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Last mile delivery in Scotland

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Executive summary

Introduction and approach

Scotland has set a binding target to reach net-zero greenhouse gas (GHG) emissions by 2045. Commercial vehicle emissions present a significant challenge to achieving this; from 2012 to 2019, van and heavy duty vehicles (HDVs) emissions increased 25% and 4%, respectively[1].

Transport Scotland (TS) defined 'last mile' for this project as "the movement of goods…from a transportation hub to the final delivery destination". Last mile is poorly understood, with gaps in knowledge around vehicles, operators, goods moved, and trip start and end locations. There is a need for an improved understanding of the sector, so that TS and local authorities can implement effective measures to mitigate negative social and environmental impacts.

The objectives of this project were to:

- Develop a profile of last mile delivery in Scotland, for example the number of vehicles in the sector, mileage travelled, and goods moved.
- Estimate GHG emissions from last mile deliveries in Scotland.
- Understand what activities are underway in other jurisdictions to reduce emissions.
- Collate details of commitments made by businesses to improve sustainability.

We analysed secondary data from TS, Scottish Government, and the UK Department for Transport. While there is no single source of last mile data, there are sources available on vehicle registrations, movements and use, from which we developed a profile of the sector. We augmented the outputs from this exercise with a fleet survey, stakeholder engagement and a desk-based review.

[1] https://www.transport.gov.scot/media/47300/scottish-transport-statistics-2019.pdf

Last mile profile and emissions

Table 1: LCV last mile figures

		LCVs
Number of vehicles	**Average**	40,800
Annual average delivery mileage	**Average**	25,300
Annual total miles	**Average**	**1,034,569,100**
Number of trips	**Average**	21,213,700

- Light commercial vehicles (LCVs) completing last mile trips in Scotland cover an average of 25,300 miles per year and over 1bn miles in total.
- The number of LCVs in the last mile sector is estimated to be 40,800 vehicles.

Table 2: HGV last mile figures

		HGVs		
		Rigids[2]	**Artics[3]**	**Total**
Number of vehicles	**Average**	3,800	4,700	8,500
Annual average delivery mileage	**Average**	18,100	58,100	-
Annual total miles	**Average**	68,675,600	225,417,500	294,093,100
Number of trips	**Average**	784,000	1,547,100	2,331,100

- There are around 8,500 HGVs completing 2.3m last mile trips in Scotland.
- Of these around 44% are rigids and the rest are articulated (artic) vehicles. These vehicles cover around 69m and 225m miles, respectively.

Hot food delivery

- The distance covered for hot food delivery is around 54m miles per year.
- The majority of miles covered in this sector are by car.
- Analysis of hot food delivery trips relies on a large number of assumptions and as such we have lower levels of confidence in the outputs.

Fleet size and composition

- Royal Mail is likely to be the largest last mile fleet in Scotland. Other large fleets are last mile couriers, supermarkets, and a pharmaceutical company.

[2] Rigid vehicles are HGVs which do not have flexibility between the cab and the portion of the vehicle carrying goods. These vehicles are more than 3.5 tonnes gross vehicle weight (GVW) and can be up to 32t GVW.

[3] Articulated or artic vehicles comprise a tractor unit with a semi-trailer attached, where part of the load is borne by the drawing vehicle. They will be at least 26t GVW, though most are over 36t GVW, up to the maximum permitted weight in the UK of 44t GVW.

- The largest fleets operate a relatively small share of all last mile LCVs in Scotland. This suggest that the vast majority of the last mile sector is made up of SMEs and sole traders running small fleets.

Summary of the last mile sector

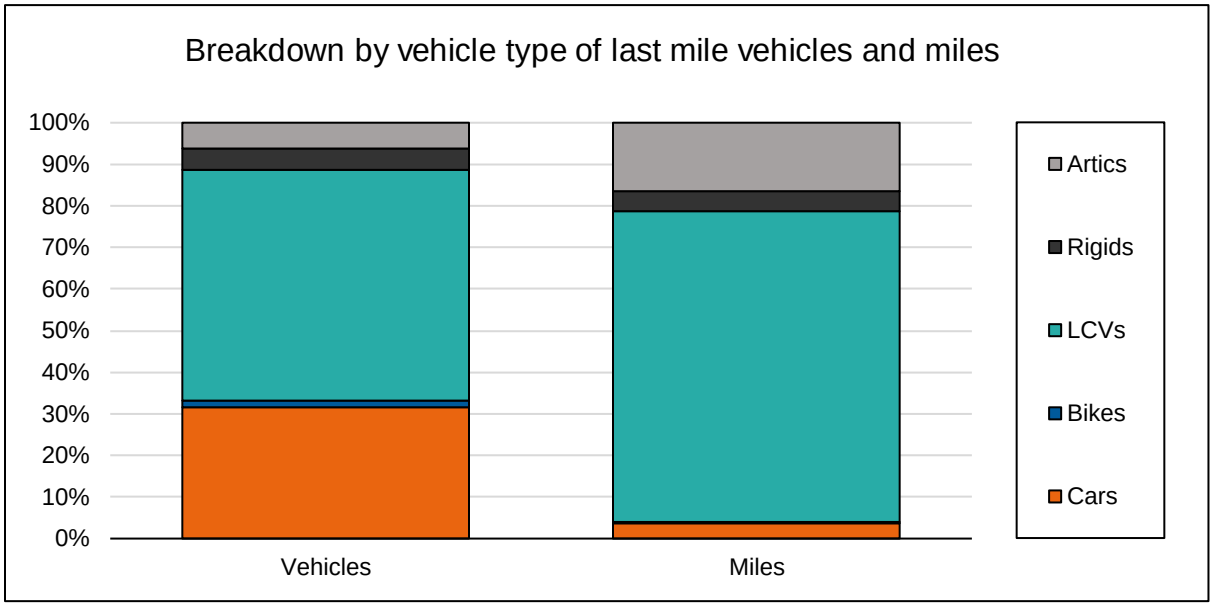

Figure 1: Breakdown of vehicles and mileage by vehicle type for last mile delivery in Scotland

- LCVs make-up the majority (75%) of all miles driven in the last mile sector.
- Over 10 million tonnes of goods are moved annually in Scotland within last mile.

Emissions

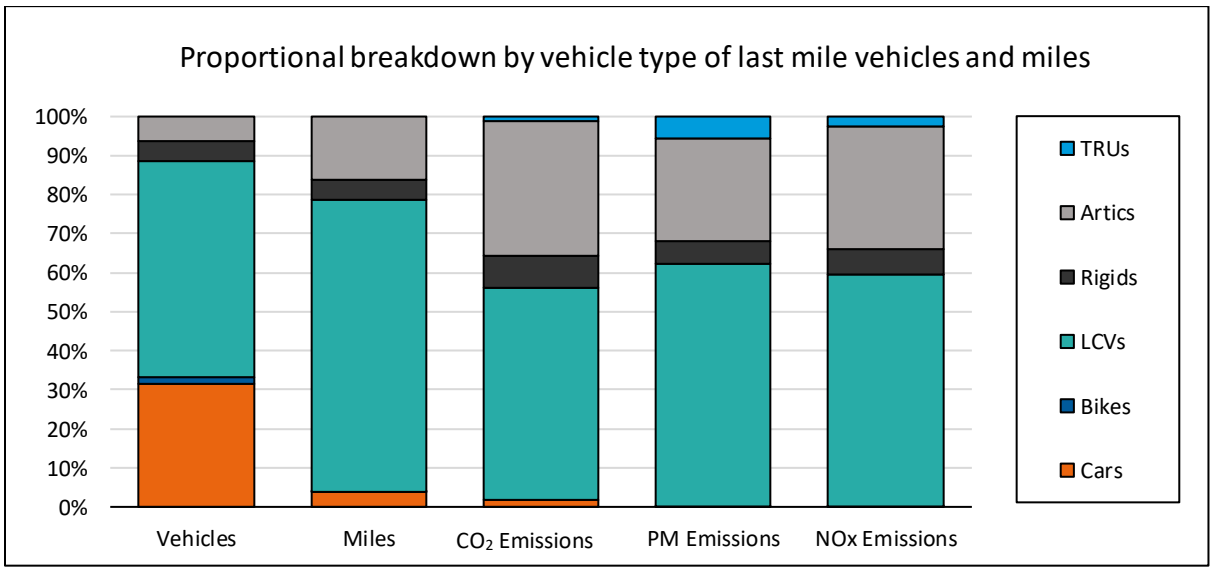

Figure 2: Breakdown of vehicles, mileage, and emissions by vehicle type for last mile delivery in Scotland[4]

[4] TRUs are transport refrigeration units, used to control temperature for chilled and frozen goods.

- Last mile deliveries in Scotland produce 750,000 tonnes carbon dioxide (CO_2) per year, of which 407,000 tonnes are from LCVs and 259,000 tonnes from artics.
- LCVs have relatively high emissions per tonne kilometre, compared to HGVs.

Last mile in context (all figures are for 2019):

- **Last mile vehicles comprise 2.7%** of all vehicles (cars, LCVs and HGVs).
- **Last mile is 4.7%** of total miles covered by cars, LCVs, and HGVs.
- **Last mile emissions are 6.6%**[5] of all road transport emissions.

Approaches in other jurisdictions and business fleet commitments

- Based on a review of completed initiatives in other jurisdictions no examples of specific policies were identified that specifically target last mile deliveries. The examples typically involve a fleet working with a city municipality, and potentially other stakeholders, to develop a distinct project aimed at reducing emissions from last mile deliveries.

- A number of large UK-wide businesses have made public commitments to tackle emissions from their home delivery vehicle fleets. These commitment include the roll out of electric vans, ending the use of fossil fuels vehicles across their fleets and use of cargo bikes for deliveries.

[5] Including emissions from TRUs

Glossary of terms

Term	Definition
Articulated or artic vehicles	A tractor unit with a semi-trailer attached, where part of the load is borne by the drawing vehicle. Units will be more than 26t gross vehicle weight (GVW), though most are over 36t GVW, up to the maximum permitted weight in the UK of 44t GVW.
B2B	Business to business deliveries.
B2C	Business to consumer deliveries.
Euro emissions standards	Regulations on engine and vehicle pollutant emission limits set by the European Commission and adopted into UK legislation.
Greenhouse gas (GHG) emissions	Gases that absorb and emit radiation and contribute to rising global temperatures. Includes carbon dioxide (CO_2) and methane (CH_4).
Heavy duty vehicles (HDVs)	Vehicles over 3.5 tonnes gross vehicle weight, including trucks and buses.
Heavy goods vehicles (HGVs)	Commercial vehicles over 3.5 tonnes GVW.
Last mile	The movement of goods, most likely from a transportation hub to the final delivery destination.
Light commercial vehicles (LCVs)	Commercial vehicles up to 3.5 tonnes gross vehicle weight.
Nitrogen oxides (NOx)	Air pollutants that include nitric oxide (NO) and nitrogen dioxide (NO_2). Formed from combustion of fossil fuels. Road transport is a significant source of NOx.
Particulate matter (PM)	Air pollutants that comprise tiny particles suspended in air. Road transport is a significant source of PM. These include emissions from combustion of fossil fuels and also wear from tyres and brakes.
Rigid vehicles	HGVs which do not have flexibility between the cab and the portion of the vehicle carrying goods. These vehicles are more than 3.5 tonnes GVW and can be up to 32t GVW.
Tank to wheel (TTW) emissions	Emissions from the vehicle tailpipe resulting from the combustion of the fuel.
Transport refrigeration unit (TRU)	Units typically powered by an auxiliary diesel engine, used to control temperature for chilled and frozen goods.
Well to wheel (WTW) emissions	Total emissions resulting in the production and transmission of the fuel from source to vehicle (known as well to tank emissions), *and* the TTW emissions.

