Chapter 5 Annex: Growth in Van Demand

Acknowledgements

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Summary and key messages

Since the mid-1980s, van travel has increased by 50 billion kms (176%), much faster than travel by car or HGV. The rising trend pre-dates the advent of retail internet shopping in 2000, which only partially explains the increase. In this Annex we set out detailed analysis of the growth in van demand and assess research on reducing emissions from vans making 'last-mile' deliveries. Our key findings are:

- In 2016, there were 4 million vans on the road, emitting 19.2 $MtCO_2$ and accounting for 15% of domestic transport emissions.
- Over the last 20 years the fastest growth has been among the largest vans and those operating on motorways and rural A-roads.
- Since the start of internet shopping in 2000, van travel has increased by 27 bn kms, of which up to 6 bn kms or 22% can be attributed to online retail parcel deliveries.
- Around 60% of the growth since 2000 can be attributed to growth in GDP and self-employment in sectors associated with high van use such as construction, transport, utilities, ICT, wholesale, retail and food. The advent of e-commerce in these sectors is also likely to have contributed to van growth.
- The supply of electric vans with a real-world range suitable for courier deliveries is low but increasing. New electric vans on the market come much closer to meeting average driving distances of urban deliveries.
- Initial research suggests there is considerable scope to reduce length of trips associated with 'last-mile' deliveries through logistics measures such as improved clustering and routing. Further work on these and other logistics options is needed to address rising van emissions.
- We welcome DfT's plans to undertake a new survey of van use, given the lack of recent data in this area. The results of this should be published in 2019.

Introduction

In previous CCC reports[1], we have noted a large increase in van demand that cannot be explained by traditional economic indicators, such as GDP growth and driving costs. The rapid growth in online shopping deliveries is often cited as an explanation, though this is a relatively recent development and is not the sole factor. Recent studies have attempted to quantify the impact of the parcel delivery market on van kilometres, but conclusive results require better data on how vans are currently being used[2]. In this annex we take a detailed look at recent trends in van growth and explore possible explanations for the increase. We review recent research that addresses improvements in efficiency and carbon intensity of last mile deliveries.

We set out our analysis in the following sections:

1. Trends in van use and demand over time

2. Key drivers of van demand

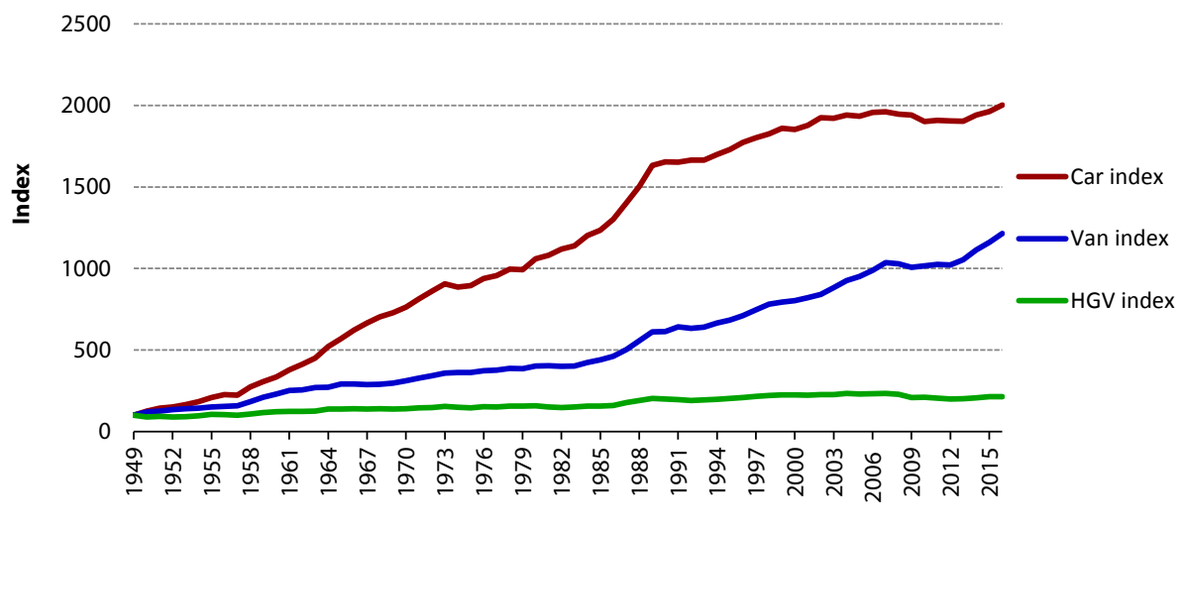
3. Research on managing van growth in urban areas: electric vans and last mile logistics

