LowCVP
Low Carbon Vehicle Partnership

An Analysis of the UK Coach Market

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Executive Summary

The COVID-19 pandemic has severely affected the UK coach industry during what would normally be the busiest time of year. At the time of publication there is still much uncertainty as to the continuing viability of many businesses, especially those with smaller fleets, as many people avoid travelling and restrictions on associated industries that coaches support are still in place. The analysis presented here is historic and does not reflect the current condition of the market which will require special consideration from government policy to continue to support thousands of jobs and support the UK's net-zero ambitions for 2050.

A summary of the key findings of the UK coach market in 2018 are:

- **27,500 coaches in-service**
- **99% single deck diesel, running on 100% UK pump average diesel**
- **950 new coach registrations annually across 2006-2018**
- **Around 15% of the coach fleet were Euro VI standard**
- **The UK coach industry contributes £6bn to the UK economy (CPT,2020)**
- **Around 700 operators of coaches in the UK (CPT, 2020)**
- **24 different international coach chassis suppliers to the UK, 2006-2018**
- **No UK coach chassis manufacturers, but some body builders**
- **Estimated 1.29 bn vkm annually by UK coaches**
- **Around 400 million passenger journeys (CPT, 2020)**
- **LowCVP estimate 1.68 Mt greenhouse gas emissions produced annually by the UK coach fleet (1.5% UK road GHG emissions).**
- **LowCVP estimate 6.8 kt NO_x and 77 tonnes particulate matter are produced annually by the UK coach fleet, equivalent to £48.4m in air quality damage cost annually**
- **Only a handful of electric coaches and one diesel-hybrid coach is in operation in the UK currently, with no incentives for manufacturers or operators to encourage adoption of lower emission technologies.**

The coach industry is smaller than other heavy-duty markets such as bus and trucks but plays a vital role in providing affordable solutions across a diverse range of key areas such as education, tourism and commuting. For every new coach registered in the UK annually, there are typically 3 new buses registered, although this ratio has reduced in recent years as the bus market has shrunk.

Coach operator fleets vary in size, the smallest having less than 10 vehicles and the largest around 100-150. Many operators are family run business with depots in one or two locations in a region. Operators will have a range of different vehicles sizes to meet different demands of customers and often supplement their ad hoc coach work with regular scheduled local bus services.

Operators will typically buy one or two vehicles every few years, with a strong trade in second-hand vehicles, although this has changed in recent years with the need for Euro VI vehicles to comply with Clean Air Zones and regulations in the EU. The typical lifetime of a coach can be anywhere between 15-30 years, with older vehicles cascaded down onto lower value work, often local school transport contracts.

The coach industry is highly seasonal, peaking around holiday periods and across the summer, with much lower demand in the winter. The typical business model is to try and meet as much ad hoc demand in the summer and compensate with lower value regular work across other parts of the year.

Annual vehicle mileage will be highly dependent on the type of service a vehicle is placed on, from as little as 10,000 km a year for local schoolwork, to over 200,000 km a year on scheduled intercity services. Payback time on vehicles will vary depending on the type of work it was purchased for, ranging from 2-5 years.

In 2018, diesel powertrains running UK pump diesel was the standard technology and fuel of choice for UK coach operators. LowCVP have estimated that UK coaches contribute around 1.5% of the total UK road transport greenhouse gas emissions and 2% of UK roadside NO_x emissions. Though this is a relatively small amount, coaches provide a low carbon affordable alternative to private cars and will be crucial to achieving net-zero greenhouse gas emissions ambitions by 2050.

Due to the small size and turnover of the UK fleet and lack of direct incentives or targets for developing affordable alternatives, Euro VI diesel powertrains are likely to remain the standard for the foreseeable future.

Glossary

Acronym	Phrase
bn	Billion
CAZ	Clean Air Zone
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
CPT	Confederation of Passenger Transport
DBEIS	Department for Business, Energy and Industrial Strategy
Defra	Department for Environment Food and Rural Affairs
DfI	Department for Infrastructure, Northern Ireland
DfT	Department for Transport
DPF	Diesel Particulate Filter
DVLA	Driver and Vehicle License Agency
DVSA	Driver and Vehicle Standards Agency
EU	European Union
JAQU	Joint Air Quality Unit
km	Kilometres
kt	Kilotonnes
l/100km	Litres per 100 kilometres
LEZ	Low Emission Zone
mpg	Miles per gallon
Mt	Million tonnes
N_2O	Nitrous Oxide
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen (Nitrogen Oxide + Nitrogen Dioxide)
NTS	National Travel Statistics
OEM	Original Equipment Manufacturer
PM	Particulate matter
PSV	Public Service Vehicle
SCR	Selective Catalytic Reduction
SMMT	Society of Motoring and Manufacturing Traders
ULEZ	Ultra Low Emission Zone
vkm	Vehicle kilometres

1.0 Introduction

LowCVP have assessed the UK coach market in 2018 to understand the size, fleet turnover, annual mileage and estimated the associated greenhouse gas and air pollutant emissions. This has been achieved through engagement with operators, manufacturers and assessing publicly available data through government statistics and online media reports. Any future incentives and interventions can then be evaluated against this baseline market status.

There is limited publicly available data on coaches, with much of the national data published combining bus and coach statistics. Based on this data, LowCVP estimate there were around 27,500 coaches in the UK, with around 900 new coaches registered annually.

The Confederation of Passenger Transport (CPT) estimate there to be around 700 operators of coaches in the UK, contributing around £6bn to the UK economy each year (CPT, 2020).

1.1 Estimating UK Coach Fleet Size

There were 39.4 million registered vehicles on the UK roads in 2018, with 32.5m passenger cars making up 83% of the fleet, 4.1m light duty vehicles, 1.2m motorbikes and 525,000 heavy duty vehicles.

The bus and coach vehicle category which includes minibuses, totals 160,500 vehicles or 0.4% of the total UK vehicle parc, of which 71,895 are classed as single or double deck bus or coach (Figure 1), with roughly twice as many single decks vehicles in-service compared with double decks.

Buses and coaches are not registered in different categories in the DVLA database currently, so an estimate is required for the number of coaches in service using a range of sources.

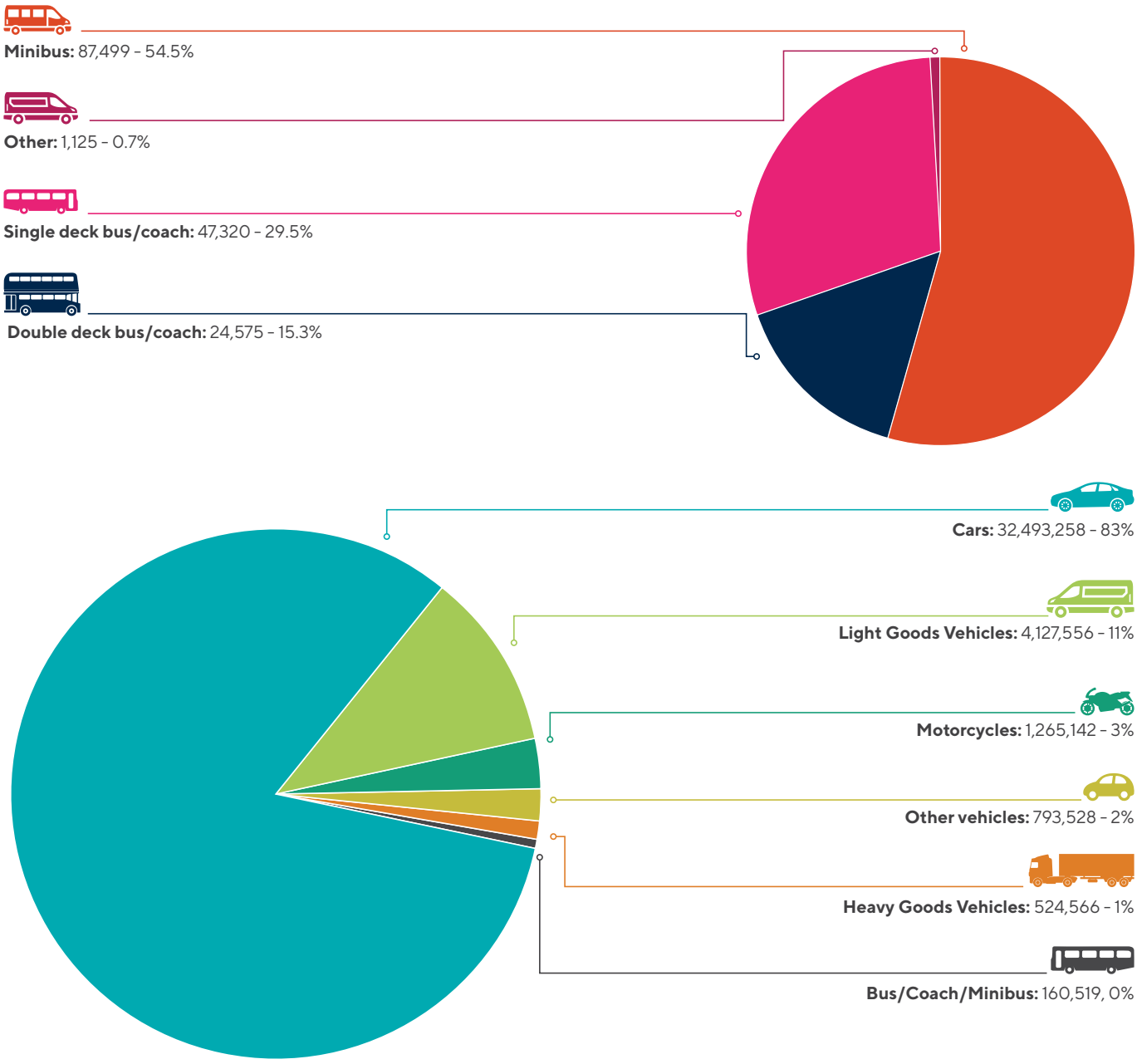

Figure 1: Breakdown of UK vehicle parc in 2018, with expanded bus, coach and minibus segment (DfT,2019: VEH0101, VEH0601)

The public service vehicle (PSV) survey carried out by DfT (DfT, 2019: BUS0601) details operators running local-only bus services in Great Britain that excludes dedicated coach operators, while historic surveys up to 2011 did include operators carrying out local and non-local work, providing a better insight into market size.

In 2010/11, the PSV survey estimated there to be 23,8000 coaches operating in Great Britain, on local and non-local work, out of a total of the 69,800 buses, minibuses and coaches (Figure 2). This figure of 69,800 in the survey for 2010/11 is only slightly smaller than the 72,718 licensed single and double deck bus and coaches in Great Britain (DfT,2019: VEH0601).

DfT now only collect PSV data on operators serving local-only services. To estimate the number of coaches, LowCVP have first calculated the total number of buses in the UK by comparing the differences in historic local and non-local datasets with local-only data.