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1 Introduction

1.1 Research context

Scotland continues to lead the UK in delivering zero-emission transport. The commitment in the Climate Change (Scotland) Act 2019 to reach net GHG emissions by 2045 is one such example, as is the target to phase out the sale of new petrol and diesel vans by 2030. Through a package of incentives and other measures, the Scottish Government (SG) is accelerating a switch to electric vehicles (EVs). However, at the time of writing, there are fewer than 800 plug-in vans in Scotland. Currently, the vast majority of commercial vehicles are diesel powered, with associated carbon and air quality pollutant emissions, and these challenges will remain in the short to medium term.

Van and HGV emissions present a significant challenge to achieving the net-zero target. Vans and trucks are a small percentage of on-road vehicles, but they account for a disproportionate amount of GHG and air pollutant emissions: vans and HGVs are each responsible for 12.6% of transport GHG emissions in Scotland[6]. Between 2012 and 2017, van and HGV vehicle kilometres increased by 22% and 7%, respectively[7], and van and HGV emissions increased by 28% and 12%, respectively[8].

The growth in van and HGV numbers will worsen congestion if left unchecked. The NTS2[9] reports that "businesses located in or supplying firms in city centres are seeing increasing journey times and unreliability, thus impacting on costs and overall business performance". This problem is acute in Scotland, with the same document reporting that Glasgow was the third most congested city in the UK while Edinburgh was sixth.

Finally, an increase in commercial vehicle traffic in urban areas poses a safety challenge for vulnerable users, particularly at peak times when commuters are travelling to or from work and children are travelling to and from school.

1.2 Last mile deliveries

'Last mile' was defined in the brief for this project as "the movement of goods, most likely from a transportation hub to the final delivery destination". For this research we assume that this covers business to consumer (B2C) and business to business (B2B) deliveries. B2C trips are primarily linked to online shopping and home delivery, while B2B trips typically comprise freight deliveries from distribution hubs to retail stores.

Under these definitions, B2C journeys are primarily completed by light commercial vehicles (LCVs) under 3.5 tonnes gross vehicle weight (GVW), with a small proportion by rigid HGVs, and a further sub-set of hot food deliveries completed by car, powered two-wheeler, and bicycle. B2B deliveries encompass a wider range of vehicle sizes, from LCVs up to artics.

There is a lack of data about the extent to which last mile is contributing to increases in freight traffic and emissions. Last mile is poorly understood, with gaps in knowledge around vehicles, operators, goods moved, and trip start and end locations. The problem is particularly acute in the van market, as the Office of National Statistics (ONS) and

[6] https://www.transport.gov.scot/media/47300/scottish-transport-statistics-2019.pdf
[7] Scottish Transport Statistics 2019, Table 5.3.
[8] https://www.transport.gov.scot/media/47300/scottish-transport-statistics-2019.pdf
[9] https://www.transport.gov.scot/our-approach/national-transport-strategy/

Department for Transport (DfT) does not publish statistics on the van parc and its use. These issues are compounded by franchise and 'gig economy' employment practices.

DfT's *Position statement on last mile logistics*[10] cites evidence of growth in last mile deliveries in the UK as measured by parcels shipped, value of next day deliveries, and van traffic. However, there is no report showing similar metrics specifically for Scotland.

The number of last mile deliveries has been increasing for some time because of the growth in online shopping. Covid-19 has accelerated this trend; the Office for National Statistics reported in September 2020 that online sales were up by nearly half on the start of the year[11]. Royal Mail announced pre-tax profits of £726m for the year to March 2021, with revenues up 16.6% year on year[12].

There is therefore a need for an improved understanding of last mile, so that effective measures can be implemented to mitigate negative social and environmental impacts.

1.3 Research purpose and objectives

The purpose of this research is to help Transport Scotland (TS) improve its understanding of last mile. The specific objectives were to:

- Develop a profile of last mile delivery in Scotland, for example the number of vehicles in the sector, mileage travelled, goods moved, market size, key operators, and geographical variation.
- Develop a high-level estimate of GHG emissions from last mile deliveries in Scotland.
- Understand what activities are underway in other jurisdictions to reduce emissions from this source.
- Collate details of commitments made by businesses operating in Scotland to reduce last mile emissions.

Outputs will be useful for TS to help it engage with the freight and logistics industry, identifying challenges and opportunities for decarbonisation. Findings will also help local authorities and fleet operators, by providing a sample of information on commitments made by businesses in Scotland to improve sustainability, and visibility of innovative schemes outside Scotland, which could potentially be replicated here.

1.4 Structure of the report

Section 2 outlines the methodology, with further detail in the Appendix. Section 3 presents the profile of last mile trips and the high-level emissions estimate. Sections 4 and 5 contain examples of activities underway in other jurisdictions, and commitments made by businesses in Scotland, respectively. Section 6 contains a brief discussion of key findings and implications for sustainability in the last mile sector.

[10] https://www.gov.uk/government/publications/review-of-last-mile-logistics-2019/position-statement-on-last-mile-logistics

[11] https://blog.ons.gov.uk/2020/09/18/how-the-covid-19-pandemic-has-accelerated-the-shift-to-online-spending/

[12] https://www.royalmail.com/sites/royalmail.com/files/2020-06/royal_mail_plc_full_year_results_2019-20.pdf

1.5 Acknowledgements

Cenex engaged with a wide range of stakeholders for this project and their contribution is noted and appreciated. We would like to highlight the assistance provided by the Scottish Wholesale Association (SWA) and Road Haulage Association (RHA).

2 Methodology

This section outlines the methodology followed by Cenex to address the research objectives. Further details can be found in the Appendix.

Our approach primarily consisted of a detailed review and analysis of secondary data available from TS, SG, and the Department for Transport (DfT). While there is no single source of data available on last mile, there are data sources available on vehicle registrations, movements, and use, which can be combined to develop a profile of the sector. We aimed to source and use Scottish datasets where available, and only used GB or UK-wide data when this was the best option.

The methodology consisted of the following:

- **Profile of Scottish road transport**. A high-level profile of road transport in Scotland, to understand key differences with the rest of the UK, which were then applied in subsequent stages of the methodology.
- **LCV and HGV last mile analysis**. An estimate of the number of vehicles and mileage associated with last mile delivery using UK and Scotland-specific secondary data. Where available, evidence gathered on type of goods moved and journey purpose (business-to-business or business-to-consumer).
- **Hot food last mile estimate.** A rough estimate of the hot food last mile sector, including number and type of vehicles and number of journeys undertaken. Due to a lack of available data these estimates are subject to significant uncertainty.
- **Emissions estimate.** A benchmark estimate for the GHG emissions associated with last mile delivery in Scotland, using outputs from the earlier tasks plus additional secondary data. We also estimated emissions from auxiliary engines used to power temperature reduction units (TRUs) for the transport of temperature controlled goods.
- **Review of other markets and business commitments**. Desk based review of examples of activity in other markets to reduce last mile delivery emissions, and commitments made by businesses operating in Scotland to reduce last mile delivery emissions.

3 Last mile profile and emissions estimates

This section presents the profile of last mile journeys in Scotland and the estimate of associated emissions. Results are displayed in charts and tables with brief commentary to highlight key points. Where relevant, the confidence level of the findings for the estimates are displayed. There are two categories to reflect the level of confidence: high and low, as we do not have enough data to quantify the uncertainty.

3.1 Scottish road transport

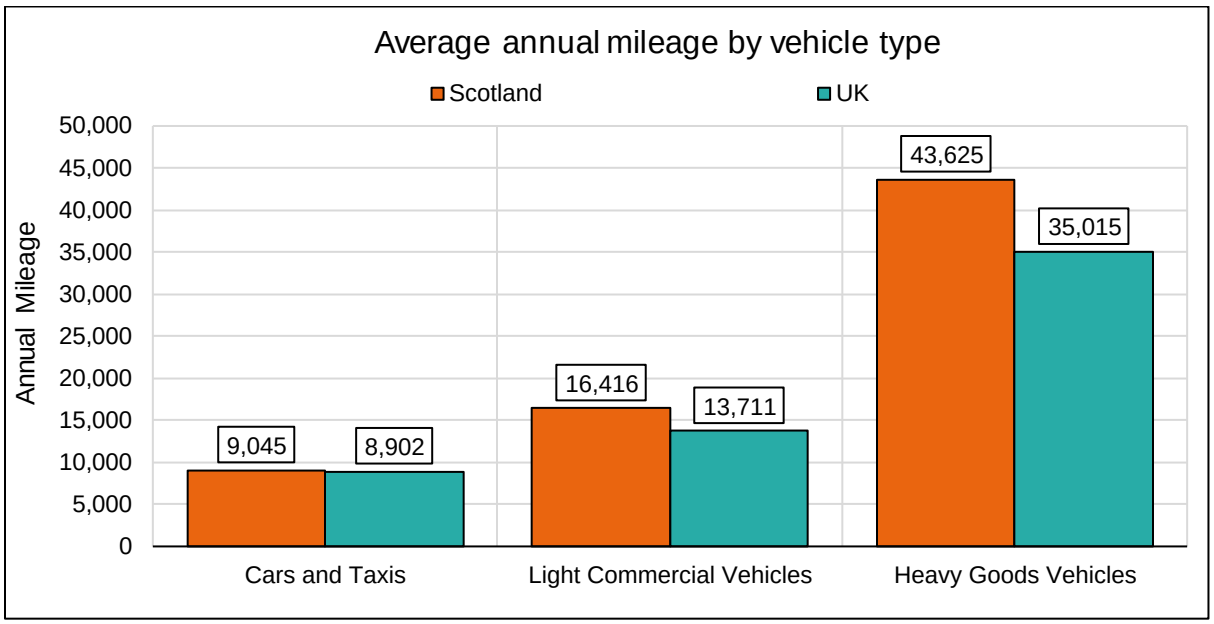

Figure 3: Average annual mileage by vehicle type for Scotland vs the UK

- HGVs cover significantly higher mileages per vehicle than light duty vehicles.
- Annual mileage for LCVs and HGVs is higher in Scotland than the rest of the UK.

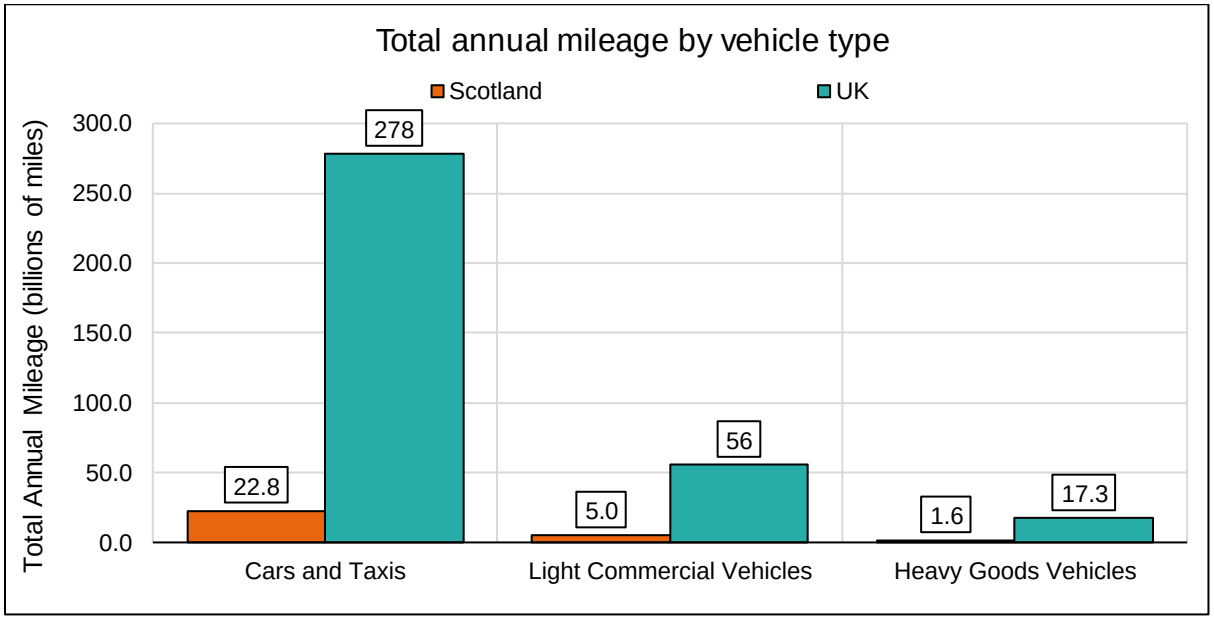

Figure 4: Total annual mileage by vehicle type for Scotland vs the UK

- Commercial vehicles are responsible for a small proportion of total mileage in Scotland and the rest of the UK. The vast majority of mileage and associated emissions comes from passenger cars.

