience stores, 30,000 catering, hospitality, tourism and leisure businesses and the majority of all public sector establishments including hospitals, schools and prisons.

The Association fulfils a number of critical roles on behalf of members including liaison between our members, suppliers, the wider food and drink trade and partners in retail, tourism and hospitality. SWA also represent the best interests of our members in policy and legislative processes at UK, Scottish and local government levels and provide members with practical advice, support and compliance material in relation to relevant legislative and regulatory provisions.

Throughout the Covid-19 pandemic and the resultant restrictions, SWA has shared sector specific information with the Scottish Government to ensure politicians understood the severe impact market restrictions and other issues were having on Scottish wholesalers.

The Association represents 98% of the Scottish wholesale industry, by monetary value, and has 70 wholesale members. They range from family run single depot businesses to large national household names. 90% of the total number of Scottish wholesalers are Small and medium sized enterprises (SME).

Our members have over 100 depots, located throughout Scotland from Orkney to the Scottish Borders. 56% are located in the central belt and a breakdown of the main depots, by region, can be found below.

- Highlands & Islands: **16**
- Fife & Stirling: **13**
- Lothians: **17**
- Aberdeen & Dundee: **16**
- Greater Glasgow & Ayr: **43**
- Dumfries & Borders: **3**

From Department of Transport information, wholesale operators account for 3% of all Scottish Heavy Goods Vehicles (HGV) registered in Scotland.

The wholesale industry represents a significant part of the Scottish food and drink sector which, prior to the pandemic, was worth £2.9bn and employed around 6,500 people.

Appendix B: Methodology

Data was collected through desk research, supplemented by a survey of members and a series of in-depth conversations with owners and managers of fleets within the wholesale sector.

A survey of members collected data on:

- Types of Vehicles in the fleet and number of each type.
- Fuel Used including type and volume.
- Number of refrigerated vehicles.
- Opportunities and barriers to action.

The survey achieved a response from 33% of members. The survey request coincided with a relaxation of COVID-19 restrictions on hospitality and leisure businesses which may have created additional pressure on the time which members had to respond.

Respondents were sorted into large, medium and small wholesalers and responses were scaled up according to the number of similarly sized businesses within the Scottish Wholesale Industry.

This information was collected to determine an emissions baseline and to inform considerations on the nature of actions, technologies and supporting infrastructure required to reduce emissions.

The figures presented here do not include any emissions associated with electric vehicles. This is because it was not possible to separate the electricity used to charge these vehicles from the rest of the electricity used on site. Emissions from charging of electric vehicles will be accounted for in the analysis of the carbon produced by building and energy emissions in phase 2 of the Decarbonisation of the Wholesale Industry project.

GREENHOUSE GASES

GREENHOUSE GASES ARE SO CALLED BECAUSE OF THEIR EFFECT ON GLOBAL TEMPERATURES. CARBON DIOXIDE, OFTEN SIMPLY CALLED CARBON, IS THE GREENHOUSE GAS PRODUCED IN GREATEST VOLUME BY FOSSIL FUEL COMBUSTION.

Appendix C: Additional Resources for Measuring Emissions

Scottish Wholesale Association
SWA: Decarbonisation of the Scottish Wholesale Industry: Fleet Emissions Baseline

SWA: Measuring Your Emissions: Road Freight and Vehicle Emissions Toolkit

DEFRA (UK Government)

Guidance on reporting Greenhouse Gas (GHG) emissions from freight transport

Available at :
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/218574/ghg-freight-guide.pdf

Zero Waste Scotland

Carbon Management: Reporting

Available at: https://www.zerowastescotland.org.uk/sites/default/files/Reporting%20-%20carbon%20management%20plans.pdf

Science Based Targets

Transport Science-Based Target Setting Guidance

Available at: https://sciencebasedtargets.org/sectors/transport#sectoral-decarbonization-approach-sda-transport