[1] CCC (2017) *2017 Report to Parliament - Meeting Carbon Budgets: Closing the policy gap.*
[2] RAC Foundation (2017) *The Implications of Internet Shopping Growth on the Van Fleet and Traffic Activity;* Sewells (2017) *The UK Van Fleet Market;* FTC2050 (2017) *An analysis of online shopping and home delivery in the UK.*

1. Trends in van use and demand over time

There were 4 million vans on the road in 2016, which emitted 19.2 $MtCO_2$ and accounted for 15% of domestic transport emissions, up from 9% in 1990.

Figure A1. Long term demand trends across road transport modes



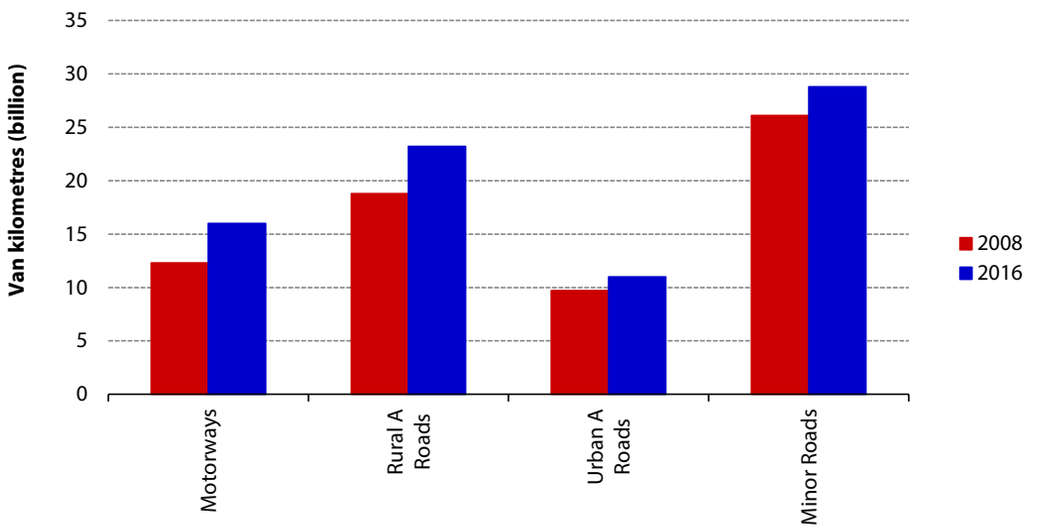
Source: DfT (2017) *Road Traffic Statistics*; CCC analysis.
Notes: Index of vehicle-km, base year (1949)=100.

Vans have been the fastest growing source of road transport demand since 1985. Over the last 20 years van kilometres driven have increased by 71%, whilst car and HGV kilometres have increased by 13% and 2% respectively[3] (Figure A1).

Across road types, the fastest growth has been on motorways and rural A-roads, where half of all GB van kilometres were driven in 2016 (Figure A2).

[3] Over the period 1996 - 2016, as DfT statistics for 2017 have not yet been released.