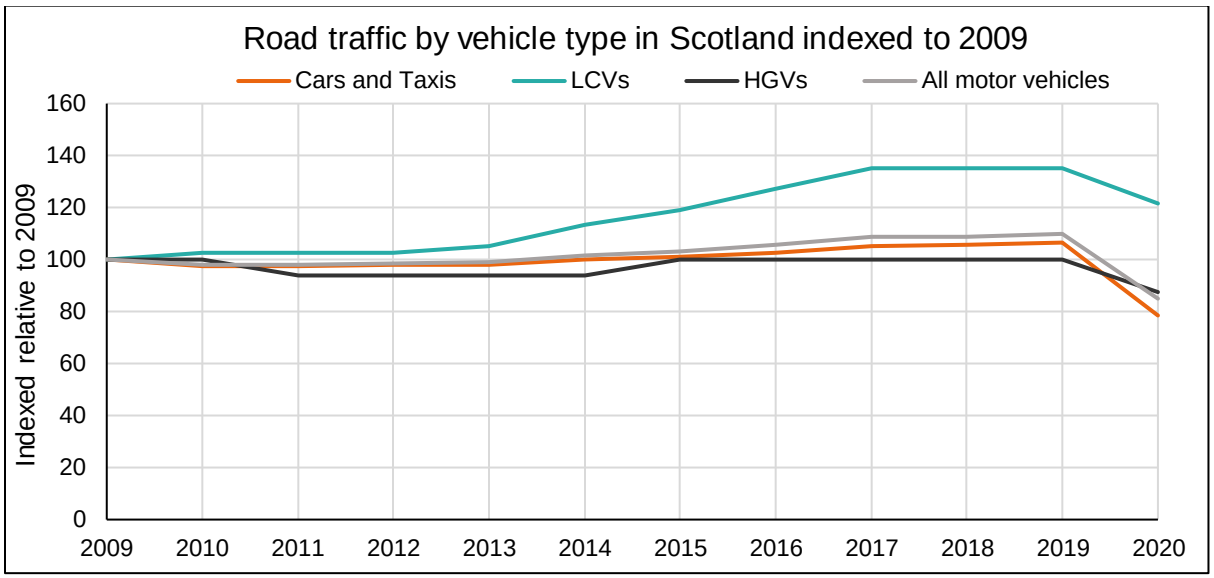

Figure 5: Historical road traffic data for all vehicle types indexed to 2009

- This chart shows the change in road traffic by vehicle type, compared to a 2009 baseline. It illustrates that total LCV mileage has increased significantly, compared to other vehicle types.
- Mileage increased for all vehicles from 2009 to 2019, then reduced in 2020.

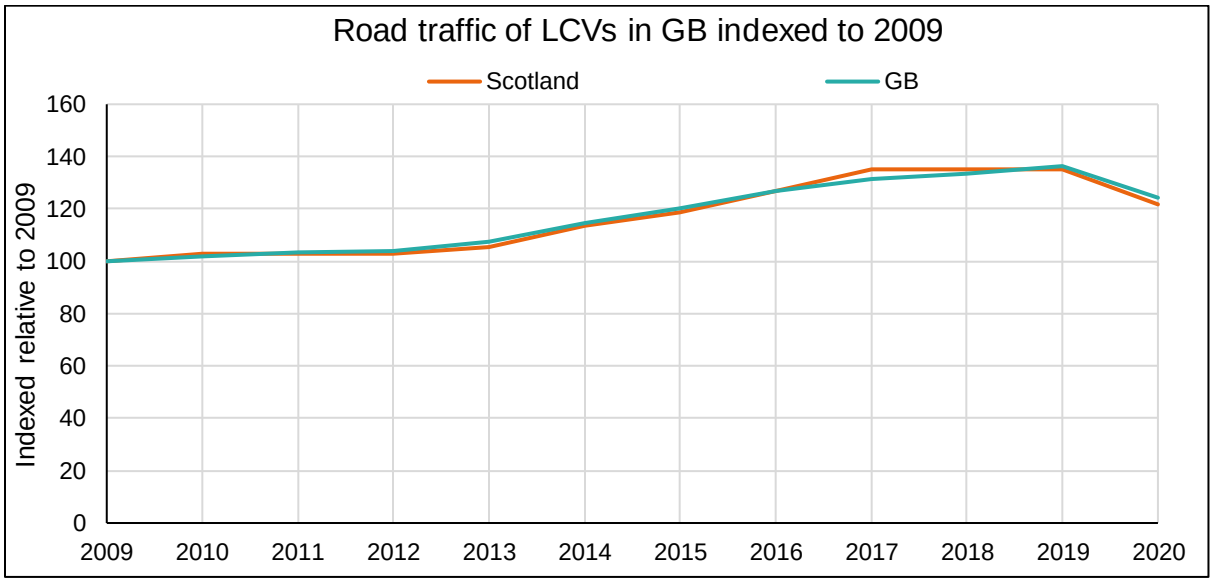

Figure 6: Historical road traffic data for LCVs indexed to 2009 for Scotland vs GB

- The change in LCV road traffic levels has been consistent between Scotland and GB (UK data not available).

3.2 LCV last mile

Table 3: LCV last mile figures

		LCVs
Number of vehicles	**Average**	40,800
Annual Average Delivery Mileage	**Average**	25,300
Annual Total Miles	**Average**	1,034,569,100
Number of Trips	**Average**	21,213,700

- LCVs completing last mile trips in Scotland cover an average of 25,300 miles per year.
- The number of LCVs in the last mile sector is estimated to be 40,800 vehicles.
- We have a high level of confidence in these figures.

Table 4: Split of B2B and B2C for last mile delivery

	Return to base after calling point		**Multiple calling points before returning to base**	
	One calling point	**Multiple calling points**	**One return to base**	**Multiple return to base**
	B2B		**B2C**	
Delivery/collection of goods to other businesses/individuals	39.6%	10.8%	29.7%	19.9%

Table 5: Age profile of LCVs in Scotland vs UK[13]

Age	Equivalent Euro Standard[14]	UK	Scotland
10 years +	Pre-Euro 4	33%	21%
3-10 years	Euro 4 & Euro 5	40%	44%
0-3 years	Euro 6	27%	35%

- LCVs in Scotland are typically newer (and therefore less polluting) than in the rest of the UK, with more low emission zone (LEZ)-compliant Euro 6 and fewer pre-

[13] Refer to the Appendix for a more detailed age profile

[14] 'Euro Standards' refers to regulations on engine and vehicle pollutant emission limits set by the European Commission (EC) and adopted into UK legislation. For more detail, please see the EC website.

Euro 4 vehicles. It is possible that the accelerated turnover of the fleet reflects the higher annual mileages completed in Scotland, leading to shorter replacement cycles.

- Despite this relatively good performance, around one fifth of LCVs predate Euro 4, and two thirds are LEZ-non-compliant, which are potential causes for concern.
- The Appendix provides a breakdown of a sample of fleets by vehicle age and replacement cycle. This shows that the average LCV age in Scotland is highly sensitive to the Royal Mail fleet. Royal Mail is believed to operate the largest last mile fleet in Scotland, comprising an estimated 3,500 vans with a replacement cycle of around 9 years. The average age of last mile vehicles including Royal Mail is 8 years, whereas without Royal Mail this falls to between 4.9 and 5.5 years.

3.3 HGV last mile

Table 6: Full breakdown of vehicles, miles, and goods moved by vehicle type and GVW

	Rigids					Artics		
	Over 3.5t to 7.5t	Over 7.5t to 17t	Over 17t to 25t	Over 25t	All Rigids	Over 3.5t to 33t	Over 33t	All Artics
Total Last Mile Scotland vehicles	1,351	391	858	1,191	3,789	287	4,397	4,684
Average annual miles total	11,875	18,750	20,625	21,875	18,125	31,875	48,750	48,125
Total Last Mile Scotland annual miles (million)	16.04	7.32	17.69	26.04	68.68	9.15	214.37	225.44
Tonnes moved (thousands)	344	165	284	574	1,367	152	2,317	2,469
Tonnes moved per km (millions)	26	12	28	42	107	15	343	358

Table 7: HGV last mile figures

		HGVs		
		Rigids	Artics	Total
Number of vehicles	**Average**	3,800	4,700	8,500
Annual average delivery mileage	**Average**	18,100	58,100	-
Annual total miles	**Average**	68,675,600	225,417,500	294,093,100
Number of trips	**Average**	784,000	1,547,100	2,331,100

- We estimate there are around 8,500 HGVs completing over 2.3 million last mile journeys in Scotland.
- Of these around 44% are rigids and the rest are artics. These vehicles cover around 69 million and 225 million miles, respectively.
- High level of confidence in figures.
- There is no data to show the split of HGV movements between B2C and B2B trips. An indicative assumption would be that rigids below 17t are completing B2C trips, while larger rigids and artics are completing B2B trips.
- Low level of confidence in this assumed split.

3.4 Hot food delivery last mile (takeaway vehicles)

- The data in this sub-section relies on a large number of assumptions and as such we have lower levels of confidence in the outputs.

Table 1: Delivery statistics for Scotland

	Vehicles	Total mileage
App users	16,347	35,800,600
Non app users average	8,174	17,900,300
Total average	**24,521**	**53,700,900**

- The total distance covered for hot food delivery is around 54 million miles per year in Scotland.

Table 2: Hot food delivery last mile

		Cars	Pedal bikes
Number of vehicles	**Average**	23,300	1,200
Annual average delivery mileage	**Average**	2,200	2,200
Annual total miles	**Average**	51,015,900	2,685,000
Number of trips	**Average**	25,507,900	1,342,500

- The breakdown of hot food deliveries by car and pedal bike shows that the majority of miles covered in this sector are by car rather than a more sustainable mode.
- Low level of confidence in figures

3.5 Fleet size and composition

The table below shows the estimated breakdown of the largest last mile fleets in Scotland, using data from the Fleet News FN200 list, with a pro rata split for Scotland as detailed in the methodology.

Table 3: Top 10 last mile fleets in Scotland

Company	Industry	Estimated Scotland fleet		
		Cars	Vans	HGVs
Royal Mail	Parcel delivery	353	3,213	281
DPD	Parcel delivery	55	425	83
Asda	Food & home	57	175	82
John Lewis/Waitrose	Food & home	121	152	52
Iceland	Food	24	129	0
DHL	Parcel delivery	36	106	0
Morrisons	Food & home	0	73	35
Fed Ex/TNT	Parcel delivery	75	65	0
Well Pharmacy	Medical	7	42	0
Yodel	Parcel delivery	0	40	22

- Royal Mail is likely to be by far the largest last mile fleet in Scotland. As discussed above its longer replacement cycle skews data on average LCV age.
- The rest of the top 10 is comprised of last mile couriers, supermarkets, and one pharmaceutical company.
- These fleets operate some 4,400 vans, out of our total estimate of 40,800 last mile LCVs in Scotland.
- This suggest that the vast majority of the last mile sector is made up of SMEs and sole traders running small fleets. Unfortunately, there is no data available to quantify this part of the market.

3.6 Last mile sector: additional metrics

There is limited data available to quantify the size of the last mile sector, beyond the metrics already presented (number and type of vehicles, mileage covered, and key fleet operators). The project brief requested an estimate of the value of the last mile sector, number of employees involved, goods moved, and significant geographical variations.

Goods moved

The table below provides a breakdown of the last mile sector by tonnes goods moved.