Comparing historic local and non-local datasets collected by the PSV survey in 2010/11, there is a difference of around 3,624 buses. By adding this difference to the 2018/19 local-only data we can assume there are around 43,176 buses in service in Great Britain. Adding the 1,143 from Northern Ireland Department for Infrastructure transport statistics (DfI, 2019) results in 44,319 buses in total across the UK.

Based on the total number of single and double deck bus/coach registered (DfT, 2019: VEH0601) LowCVP estimate there to be around 27,500 coaches in-service in the UK. Using Northern Ireland transport stats, we can estimate the number of coaches in Northern Ireland to be around 1,300.

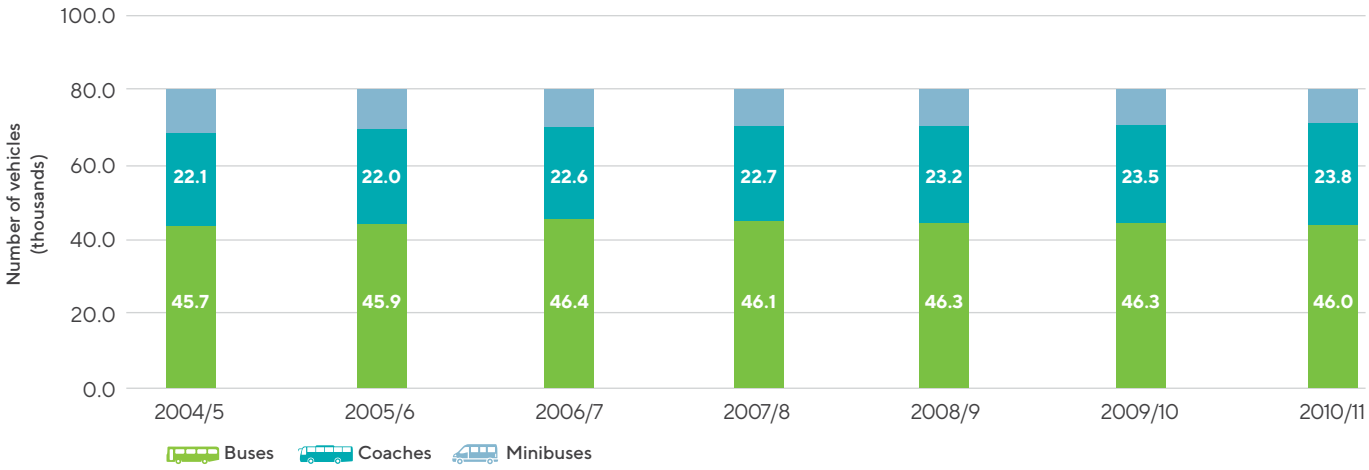

Figure 2: Historic public service vehicle stock by type of vehicle, including local and non-local service operators in Great Britain (DfT, 2019: BUS0601)

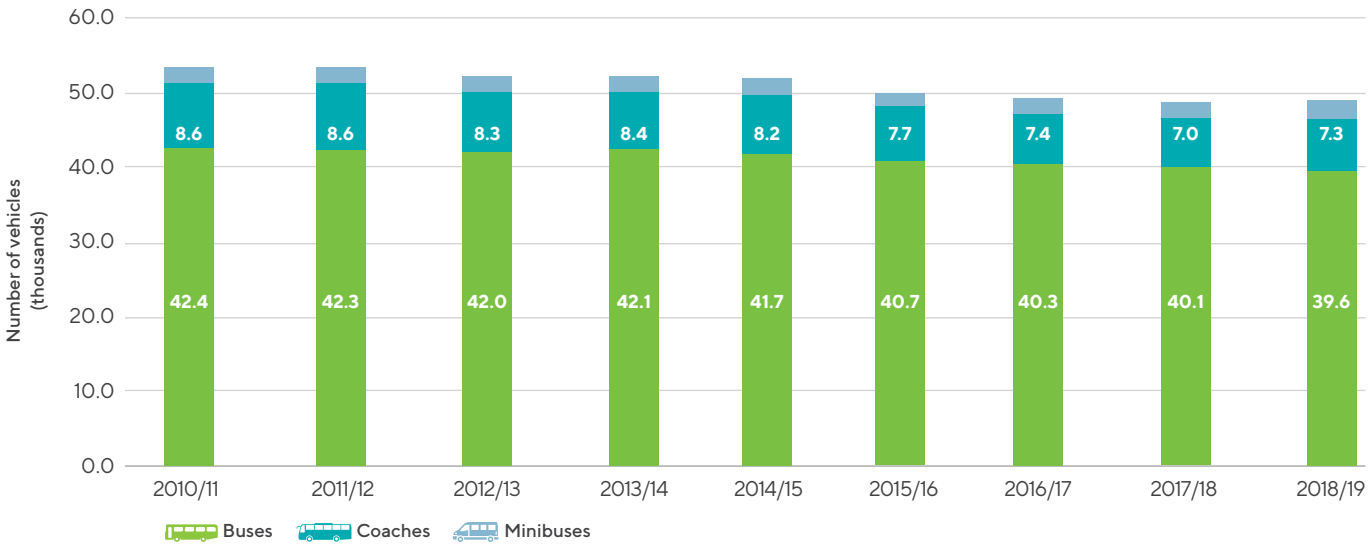

Figure 3: Current PSV data for vehicles running local-only services (DfT, 2019: BUS0601)


Limited Speed
100km/h

1.2 Annual New Coach Registrations

To understand fleet turnover and purchasing behaviour of the coach market, LowCVP have analysed new registrations for coaches from 2006 – 2015/16 based on SMMT statistics and estimated registrations between 2016/17-2018. Due to concerns with competition, publication of specific model registrations in the heavy-duty markets in the EU was halted halfway through 2016, with only numbers of vehicles registered per manufacturer available for part of the year. As such, data for 2016-18 has been estimated based on total manufacturer registrations and online media reports.

From 2006 – 2018, an estimated total of 12,395 coaches were registered in the UK, representing an average of 953 new coaches added every year between 2006 – 2018. This compares to an average of 2,500-3,000 new vehicles annually in the bus market.

There has been a general decline in bus registrations and bus mileage due to service reductions across the same period, but this does not seem to have filtered through to the coach market as 2018 in terms of new registrations.

DfT statistics state the average age of buses, coaches and minibuses in the UK in 2018 was 10.6 years, as shown in Figure 5 (DfT,2019: VEH0611). This is the highest average age of this market sector over the last 30 years, with average age steadily increasing since the financial crisis in 2008/9.

This is reflected when comparing new bus, coach and minibus registrations which are down 30% in 2018 compared with 2008.

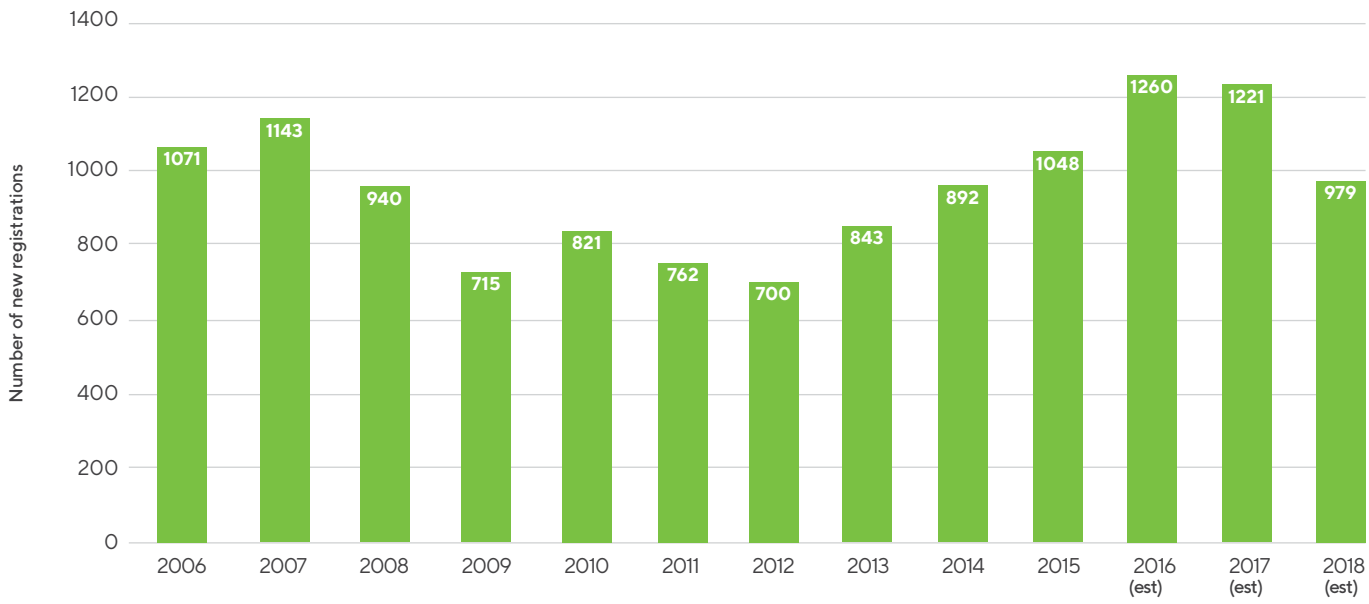

Figure 4: New coach registrations in the UK, from 2006-2018. 2016-18 figures are estimated due to restrictions on new registration model information (SMMT, 2017; LowCVP 2019)

Between 2006-2018, there was an average of 950 new coaches registered annually in the UK

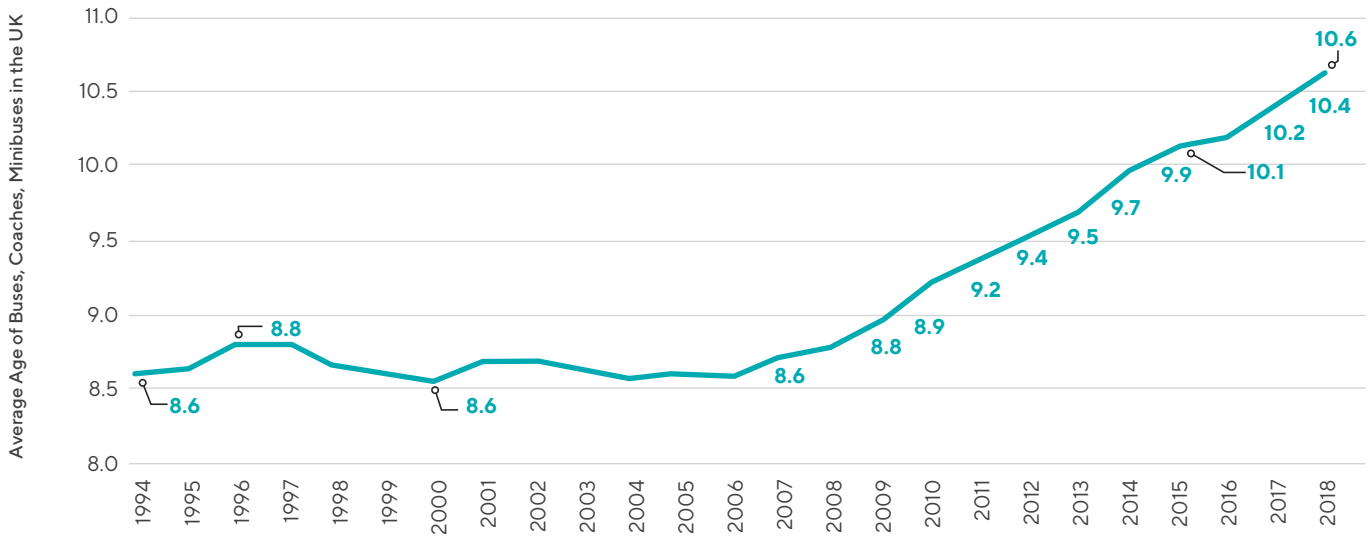

Figure 5: Average age of buses, coaches and minibuses in the UK (DfT,2019: VEH0611)

The reduction in bus services and therefore new buses bought over this time is likely the largest contributor to this as the market shrinks and operators hold onto their vehicles longer. The number of new minibuses registered annually has also fallen significantly over the same time period. Retrofitting of vehicles in recent years with selective catalytic reduction (SCR) exhaust aftertreatment systems to enable them to operate cleaner for longer has also likely contributed to the increase in age of vehicles.