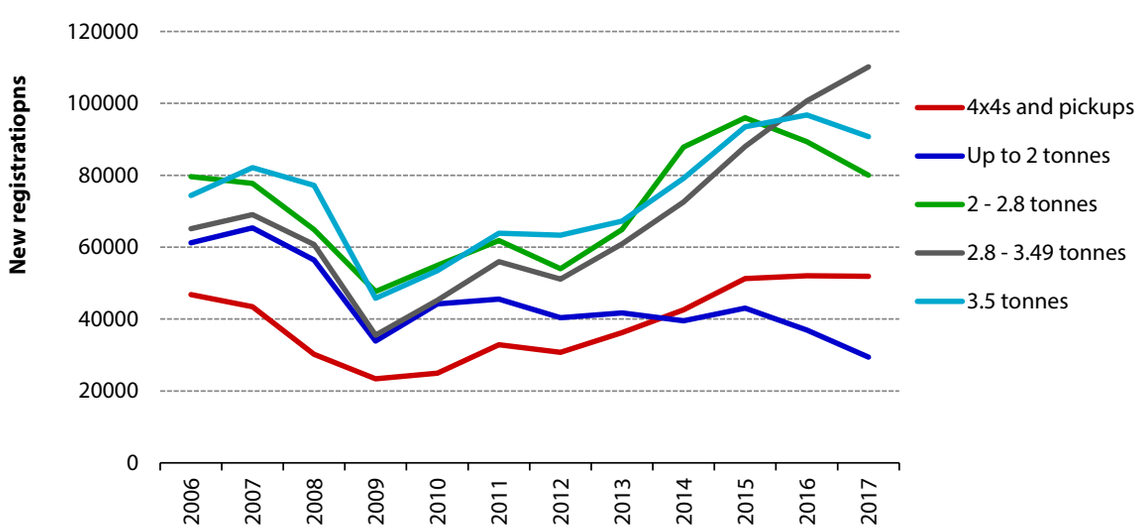
Figure A2. Van demand by road type



Source: DfT (2017) *Road Traffic Statistics*; CCC analysis.

In terms of sales, the increase in demand has been skewed towards the largest vans (vehicles weighing 2.8 - 3.5 tonnes), whilst vans weighing under 2 tonnes have declined in popularity over the last five years (Figure A3).

Figure A3. Van sales by weight



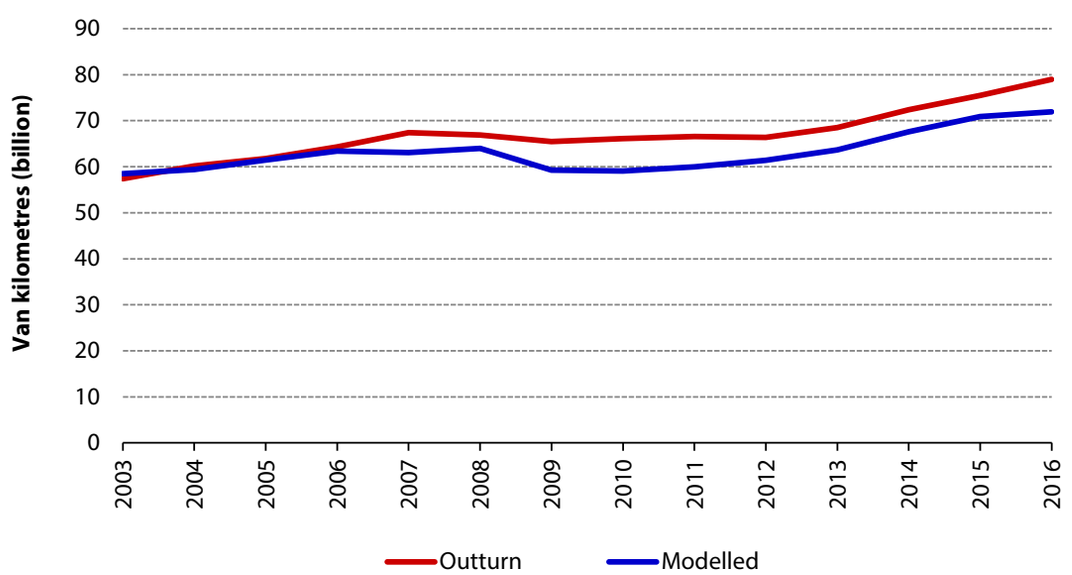
Source: CCC analysis of SMMT data.

This increase in van demand is not recent. As shown in Figure A1, there has been an upward trend in van kilometres for over 50 years, with accelerated growth from the mid-80s that has been broadly maintained to today.