Table 11: Total goods moved annually for last mile in Scotland

Vehicle type		Goods moved (tonnes annually)	%
LCVs		6,364,100	62%
Rigids	Over 3.5t to 7.5t	344,500	3%
	Over 7.5t to 17t	164,900	2%
	Over 17t to 25t	283,600	3%
	Over 25t	573,6300	6%
Artics	Over 3.5t to 33t	152,000	1%
	Over 33t	2,317,400	23%
Total		**10,200,000**	**100%**
Tonnes moved in Scotland with a Scotland destination		**111,400,000**	**Scottish transport statistics 2019**
% of last mile goods movement vs total goods movement in Scotland		**9.16%**	

- The breakdown of goods moved by vehicle weight category shows that the majority of goods are moved by LCVs and artics over 33t GVW.
- Over 10 million tonnes of goods are moved annually in Scotland within last mile.
- Around 9% of all goods movements in Scotland are last mile trips.
- High level of confidence for HGVs
- Low level of confidence for LCVs

Economic value and number of employees

There is limited data available to indicate the economic value of the last mile sector. Mintel's 2021 *UK Courier and Express Delivery Market Report*[15] states that the value of the UK courier and express delivery market rose by 17% in 2020, reaching £12.2 billion. This is lower than the figure of £15 billion for the UK parcels market, as estimated in the *UK Parcels Market Insight Report 2020*[16].

Assuming this value is split across the UK in proportion with mileage (i.e., the value of a mile driven is the same in Scotland as the rest of the UK), then the market in Scotland would be worth around £1.1 billion to £1.4 billion. However, we have no insight into how these figures were derived, or how the definitions of the courier market and parcels market align with our understanding of last mile, and therefore this estimate should be used with caution.

There is even less data available on the number of employees involved in the last mile sector. The Society of Motor Manufacturers and Traders (SMMT)[17] estimates that there are 3.4 million people who use or depend on vans for their work. Assuming 16% of this is for last mile (as per the data on van use already described), and splitting this pro rata by population would give a figure of around 45,000 people in Scotland dependent on

[15] https://store.mintel.com/uk-courier-and-express-delivery-market-report
[16] https://apex-insight.com/product/uk-parcels-market-2020/
[17] https://www.smmt.co.uk/wp-content/uploads/sites/2/SMMT-Light-Commercial-Vehicles-Delivering-for-the-UK-economy.pdf

vans. The SMMT do not explain what they mean by “depend on” and as such this figure will likely be more than the number of employees driving in the last mile sector.

For HGVs, Statista has published data estimating there are 323,000 HGV drivers in the UK. Splitting this by last mile sector and population gives an estimate of around 6,000 HGV drivers in last mile in Scotland. Again, we caveat this as we do not know the source of the Statista data, and the assumptions applied will introduce uncertainty.

We advise caution in interpreting and using the figures provided in this sub-section.

Geographical variations

Freight traffic will be greatest near to major population and economic centres, and where there are large distribution hubs or modal interchanges. In Scotland these will be:

- The most populous cities: Glasgow, Edinburgh, Aberdeen and Dundee. Private sector fleets will typically have their distribution centres close to these major urban centres.
- Major inter-modal hubs: including Grangemouth rail freight interchange, Aberdeen Harbour, Cairnryan/Loch Ryan Port, Edinburgh Airport, Eurocentral (east of Glasgow), the Forth Ports (Grangemouth, Dundee, Leith, Rosyth, Methil, Burntisland, Kirkcaldy), Freightliner's Coatbridge Terminal, Glasgow Prestwick Airport, Glensanda, and Hillington Park.

Within the scope of this project, we were unable to collate and analyse traffic flow information to quantify vehicle movements in specific areas or on specific routes. Due to a lack of data on vehicle movements and journey purpose we cannot provide quantified insights into which of the locations listed above see more last mile traffic, compared to other forms of freight traffic. It is likely that the major sea ports will not have much last mile traffic, as this will be downstream of a further distribution hub.

3.7 Summary of the last mile sector

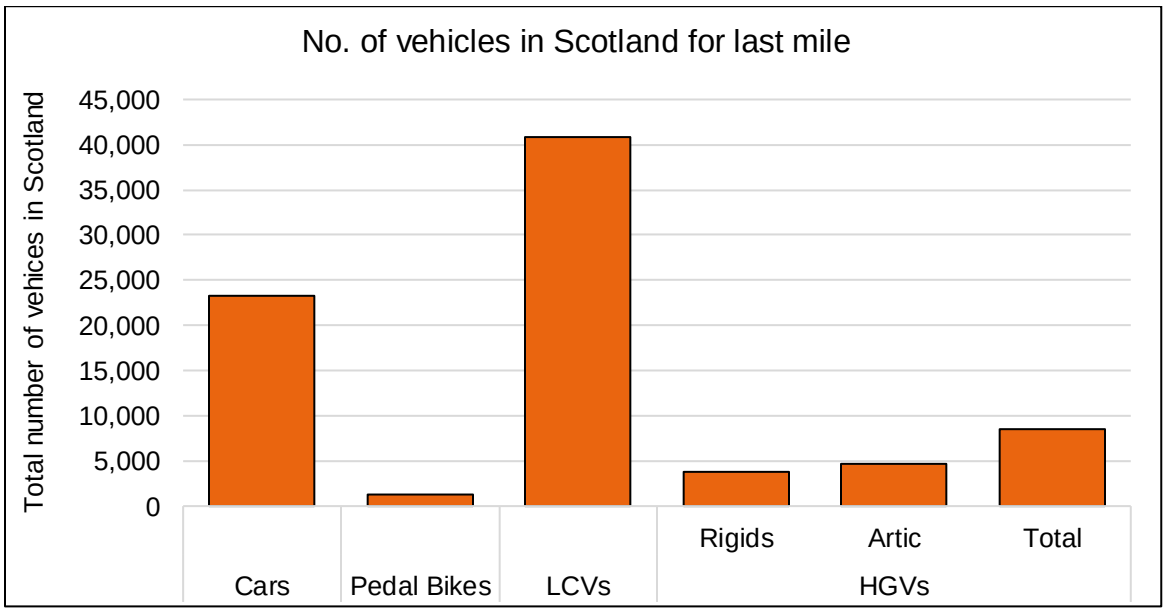

Figure 7: Number of vehicles for last mile delivery in Scotland

- The chart above shows the number of vehicles involved in last mile deliveries
- LCVs are the most commonly used vehicle type, followed by cars.

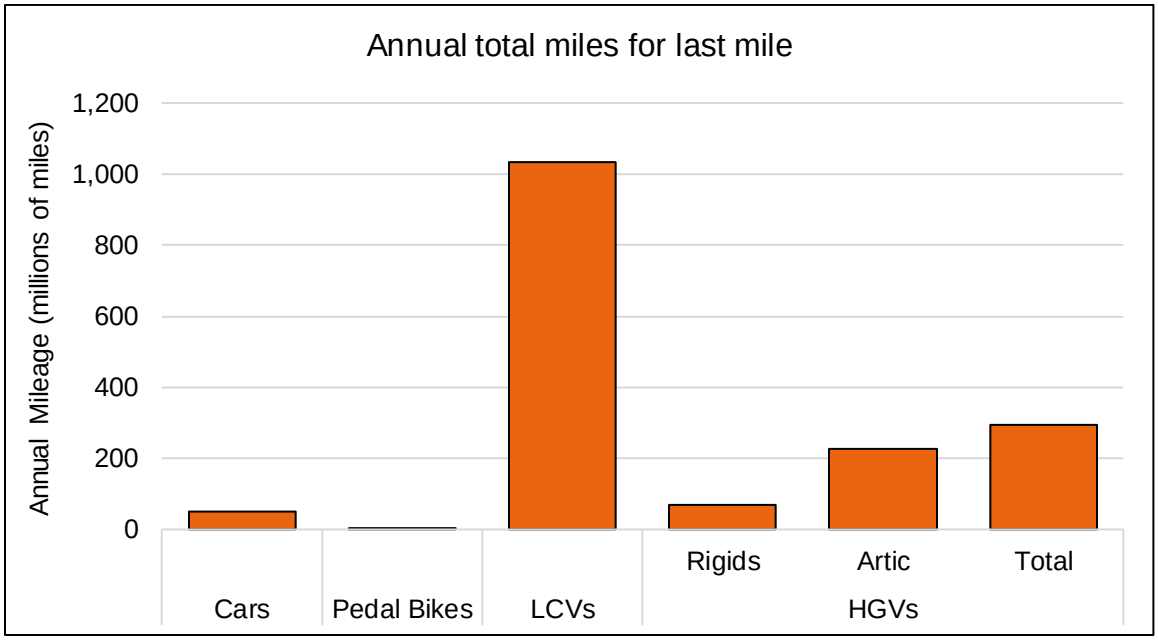

Figure 8: Annual miles for last mile delivery in Scotland

- The chart above shows the breakdown of annual mileage by vehicle type, which is a more useful metric.
- This illustrates that, due to low annual mileages, average car mileage is relatively low.
- LCVs make-up the majority (75%) of all miles driven in the last mile sector.

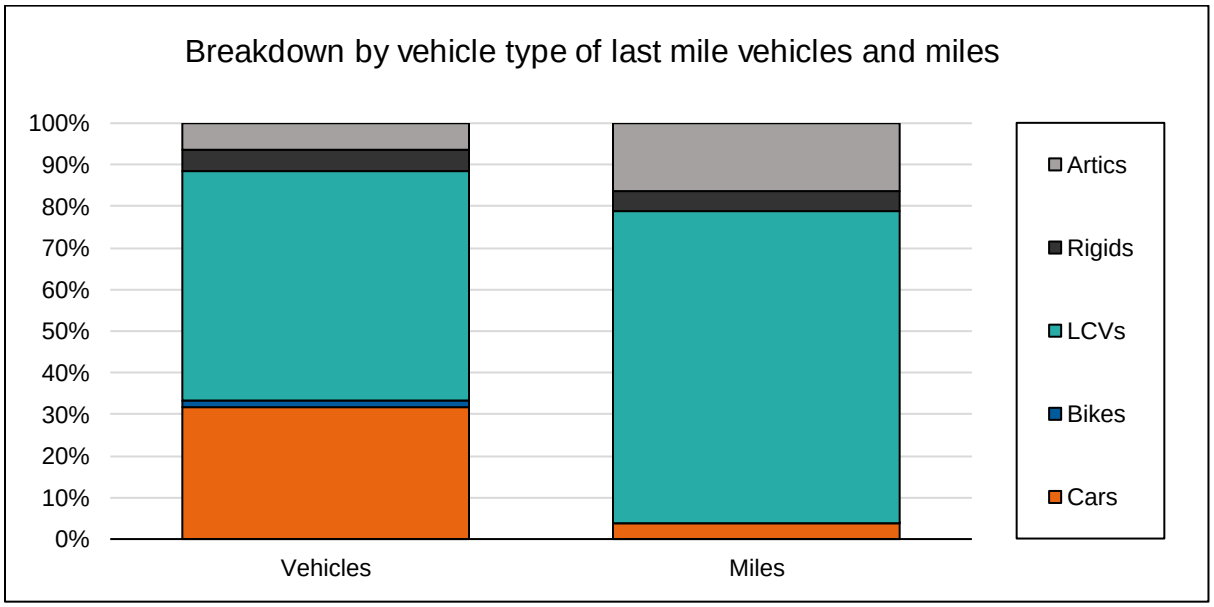

Figure 9: Breakdown of vehicles and mileage by vehicle type for last mile delivery in Scotland

- The chart above displays the same data in another format, which serves to illustrate that LCVs dominate the last mile sector both in terms of vehicle numbers and miles driven.