Appendix D: Additional Resources for Fuel Management

Ecostars

Free Fleet Audit Service
Available at: https://www.ecostars-uk.com/

Energy Saving Trusts

Free Fleet Audit Service

Available at: https://energysavingtrust.org.uk/service/sustainable transport-business-review/

Fleet Management Guide

Available at: https://www.energysavingtrust.org.uk/sites/default/files/Van-fleet-management-best-practice-guide.pdf

Mileage Management Guide

Available at:
https://www.energysavingtrust.org.uk/sites/default/files/reports/4548_EST_A4_mileage_mmt_4.pdf

The Freight Portal

Fleet Efficiency Advice

Available at: https://thefreightportal.org/improve-your-fleet

Cenex

Fleet Audit Service and Other Resources
Available at: https://www.cenex.co.uk/transport/

Appendix E: Additional Resources for Alternative Fuel

Cenex

Renewable Fuel Guide

Available at: https://www.cenex.co.uk/app/uploads/2020/03/RenewableFuelsGuide_email-web-copy.pdf

Zemo Partnerships

Renewable Fuel for Heavy Duty Vehicles Guide

Available at:
https://www.zemo.org.uk/assets/lowcvpreports/Market_opportunities_decarb_HDVs%20using%20HBRF_2021_.pd

Gasrec

UK Leading Supplier of Liquefid Natural Gas

Available at: https://www.gasrec.co.uk/

Logan Energy

Design, install, commission and maintain integrated energy systems across UK and Europe.

Available at: https://www.loganenergy.com

Appendix F: Additional Resources for Electric Vehicles

The Low Carbon Vehicle Partnership

The Low Emission Van Guide

Available at: https://www.cenex.co.uk/app/uploads/2019/10/LowEmissionVanGuideFINAL-1.pdf

LoCity

Fleet Advice Tool- input mileage, payload and environment operating in to get advice on the type of low emission vehicle that would be best for the business

Available at: https://locity.org.uk/fleet-advice-tool/

Energy Saving Trust

Advice on Electric Vehicles including advice on financial aid and vehicle types

Available at: https://energysavingtrust.org.uk/advice/electric-vehicles/

Reflex Orkney

Funding Opportunities for Electric Vehicles on Orkney

Available at: https://www.reflexorkney.co.uk/news

RAC

List of All Electric Cars Available on The Market

Available at: https://www.rac.co.uk/drive/car-reviews/hybrid-plug-in-electric-hydrogen/

Zap Map

Guide for Electric Vehicles, Chargers as well as where Charging Points are Located

Available at: https://www.zap-map.com/charge-points/

Global Drive to Zero

Fleet Advice Tool and Vehicle Advice Tool

Available at: https://globaldrivetozero.org/tools/zero-emission-technology-inventory/

Appendix G: Additional Resources for Hydrogen Vehicles

Arcola Energy

Leading specialist in hydrogen and fuel cell technologies, providing zero emission solutions for heavy duty transport.

Available at: https://arcolaenergy.com/

ULEMCo

Leader in providing hydrogen hybrid vehicles and developers of hydrogen internal combustion engine vehicles.

Available at: https://ulemco.com/

Toyota

Toyota produce one of the first commercially available hydrogen powered cars for the UK market.

Available at: https://www.toyota.co.uk/new-cars/mirai/

UKH_2 Mobility

What is Hydrogen?

Available at: http://www.ukh2mobility.co.uk/hydrogen/

Scottish Power

Green Hydrogen

Available at: https://www.scottishpower.co.uk/about-us/green-journey/hydrogen

Scottish Hydrogen and Fuel Cell Association

Available at: http://www.shfca.org.uk/

SCOTTISH WHOLESALE ASSOCIATION

The voice of the Scottish Food, Drink and Allied Trades

Scottish Wholesale Association, 30 McDonald Place, Edinburgh, EH7 4NH

www.scottishwholesale.co.uk