2. Key drivers of van demand

Traditional models of forecasting transport demand have been based around how van ownership and use might grow over time, reflecting changes in key factors such as population, income, fuel prices, and road capacity. The Department for Transport (DfT) use an elasticity based approach to forecast van demand with income, fuel prices and fuel efficiency as key explanatory variables. The most recent forecasts (RTF15) have different scenarios for van demand based on different assumptions for GDP and fuel prices. Back-casting the underlying equations using historical data on key drivers, and comparing this modelled output with actual van kilometres driven gives an indication of how accurate the model has been in the past (Figure A4). Over the period from 2003-2016, outturn has been higher than modelled, with an average difference of 6% between predicted and actual van-kms.

Figure A4. Actual vs predicted van growth



Source: CCC calculations based on DfT LGV equations in RTF15.

The DfT has updated the methodology used to forecast van demand in 2015 which will be used in the upcoming Road Traffic Forecasts 2018 (RTF18). Assumed elasticities of response to GDP and average fuel costs per km have been updated and new lagged variables of van demand have been added to existing models. Additionally the model now forecasts at regional and road type level, rather than just at the aggregate level. The updated model gives a better forecast performance than the previous model. However, it still only uses GDP and fuel as explanatory variables and can only partially explain recent trends in van demand.

Understanding why van demand is increasing at the micro level is important in developing appropriate policy responses to help reduce emissions associated with the LGV fleet. Our analysis has focussed on three potential key drivers of van demand:

- Online shopping deliveries
- Growth and self-employment in sectors associated with van use
- Switching from HGVs

Online shopping deliveries

Several recent studies have cited the growth in online retail as a key factor in the recent rise in van use[4]. However, none of these has attempted to quantify to extent to which this growth can be attributed to internet retail deliveries.

The arrival of online retail has changed the way we shop, from 20 years ago when almost all retailing was physical, to today where the online retail market in Great Britain is worth £60.8 billion and makes up 17% of all retail sales[5]. We set out to estimate the number of vans being used today to deliver online shopping packages, to assess the claims that this sector is the main cause of the increase in van demand.

We have taken two different approaches to estimating the size of the van fleet used to deliver online shopping packages:

- A top down approach that uses data on the total value of online retail sales in Great Britain and applies assumptions on average parcel value to estimate the number of parcels delivered annually, and how many vans would be needed to deliver these parcels.
- A bottom up approach which combines fleet estimates of businesses carrying out online deliveries to estimate the size of the delivery fleet.

In the first of these approaches, we took the ONS figure for the value of online retail sales in Great Britain in 2016 (£52bn) and divided it by average parcel value (Table A1) to obtain an estimate of the total number of parcel deliveries. This number was adjusted to take account of additional journeys generated by returns and redeliveries and to include parcels sent from business to business which are not included in the ONS figure. We then used estimates of the number of parcels that can be delivered in a day and how many days of the year a van is driven to get the number of GB delivery vans and the associated van kilometres. This approach gave an estimate of up to 142,000 vans driving 6 billion kilometres a year needed to deliver Great Britain's online shopping in 2016. This corresponds to online retail delivery vans making up 4% of all GB vans, and 8% of all GB van kilometres. For context on the assumptions employed, this van activity is servicing nearly £2000 spent on online shopping per household per year, or just under 1 delivery per household per week.

[4] RAC Foundation (2017) *The Implications of Internet Shopping Growth on the Van Fleet and Traffic Activity;* Sewells (2017) *The UK Van Fleet Market*; FTC2050 (2017) *An analysis of online shopping and home delivery in the UK.*
[5] ONS (2018) *Retail Sales Index Internet Sales.*

Table A1. Assumptions for top down delivery fleet estimates	
Factor	**Assumed range**
Average value of a retail parcel	£40 - £50
Parcels delivered per day by a single van	60 - 100
Days van is driven per year	252 - 304 (five to six days a week excluding UK public holidays)
Percentage of parcels that are returned or fail to be delivered	12.5% - 25%
Uplift for percentage of parcels that are sent business to business	33%
Average annual distance driven by parcel courier vans	40,000 km
Average annual distance driven by grocery delivery vans	60,000 km
Average annual distance driven by parcel courier and grocery delivery vans (weighted by number of orders)	42,000 km
Result: Up to to 6 billion van-kms associated with internet retail sales in 2016 (8% of GB van-kms)	
Source: CCC assumptions based on: RAC Foundation (2017) *The Implications of Internet Shopping Growth on the Van Fleet and Traffic Activity*; FTC2050 (2017) *An analysis of online shopping and home delivery in the UK*; FTA (2017) *Van Excellence Report 2016 - 2017*; IMRG (2017) *MetaPack UK Delivery Index Report*. **Notes:** The delivery van fleet estimates mentioned in the text use the upper bound of these ranges.	