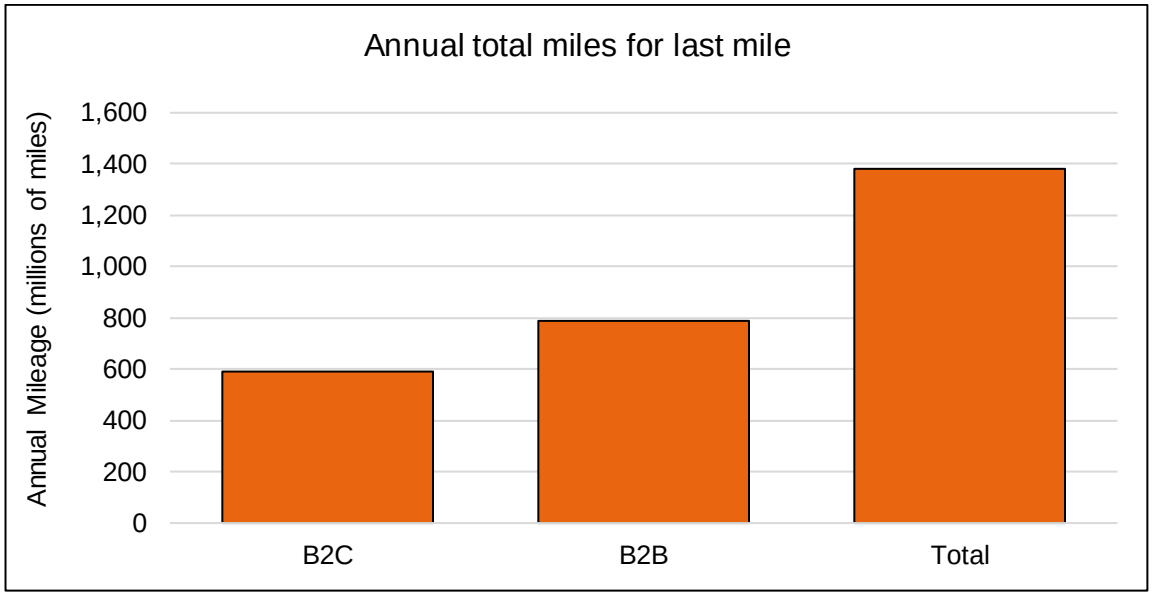

Figure 10: Breakdown of B2C vs B2B last mile delivery annual mileages

- The chart shows the split of B2C and B2B mileage. We emphasise again that there is a high degree of uncertainty around these outputs.
- This high-level estimate suggests that there is a roughly even split between the two journey types, and therefore both would need to be tackled.
- Low level of confidence in figures

3.8 Emissions

The tables below show the breakdown of emissions from the last mile by vehicle type, first as absolute figures and then in percentages.

Table 12: Annual emissions from last mile vehicles

	Total Emissions						
	Cars	Bikes	LCVs	Rigids	Artics	TRUs	Total
CO_2 TTW[18] (000s tonnes)	11	0	328	49	209	7	**605**
CO_2 WTW[19] (000s tonnes)	14	0	407	61	259	9	**750**
PM (tonnes)	0.1	0	38.0	3.4	16.1	3.5	**61.1**
NOx (tonnes)	4	0	1,640	180	866	66	**2,756**

Table 13: Annual emissions as a percentage of total last mile emissions

	Total emissions (%)						
	Cars	Bikes	LCVs	Rigids	Artics	TRUs	Total
CO2 TTW (000s tonnes)	1.9%	0.0%	54.2%	8.2%	34.5%	1.2%	**100%**
CO2 WTW (000s tonnes)	1.9%	0.0%	54.2%	8.2%	34.5%	1.2%	**100%**
PM (tonnes)	0.2%	0.0%	62.2%	5.6%	26.3%	5.7%	**100%**
NOx (tonnes)	0.1%	0.0%	59.5%	6.5%	31.4%	2.4%	**100%**

- In total we estimate that last mile deliveries in Scotland produce around 750,000 tonnes CO_2 per year.
- The largest contributor to this by vehicle type is LCVs with 407,000 tonnes, followed by artics with 259,000 tonnes.
- Vans are also the largest source of PM and NOx emissions which contribute to poor local air quality.
- High level of confidence for vehicle emissions.
- Low level of confidence for TRU emissions.

[18] Tank to wheel (TTW) emissions are the emissions from the vehicle tailpipe resulting from the combustion of the fuel.

[19] Well to wheel (WTW) emissions are the total emissions resulting in the production and transmission of the fuel from source to vehicle (known as well to tank or WTT) emissions, and the TTW emissions.

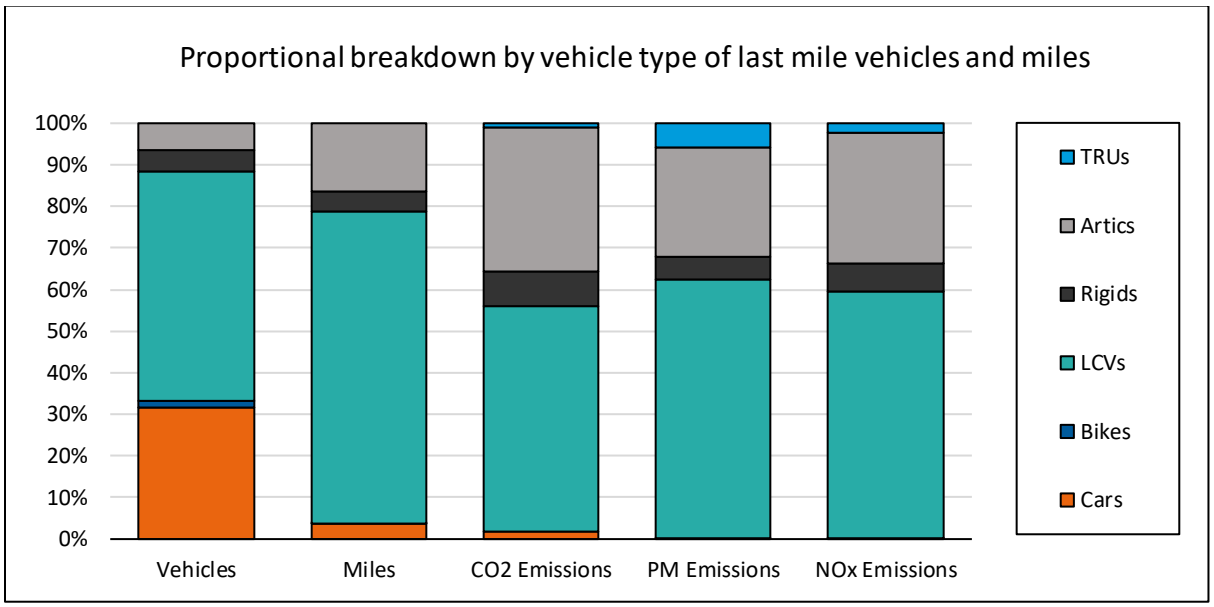

Figure 11: Proportional breakdown of vehicles, mileage, and emissions by vehicle type for last mile delivery in Scotland

- The chart above provides a clear visual representation of the breakdown of vehicles, miles and emissions by vehicle type.
- LCVs are the dominant vehicle type in terms of numbers of vehicles and miles driven and, to a lesser extent, emissions.

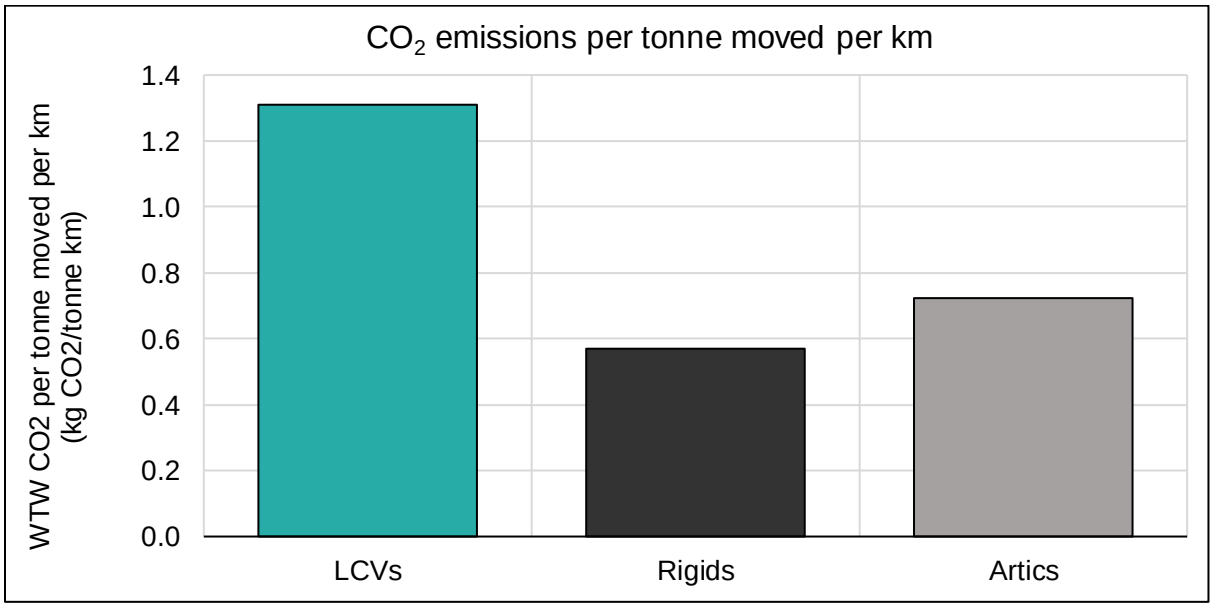

Figure 12: CO_2 emissions per tonne moved by vehicle type

- The chart above displays emissions per tonne moved per kilometre driven for each vehicle type. This is a much more useful metric than simply emissions per vehicle or per mile, as it highlights the sustainability of each vehicle type.

- LCVs are significantly less efficient than HGVs. Our analysis finds that rigids are more efficient than artics, and though we have high levels of confidence in the result, it is unclear why that should be the case. One theory is that rigid trucks have a shorter lifecycle than artics and therefore there may be more newer, fuel efficient models on the market.

3.9 Last mile in context

The summary statistics below place our findings around last mile in the context of goods movements and road transport in Scotland, compared to 2019 emissions figures.

- **Last mile vehicles comprise 2.7%** of all vehicles (cars, LCVs and HGVs) in Scotland.
- **Last mile mileage is 4.7%** of total miles covered by cars, LCVs, and HGVs in Scotland.
- **Last mile goods moved equates to 9.2%** of all goods moved.
- **Last mile emissions are 6.6%**[20] of all road transport emissions in Scotland.

4 Examples from other jurisdictions

This section presents examples of schemes in other jurisdictions which aim to reduce emissions from last mile deliveries. It is not intended to be comprehensive; rather, to provide examples of measures implemented. Our review found no examples of policies which specifically target last mile deliveries, most likely because enforcement would be almost impossible. Instead, the examples identified typically involve a fleet working with a city municipality, and potentially other stakeholders, on a sustainable last mile project.

4.1 Rural parcel delivery – Scotland

- **Description of measure**: In remote areas with low population density, it is not economic for each delivery company to provide coverage. Consolidated delivery supports coverage across the region. Menzies Distribution acts as the 'carriers' carrier', providing consolidation and delivery for APC, Aspray24, DHL, DPD, DX, Fedex/TNT, ParcelForce, Tuffnells, UK Mail, UPS, XDP and Yodel. The business model has been built up gradually by Menzies, without any reported public sector subsidy.[21] [22]
- **Date of implementation**: 2015.
- **Vehicles in scope**: Vehicles are currently diesel powered, although there is interest in using EVs in the future dependant on payload and charging provision.
- **Scale**: 13,000 parcels per day, average 42,000 miles per year per vehicle.
- **Evaluation**: No data on cost or emissions savings is available. However, if the service was not in place delivery costs would likely be higher in these areas.

[20] Including emissions from TRUs

[21] Delivering the goods (theiet.org)

[22] thepostcodepenaltytechnicalreport-industryinterviews.pdf (cas.org.uk)

4.2 Micro depot – Berlin

- **Description of measure**: DPD micro-depot which is supplied in the morning by an electric VW Crafter with deliveries completed by e-cargo cycles supported by a mobile charging unit and battery swapping facilities. It is unclear who owns the depot, or whether any Capex or Opex costs were covered by a public subsidy.
- **Date of implementation**: launched February 2021.
- **Vehicles in scope**: two heavy duty cargo bikes, range of 60km and capacity of 2 cubic metres, and a VW E-Crafter.
- **Stakeholders**: DPD, ONOMOTION GmbH, Swobbee, Sprint Tan GmbH.
- **Scale**: 400 parcels per day, with quantities rising in the future.
- **Evaluation**: The scheme is zero emissions at the tailpipe, but no data is available on emissions under the previous logistics arrangement.