We are not able to extract the average age of coaches specifically from this data but through operator engagement, the average age of minibuses is 7-8 years, buses 15-20 years and coaches typically 15-30 years.

The longer life of coaches provides challenges for some operators when new regulations are introduced requiring new safety standards or technology integration e.g. smart tachographs or accessibility requirements.

Scheduled coach service providers such as National Express and Megabus whose vehicles do 200,000+ km annually have much higher fleet turnover than smaller operators, with average vehicle ages of 3-6 years.

Typically, smaller coach operators will purchase 1-2 vehicles a year, one of which may be new and the other second hand. Operators have a range of vehicles types and ages matched to difference services offered. Older vehicles will be run on lower value services where annual mileage is low, such as school runs, using new vehicles on high value, high mileage services such as touring or day-excursions.

1.3 Coach Manufacturers

As 2017-2018 model data is unavailable for manufacturers, this section focuses on the period between 2006-2016.

Over 24 different coach chassis manufacturers registered 10,195 coaches in the UK from 2006-2016. Figure 6 shows the total number of vehicle registrations by manufacturer. Volvo has the largest share of registered vehicles in the UK, with over 3,500 registrations, making up 35% of the total market. Scania models were the second most popular, with 1,370 vehicles contributing 13% of the total market, followed by Mercedes with 1,032 vehicles totalling 10%. Other popular manufacturers include VDL Bus, Van Hool, Setra and Neoplan.

European manufactures are by far the most popular choice for UK operators, with some increasing popularity in manufacturers coming from other parts of the world, especially China. UK Chassis building for coaches has largely ceased, focusing on bus chassis and body building for bus, coaches and minibuses e.g. Plaxton by ADL or Orion by Mellor.

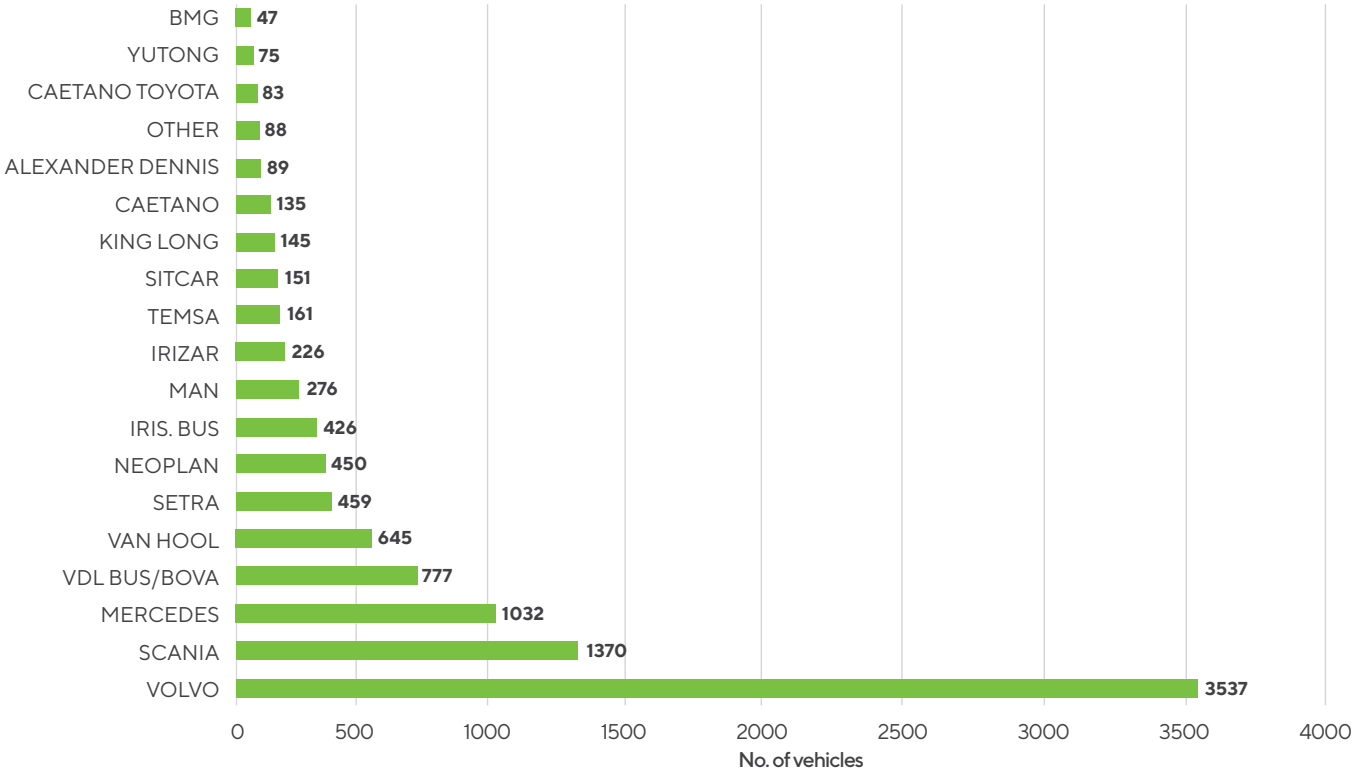

Figure 6: Total number of coach registrations by chassis OEM between 2006- 2016 (SMMT,2017)

As the dataset for 2016 coach models was not complete, Figure 7 shows the top 10 selling coaches in 2015 by OEM chassis. The Mercedes Tourismo was the most popular model with 183 registered, 17% of total, with the Scania K series the second most popular model in 2015, with 163 coaches making up 16% of total. The Volvo B Series was cumulatively the most popular across a range of models with 296 registrations or 28% of total.

The vast majority of coaches registered were single deck vehicles, with only a small number of double deck models available on the market. All coaches registered between 2006-2018 had diesel powertrains, with only one hybrid coach from Irizar registered. This compares with over 3,000 hybrid buses registered across the same period (the vast majority of which were purchased with support from the Green Bus Fund or by TfL). In 2019, Yutong registered the first full electric coach in the UK. At the time of writing there are 4 electric coaches currently in the UK with a further 4 expected in 2020.

With no current incentives to encourage low carbon coach technologies and with the average fleet age of 10.6 years, diesel coaches are set to play a significant role in coach operations well into the 2020s and likely into the 2030s. This will have an impact on the options available to policy makers targeting decarbonisation of the existing fleet.

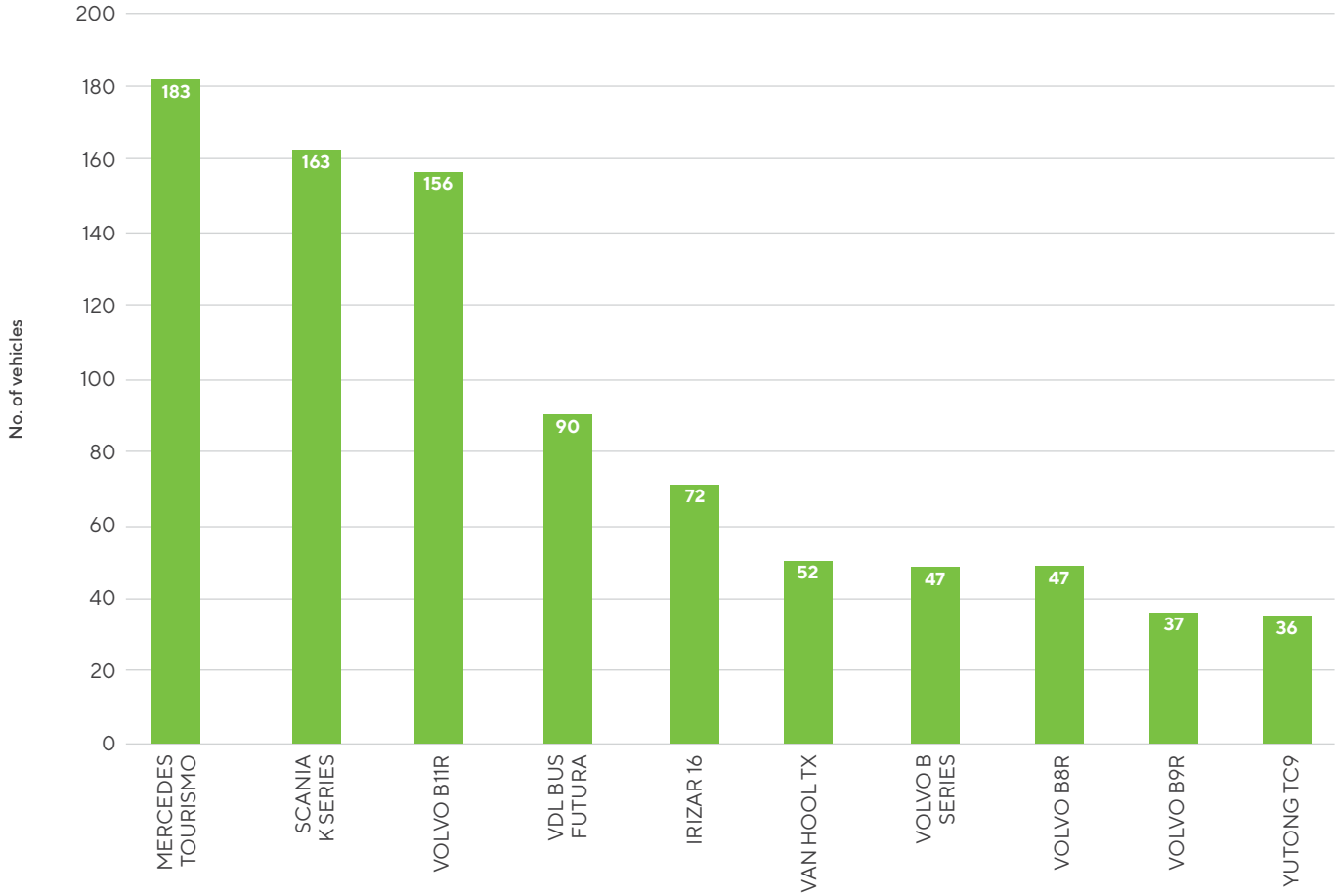

Figure 7: Top selling coach models in the UK in 2015 (SMMT,2017)

Between 2006-2018, all coaches registered in the UK had diesel powertrains, with only one hybrid vehicle registered

1.4 Travel Statistics

There are an estimated 400 million coach journeys done annually in the UK (CPT,2020), with each coach making around 14,500 passenger journeys a year. This compares to 4.8 billion passenger journeys performed by buses. National Express, the largest national franchised coach operator recorded 20.7 million passenger journeys in 2018 (National Express, 2019).