In the second, 'bottom up', approach, we estimated the size of the van fleet based on research by the RAC and Sewells[6]. This includes parcel delivery service companies such as Royal Mail and UPS, and companies carrying out their own deliveries e.g. Sainsbury's[7]. This gives an estimate of 127,000 online shopping delivery vans (Table A2). Applying assumptions on distance driven (Table A1), we estimate that 6.1 billion kms were associated with online retail deliveries in 2016, which is consistent with the estimate of up to 6 billion kms from the previous approach. Our estimates are also broadly in line with those found in the literature; the exhaustive study by the RAC gives a range from 110,000 to 160,000 vans for the delivery van fleet.

6 RAC Foundation (2017) *The Implications of Internet Shopping Growth on the Van Fleet and Traffic Activity*; Sewells (2017) *The UK Van Fleet Market.*

7 All data used in our estimates of the online retail delivery van fleet are for Great Britain, apart from fleet estimates from the Sewells report, which are for the UK. We have made no adjustment to the Sewells data, but the impact of this is likely to be within the uncertainty bounds of estimates.

Table A2. Ten largest delivery fleets	
Company	**Fleet size**
Royal Mail Group	36,000
Hermes	9,500
Yodel	6,000
APC Overnight	5,000
Tesco	5,000
Geopost (DPD)	4,000
Amazon	3,800
TNT	3,500
CItySprint	2,800
DX	2,800
Result: Total delivery fleet of 131,000 and 6.1 billion van-kms associated with internet retail sales in 2016.	
Source: CCC estimates based on RAC Foundation (2017) *The Implications of Internet Shopping Growth on the Van Fleet and Traffic Activity;* Sewells Research & Insight (2017) *The UK Van Fleet Market.*	

In order to estimate how much of the growth in van kilometres can be attributed to retail internet sales, we would ideally re-calculate these for each year from the start of internet sales. However, we do not have the time-series data needed to do this, as many of the factors in Table A1 above are only available for the last few years. Most retailers established an online presence after 2000. In 2001 just 0.3% of sales in the sector covering retail sales were made over the internet[8]. We therefore use 2000 as the starting point of retail internet sales (Figure A5).

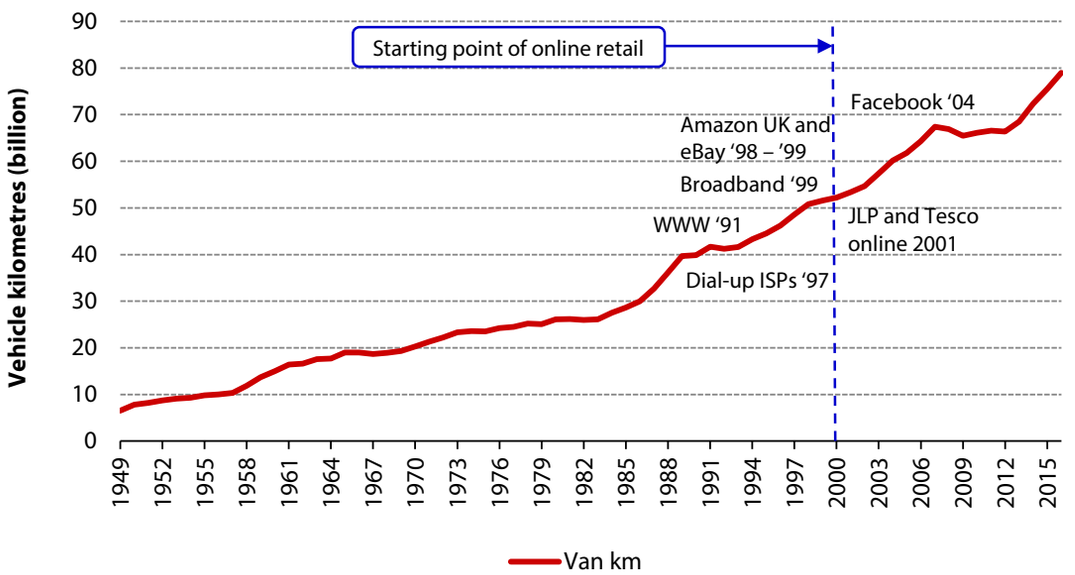
Our analysis found that internet retail delivers account for up to 22% of the increase in van-kms since 2000:

- Since the starting point of internet sales in 2000, total distance driven by vans has increased by 27 billion kms.
- In 2016, online shopping deliveries accounted for up to 6 billion van-kms.
- This represents 22% of the increase in van-kms since 2000.