4.3 Walking and cycling freight deliveries – Dublin

- **Description of measure**: Eco-hubs take in larger consignments of deliveries and redistribute them to walkers and cyclers using removable cube containers.
- **Date of implementation**: Unveiled in June 2017 in one location with a second location added in July 2020. If successful it could expand to other cities.
- **Vehicles in scope**: eQuad, eWalker and cube container.
- **Stakeholders**: UPS, Dublin City Council, Enterprise Ireland and Belfast City Council. Fernhay, Trinity College Dublin.
- **Scale**: 720 delivery stops per day.
- **Evaluation**: Five diesel vehicles removed, reducing emissions by up to 45%.

4.4 Mode shift to electric three wheelers – Taiwan

- **Description of measure*:*** Taiwan is encouraging use of electric two and three wheelers for deliveries. The Ministry of Transport approved an increase in the maximum carrying capacity of 3-wheel electric scooters from 80 kg to 200 kg.
- **Date of implementation:** October 2019.
- **Vehicles in scope:** Three-wheeler motor scooters up to 200Kg carrying capacity.
- **Evaluation:** no data available

4.5 Consolidation centre – London

- **Description of measure**: Clipper was appointed by the Crown Estate to operate the Regent Street delivery consolidation scheme. Deliveries were consolidated in a single depot outside the Congestion Charge Zone, and then delivered in fewer vehicles to retailers on Regent Street and in the West End.
- **Date of implementation**: 2008.
- **Vehicles in scope**: Last mile trips downstream of the consolidation centre were completed by an electric Smith Edison van.
- **Stakeholders**: Clipper, Crown Estate, West End retailers
- **Scale**: Over 35 retailers participated in the scheme.
- **Evaluation**: Evaluation by Clipper found a 77% reduction in vehicle movements.
- **Challenges**: While downstream mileage decreased, vehicles drove additional miles to reach the consolidation centre (no data is available to quantify this). This shifted emissions and congestion to other areas. More critically, there were

significant costs to cover, including the cost of acquiring and operating a site, and labour and opportunity costs associated with the double handling of goods. Without ongoing support and/or disincentives for other delivery mechanisms, consolidation centres will struggle to develop a sustainable business case.

4.6 Disincentives - London

- **Description of measures**: London introduced a Congestion Charge Zone (CCZ), Low Emission Zone (LEZ), and Ultra Low Emission Zone (ULEZ), to disincentivise use of older vehicles, and to reduce vehicle mileage in the city.
- **Date of implementation**: 2003 (CCZ), 2008 (LEZ), and 2019 (ULEZ).
- **Scope**: Charges applied to pre-Euro 4 petrol and pre-Euro 6/IV diesel vehicles.
- **Scale**: Central London only (CCZ and ULEZ) and Greater London (LEZ only).
- **Evaluation:** The zones have contributed to a reduction in emissions in the capital. Detailed reports are available online[23].

4.7 Delivery lockers

- **Description**: Self-service lockers for consumers to collect parcels. They aim to reduce mileage in residential areas and prevent incomplete deliveries.
- **Date of implementation**: Trials from 2011, with recent growth in the market
- **Stakeholders**: Available from companies including Keba, Amazon and InPost.
- **Evaluation**: No data available.

5 Business Commitments

This section first provides information on the major schemes available for businesses to publicly state their sustainable fleet commitments. It then provides some specific examples from fleets operating in Scotland. As with the previous section this is not intended to be comprehensive, but indicates that the industry is taking voluntary steps to improve sustainability.

The commitments listed are from large UK-wide businesses, rather than SMEs. This is likely because it is more difficult for SMEs to publicise any commitments made, and because larger organisations can more easily afford the transition to electric vehicles. Some SMEs in Scotland, including last mile operators, have accessed the Low Carbon Transport Business Loan to decarbonise their vehicles, but overall numbers of vehicles are necessarily small.

5.1 Example schemes

- **Climate Group UK Electric Fleets Coalition**. Launched in 2020 the UK Electric Fleets Coalition brings together businesses calling for the UK government to set a target for 100% EV sales by 2030. Founded by BT and Openreach, there are 29 organisations involved including Tesco, DPD, Ikea and the Royal Mail.
- **Climate Group EV100**. EV100 is a global group of over 100 companies committed to switching their fleets to EVs and installing charging infrastructure for

23 https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/central-london-ulez-ten-month-report

employees and customers by 2030. EV100 members aim to influence government policy as well as change their own operations.
- **Global Action Plan Clean Van Commitment**. A pledge to use zero emission vans in cities by 2028, with 34 signatories including Tesco and City Sprint.

5.2 Fleet case studies

Tesco

- **Vehicle type(s)**: Home delivery fleet – vans.
- **Commitment and target**: Roll out EVs across its fleet by 2028. Roll out started in London. No date stated for deployment in Scotland.
- **Scale**: 5,000 vehicles on fleet.

John Lewis Partnership

- **Vehicle type(s)**: Home delivery fleet – vans.
- **Commitment and target**: End the use of fossil fuels across its fleet by 2030, primarily by switching its vans to EVs.
- **Scale**: Expected to save more than 20,000 tonnes CO_2 annually.

Amazon

- **Vehicle type(s)**: Home delivery fleet – vans.
- **Commitment and target:** Amazon announced plans to purchase 100,000 electric vans globally from Rivian to bolster its delivery fleet.
- **Scale:** Amazon will have 10,000 vehicles on the road as early as 2022, and all 100,000 by 2030. It is not clear when these will deploy in the UK; however, Amazon is opening a concept distribution hub in Glasgow on a 150,000 square foot site which will have 500 electric van parking spaces.[24]

Ikea / ARCT Transport

- **Vehicle type(s):** Home delivery fleet – rigid trucks. ARCT operates last mile logistics services for Ikea.
- **Commitment and target:** Ikea has set a zero carbon target of 2025. The main limitations to EV roll-out are the lack of suitable vehicles (large vans and small trucks) with enough range, and the company's decision not to use Scotland's publicly accessible charging infrastructure, and instead to rely solely on charge points installed at their private depot.

City Sprint

- **Vehicle type(s)**: Small vans: most of the fleet is diesel though there are EVs operating in London. City Sprint also operates bicycles and cargo bikes.
- **Commitment and target**: City Sprint joined the Global Action Plan Clean Van Commitment in 2019 and set a target of 2028 for zero emission city operations. This will be achieved by using EVs and mode shift to cargo cycles.
- **Location**: Most activities on modal shift and EVs are in London. City Sprint have hubs in Edinburgh, Glasgow and Aberdeen but no indication of activity there yet.

[24] https://www.glasgowlive.co.uk/news/glasgow-news/amazon-jobs-glasgow-warehouse-baillieston-19239167

DPD

- **Vehicle type(s)**: Home delivery fleet – vans. DPD has 700 EVs, making it proportionately one of the largest EV fleets in the UK.
- **Commitment and target**: In October 2020, DPD committed to shifting towards zero and low emission deliveries in 225 European cities. In the UK it aims to electrify its fleets by 2028. So far activity has focused on England, with four micro-depots in London, and other projects in Cardiff, Leeds and Manchester. DPD has also announced plans to deliver to 25 of the UK's largest towns and cities – including Glasgow and Edinburgh – with zero and low-emission delivery means by 2025.[25]

Royal Mail

- Royal Mail has announced its first delivery office to have an all-electric fleet of collection and delivery vehicles. Bristol East Central Delivery Office's 23 diesel vehicles have been replaced by fully-electric ones.
- Royal Mail said Bristol was selected because of its plans to introduce a Clean Air Zone (CAZ) later this year.
- Six electric charging posts have also been installed on the site, with electricity for powering the office and charging the vehicles coming from renewable sources.

Royal Mail has not announced similar plans for any Scotland depots, but given its fleet size if a shift to EVs could be encouraged it would have a significant impact on overall last mile emissions in Scotland.

Cargo cycle deployment: Edinburgh

- Farr Out Deliveries:
    - Launched during the Covid-19 pandemic, and has increased from being an 'only mile' service to providing first/last mile, same-day deliveries, stock holding and delivery fulfilment services.
    - It started with three riders and five clients and has grown to servicing 50 businesses each month, and fulfilling over 5,000 deliveries a month.
    - Mostly serves local businesses requiring home deliveries, such as bakers, brewers, a zero waste supermarket, bookshops, and clothes shops.
    - Rides cover 40 to 60 kms per day and deliver 40 to 50 packages per day.

- Cargo Bike Movement (CBM)
    - CBM serves to promote use of cargo bikes.
    - It also has volunteers who deliver food from supermarkets to vulnerable consumers, reaching people suffering from food insecurity.

6 Discussion

This section provides some thoughts on the implications of this research and suggestions for next steps for TS.

Importance of delivery vehicles

There are some 50,000 vehicles involved in last mile deliveries in Scotland, the majority of which are LCVs. Emissions from the last mile are estimated to be 6.6% of all road

[25] DPD (UK) - Green delivery to 25 UK towns and cities by 2025

transport emissions in Scotland. Many of these vehicles pre-date the Euro 6/VI emissions standards and will therefore contribute to poor air quality in towns and cities. There is therefore a case for improving the sustainability of the last mile. These trips are part of Scotland's economy, making essential deliveries to businesses and consumers. Any measures to encourage more sustainable practices must be implemented in such a way that does not harm, and ideally benefits, businesses in this sector.

Definition of 'last mile'

The term last mile has no clear definition and is used in different ways by different stakeholders. Some see last mile as the final leg of a B2C journey only, with hub to retail defined as part of the supply chain. However, for other organisations, the term last mile does cover B2B trips. It may be helpful to reduce use of that term, as there is risk of confusion, and instead focus on delivery vehicles completing B2C and B2B journeys.

Barriers to improved sustainability

Many fleets recognise the need to reduce emissions and have set targets for emissions cuts or EV deployment. EVs increasingly offer a practical solution for van fleets and save money on a whole life cost basis. Barriers to entry to EV are lower for larger organisations, which can afford increases in upfront capital cost, benefit from reduced costs through scale procurement, and have the expertise to plan the deployment of vehicles and charging infrastructure. SMEs and small traders do not typically have these benefits, and tend to run older vans. There is a risk that smaller organisations will be slow to adopt EVs, meaning Scotland does not capture the environmental benefits, and the fleets miss out on the reduced running costs.

Technology uncertainty, lack of suitable vehicles, and high cost are constraining uptake of low and zero tailpipe emission HGVs. It is unclear what the long-term roles of EV and hydrogen vehicles will be, and the extent to which biogas and renewable biodiesel will be used in the short term. In July 2021, the UK government announced its intention to phase out the sale of new diesel and petrol heavy goods vehicles (HGVs) by 2040, subject to consultation. Scotland may wish to align with this ambition, or potentially set an earlier target if the technology pathways support it, noting that the proposed timescale is already ambitious.

Focus needed on van emissions

HGVs, particularly artics, are generally used efficiently by the logistics industry because they are expensive to acquire, and therefore fleets seek to derive maximum value from the asset. This includes double or triple shifting vehicles, route optimisation, and maximising payload or load volume. In the van market by contrast, cost of entry is lower, so there is less incentive to maximise efficiency. Restrictions on HGV drivers' hours means route planning is more crucial than it is for vans.

Quantifying the difference in efficiency of vehicle use is challenging because of the lack of data on the van market in particular. There is no data available for Scotland (or the UK) showing metrics such as journey purpose, start/end location, or loading factor. DfT's van survey is the most comprehensive review of the LCV market. There may be further detail available which has not been published, and detail of the sample stratification in Scotland. We suggest TS follow up with DfT to discuss these topics.