The National Travel Survey estimates that around 4% of journeys over 50 miles are done by coach in England, compared to 15% by rail and 79% by car or van (NTS,2018: NTS0317). An average of 8 trips a year per person in England are done by private hire bus and coach (NTS,2018: NTS0409). The most popular drivers for travel by coach are leisure and education (school services).

1.5 Coach Operators

The CPT estimates there to be around 700 coach operators in the UK. The vast majority of these are all private commercial operators. The size of each fleet varies from very small, 1-15 coaches, to large, between 50 -100 vehicles. This is relatively small compared to a typical large bus operator which might have thousands of buses across numerous depots. With such small fleets, operators will typically purchase only one or two new vehicles a year.

Operator Size	Number of Vehicles
Small	1-15
Medium	16-50
Large	50+

Table 1: Typical fleet sizes of coach operators

There are 400 million passenger journeys by coach each year in the UK (CPT,2020)

National Express (Nat Ex) is the largest coach operator in the UK with 150 of its own vehicles and a further 400 vehicles operating under its franchise, the vast majority of which are scheduled intercity services. Independent operators such as Park's of Hamilton operate regional and national services as far as London to Glasgow.

Scheduled intercity services represent the highest mileage operations of coach operations, with one coach averaging over 200,000 kms annually depending on the route. Often small fleets of ten or twenty vehicles will be allocated to operating on specific scheduled routes which will typically operate most days of the year. As such coaches operated on these routes are designed specifically to cater for these for intercity travel, with Nat Ex having a specific body and chassis combo which are required to operate its services.

Vehicles to be used on scheduled services are usually purchased on a 3 or 5-year lease as operators have greater confidence expected income and annual mileage. These vehicles will then be purchased second-hand by operators to run lower mileage services.

Coaches that take tourists on UK or international tours will also average high annual mileages, though typically less than scheduled services. Some operators may have dedicated vehicles for performing these services, however vehicles will often be moved around from different types of service based on demand, the type of customer and vehicle availability.

The main advantage of coaches is that they are flexible and can often perform a variety of different mobility services. Many coach operators business models are based on moving vehicles across different services as they respond to demands across the seasons. A vehicle that is used on a ski trip one week could then be used the following week to take tourists to a castle and then a group of pensioners to a theatre.

Types of coach journeys	Number of vehicles	Annual Mileage (km)
Scheduled Service (Intercity)	1,250	220,000
Touring	6,500	100,000
Tourist Day Trips	8,000	80,000
Leisure	6,250	60,000
School Services (scheduled)	5,500	15,000
Total	**27,500**	

Table 2: Typical coach operations and associated annual mileage

Vehicles are designed to be able to perform these multiple tasks of moving lots of people and luggage large distances. This is why rail replacement services are often performed by coach operators who can offer vehicles and drivers at short notice. New coaches are often used on higher value services like touring and day trips, while older vehicles are used on lower value services like school services.

A challenge for operators is that demand is highly seasonal and is often ad hoc. Demand for coaches is high in late spring and across the summer as more people travel for events and holidays, while demand is very low in the winter. Often there are not enough vehicles to meet demand in summer, while there are often too many drivers available in winter. This means that taking on contracted staff is risky for operators as summer profit must balance winter loses. This ad hoc and fluctuating demand means that operators will have a wide range of vehicles of different sizes to perform different tasks. It also means that many vehicles are bought second-hand vehicles as operators shift the capability of their fleet annually to cater for different demands.

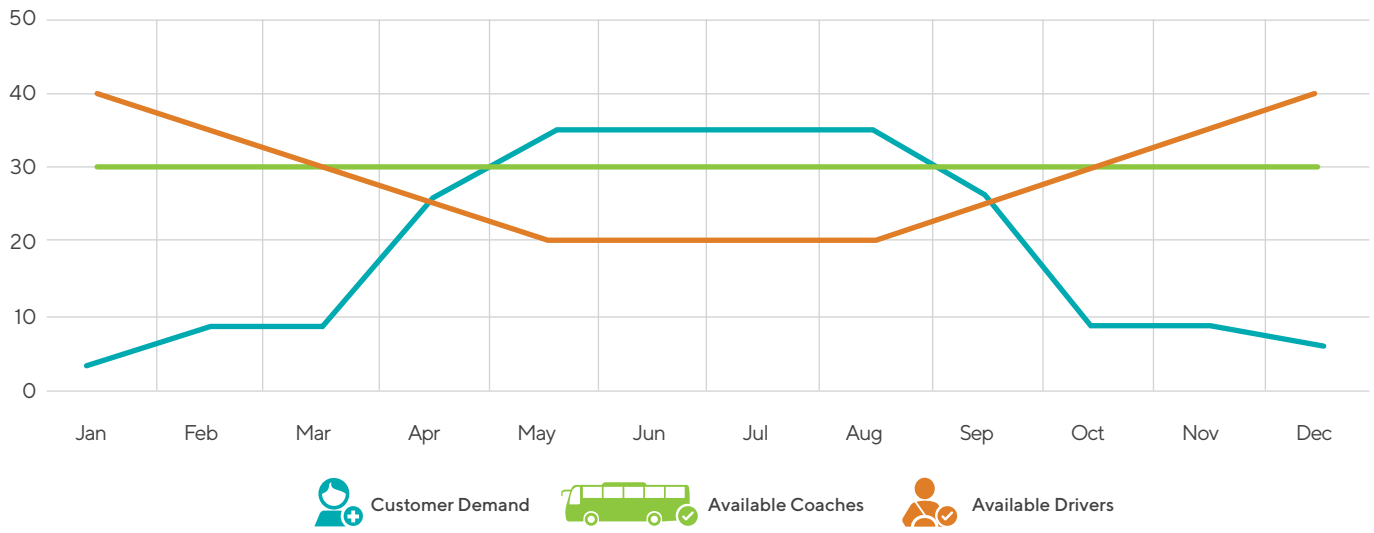

Figure 8: Typical seasonal demand, vehicle, and driver availability for coach operators

2.0 Greenhouse Gas Emissions

Quantifying the contribution of each vehicle sector to greenhouse gas emissions is important for policy makers to understand whether current policies are successful and if further government intervention is required to influence markets. Based on the registration data and operational fleet data, LowCVP has sought to estimate the contribution of the coach market towards the UK's greenhouse gas emissions with the long term goals of decarbonising the coach sector in the UK and presenting opportunities for UK plc.

2.1 Introduction to UK Greenhouse Gas Emissions

The requirement to drive down greenhouse gas emissions is set out in UK law in the Climate Change Act 2008. A target of net-zero carbon emissions by 2050 has now been set.

In 2016, the transport sector became the largest contributor to UK greenhouse gas emissions in the UK, contributing 26% (125.9 Mt CO_2e) of total emissions in 2018. Transport emissions have begun to rise since 2013 due to many factors including increasing LDV increasing congestion, increased car ownership and mileage, rising average new car CO_2 emissions, reduced bus patronage and others.

The vast majority of transport greenhouse gas emissions come from road transport in the UK, 113 Mt CO_2e or 91%, excluding international aviation and international shipping.

From this 91 %, cars are the major contributor with 61% of road transport emissions, followed by heavy-goods vehicles with 18%, light duty vehicles 17%. The DBEIS estimates that buses and coaches are responsible for 3.2 Mt CO_2e annually, around 3% of total road transport emissions.

This value is higher than the contribution of domestic railways (1.78Mt CO_2e) which demonstrates the importance of driving emissions reductions in the bus and coach sector. High occupancy vehicles like coaches will be an essential tool in achieving net zero emissions as reducing the number of vehicles on the road through modal shift will be required to reduce transport energy demand and associated greenhouse gas emissions.

The 3.2 Mt CO_2e contribution from buses and coaches is estimated through greenhouse gas emissions associated with vehicle type at average road speeds, multiplied by vehicle counts on the strategic road network, using the Emisia COPERT emissions model. The estimates are also compared and aligned with overall diesel and petrol sales data in the UK reported in Digest of UK Energy Statistics (DUKES). The greenhouse gas emissions statistics do not separate the contribution from bus and coach.

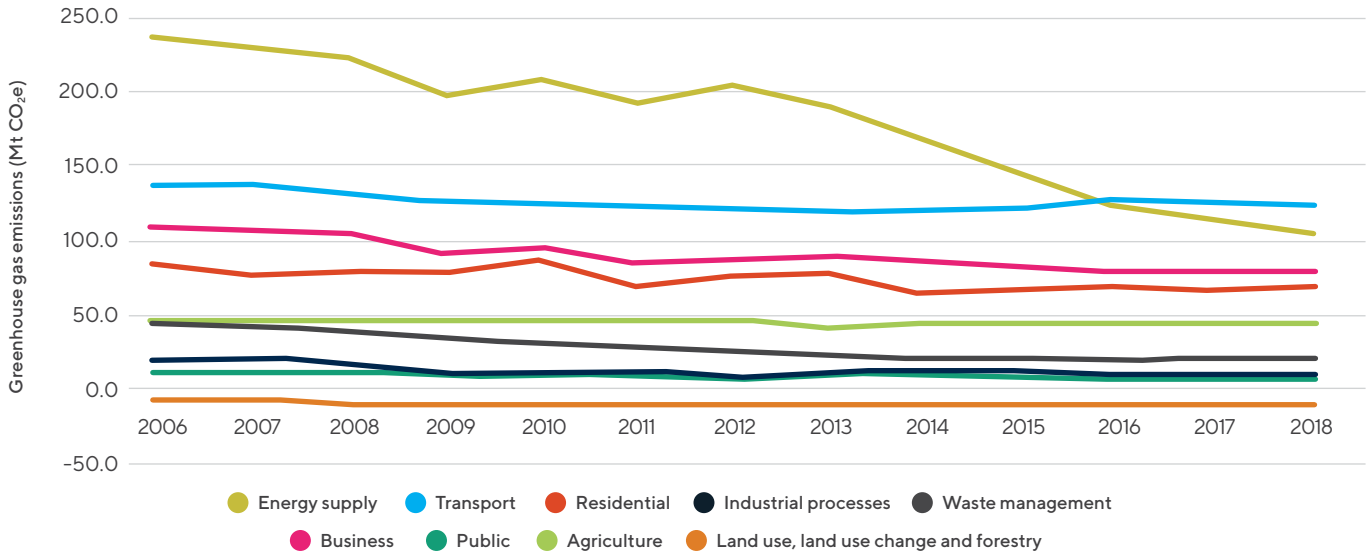

Figure 9: UK greenhouse gas emission estimates by sector, 2006 -2018 (DBEIS,2020)

The link between distance travelled and associated CO_2e is demonstrated in Figure 11. As total annual mileage falls so does associated greenhouse gas emissions, with annual mileage falling for bus and coach by 25% and greenhouse gas emissions falling 26%, from 2007-2017. This significant fall in annual mileage is associated predominantly with the competition from other transport modes and reduction in rural bus services that have been cut by local authorities and have not been replaced by commercial services.