[8] ONS (2001) *E-commerce Inquiry to Business 2000.*

However, there are many uncertainties around how many personal trips one van of deliveries replaces, which mode these trips would have been carried out in in the absence of home delivery, and whether the use of online shopping affects the mode in which remaining trips are carried out. Work by Leeds Demand Centre also points out complex links between physical and online retail (Box A1). [9]

Figure A5. Online retail developments



Source: DfT (2017) *Road Traffic Statistics.*

[9] Leeds Demand Centre (2017) *The Last Mile and the Next Day: The changing times and spaces of shopping - implications for energy demand.*

Box A1. Changes in shopping patterns and the implications for travel demand

Changes in the way we shop have affected the way people travel, as well as the movement of goods by vans. The Commission on Travel Demand, an independent research group led by Leeds University, has recently published research explaining recent trends.

In the past, a traditional shopping trip would include browsing multiple stores for products, before selecting a particular store to purchase from and then travelling home with the purchases. However, new forms of shopping can include browsing online on smartphones and in homes, and there are multiple options for receiving products including having your purchases delivered at home, delivered at work or collecting a reserved product from a store or a parcel collection location. Counting shopping trips by individuals and households is no longer an accurate way to understand shopping related travel.

Consumers also expect their goods to arrive increasingly quickly and at a specified time. 74% of online retailers now offer next day delivery services and whilst only 4% currently offer same day delivery, the demand for this service is increasing. Nominated delivery timeslots are now offered by around 18% of retailers. These short delivery windows reduce opportunities for consolidation. Retailers are also increasingly offering free delivery and returns for orders over a certain value which can result in consumers making more frequent orders, as well as purchasing more products with the intent of returning the majority of them.

These trends increase the cost of deliveries to businesses and the associated kilometres driven by vans. Collection points which enable people to pick up goods en-route whilst travelling for other purposes, such as at rail stations or convenience stores, could provide an effective solution to this issue. Crowdshipping services have also emerged over the past five years in the US, Australia, China and Norway, where members of the public who are already making journeys act as couriers for the distribution of parcels and other small items, creating new informal logistics networks.

It is difficult to predict how these trends will change over the coming years, although it seems likely that the proportion of goods purchased over the internet will continue to grow. It is clear that any future studies in this area must consider both the travel of the people receiving the goods, as well as van travel, in order to accurately understand the changing trends.

Source: Commission on Travel Demand (2018) *All change? The future of travel demand and the implications for policy planning*; Freight Traffic Control 2050 (2017) *Commission on travel demand call for evidence: Understanding charging travel demand*; DEMAND (2018) *Online shopping: What are the transport energy implications?*; Cherrett T. (2017) *Trends in travel demand: Last-mile logistics*; Cass N. and Shove E. (2017) *The Last Mile and the Next Day. The changing times and spaces of shopping – implications for energy demand*.