Recommendations for Transport Scotland

It will be difficult to implement new policies or measures which specifically target the last mile, because of the lack of visibility of which organisations are involved and what goods are being moved. Enforcement would be challenging as there is no low-cost way to determine what is in a particular vehicle on a given journey. Broader approaches, such

as time restrictions on operating commercial vehicles in urban areas, would be deeply unpopular with the freight sector and are likely to have negative economic impacts.

We would suggest a model of engaging and working with the freight industry to improve a shared understanding of the last mile, and to identify opportunities and challenges associated with improving sustainability. Transport for London's commercial vehicle programme, branded as LoCITY[26], provides a template which TS may wish to review and replicate. The programme involves:

- Working groups attended by fleet operators, vehicle manufacturers, alternative fuel providers, and trade associations.
- Online tools to help fleets find and review the latest low emission vehicles on the market.
- Support for SMEs to help them adopt EVs and low emission fuels.
- Links to the Fleet Operator Recognition Scheme[27] (FORS) to provide accreditation for fleets which have proven emissions reductions.

A focus on SMEs will be crucial, as there is likely a large number of small fleets, perhaps running older more polluting vans, which may be late adopters of EVs. Stakeholders who supported this research, in particular the SWA and RHA, will be crucial in linking government with these organisations, which can often be a hard-to-reach audience.

Covid-19

Covid-19 and associated restrictions have had a significant impact on the freight sector, as shown by the reduction in vehicle mileage in 2020. It is too early to know what structural changes the market will undergo as we recover from the pandemic. Some fleets reported significant increases in home deliveries. This may turn into a long-term trend particularly with a shift to a hybrid model of home and office work. In the food sector, wholesalers which previously completed B2B trips have pivoted to providing B2C deliveries. This is unlikely to be permanent, as it is not an economically viable use of larger trucks, and as hospitality reopens demand is likely to return to previous patterns.

Covid-19 has accelerated changes already underway, such as the decline in high street retail and increase in online shopping. B2C last mile is likely to continue growing, and investments are being made by leading online retailers in warehouse and distribution facilities in Scotland. Other trends may emerge, such as the growth of disruptive grocery delivery services offering immediate order fulfilment. Start-ups such as Getir, Gopuff and Gorillas are attracting investment and, if successful, would likely lead to an increase in last mile deliveries, though it is unclear whether these would be by LCV or two-wheeler.

Limitations in research

We conclude by emphasising that we have had to triangulate multiple data sources and make some assumptions to produce best available estimates. Results should be treated with caution, as highlighted throughout the report. The key uncertainties are:

- Assumptions over the split of B2B and B2C journeys.
- All data on hot food deliveries.
- We may be under-estimating the scale and emissions from last mile as there is no data available on so-called 'gig economy' drivers and vehicles.

[26] https://locity.org.uk/

[27] https://www.fors-online.org.uk/cms/

Appendices

Appendix A – Last mile methodology

This appendix details the methodology applied.

Scottish road transport

Initially we profiled road transport in Scotland, to understand key differences with the rest of the UK, which were then applied in subsequent stages of the methodology.

Average mileages for cars, light commercial vehicles (LCVs), and HGVs were calculated from the following sources:

- Number of registered vehicles: DfT Vehicle Statistics (VS) table VEH0105
- Annual Road Mileages: VS table TRA0106
- Historical trends of car, LCV and HGV traffic: VS table TRA0106

These sources provide Scotland-specific figures and a comparison to the rest of the UK.

Fleet sizes were estimated using the Fleet News FN200 database[28]. This provides a breakdown of the UK's largest commercial vehicle fleets. We selected the largest fleets which operate in the last mile sector (excluding fleets in other sectors such as servicing). The proportion of each fleet operating in Scotland was estimated by applying the relevant ratio of vehicle type in Scotland compared to the rest of the UK, using VS table VEH0105: 8.08% for cars, 7.59% for LCVs, and 7.45% for HGVs.

LCV last mile

DfT surveyed van activity in Great Britain in 2019/20, covering all LCVs registered in the UK. The statistical release was published in April 2021 and is available online[29]. We applied the following approach to calculate the number of vehicles and mileage associated with last mile delivery:

- The number of LCVs registered in Scotland was taken from VS table VEH0105.
- The proportion of last mile vehicles was taken from VS table VAN0201 from the 2019/20 van survey, which states that 15.9% of LCVs in the UK are used for delivery of goods. We have assumed that this equates to the last mile sector as defined for this research.
- The average mileage for delivery (last mile) vehicles was taken from VS table VAN0211.
- We applied an uplift factor to all outputs to reflect the fact that van mileages in Scotland are 19.7% higher than the rest of the UK, as per section 0 above.
- The average age of Scotland LCVs was taken from VS table VAN0403.

The below table shows a full breakdown of the Scottish fleet of LCVs according to Euro Standard.

[28] https://cdn.fleetnews.co.uk/web/1/digital-issue-categories/september-2020/Fleet_News_September_2020/index.html#page=38

[29] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/978087/van-statistics-2019-to-2020.pdf

	Scotland					
	Petrol	Diesel	Gas	Electric	Other	Total
Unknown	12	377	1	1	0	391
Pre-Euro 1	31	936	1	2	0	970
Euro 1	22	672	1	2	0	697
Euro 2	30	910	1	2	0	943
Euro 3	181	5,493	7	14	2	5,697
Euro 4	277	8,413	11	22	3	8,726
Euro 5	317	9,655	13	25	3	10,013
Euro 6	424	12,905	17	33	4	13,383
Total	1,294	39,361	52	101	12	40,820

B2C/B2B Breakdown

Estimating the split of B2C and B2B deliveries was a significant challenge for this research, due to a lack of data on journey purpose. We made a best available estimate by applying the following methodology to the data in VS table VAN0307.

- VAN0307 provides a breakdown of the travel pattern for delivery/collection of goods to business and individuals. We assume that "Return to base after calling point" and "Return to base after each calling point" are B2B trips. We assume that "Multiple calling points before returning to base" for single and multiple returns to base are B2C trips.

Though we have a high degree of confidence in the number of vehicles and miles covered by LCVs the split of B2B and B2C is less certain due to the assumptions made.

HGV last mile

The HGV last mile profile was developed using the following methodology:

- VS table RFS0106 details goods lifted by weight and tonne kilometres by commodity type. We assumed that food products, furniture and manufactured goods, and mail are last mile sector trips. The percentage of tonnes moved associated with these commodities was calculated along with a relative percentage of groupage[30]. All data was broken down into the following GVW categories: Rigids: 3.5t-7.5t, 7.5t-17t, 17t-25t, 25t+; artics: 3.5t-33t, 33t+.
- Using this data we estimated average haul length per tonne of goods moved by dividing total tonne kilometres by total tonnes moved for each commodity type.
- Total mileage for HGVs by vehicle type and GVW taken from VS table RFS0110.
- The share of last mile goods moved was multiplied by the relevant RFS0110 statistics to estimate UK HGV last mile movements.
- The relative percentage for Scottish last mile was estimated as a share of total UK goods moved by applying the ratio of vehicles registered in Scotland vs the rest of the UK, from VS table VEH0105.
- The number of vehicles was then calculated using estimates already derived for total mileage (disaggregated by vehicle sector and GVW), annual average mileage for HGVs by vehicle type, and VS table RFS0112 detailing loaded and empty mileage.

[30] Groupage accounts for any consignment delivered that is less than 75% of the classified commodity types.

The below table shows the full calculations for the last mile HGV vehicles.

		Rigid vehicles					Articulated vehicles		
		Over 3.5t to 7.5t	Over 7.5t to 17t	Over 17t to 25t	Over 25t	All Rigids	Over 3.5t to 33t	Over 33t	All Artics
	Food	8.30%					26.70%		
	Furniture	1.30%					1.00%		
	Mail	2.90%					4.20%		
	Groupage	16.80%					16.20%		
	Groupage as proportion	2.52%					6.17%		
	Total	15.02%					38.07%		
	Average km per trip per tonne	74.51	71.05	99.81	72.64	87.65	96.37	148.00	145.72
	Average annual km loaded	14,000	22,000	24,000	22,000	20,000	39,000	55,000	54,000
	Average annual km empty	5,000	8,000	9,000	13,000	9,000	12,000	23,000	23,000
	Average annual km total	19,000	30,000	33,000	35,000	29,000	51,000	78,000	77,000
	Average no trips	255	422	331	482	331	529	527	528
UK	Total UK annual km (million)	1,976	902	2,179	3,208	8,264	445	10,422	10,867
UK	Food	164	75	181	266	686	119	2,783	2,901
UK	Furniture	26	12	28	42	107	4	104	109
UK	Mail	57	26	63	93	240	19	438	456
UK	Groupage as proportion	50	23	55	81	209	27	643	670
UK	*Total Last Mile UK annual km (million)*	***297***	***136***	***327***	***482***	***1,242***	***169***	***3,967***	***4,137***
UK	Total UK vehicles	104,000	30,067	66,030	91,657	284,966	8,725	133,615	141,130
UK	Food	8,632	2,496	5,481	7,608	23,652	2,330	35,675	37,682
UK	Furniture	1,352	391	858	1,192	3,705	87	1,336	1,411
UK	Mail	3,016	872	1,915	2,658	8,264	366	5,612	5,927
UK	Groupage as proportion	2,625	759	1,667	2,313	7,193	538	8,240	8,703
UK	*Total Last Mile UK Vehicles*	***15,625***	***4,517***	***9,920***	***13,771***	***42,813***	***3,322***	***50,863***	***53,724***
Scotland (total vehicles 36,837 goods vehicles)	Total Scotland annual km (million)	171	78	188	277	714	38	901	939
Scotland (total vehicles 36,837 goods vehicles)	Food	14	6	16	23	59	10	241	251
Scotland (total vehicles 36,837 goods vehicles)	Furniture	2	1	2	4	9	0	9	9
Scotland (total vehicles 36,837 goods vehicles)	Mail	5	2	5	8	21	2	38	39
Scotland (total vehicles 36,837 goods vehicles)	Groupage as proportion	4	2	5	7	18	2	56	58
Scotland (total vehicles 36,837 goods vehicles)	*Total Last Mile Scotland annual km (million)*	***26***	***12***	***28***	***42***	***107***	***15***	***343***	***358***
Scotland (total vehicles 36,837 goods vehicles)	Total Scotland vehicles	8,991	2,599	5,708	7,924	24,636	754	11,551	12,201
Scotland (total vehicles 36,837 goods vehicles)	Food	746	216	474	658	2,045	201	3,084	3,258
Scotland (total vehicles 36,837 goods vehicles)	Furniture	117	34	74	103	320	8	116	122
Scotland (total vehicles 36,837 goods vehicles)	Mail	261	75	166	230	714	32	485	512
Scotland (total vehicles 36,837 goods vehicles)	Groupage as proportion	227	66	144	200	622	47	712	752
Scotland (total vehicles 36,837 goods vehicles)	*Total Last Mile Scotland vehicles*	***1,351***	***391***	***858***	***1,191***	***3,701***	***287***	***4,397***	***4,645***

B2C/B2B breakdown

We made a best available estimate of the split of B2B and B2C trips as follows:

- We assumed that all artics completing last mile trips are B2B, as it is unlikely that consumers will receive direct delivery via artics.
- The split of rigid HGV last mile mileage was estimated assuming that vehicles below 17t GVW are B2C and vehicles above 17t are B2B. Smaller rigid vehicles are more likely to be used on B2C deliveries, while larger vehicles are more likely to be used to deliver to stores and other businesses which will most likely delivery to store final destinations.

Though we have a high degree of confidence in the number of vehicles and miles covered by LCVs the split of B2B and B2C is less certain due to the assumptions made. In particular we are aware that the assumption around the breakdown of rigid HGV use is highly uncertain.

Hot food delivery last mile

There is limited data available on hot food last mile trips. We have developed a high-level estimate from the little evidence we collated, but there are significant uncertainties around the outputs.