However, in the same period, local passenger journeys have fallen by less than 1% overall across Great Britain (BUS0101, DfT 2019), though decline in areas outside London has been much more significant e.g. Wales: 15% reduction, Scotland: 14% reduction.

Overall vehicle numbers have also largely tracked the annual mileage of bus and coaches, with a fall in licenced bus and coaches reflecting a shrinking market and reduced number of bus routes in-service.

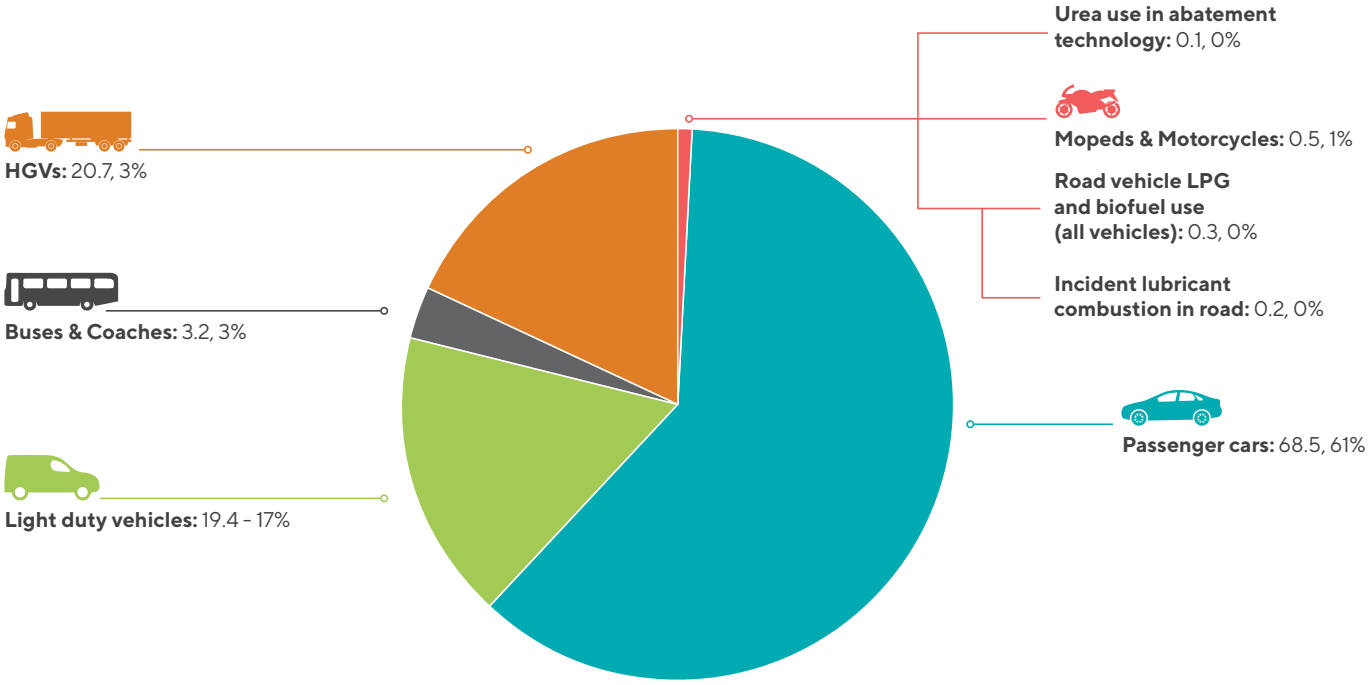

Figure 10: Greenhouse gas emissions from the UK road vehicles by type in 2018, in Mt CO_2e (DBEIS, 2020)

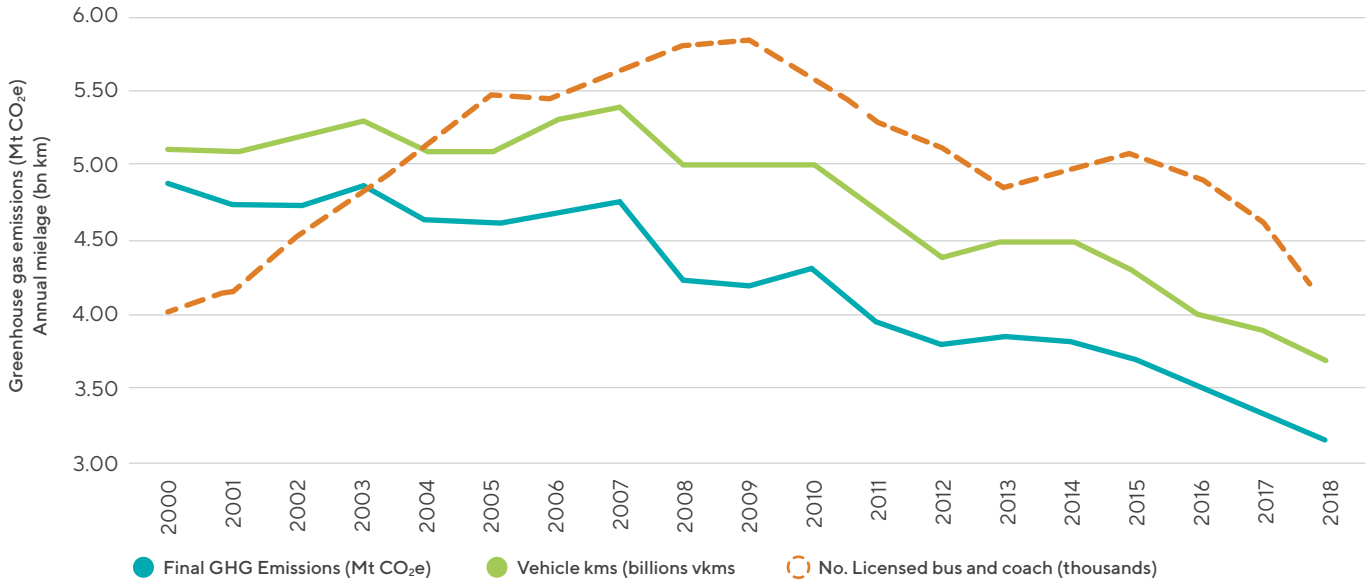

Figure 11: Comparison of bus and coach greenhouse gas emissions in UK, annual total mileage and number of licensed bus and coach, 2000-2018 (TRA0201, VEH0601: DfT, 2019).

2.2 Estimating Greenhouse Gas Emissions from Coach Operations

By comparing GHG emissions and vehicle mileage it is possible to infer an improvement in the efficiency in the bus and coach fleets. From 2006 -2018, there has been a 3.2% reduction in g CO_2e /km for the UK bus and coach fleet vehicles, averaging 884 g CO_2e/km in 2006, reducing to 856 g CO_2e/km in 2018 (8.8 mpg or 32 litres/100km).

This number is relatively low and suggests an underestimate of either GHG emissions or mileage when comparing to LowCVP test data and average bus fleet fuel consumption data provided by EP Morris.

Euro VI diesel buses averaged 1180 g CO_2e/km (43 l/100km, 6.6 mpg) over the LowCVP's UK Bus Cycle which includes inner and outer urban phases and a higher speed rural phase. EP Morris, who audit BSOG claims for bus operators, estimate an average MPG of 7.8 mpg (36 l/100km) for buses fleets in the UK, which equates to 941 g CO_2e /km.

Based on LowCVP's UK Coach cycle (see Figure 12) limited test data, typical motorway fuel consumption for coaches is around 25-30 litres/100km (11.3-9.4 mpg) for Euro VI, equivalent to 700-820 g CO_2e/km. In urban environments fuel consumption can increase to 55-65 l/100km (5.1- 4.4 mpg), with performance in rural environment 43-49 l/100km (6.6-5.8 mpg).

LowCVP UK Coach Cycle	**Average Fuel Consumption** (litres/100km)	**Greenhouse gas emissions** (g CO_2e /km)
Urban Phase	60	1600
Rural Phase	46	1250
Motorway Phase	27	750

Table 3: LowCVP Fuel Consumption and Greenhous Gas Emission performance estimates for Euro VI coaches based on limited test data over the LowCVP UK Coach Cycle