Growth and self-employment in sectors associated with van use

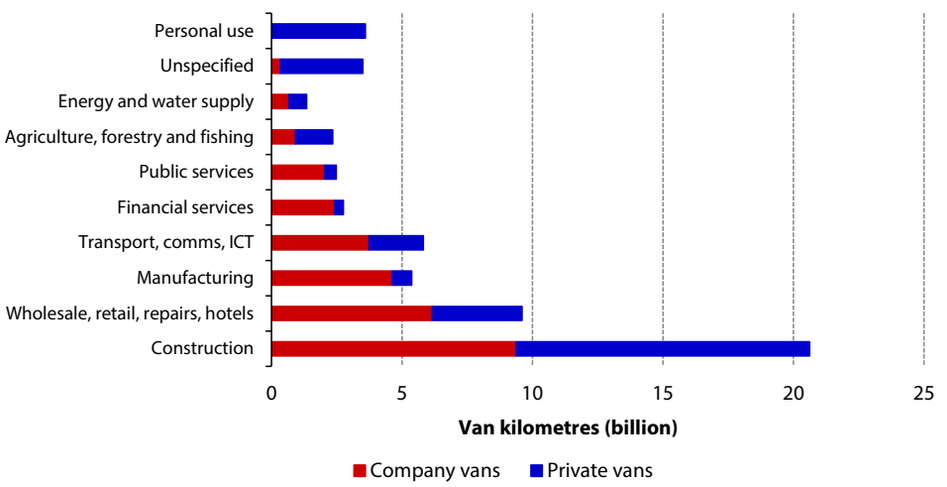
Growth in van demand can also be a result of growth in economic activity in sectors of the economy that use vans. There is little up to date information on sectoral van activity, making it hard to identify which sectors are most 'van dependent' (i.e. have the most vans per £ of gross valued added (GVA) or per numbers of self-employed in the sector). However, a DfT survey of van activity from 2003-2005 contains useful information on van-kms by sector, with construction, transport, utilities, ICT, wholesale, retail and food identified as sectors that accounted for a high proportion of all van-kms and had high van-kms per GVA[10]. Assuming the ratio of van-kms to GVA and van-kms to self-employment for company-owned cars and privately-owned cars respectively is unchanged over time, we estimate that growth in GDP and self-employment in sectors associated with van use could account for at least 60% of the increase in van kilometres since 2000 (Box A2).

[10] DfT (2006*) Road Freight Statistics 2005. Section 4: The activity of GB-registered vans in Great Britain: 2003 - 2005.*

Box A2. Estimating the effect of sectoral growth and self-employment on van use

DfT undertook a survey of van activity between 2003-2005, covering both company and privately owned vans. The construction sector accounted for 36% of van kilometres with wholesale, retail, repairs and hotels accounting for 17% (Figure A6).

Figure A6. Van use by sector (2003 - 2005)



Source: DfT (2006*) Road Freight Statistics 2005. Section 4: The activity of GB-registered vans in Great Britain: 2003 - 2005;* DfT (2003) *Survey of privately owned vans*.

In order to estimate how much growth and structural change in these sectors has contributed to the growth in van demand, we estimated van-kms per £ of sectoral GVA in 2003 for company owned vans and van-kms by self-employment rates in 2003 for privately-owned vans. Assuming these ratios remain constant to 2016, we estimate that sectoral growth in self-employment for privately-owned vans and increases in GVA for company vans can explain 60% of the growth in van-kms from 2000. The underlying assumption in this is that income elasticity of demand for van-kms is constant over time. This is a simplifying assumption and is likely to underestimate the amount due to sector growth because in practice it is likely that the average propensity to use vans increases with income (the income elasticity is greater than 1). This would be consistent with businesses requiring fleet vehicles after expanding, or a bike courier purchasing a van after witnessing growth in the parcel delivery market.

Related to this, the rise in e-commerce across all sectors of the economy could have contributed proportionately more to the growth in van demand. E-commerce covers all business conducted electronically, including payments such as website wholesale orders and online subscription services, as well as online retail. Between 2008-2015 e-commerce sales have risen much faster than aggregate sales; by 42% compared with 16% for all sales across all sectors. The highest growth has been in sectors identified above as being associated with high van use: construction, food and hoteling and transport and ICT. Although a lack of data means we cannot quantify this effect, the access to wider, more distant markets that e-commerce enables is likely to have impacted van-kms driven.

Source: CCC calculations; ONS GVA and self-employment statistics.
Notes: A method which uses GVA growth for both company and private vans gave similar results. There could be some double-counting with section (1) above, between internet retail sales and GVA in retail. However these are different metrics therefore it is not possible to take this into account.

Switching from HGVs

Mode switching from HGVs has also been identified as a potential driver of van demand. There are many differences between driving a van and driving an HGV; unlike van drivers, HGV drivers require special licences, and since 2007, have been subject to EU regulation on working hours and breaks.[11] In addition, there are often restrictions on weight, berth and height in urban areas, which alongside schemes like London's Low Emission Zone have limited the types of HGV that can easily drive within cities. With the influx of cheap van driving labour from gig economy workers, it is feasible that some fleet managers may have decided to shift their freight to vans from HGVs.