Using statistics available for Deliveroo and the UK hot food delivery market[31] we applied the following methodology to profile last mile hot food delivery by cars and two wheelers:

- The hot food market report shows that 50% of UK takeaway food orders are made via apps, with 600,000 food orders per day on apps in the UK in 2020.
- We assumed that (i) all app users request delivery and (ii) between 25% and 75% of non-app orders are fulfilled via delivery. These are indicative assumptions as there is no data available and results should therefore be treated as indicative.
- The average delivery distance was 2 miles in 2020. Deliveroo fulfils 45,000 orders per day with a fleet of 15,000 couriers, equating to one courier per three deliveries daily[32].
- Using the assumptions above, we estimate that there are 200,000 couriers in the UK fulfilling app orders and a further 50,000 to 150,000 fulfilling non-app orders, with the average courier delivering 1,100 orders per year.
- Scottish figures were derived as a pro rata estimate based on Scotland's population (8.17% of the UK population).

The below table shows the breakdown of the total Scottish vehicles for hot food delivery.

	Vehicles	Total mileage	Average mileage
App users	16,347	35,800,599	2,190
Non app users average	8,174	17,900,299	2,190
Non app users max	12,260	26,850,449	2,190
Non app users min	4,087	8,950,150	2,190
Total average	24,521	53,700,898	2,190
Total max	28,608	62,651,048	2,190
Total min	20,434	44,750,749	2,190

Emissions estimate

GHG emissions from last mile vehicles were estimated by applying to the outputs from Sections 2.1 to 2.4 the following methodology:

- UK vehicle registration data was collated, and the Euro Standards taken from VS table VEH0126. This gives a proportion of each vehicle type per Euro Standard.
- An adjustment to the proportion of vehicles in each Euro Standard category for LCVs was made using VS table VAN0403 as this shows that the average age of LCVs in Scotland is considerably lower than the UK average.
- CO_2 emissions were estimated by applying the breakdown of vehicles by Euro Standard to VS table VEH0156 for cars and LCVs, and ENV0104 for HGVs. For HGVs, DEFRA 2019 figures were used to convert mpg to CO_2.
- The breakdown of vehicles by Euro Standard was used to calculate the particulate matter (PM) and nitrous oxide (NOx) emissions using Copert 5 datasets[33].

We also estimated emissions from auxiliary engines used to power temperature reduction units (TRUs) for the transport of temperature controlled goods. Finally, we

[31] https://www.businessofapps.com/data/deliveroo-statistics/

[32] The ratio of couriers to deliveries seems high; our hypothesis is that many of the 15,000 couriers are registered but not active riders, while a smaller share of couriers will complete the majority of deliveries.

[33] https://www.emisia.com/utilities/copert/

estimated emissions per tonne moved for each vehicle category. Refer to the Appendix for details of these methodologies.

Survey and stakeholder engagement

The comprehensive review of secondary data allowed us to develop a detailed profile of last mile deliveries in Scotland. We undertook a brief fleet survey and stakeholder engagement exercise to check and refine our findings. We issued a survey to Cenex's database of fleet contacts, and via the SWA and RHA membership. Response rate was low, most likely because of the timing of the survey in spring 2021; however, we gathered data on 15 fleets operating around 5,000 commercial vehicles in Scotland. Finally, we interviewed a sample of stakeholders including SME and large fleets and trade associations to capture views and other evidence on the last mile sector. All fleet data has been aggregated in this report, apart from information already in the public domain, such as the fleet sizes reported in the Fleet News FN200 list.

Desk-based review

Approaches in other jurisdictions

We undertook a rapid evidence review of approaches being taken in other jurisdictions to reduce emissions from last mile delivery. This aimed to provide a high level and broad summary of interventions and solutions being deployed in other countries. This was completed via online research of a wide range of projects and initiatives, aiming to describe and catalogue examples by date of implementation, vehicles in scope, scale and, if available summary evaluation data on their effectiveness will be reported.

Business commitments

We collated and summarised commitments made by businesses operating in Scotland to reduce last mile delivery emissions. This was undertaken by reviewing sources including the Global Action Plan Clean Van Commitment, the Climate Group EV100, the Climate Group UK Electric Fleets Coalition, and the FN200. We also incorporated any commitments gathered via the survey and stakeholder engagement work. Subject to data availability we aimed to catalogue each commitment by vehicle type, date the commitment was made, date of target, nature of target (reduction in emissions or switch to electric vehicles (EV)), scale of target (number of vehicles or proportion of fleet), technology expected to be used, and forecast carbon emission savings.

HGV alternative methodology

The following methodology was developed as an alternative approach to modelling HGV emissions, but not used as it involves too many assumptions and uncertainties.

Using the VEH0522 rigid vehicles that are not capable of last mile delivery were excluded (e.g. refuse, skip loaders, tankers, tower wagons) leaving 73% of rigids capable of last mile. This was split into 4 vehicle weights (<7.5t, 7.5t – 18t, 18t – 26t, >26t).

The UK figures were apportioned to a Scottish fleet using VEH0105 for rigids and artics (artics split into <34t and >34t).

	Rigids in Scotland excluding non-capable vehicles				
	Up to 7.5t	Over 7.5t to 18t	Over 18t to 26t	26t+	Total
Unknown	35	31	18	14	98
Pre-Euro 1	80	71	41	31	223
Euro 1	63	56	32	25	176
Euro 2	137	122	70	54	383
Euro 3	546	488	279	215	1,528
Euro 4	552	493	282	217	1,544
Euro 5	762	680	389	300	2,131
Euro 6	3,093	2,762	1,581	1,217	8,653
Total	5,268	4,703	2,692	2,073	14,736

Using TRA3105 for both rigids and artics the vehicles were determined as either last mile or not last mile. This was through the % of vehicle miles covered on specific roads: Motorway and trunk roads were excluded, rural and urban principal roads included along with minor roads. This gave a proportion of last mile: non last mile of 49:51 for rigids and 18:82 for artics.

	TRA3105 – Rigids			
	2 axle	3 axle	4 axle	4 axle
Motorway	34.4%	27.7%	28.8%	28.8%
Trunk rural A	16.8%	16.0%	18.3%	18.3%
Trunk urban A	1.6%	1.5%	1.9%	1.9%
Total	52.8%	45.2%	49.0%	49.0%
Rural principal	18.8%	20.2%	26.6%	26.6%
Urban principal	11.3%	9.8%	11.5%	11.5%
Minor roads	17.1%	24.8%	12.9%	12.9%
Total	47.2%	54.8%	51.0%	51.0%
Total	100.0%	100.0%	100.0%	100.0%

	TRA3105 - Artics
Motorway	57.4%
Trunk rural A	22.9%
Trunk urban A	1.8%
Total	82.1%
Rural principal	12.2%
Urban principal	3.7%
Minor roads	2.0%
Total	17.9%
Total	100.0%

	Last mile rigids				
	Up to 7.5t	Over 7.5t to 18t	Over 18t to 26t	26t+	Total
Unknown	17	17	9	7	50
Pre-Euro 1	38	39	21	16	114
Euro 1	30	31	16	13	90
Euro 2	65	67	36	28	196
Euro 3	258	267	142	110	777
Euro 4	261	270	144	111	786
Euro 5	360	373	198	153	1,084
Euro 6	1,460	1,514	806	621	4,401
Total	2,489	2,578	1,372	1,059	7,498

	Last mile artics		
	Up to 34t	34t+	Total
Unknown	1	11	12
Pre-Euro 1	2	24	26
Euro 1	2	19	21
Euro 2	3	41	44
Euro 3	14	165	179
Euro 4	14	167	181
Euro 5	19	231	250
Euro 6	77	936	1,013
Total	132	1,594	1,726

Appendix B – Emissions calculations

TRUs

It is important to account for emission from auxiliary engines used for temperature controlled transport. The below methodology was used to calculate the relative number of TRUs for last mile delivery and their emissions:

- A report produced by Cenex in 2018 (unpublished) researched the relative percentage of insulated vehicles travelling through the Leeds area (ref Leeds Dearman report). This showed 1.0% of LCVs, 7.8% of rigid HGVs 3.5t-17t, 8.8% of rigid HGVs 18t+, and 11.6% of artic HGVs were insulated and using TRUs.
- This relative percentage for each vehicle type was applied to the last mile Scotland vehicles to estimate the total number of TRUs.
- Average litres of fuel used per mile by a TRU were taken from the Cenex report on refrigerated transport (found here) for each vehicle type and the relative mileages used to calculate the total CO_2 emissions from TRUs for last mile transport in Scotland.

Emissions per tonne of goods moved

The following methodology states how emissions per tonne of good moved were calculated for each vehicle category:

- The total tonnes of good moved by HGVs is known from the previous methodology in Appendix A.
- For LCVs this was calculated assuming that half of the maximum loading capacity was utilised per trip. The total number of trips per vehicle annually was calculated by dividing the total annual mileage for a last mile LCV, as calculated in Appendix A and dividing by the average trip distance performed by an LCV taken from the VAN0302 table from the 19/20 van statistics. The number of trips per vehicle was then multiplied through by the total number of last mile LCVs and the average load capacity per trip.
- The total CO_2 produced by last mile rigid HGVs, artic HGVs and LCVs was then divided by the total goods moved in tonnes to calculate the average emissions per tonne moved for each vehicle type.

It should be noted that there is more confidence in the calculation of goods moved and emissions per tonne of goods moved for HGVs than LCVs, due to the higher number of assumptions used for LCVs.

Appendix C – Age profiling

LCVs

The average age of Scotland LCVs was taken from VS table VAN0403. This does not provide a breakdown by Euro Standard unlike the DfT VEH0126 which provides a full breakdown of the age of vehicles however this is not Scotland specific and represents the whole of the UK.

The table below uses the VEH0126 and VAN0403 figures to provide a Scotland specific Euro Standard breakdown for LCVs.

	VEH0126 - UK	VAN0403 - Scotland	Estimated equivalent of VAN0403
Unknown	0.96%	21%	0.94%
Pre-Euro 1	2.38%		2.34%
Euro 1	1.71%		1.68%
Euro 2	2.31%		2.28%
Euro 3	13.96%		13.75%
Euro 4	21.37%	44%	20.49%
Euro 5	24.53%		23.51%
Euro 6	32.79%	35%	35.00%
Total	**100.00%**	**100.00%**	**100.00%**

For reference purposes the dates of when each Euro Standard became live are stated below:

	LCVs
Euro 1	Jan 1993
Euro 2	Jan 1997
Euro 3	Jan 2001
Euro 4	Jan 2006

Euro 5	Jan 2011
Euro 6	Sep 2015

HGVs

No Scotland specific data exists on the age profile of HGVs. The table below shows the UK breakdown of HGVs by Euro Standard from VEH0126 along with the year these standards became live.

	VEH0126 - UK	Date of Euro Standard
Unknown	0.66%	-
Pre-Euro 1	1.52%	-
Euro 1	1.20%	1992
Euro 2	2.59%	1996
Euro 3	10.37%	2000
Euro 4	10.48%	2006
Euro 5	14.47%	2009
Euro 6	58.71%	2013
Total	**100.00%**	

Appendix D – Survey profiling

The below table states the results of a survey of last mile fleets operating in Scotland. This is broken down into two weight categories for LCVs and two weight categories for Rigid HGVs.

	Van <2.5t	Van 2.5-3.5t	Rigids <7.5t	Rigids >7.5t
No. of vehicles	2,365	2,430	276	358
Replacement cycle (years)	8.0	8.1	10.6	5.9
Annual mileage	30,800	32,800	21,700	40,000

It was found that due to the large fleet size of Royal Mail the values in the table above are biased towards Royal Mails operations. The same table is given below with the Royal Mail fleet removed.

	Van <2.5t	Van 2.5-3.5t	Rigids <7.5t	Rigids >7.5t
No. of vehicles	636	701	201	224
Replacement cycle (years)	4.9	5.5	10.6	5.9
Annual mileage	30,800	32,800	21,700	40,000

The values in the tables above map closely to those calculated in the model with average annual mileages calculated in the model as 25,345 for LCVs and 18,125 for Rigids.

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