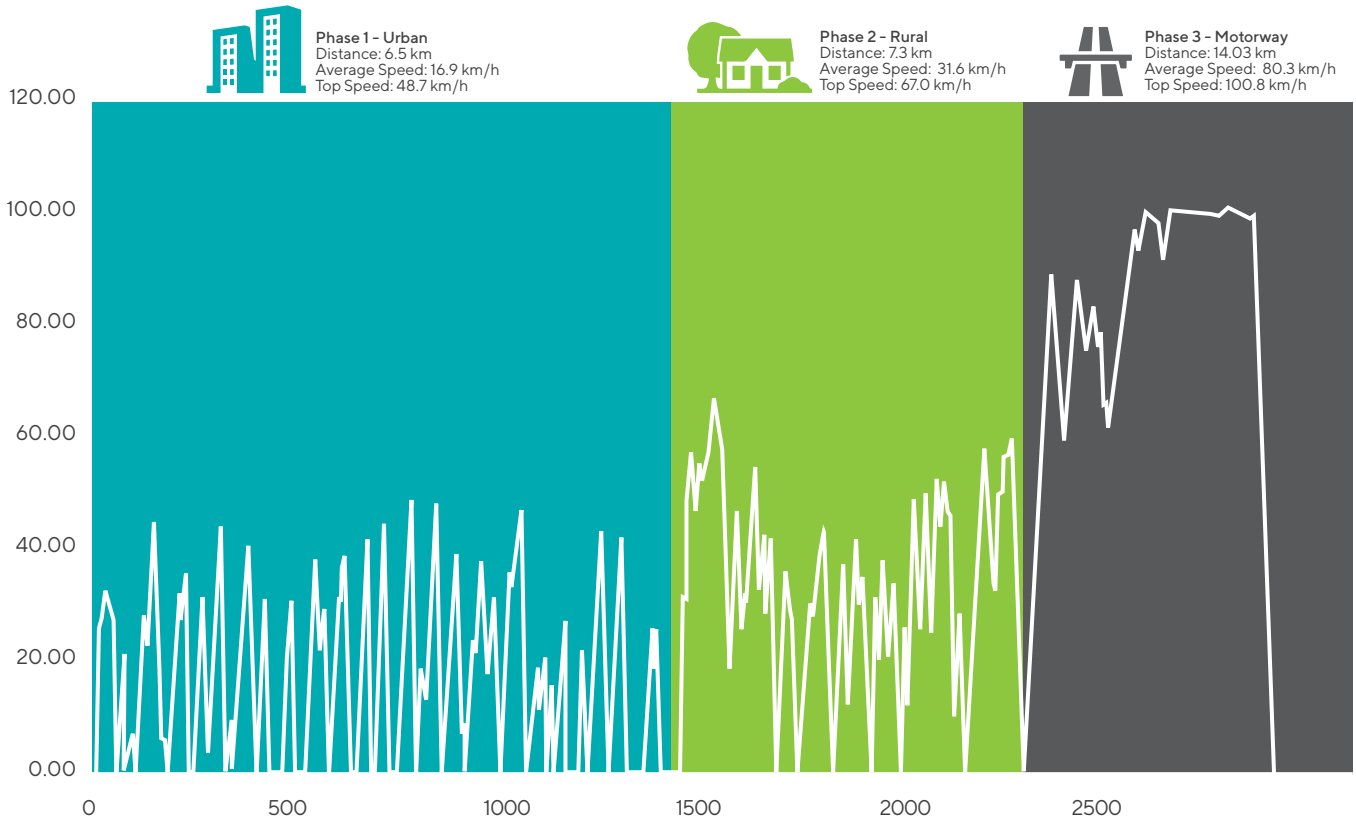

Figure 12: LowCVP UK Coach Cycle speed-time trace.

As there is no specific UK government estimate for the contribution that the coach sector has to greenhouse gas emissions, LowCVP has looked to estimate the contribution using other publicly available statistics and available test data.

Buses and Coaches were estimated to cover 3.7 billion vehicle-kilometres (vkm) in Great Britain in 2018 (DfT,2019: TRA0201). Journeys on local buses were estimated at 2.3bn vkm in 2018/19 for Great Britain (DfT,2019: BUS0203). An estimated 0.70 billion vkm were estimated to be covered in Northern Ireland by buses and coaches (DfI, 2019). This results in a total of 4.40 bn vkm covered by bus and coach in the UK.

In 2015, the 'Streamlined PCM Technical Report' by Ricardo AEA assumed that coaches cover 28% of mileage performed on urban and rural roads and 100% of motorway mileage based on roadside vehicle counts (Ricardo AEA, 2015).

	Bus (billion vkm)	**Coach** (billion vkm)	**Total** (billion vkm)
GB Urban	1.58	0.62	2.30
GB Rural	0.86	0.34	1.20
GB Motorway	0.00	0.30	0.30
GB Total	**2.45**	**1.25**	**3.7**
Northern Ireland	0.07	0.03	0.1
UK Total	**2.52**	**1.29**	**3.80**

Table 4: Distribution of annual mileage of bus and coach by road type in Great Britain and Nortern Ireland in 2018. *Estimated based on coaches performaing 50% of bus mileage(DfT, 2020: TRA0204, DfI, 2020)

Table 4 estimates that coaches covered 1.29 billion vkm annually across the UK in 2018. This figure is lower compared to the 1.78bn vkm estimated by Ricardo AEA for the estimated annual mileage of coaches in 2020. The estimate of 2.52bn vkm for all UK buses demonstrates similar alignment with the 2.3bn vkms DfT estimate for local-only bus services. With 27,500 coaches in the UK, based on these assumptions an average UK coach performs 46,800 km annually.

A perhaps surprising outcome here is that coaches perform almost 50% of their mileage in urban environments. This is counter intuitive to the idea that coaches perform most of their mileage on motorways, with operators anecdotally stating that mileage is split 80% on motorways and 20% in urban environments. Operators have reported vehicles are spending more time in urban areas due to congestion in most recent years, though this should not directly increase overall mileage The increased time spent in urban environments will likely increase fuel consumption and overall emissions for the coach sector.

This has potentially significant implications for planning for clean air zones and lends favour to the potential application of zero emission capable technologies to coaches if they are operating for significant periods in low-speed urban environments. Further work is needed to validate the estimated split between bus and coach mileage on the road network.

Road Type	**UK Coach** (bn vkms)	**Average Fuel Consumption** (litres/100km)	**Greenhouse gas emissions** (g CO_2e/km)	**Total UK GHG emissions** (Mt CO_2e)
Urban	0.62	60	1600	1.01
Rural	0.34	46	1250	0.43
Motorway	0.31	27	750	0.23
Total	**1.29**	**-**	**-**	**1.68**

Table 5: Estimate of GHG emissions from coach operations across the UK in 2018 based on estimated mileage and limited test data over LowCVP UK Coach Cycle.

Table 5 outlines LowCVP's estimate that coach operations emitted around 1.7 Mt CO_2e in 2018, based on very limited test data over LowCVP's UK Coach Cycle. This equates to the average coach producing around 1300 g CO_2e/km or 48 litres/100km (5.9 mpg). This fuel consumption is much higher compared to what most operators would expect typical fuel consumption to be between 25-31 l/100km (9-11 mpg) depending on operation. An average MPG of 10.5 would give a total GHG emissions contribution of around 0.98 Mt CO_2e.

It is likely that that total mileage for UK coaches is a reasonable estimate, however in reality the split in mileage may be too highly skewed towards urban mileage. More data is required to evidence the overall GHG impact of coaches in the UK.

An alternative method for estimated the GHG contribution of coaches is to deduct the contribution of buses from the DBEIS estimate for total bus and coach GHG. Table 6 sets out comparative estimates of expected annual coach GHG emissions based on bus mileage and fuel consumption data for buses.

All three estimates set out in Table 5 are much lower than LowCVP's 1.68Mt CO_2e estimate for UK Coach operations. Due to the lack of data available on coaches, it is likely that the total contribution is underestimated by current government modelling.

Further detailed study and vehicle testing is required to achieve a more accurate estimate of greenhouse gas emissions associated with coach operations in the UK. Due to the disparate nature of the coach industry and the locally dependent nature of vehicle counts it is unlikely that more accurate estimates could be made without investment in vehicle test programmes and operational data collection e.g. collating telematics databases.

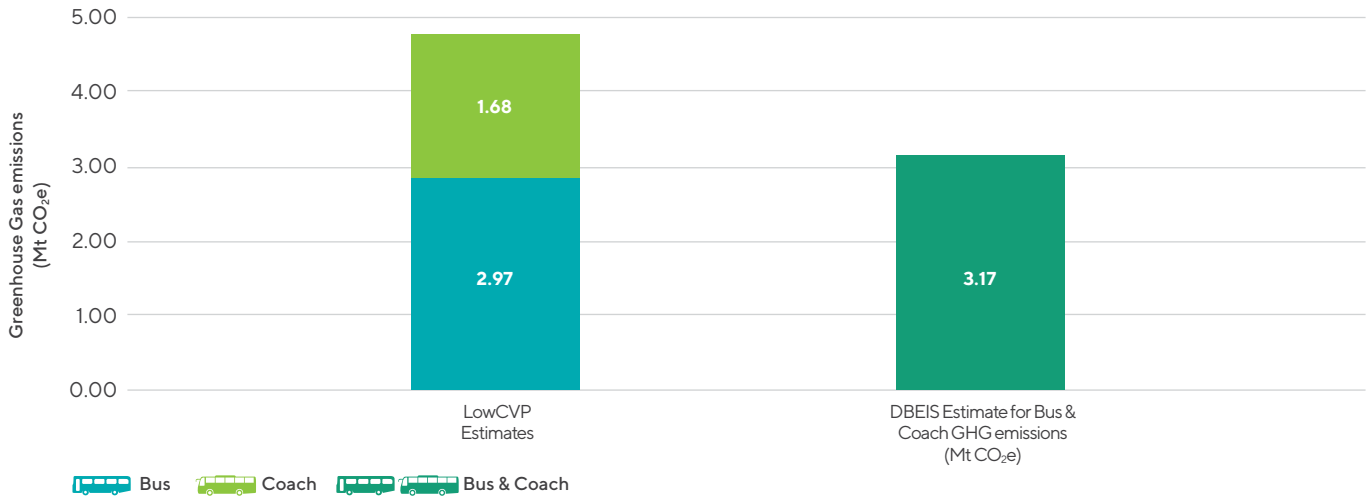

Figure 13: A comparison between LowCVP and DBEIS estimates for GHG emissions from bus and coach operations.

	DBEIS total bus and coach GHG emissions, 2018 (Mt CO_2e)	**LowCVP UK bus mileage estimated** (bn vkm)	**Fuel Economy** (litres/100km)	**g CO_2e /km**	**Calculated bus GHG emissions** (Mt CO_2e)	**Estimated UK coach GHG emissions** (Mt CO_2e)
DfT average (TRA0201, DBEIS)	3.2	2.52	32	850	2.14	1.06
LowCVP bus test data (43 l/100km)	3.2	2.52	43	1180	2.97	0.23
EP Morris (7.8mpg)	3.2	2.52	36	960	2.42	0.78
LowCVP estimated GHG contribution from UK Coaches						1.68

Table 6: Comparative estimates of coach GHG emissions based on bus mileage and fuel consumption.

LowCVP estimate that coaches contributed around 1.68 Mt CO_2e annually in 2018

3.0

Air Quality Emissions

There is a significant air quality challenge facing a number of UK towns and cities and the strategic road network, as local concentration levels of roadside nitrogen dioxide (NO_2) exceed EU NO_2 limit values. Nitrogen Dioxide can have adverse effects on cardio-vascular and respiratory systems and congested roads in urban areas with stop-start conditions record the highest levels of NO_2.

In July 2017 the Government published the "UK plan for tackling roadside NO_2 concentrations"1, which originally required local authorities in areas expected to exceed the European Union (EU) NO_2 limit values beyond the next three or four years to develop innovative local plans that will achieve statutory NO_2 limit values within the ''shortest possible time'.

National modelling available from the National Inventory for Emissions Inventory (NAEI) estimates that buses and coaches are responsible for an average of 5% of all roadside NO_x emissions in the UK, with diesel cars responsible for 44%, diesel vans and light goods vehicles responsible for 35% and heavy goods vehicles responsible for 10% (Figure 14).