It is difficult to fully assess the potential impact of these factors without undertaking a detailed econometric study. However, an initial premise is that if outturn HGV-kms are lower than would have been predicted given trends in incomes and prices, this would suggest that some HGV growth has failed to materialise due to a switching to vans. Analysis based on elasticities derived from DfT models used in forecasting HGV demand suggests that this has not been the case, with outturn HGV-kms generally being higher than would have been expected given trends in income and prices. However, this area requires further analysis. Research identifying the types of journeys and vehicles that would be most capable of switching, and the number of vans needed to replace a typical HGV load could help identify the potential impacts of this effect and determine if it is taking place.

3. Research on managing van growth in urban areas: electric vans and last mile logistics

Identifying the reasons behind the growth in van demand helps to identify effective options to address the resulting emissions. Our cost-effective path to meeting the fifth carbon budget focusses on technology solutions to reduce van emissions: electrification, with 60% of new van sales being electric by 2030, and improved efficiency of conventional vans. Underpinning this is a profile of future van demand in line with DfT Scenario 1 (their central scenario). If van demand forecasts continue to be revised upwards, there is a risk that the abatement in our cost-effective path will not be enough, and further decarbonisation will be required to meet carbon budgets. To ensure this does not happen, barriers to electric van uptake must be addressed, and demand-reduction strategies deployed.

Electric Vans

In 2017, electric vans made up 0.34% of sales, which is below our indicator of what is required to meet future carbon budgets of 1.24%. Though many barriers faced by electric van uptake are similar to those for electric cars, such as upfront price differentials and range anxiety, recent work has pointed out barriers that are specific to commercial fleet operators contemplating switching from conventional to electric vehicles[12]. The main barriers identified were insufficient range to carry out duty cycles, queueing anxiety, payload restrictions and grid capacity for fleet charging. Some of these barriers are on their way to being overcome; for example, the 60% range improvement for the new Nissan e-NV200 and Renault Kangoo models bring electric vans a lot closer to meeting urban duty cycles, and the DfT proposed derogation addresses payload

[11] EU Drivers Hours Working Time Rules https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/603096/simplified-guidance-eu-drivers-hours-working-time-rules.pdf.

[12] Morganti, E. and Browne, M. (2018) *Technical and operational obstacles to the adoption of electric vans in France and the UK: An operator's perspective.*

restrictions by allowing extra weight for electric vans of up to 750kg to compensate for the weight of the battery[13].

Other barriers, however, have not been adequately addressed. Though all drivers wish to avoid queueing at charge points, this lost time may carry a higher opportunity cost for those driving vehicles for commercial purposes. A reliable urban rapid charger network, or dedicated chargers for taxis and vans could help avoid this. There is also further work needed to address the grid capacity issues that could arise if fleet vehicles are simultaneously charged. However, the UPS charging depot in Camden shows that costly grid upgrades are not the only way around this; smart charging solutions and battery storage should also be employed where possible[14].

Demand Management

As well as encouraging the uptake of electric vans, measures to slow demand growth must be considered and have significant co-benefits in reducing congestion and improving air quality. Research carried out as part of the Freight Traffic Control 2050 project[15] found significant reductions in driving distances could be made through measures such as: technology to help inexperienced drivers (-44% driving distance); better clustering and routing of 'last mile' deliveries (-15% with basic clustering to -47% under a porter model with significantly fewer drop-off points), and use of micro-consolidation centres. Further work needs to be done to address challenges around these e.g. raising awareness of fuel and time savings for delivery firms; high land prices associated with micro-consolidation centres in urban areas and potential collaboration between different courier operators.

[13] DfT (2018) *Regulatory changes to support the take up of alternatively fuelled light commercial vehicles: Government response.*
[14] UKPN press release (2017) *UK Power Networks gets into gear with UPS to deliver more electric vehicles.*
[15] Bates, O. et al. (2017) *Transforming Last Mile Logistics: Opportunities for More Sustainable Deliveries.*