Buses and coaches are estimated to produce 12.4 kilotons of NO_x in 2017. This is equivalent to £76.9m of damage costs based on Defra pricing of £6,199 / tonne NO_x.

LowCVP have conducted a broad estimate of NO_x and PM emissions from coaches using COPERT Emissions factors and LowCVP's UK Coach cycle developed for the Clean Vehicle Retrofit Accreditation Scheme (CVRAS). An estimated split of Euro standards in the coach fleet and the split of operational mileage as described in Table 4 has also been used to support this estimate.

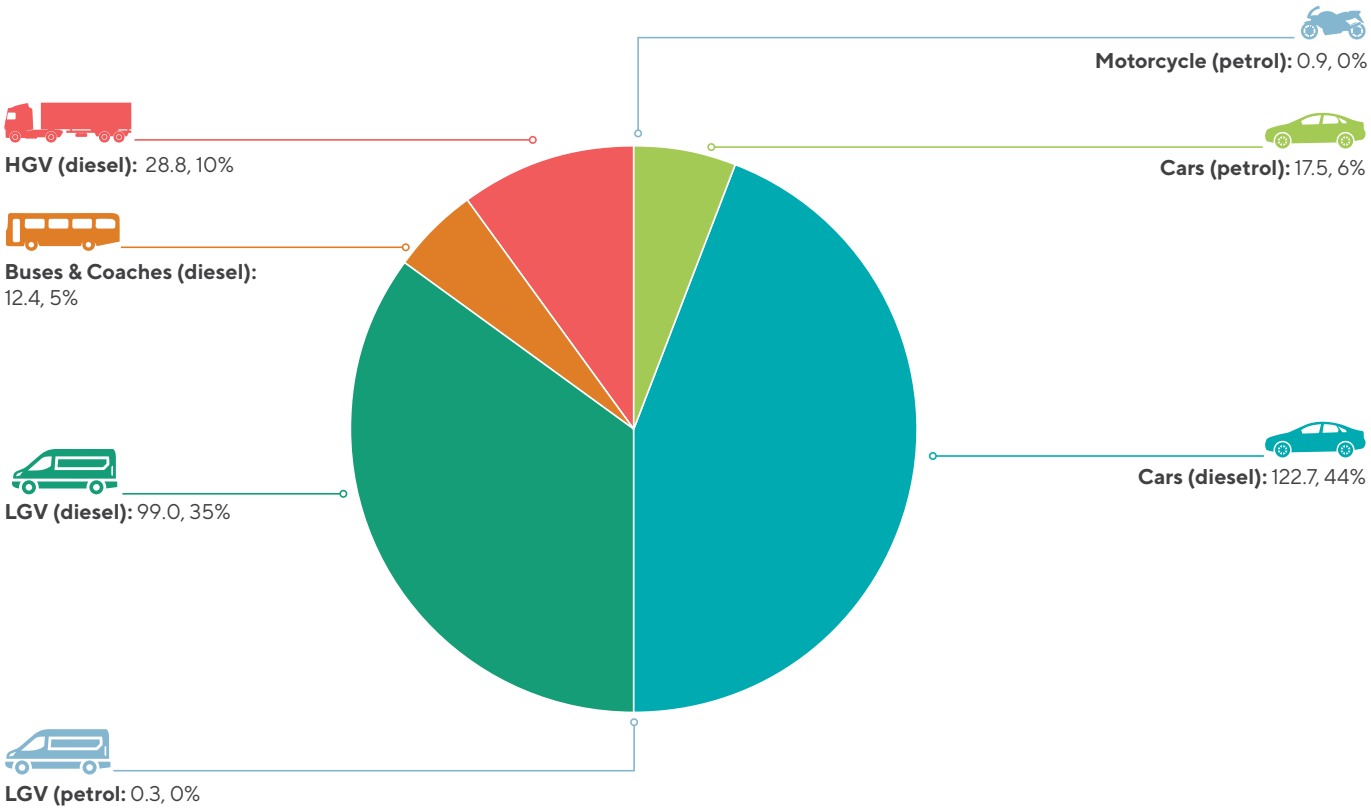

Figure 14: Source apportionment of NO_x emissions from UK fleet in 2017, kilotonnes of NO_x (NAEI, 2019)

3.1 UK Coach Fleet: Euro Standards breakdown

Based on available market data LowCVP have estimated the mix of different Euro Standards in the UK fleet in 2018 and estimated associated NO_x and PM emissions with overall damage costs incurred.

Figure 15 breaks down new bus and coach registrations by Euro Standard using historic SMMT data and assuming all new registrations in 2017-18 were Euro VI. A significant challenge in estimating air quality impacts from coaches is the lack of available Euro Standard data, as it has not been a legal requirement for manufacturers to do so. Where there is unknown data, Euro standards are often allocated based on the year of vehicle registration, however there were still many Euro IV and V vehicles registered after the Euro VI standard was introduced in 2013/14.

Figure 16 presents a snapshot of the UK coach fleet by Euro standard by combining registration data and the average age of vehicles in 2018. The breakdown highlights long vehicles are kept in the fleet, with Euro III, IV and V making up almost 70% of the coach fleet. The small turnover of the UK coach fleet means that roughly 4,100 coaches (15%) of the UK fleet are Euro VI standard.

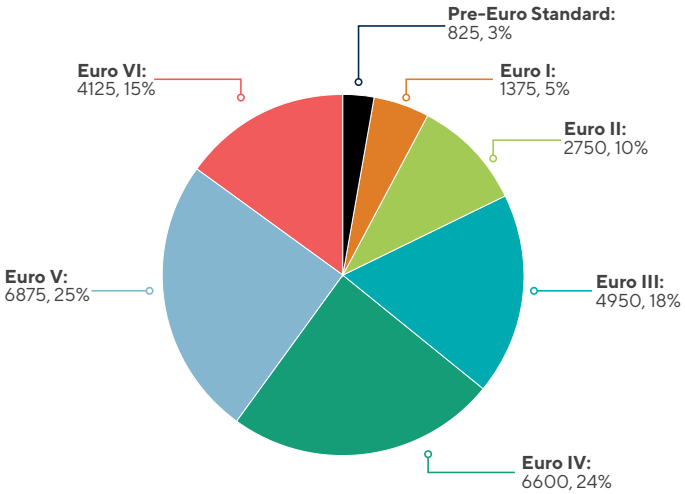

Figure 16: Estimated breakdown of UK coach fleet by Euro Standard in 2018

This fleet mix highlights why the value of older, second-hand vehicles is so important to the current business model of most operators. The introduction of Clean Air /Low Emission Zones which require Euro VI standards is causing the value of Euro III, IV and Vs to decrease as trips to city centres will incur additional costs due to non-compliance.

The wide range of different models purchased by operators in comparison to the bus market makes the development of retrofit solutions costly. LowCVP estimate that around 100 retrofits have been performed on older coach models in the UK, compared to some 8,000 in the bus market.

Despite the lower number of vehicles, it is expected that Euro VI vehicles will make up the majority of coach mileage performed in the UK. High mileage services such as scheduled interurban and touring vehicles are most likely to be Euro VI.

Ricardo AEA estimated that around 65% of bus and coach mileage in 2020 would be performed by Euro VI vehicles in 2020 (Ricardo AEA, 2015). LowCVP have adjusted this to 55% for 2018 estimates as shown in Table 7 based on lower uptake of Euro VI than was expected in 2015.

	Pre-Euro Standard	Euro I	Euro II	Euro III	Euro IV	Euro V	Euro VI	Total
% of vehicle mileage	0%	1%	1%	8%	10%	25%	55%	**100%**
Vehicle mileage (bn vkm)	0.001	0.01	0.01	0.1	0.13	0.32	0.71	**1.29**

Table 7: LowCVP estimated breakdown of UK coach mileage by Euro Standard in 2018

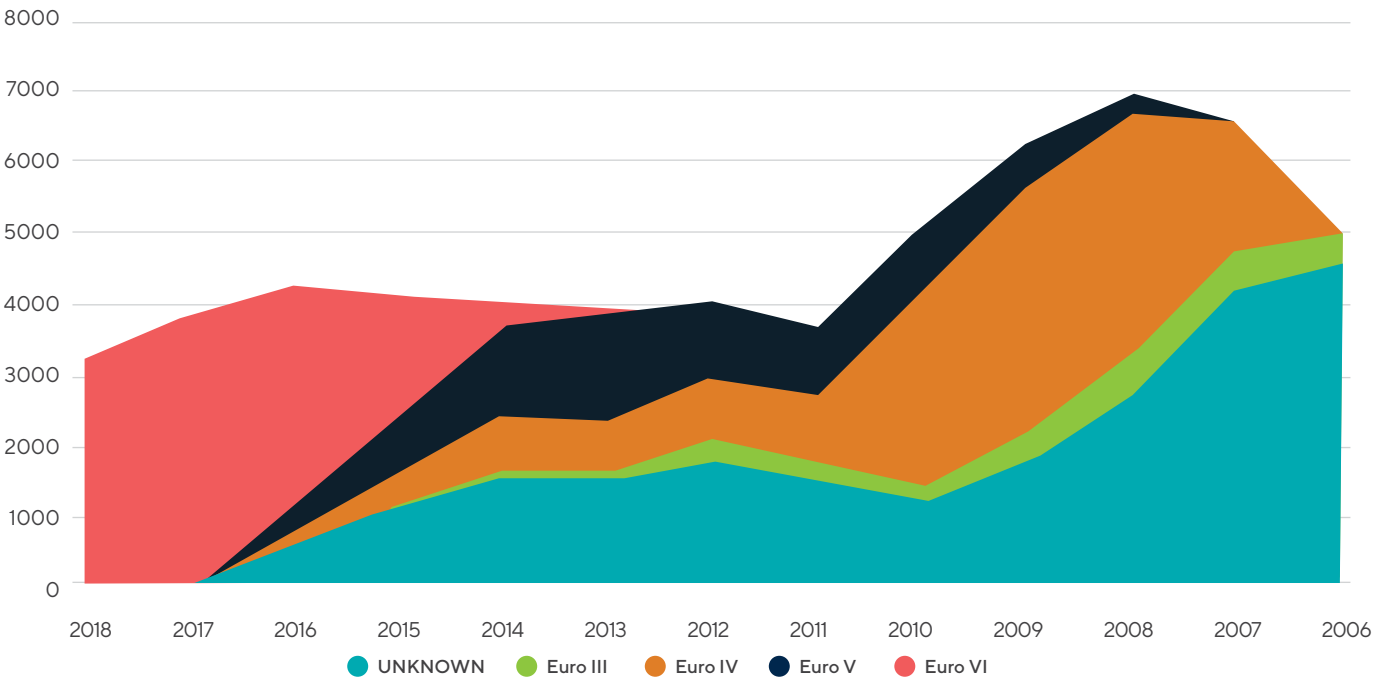

Figure 15: New bus and coach registrations by Euro Standard, 2006-2018 (SMMT,2017)

3.2 NO_x and PM emissions

The COPERT emissions model can provide a modelled estimate of air pollutant emissions from different vehicle types based on speeds, loading and road incline. Figure 17 demonstrates estimated NO_x emissions of different Euro Standard coaches at the average speeds from each of the phases of the coach test cycle. The reason why Euro VI has been chosen for Clean Air / ULEZ / Low Emission Zones is demonstrated by the much lower NO_x emissions across all speeds compared with historic vehicles.

Combining this model with average speeds from the LUC cycle, LowCVP estimate that coaches emitted around 6.5 kilotonnes of NO_x emissions in 2018, equivalent to £40.2m in damage costs. This would be equivalent to around half of the 12.4 kilotonnes NO_x emissions estimated by the NAEI for bus and coach in 2017.

LowCVP believe that the contribution of Euro VI diesel coaches is likely to be lower than the COPERT emissions model suggest based on very limited test data and comparison with Euro VI equivalent retrofit solutions. However more testing is required to understand the performance of Euro VI coaches across a range of weights and passenger capacities, as well as age.

Performing the same estimate for particulate matter (PM), LowCVP estimate that coaches emitted around 77 tonnes of PM being emitted by the coach fleet. This is equivalent to £8.2m based on Defra damage cost guidance £105,836/PM tonne.

Since the introduction of diesel particulate filters (DPF), emissions from particulate matter has been significantly decreased from heavy duty vehicles. With regular cleaning and engine maintenance, there should no longer be little to no visible smoke coming from the rear of Euro V and VI HDVs.

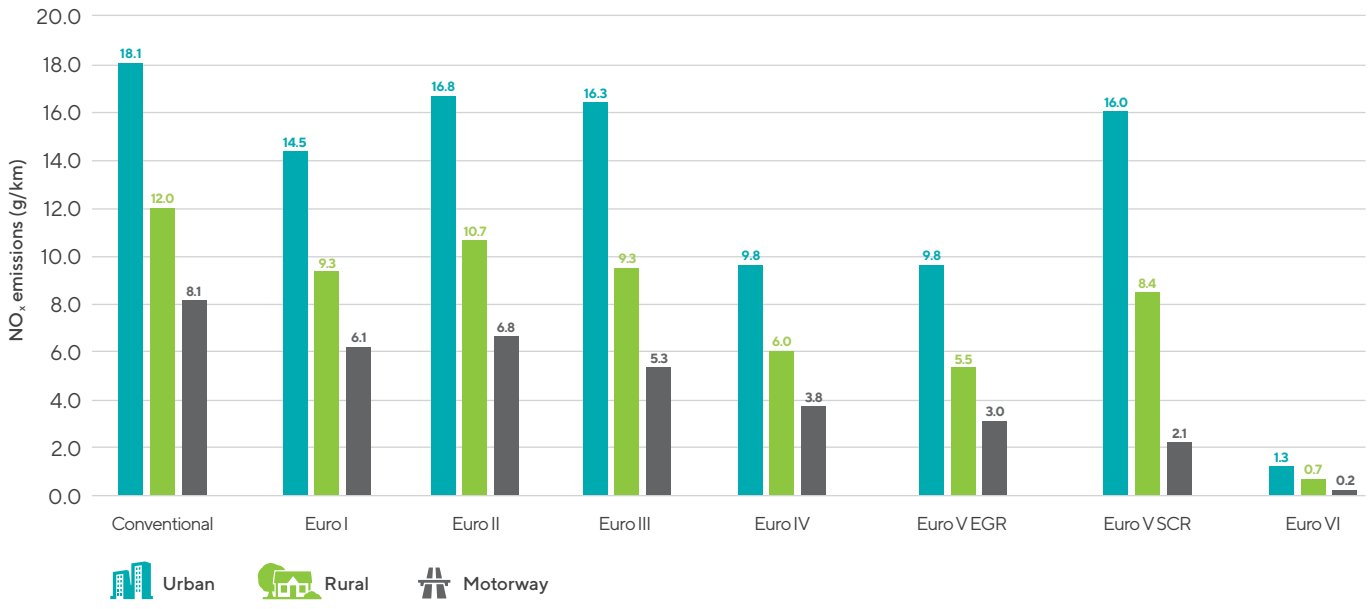

Figure 17: Average NO_x emissions by coach cycle phase using COPERT v5.2 emission factors, 50% loading, coaches <18tn (g NO_x/km)

3.3 Coach Retrofit

The introduction of Euro VI standard requirements for Clean Air Zones, the Ultra Low Emission Zone and Low Emission Zones is challenging the existing business model for coach operators. Non-compliant vehicles will incur additional cost for entering the UK's largest cities, impacting the value of second-hand vehicles. One option available to operators to comply with CAZ is to retrofit existing vehicles to Euro VI equivalence.

Retrofitting of coaches to reduce air quality pollutants to Euro VI equivalence has been proven through the Clean Vehicle Technology Fund as evidenced in LowCVP's evaluation report. There are now also retrofit SCR systems approved under Clean Vehicle Retrofit Accreditation Scheme, which is the UK's approval scheme for technologies that achieve Euro VI equivalent emission standards. These systems are specific to engine models and Euro standards, limiting the number of vehicles solution can be used on.

Small fleet sizes and a large range of different vehicle models and engine configurations has meant this market has been slow to develop to date. Operators rarely have more than a handful of the same vehicle type and so purchasing a retrofit system is often higher than the cost of entering a CAZ across a year.

More information on CVRAS approved retrofit technologies can be found on the Energy Saving Trust website and in LowCVP's Clean Vehicle Retrofit Technology Guide.

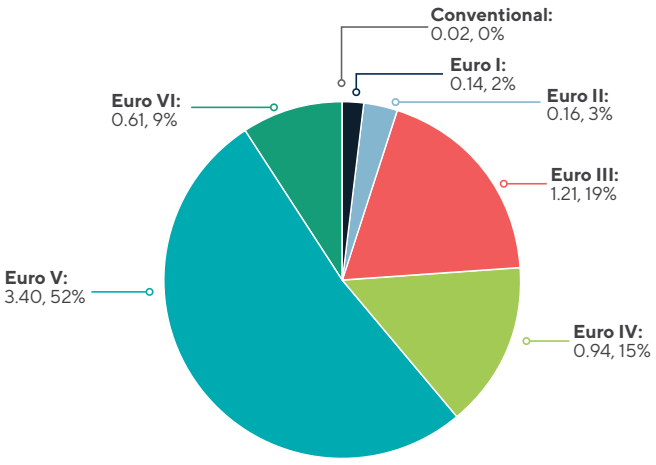

Figure 18: Estimated NO_x emissions from the UK coach fleet in 2018 (kilotonnes)

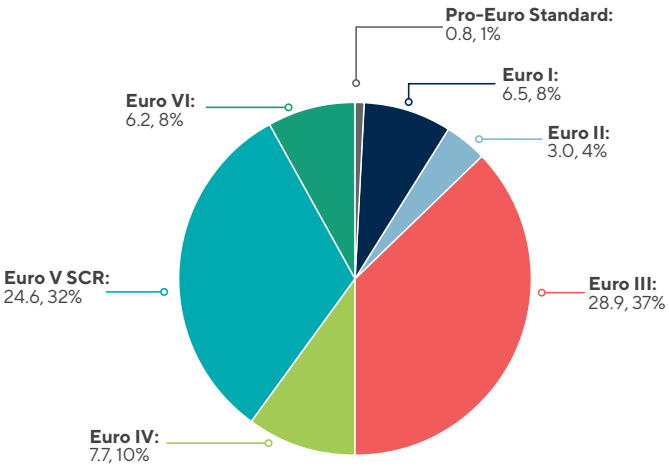

Figure 19: Estimated PM emissions from the UK coach fleet in 2018 (tonnes)

4.0 Conclusions

The paper above outlines some of the parameters of the UK coach market in terms of its size, fleet turnover and contribution to transport emissions. The findings presented are estimates based on the limited data available and these can be refined as more data becomes available in the future.

A summary of the key findings of the UK coach market in 2018 are:

- 27,500 coaches in-service
- 99% single deck diesel, running on 100% UK pump average diesel
- 950 new coach registrations annually across 2006-2018
- Around 15% of the coach fleet are Euro VI standard
- The UK coach industry contributes £7bn directly to the UK economy (CPT, 2020)
- Around 700 operators of coaches in the UK (CPT, 2020)
- 24 different international coach chassis suppliers to the UK, 2006-2018
- There is one body builder but no UK coach chassis manufacturers.
- An estimated 1.29 bn vkm annually by UK coaches
- Around 400 million passenger journeys (CPT, 2020)
- LowCVP estimate 1.68 Mt greenhouse gas emissions are produced annually by the UK coach fleet (1.5% UK road GHG emissions).
- LowCVP estimate 6.8 kt NO_x and 77 tonnes particulate matter are produced annually by the UK coach fleet, equivalent to £48.4m in air quality damage cost annually
- Only a handful of electric coaches and one diesel-hybrid coach is in operation in the UK currently, with very little choice of models and no incentives for manufacturers or operators to encourage adoption of lower emission technologies. Supporting infrastructure is also a major challenge, especially regarding publicly accessible charge points in suitable locations.

Coach operator fleets vary in size, the smallest having less than 10 vehicles and the largest around 100-150. Many operators are family run business with depots in one or two locations in a region. Operators will have a range of different vehicles sizes to meet different demands of customers and often supplement their ad hoc coach work with regular scheduled local bus services.

Operators will typically buy one or two vehicles every few years, with a strong trade in second-hand vehicles, although this has changed in recent years with the need for Euro VI vehicles to comply with Clean Air Zones and regulations in the EU. The typical lifetime of a coach can be anywhere between 15-30 years, with older vehicles cascaded down onto lower value work, often local school transport contracts.

The coach industry is highly seasonal, peaking around holiday periods and across the summer, with much lower demand in the winter. The typical business model is to try and meet as much ad hoc demand in the summer and compensate with lower value regular work across other parts of the year.

Annual vehicle mileage will be highly dependent on the type of service a vehicle is placed on, from as little as 10,000 km a year for local schoolwork, to over 200,000 km a year on scheduled intercity services. Payback time on vehicles will vary depending on the type of work it was purchased for, ranging from 2-5 years.

In 2018, diesel powertrains running UK pump diesel was the standard technology and fuel of choice for UK coach operators. LowCVP have estimated that UK coaches contribute around 1.5% of the total UK road transport greenhouse gas emissions and 2% of UK roadside NO_x emissions. Though this is a relatively small amount, coaches provide a low carbon affordable alternative to private cars and will be crucial to achieving net-zero greenhouse gas emissions ambitions by 2050.

Due to the small size and turnover of the UK fleet and lack of direct incentives or targets for developing affordable alternatives, Euro VI diesel powertrains are likely to remain the standard for the foreseeable future.

5.0

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